



# Nutri- tion for Nurses



# **Nutrition for Nurses**

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# PREFACE

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## About *Nutrition for Nurses*

### Summary

Nurses play a pivotal role in educating clients about the importance of nutrition in wellness promotion and illness prevention. *Nutrition for Nurses* emphasizes evidence-based practice and holistic assessment to facilitate the integration of nutritional awareness for pre-licensure nursing students in the provision of client-centered care. This text prepares students to serve as professionals who are part of an interdisciplinary team, which includes registered dieticians and nutritionists, and to emphasize nutrition as a key component of wellness, disease prevention, and disease management.

*Nutrition for Nurses* is written by nurses and dietitians, and is tailored specifically to nursing students to help them develop sound clinical judgment. The text promotes evidence-based practice and adheres to the nursing process

steps of assessment, diagnosis, planning, implementation, and evaluation. *Nutrition for Nurses* helps students develop nutritional competency that includes explaining the role of macronutrients, micronutrients, and hydration in nutrition; describing the structure and function of the digestive organs; applying the nursing process to assess the impact of nutrition on body systems and disease processes; and evaluating the impact of nutrition on body systems across the lifespan.

### Pedagogical Foundation

*Nutrition for Nurses* is structured to support the flexible integration of nutrition content across both system-based and nursing competency-based curricula and can be used whether nutrition is taught as a stand-alone course or as part of another nursing course. The text tailors the presentation of fundamental nutrition concepts to nursing students, helping to prepare them for nutrition concepts not only throughout the curriculum but also as a prerequisite to pathophysiology and awareness of disease processes. Throughout, the focus is on assessment of the client, including normal and abnormal findings, and the role nutrition plays in the body and its systems as a critical component of wellness. This presentation utilizes concepts promoting the development of clinical judgment by building upon the systematic model developed by the National Council of State Boards of Nursing (NCSBN).

Although the chapters in *Nutrition for Nurses* are written to be mostly independent, they do generally build on the understanding gained in the four fundamentals chapters in Unit 1. (Please bear this in mind when considering alternate sequence coverage.) Instructors may pair the chapters from this nutrition textbook with similar body system topics in a disease course.

### Organizational Framework

The table of contents for *Nutrition for Nurses* presents content in 20 chapters, organized into 9 thematic units:

- **Unit 1** features four introductory chapters that include foundational nutritional knowledge, the role of interdisciplinary teams, and agency oversight. The functions of macronutrients, micronutrients, hydration, and the physiology of digestion are presented. The discussion of these nutritional components explains how nutrition impacts wellness.
- **Units 2–9** cover the impact of nutrition on the body's organ systems, including the following systems:
  - Neurological
  - Endocrine
  - Hematological
  - Cardiovascular
  - Pulmonary
  - Renal
  - Gastrointestinal
  - Musculoskeletal and integumentary

Each unit covers one body system and includes two chapters; the first chapter helps students apply clinical judgment to promote health and wellness in the identified body system, and the second chapter covers lifespan considerations and body system illness.

- The **appendix** identifies common nutritional apps with hyperlinks for easy access to these resources.

### Nursing Features

To further enhance learning, *Nutrition for Nurses* includes the following features:

- **Clinical Tips** offer practical suggestions that help nurses deliver quality care to the client—for example, asking clients open-ended questions or helping clients to communicate better with health care professionals.
- **Media boxes** provide an opportunity to explore related content that reinforces or extends learning. Examples include a fracture risk assessment tool (FRAX) and a video highlighting changes to the Nutrition Facts label.
- **Safety Alerts** address provision of care to clients across the wellness continuum and emphasize the importance of quality and safety in client care. Examples include consuming salt substitutes that contain potassium chloride and contraindications for deep palpation.
- **Special Considerations** highlight nutritional considerations related to various client categories, including age/life stage, race/ethnicity/culture, or sex/gender. Examples include insulin sensitivity in diverse populations and populations who are at risk for vitamin B<sub>12</sub> deficiency.

- **Trending Today boxes** present nutritional and nursing trends via the lens of evidence-based practice. This feature contains a variety of social media resources and videos as well as questions for reflective thinking. Examples include promoting wellness with herbs and examining the link between nutrition and aging skin. *Some chapters in this book discuss social media with the intended purpose of preparing nurses to handle questions clients will ask about nutritional information they have read online and via social media. References to social media or specific social media sites are not an endorsement of their use as source for nutritional information or self-diagnosis. The authors advise readers to evaluate nutritional resources for their use of evidence-based practice (EBP), which uses scientific evidence rather than anecdotal evidence, and to seek the care of a trained, certified, and experienced health care provider for nutrition-related care.*
- **Unfolding Case Studies** present a hypothetical client scenario that unfolds in two or more parts throughout the chapter, with each subsequent part presenting new information on the same client, to help foster clinical judgment. In each part of an unfolding case feature, the scenario is followed by two multiple-choice questions that require students to apply their knowledge of evidence-based client care. The answers to these questions, with explanations, are included in the Answer Key for students at the end of the book.

### Pedagogical Features

To support student learning, *Nutrition for Nurses* includes the following standard elements:

- **Learning Outcomes:** Every chapter section begins with a set of clear and concise student learning outcomes. These outcomes are designed to help the instructor decide what content to include or assign and can guide students on what they can expect to learn and be assessed on.
- **Review Questions:** This end-of-chapter feature presents multiple-choice questions for students to apply their learned knowledge and integrate the chapter (and unit) concepts. The questions focus on client scenarios and body system and nutritional concepts review as relevant to the chapter material. The question answers, with explanations, are included in the Answer Key for students at the end of the book.
- **Chapter Summary:** Chapter summaries assist both students and instructors by outlining the primary subtopics addressed within the chapter.
- **Key Terms:** Key terms are presented in bold text and are followed by an explanation in context. Definitions of key terms are also listed in the end-of-chapter glossary.
- **Suggested Reading:** All chapters include a recommended list of readings that either go into more depth about topics already covered in the chapter or provide content closely related to those topics in order to form a more comprehensive view.
- **References:** References are listed at the end of the book, organized by chapter.

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## CHAPTER 1

# Introduction to Nutrition for Nurses



**FIGURE 1.1** Good nutrition, including fruits, is the foundation of good health. (credit: modification of work “Culinary fruits front view” by Bill Ebbesen/Wikimedia Commons, CC BY 3.0)

## CHAPTER OUTLINE

- 1.1 What Is Nutrition?
- 1.2 Interdisciplinary Teams and Nutrition in Nursing Practice
- 1.3 Nutrition and Population Health
- 1.4 Vulnerable Populations
- 1.5 Evidence-Based Practice and Nutrition

**INTRODUCTION** Good nutrition is fundamental to improving and maintaining health regardless of age or current health status (Centers for Disease Control and Prevention [CDC], 2021). Accordingly, nurses must be knowledgeable and prepared to incorporate nutrition science into their practice. Traditionally, the science of nutrition had focused on nutrient intake and biochemical processing only. However, food intake serves other various purposes, from celebrating milestones to providing comfort when stressed or grieving. Over time, food and food preparation has evolved to center around pleasure and convenience rather than simply a means of sustenance. Consequently, nurses must integrate these social and cultural factors with evidence-based nutritional guidelines to help their clients meet their physical, psychological, and social needs.

### 1.1 What Is Nutrition?

#### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 1.1.1 Define nutrition.
- 1.1.2 Identify key events in the history of nutrition.

## A Basic Definition of Nutrition

**Nutrition** is the intake of food to meet the needs of the body. Accordingly, **nutrients** are substances found in foods and beverages that are essential for survival. Nurses must understand the components of nutrition and its impact on bodily functions to provide effective nursing care.

Several food-related concepts are fundamental to understanding how nutrition affects the body. The term **food** refers to edible substances made of protein, carbohydrates, fat, or other nutrients. Food is comprised of macronutrients and/or micronutrients. **Macronutrients** are water and energy-yielding nutrients (carbohydrates, fats, and proteins) needed in large amounts by the body. **Micronutrients** include vitamins and minerals. Food is the building block of the **diet**, which describes the quantity and quality of food and drinks consumed.

### Nutrition in Foods

Understanding **calories** is essential to understanding how the body uses nutrients for fuel. Calories, which measure the amount of heat it takes to raise 1 kg of water by 1°C, are used to indicate the amount of energy needed or ingested daily. Human bodies need calories to function, digest food, grow, and move. The *2020–2025 Dietary Guidelines* issued jointly by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services recommend adult women consume an estimated 1,600 to 2,400 calories daily and adult men 2,000 to 3,000 calories daily based on age and activity level (USDA & USHHS, 2020).

The number of calories found in food varies based on food type. [Table 1.1](#) lists the number of calories found in macronutrients. Food preparation can modify the number of calories present. For example, a raw tomato has fewer calories than a fried tomato. Water is classified as a macronutrient. Although it serves a vital role, it does not provide energy to the body.

Macronutrient	Calories per Gram	Recommended Daily Intake
Carbohydrate	4	45–65%
Fat	9	20–35%
Protein	4	10–35%

**TABLE 1.1** Macronutrients Energy Yield and Recommended Daily Intake (source: USDA & USHHS, 2020)

### CALORIE CALCULATOR

Counting calories is one way to determine if clients are consuming an appropriate amount of food to meet their needs. Calorie needs vary based upon client age, sex, and level of physical activity. [Use this calorie calculator \(<https://openstax.org/r/calculnet>\)](#) when working with clients to determine their individual caloric needs.

## The History of Nutrition in the Provision of Client Care

Modern nutrition science advanced significantly during the 20th century (Mozaffarian, Rosenberg & Uauy, 2018). The identification of essential vitamins and minerals in the early 1900s launched the quest to identify and treat vitamin-deficient medical conditions such as beriberi. Subsequent nutritional discoveries led to the practice of fortifying certain foods to prevent deficiencies and setting the first recommended dietary allowances (RDAs).

During this same time frame, the federal government began to oversee and manage the food supply. In 1906, the Pure Food and Drugs Act was passed, which launched the federal regulation of foods by the agency later known as the U.S. Food and Drug Administration (FDA, 2018). The FDA was initially established to oversee how food was prepared for consumers. This became necessary because as more people moved from rural to urban areas, they depended on others to grow and produce the food they needed.

In 1938, the Food, Drug, and Cosmetic Act (FDCA) of 1938 was passed, significantly enhancing labeling requirements. The FDCA required food labels to include the product's recognizable name and standardized information related to the identity, quality, and amount in the container (Lam & Patel, 2022).

Later, in the second half of the 20th century, the focus of nutrition shifted toward nutrition and its relationship to health (USDA & USHHS, n.d.). In 1977, the first-ever federal guidance related to diet quality was published in *Dietary Goals for the United States*. These goals were intended to improve the typical American diet to decrease the

incidence of heart disease. The development of these goals prompted pushback from some members of the food industry. For example, the goals originally recommended to reduce the intake of red meat in the diet. However, groups such as the National Cattlemen's Beef Association opposed this recommendation since it would negatively affect the beef industry. Consequently, the language in the federal guidelines was changed from minimizing red meat to selecting foods that will minimize saturated fat intake (Stillerman, 2019).

Continuing this new shift in perspective, in 1982 the Committee on Diet, Nutrition, and Cancer, National Research Council presented their findings on the relationship between diet and cancer. These findings served as a foundation to promote nutritional factors and dietary needs that decrease the incidence of cancer. Not only did the report discuss foods linked to the potential development of cancer, but it also identified foods that supported cancer prevention. This study specifically mentioned macronutrients and micronutrients found in the diet and their impact on cancer development and/or prevention. This introduction of macronutrients and micronutrients to the public facilitated several agencies to take active roles in promoting dietary agendas. For example, the Nutrition Labeling and Education Act of 1990 prompted all food packaging entities to label foods with nutritional information and serving sizes.

Through the years, visual displays of government food guides have been modified to reflect the changing perspectives. The first guide, released in the 1940s, divided foods into seven groups and encouraged people to eat foods from all groups as well as food not included in the seven groups without specifying amounts. The widely recognized Food Guide Pyramid was first introduced in the 1990s and underwent several revisions until it was replaced by MyPlate in 2011 (Davis & Saltos, n.d.; USDA, 2021). The most recent dietary guidelines for Americans, 2020–2025, uses the original MyPlate visual guide to recommend small, simple changes to improve diet quality.

## Nutrition for Wellness

The Global Wellness Institute defines **wellness** as pursuing activities, choices, and lifestyles leading to holistic health. Multiple factors influence a person's health, including nutrition. Good nutrition is essential for keeping the population healthy (CDC, 2021).

### Origin of Nutrition Related to Wellness

The ancient Greek physician who influenced much of modern medicine, Hippocrates, is credited with saying, "Let food be thy medicine and medicine be thy food" (King, 2019). This appears to be one of the earliest statements acknowledging the role of nutrition in maintaining health. In 1948, the World Health Organization (WHO) defined health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, n.d.). This definition reflected a growing emphasis on a holistic perspective of health.

### Weight Versus Body Mass Index

Several measurements are recognized and used to assess a person's nutritional status and identify individuals at risk for illness or disease. These indicators go beyond simply measuring a person's weight to assess body composition and weight distribution. **Body mass index (BMI)** is a formula that calculates the ratio of weight and height to classify individuals as underweight, healthy weight, overweight, or obese. The **waist-to-hip ratio (WHR)** calculates the ratio of the circumferences of the waist to the hip. Evidence has shown that individuals with excess weight around their midsection may be at higher risk for certain health conditions. These assessments can be done at home or with a health care provider to gain important information about an individual's dietary-related health.

## SPECIAL CONSIDERATIONS

### BMI and Diverse Populations

Recently, the routine use of BMI as a lone indicator of obesity has been scrutinized as a result of research that shows BMI may not be a reliable indicator for diverse populations. The American Medical Association (AMA) has adopted a new policy clarifying the use of BMI as one means of identifying obesity. The policy states that BMI should not be used exclusively to identify obesity; instead, it should be used in conjunction with other assessment tools. The policy acknowledges the BMI assessment is based on data from non-Hispanic White populations and does not consider differences in body shape and composition across different race/ethnic groups, sexes, or age groups (AMA, 2023).

## CALCULATING BMI

BMI is a screening tool used to identify clients who are overweight or obese. Considering the recent policy change by the AMA, nurses should stay abreast of new research to determine how to incorporate BMI measurements when working with diverse client populations. BMI does not measure body fat directly but correlates with other more direct measures of body fat such as skinfold thickness measurements. High BMI can be correlated with obesity-linked adverse health outcomes. To determine BMI, input the client's height and weight into the [Adult BMI Calculator \(<https://openstax.org/r/cdchealthyweight>\)](https://openstax.org/r/cdchealthyweight). Use [Table 1.2](#) to interpret the results.

BMI	Weight Status
< 18.5	Underweight
18.5 to < 25	Healthy weight
25.0 to < 30	Overweight
30.0 to < 35.0	Class 1 obesity
35.0 to < 40.0	Class 2 obesity
> 40.0	Class 3 obesity

**TABLE 1.2** BMI Weight Classifications (source: CDC, 2022a)

## MEASURING WHR

Clients may be self-conscious about having body measurements taken. Provide privacy for your client when taking these measurements. To determine WHR, with the client standing upright, use a tape measure to measure the distance around the smallest part of the client's waist (waist circumference) and then the largest part of the client's hip (hip circumference). Then divide the waist circumference by the hip circumference or [use this online calculator \(<https://openstax.org/r/thecalculatorsite>\)](https://openstax.org/r/thecalculatorsite) to determine the WHR. The result is determined using [Table 1.3](#).

Health Risk	Women	Men
Low	$\leq 0.80$	$\leq 0.95$
Moderate	0.81–0.85	0.96–1.0
High	$\geq 0.86$	$> 1.0$

**TABLE 1.3** WHR Health Risk Classifications (source: Van De Walle, 2019)

## Health Promotion

Healthy People 2030 is a framework of U.S. public health objectives designed to improve the health and well-being of the population (USHHS, ODPHP, n.d.). Since its initial release in 1980, it has been updated each decade to shape health promotion and disease prevention strategies in the U.S. (CDC, 2023). In terms of nutrition, Healthy People 2030 aims to help people get the recommended amounts of healthy foods to reduce their risk for long-term diseases and improve their health (USHHS, ODPHP, n.d.)

## 1.2 Interdisciplinary Teams and Nutrition in Nursing Practice

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 1.2.1 Discuss the interdisciplinary nature of nutrition and client care.
- 1.2.2 Approach nutrition in nursing practice using the National Council of State Boards of Nursing (NCSBN) Clinical Judgment Model.

### An Interdisciplinary Team Approach to Meeting Client's Nutritional Needs

The nurse is one part of an interdisciplinary team caring for the client. Nutrition affects all aspects of a person's care.

Decisions made by each practitioner affect the client's nutritional status and influence decisions by other team members. A coordinated, interdisciplinary approach can improve health care quality and outcomes (Bendowska & Baum, 2023).

Although the primary health care provider (PCP) typically orders a specific diet for clients to follow, the PCP will often have a dietitian meet with the client to review their history, physical examination, and lab values to determine a nutrition care plan for the client. Additional input regarding nutrition may be obtained from other members of the team based upon their area of expertise and the client's needs. The nurse can work with the client and family to identify preferences and likelihood of adherence to a specific diet regime. The nurse can assist the client in understanding specific benefits of nutritional recommendations, as well as develop a plan for the client to adopt healthy eating into their lifestyle.

### Interdisciplinary Team Introduction

Dietary evaluation can begin in either the acute care setting or outpatient setting. When started in the acute care setting, a nutritional plan (meal plan) is generally developed to address a specific need with a short-term goal. For example, a client with chronic congestive heart failure experiencing an acute exacerbation would need to decrease sodium consumption to decrease fluid retention. Dietary evaluation in the outpatient setting can help develop a plan that focuses on steps that yield long-term goals. For example, a client diagnosed with Class 1 obesity could benefit from weight reduction to decrease the risk of developing type 2 diabetes. Or, a patient already diagnosed with type 2 diabetes could benefit from dietary counseling as an intervention to manage the condition. See [Table 1.4](#) for an example of the roles of an interdisciplinary team.

Client and Family	Health Care Provider	Dietitian	Nurse	Speech Therapist	Other Specialists
Shares personal preferences, ability to obtain and prepare specific foods/ nutritional supplements	Makes initial dietary order based on history and physical exam, laboratory results, and client interaction	Assesses client's nutritional needs and develops nutritional plan based on client's preferences and budget	Assesses client's understanding of proposed nutritional plan and provides ongoing assessment of eating habits	Assesses client's ability to swallow	Occupational therapist, physical therapist, mental health counselor—for example, occupational therapists can assess self-feeding skills and the need for adaptive equipment

**TABLE 1.4** Roles of an Interdisciplinary Team as They Relate to Clients' Nutritional Needs

### Integrative Nutritional Essentials and Evidence-Based Practice

**Integrative nutrition** combines medical nutritional therapy with functional medicine and other disciplines to provide education and guidance for a personalized diet based on whole foods and lifestyle recommendations (Center for Integrative Nutrition, n.d.). The integrative nutrition approach supports a multidisciplinary approach to managing nutrition. **Evidence-based practice (EBP)** involves using the best evidence to deliver health care (Chien, 2019). Nutritional interventions should be based on evidence to improve patient outcomes.

### Clinical Nursing Practice and Integrative Nutritional Essentials

Nursing practice has always had a holistic focus (Thornton, 2019). With this perspective, the nurse should view the client's physical and nutritional status in concert with other factors, consistent with the framework of integrative nutrition. In a holistic practice, psychological, social, and cultural factors should be addressed when working with clients to develop a nutritional plan (meal plan).

### The National Council of State Boards of Nursing Clinical Judgment Model

The NCSBN developed the NCSBN Clinical Judgment Measurement Model (NCJMM) in conjunction with the updated National Council Licensure Examination (NCLEX). This model is an evidence-based tool for NCLEX testing and pre-licensure preparation. The model is used to evaluate prospective entry-level nurses' clinical judgment and decision-making ability (NCSBN, 2023).



## NCJMM OVERVIEW

The NCJMM adds complexity and clinical context to NCLEX testing items to better simulate real-world practice (NCSBN, 2019). This [NCJMM video](https://openstax.org/r/ncsbnorgvideo) (<https://openstax.org/r/ncsbnorgvideo>) provides an overview of the model. Understanding the model can better prepare nurses to take the NCLEX and apply what was learned in school to post-graduate work.

### Nursing Process

The nursing process represents a five-step approach to client-centered care: assessment, diagnosis, planning, implementation, and evaluation (Toney-Butler & Thayer, 2023). During the assessment phase, most health and medical history questions are relevant to the client's nutritional status. Questions specifically related to nutrition are those asking for a dietary recall (record of what the client has eaten during a specified time frame) or asking about food frequency (how much of a food is consumed and how often). Other relevant questions include questions about food preferences, food preparation ability and concerns, how the client accesses food, and cultural and religious concerns related to nutrition. Again, many aspects of the physical assessment are related to nutrition. However, the nurse can easily collect assessment findings directly related to nutrition: height, weight, and other body measurements such as waist-hip measurements.

### NCSBN Clinical Judgment Model Identification

The NCJMM has expanded the traditional nursing process model to focus on clinical judgment and to align more closely with real-world nursing practice (Ignatavicius & Silvestri, 2023).

This educational resource will use the NCJMM as the framework to drive nursing care. The NCJMM provides a systematic approach to assess the client, analyze their situation, and form a plan of care incorporating best EBP.



## NCJMM AND NCLEX EXAM

The NCJMM is an evidence-based framework that outlines the clinical decision-making process for nursing students and new graduates. [Visit this NCLEX website](https://openstax.org/r/nclexclinical) (<https://openstax.org/r/nclexclinical>) to learn more about this model and how it relates to the traditional nursing process. This model is the foundation for designing the NCLEX exam that all nursing students must pass to become registered nurses.

## 1.3 Nutrition and Population Health

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 1.3.1 Identify the roles that government agencies and nonprofit organizations play in the creation, implementation, and enforcement of nutritional regulations.
- 1.3.2 Describe current USDA dietary guidelines, including MyPlate.
- 1.3.3 Analyze the primary sources of consumer nutrition information.
- 1.3.4 Assess the importance of client education for promoting healthy nutritional habits.

### The U.S. Department of Agriculture

It is difficult to separate an individual from the community when assessing personal ability to meet nutritional needs. Factors such as food accessibility, ability to prepare foods, and traditional dietary preferences play a role in how a client can adopt a dietary lifestyle conducive to health and wellness. Government regulations and programs and the availability of appropriate consumer nutritional education can influence these factors.

The USDA leads 29 agencies that oversee food production and consumption. The USDA (n.d.) recognizes poor nutrition as a substantial factor in illness in the U.S.—poor nutrition is linked to diabetes, obesity, and heart disease. These illnesses impact the nation more broadly by decreasing productivity and increasing health care costs. To foster health, the USDA promotes research to build support and collaboration to provide all Americans equitable access to healthy foods. The USDA's Food and Nutrition Service works to address food insecurity and provide evidence-based nutritional guidance to consumers (USDA Food and Nutrition Service, n.d.).

As part of the USDA's commitment to connecting all Americans with access to affordable, healthy food, the USDA manages programs designed to provide Americans of limited income or with special needs with healthy food. For example, the Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides a monthly allotment for enrollees to purchase certain nutrient-dense foods. The National School Lunch Program (NSLP) provides nutritional, low-cost or free lunches to eligible school-age children. [Table 1.5](#) lists food assistance programs available through the USDA for qualified individuals.

Program	Website
Supplemental Nutrition Program for Women, Infants, and Children (WIC)	<a href="https://www.fns.usda.gov/wic">https://www.fns.usda.gov/wic</a> ( <a href="https://openstax.org/r/fnsusdagov">https://openstax.org/r/fnsusdagov</a> )
Farmers Market Nutrition Program (FNMP)	<a href="https://www.fns.usda.gov/fmnp/wic-farmers-market-nutrition-program">https://www.fns.usda.gov/fmnp/wic-farmers-market-nutrition-program</a> ( <a href="https://openstax.org/r/fmnp">https://openstax.org/r/fmnp</a> )
Fresh Fruit and Vegetable Program (FFVP)	<a href="https://www.fns.usda.gov/ffvp/fresh-fruit-and-vegetable-program">https://www.fns.usda.gov/ffvp/fresh-fruit-and-vegetable-program</a> ( <a href="https://openstax.org/r/ffvp">https://openstax.org/r/ffvp</a> )
Supplemental Nutrition Assistance Program (SNAP)	<a href="https://www.ers.usda.gov/topics/food-nutrition-assistance/supplemental-nutrition-assistance-program-snap">https://www.ers.usda.gov/topics/food-nutrition-assistance/supplemental-nutrition-assistance-program-snap</a> ( <a href="https://openstax.org/r/ers">https://openstax.org/r/ers</a> )
Farmers Market Grant Program administered jointly with the National Association of Farmers Market Nutrition Programs (NAFMNP)	<a href="https://www.fns.usda.gov/snap/farmer-producer-farmers-market-grant-program">https://www.fns.usda.gov/snap/farmer-producer-farmers-market-grant-program</a> ( <a href="https://openstax.org/r/snap">https://openstax.org/r/snap</a> )
Healthy Fluid Milk Incentives (HFMI)	<a href="https://www.fns.usda.gov/snap/healthy-fluid-milk-incentive">https://www.fns.usda.gov/snap/healthy-fluid-milk-incentive</a> ( <a href="https://openstax.org/r/snaphealthy">https://openstax.org/r/snaphealthy</a> )
The Emergency Food Assistance Program (TEFAP)	<a href="https://www.fns.usda.gov/tefap/emergency-food-assistance-program">https://www.fns.usda.gov/tefap/emergency-food-assistance-program</a> ( <a href="https://openstax.org/r/tefap">https://openstax.org/r/tefap</a> )
National School Lunch Program (NSLP) School Breakfast Program (SBP) Special Milk Program (SMP) Child and Adult Care Food Program (CACFP) Summer Food Service Program (SFSP) Team Nutrition The Patrick Leahy Farm to School Program	<a href="https://www.fns.usda.gov/cn">https://www.fns.usda.gov/cn</a> ( <a href="https://openstax.org/r/fns">https://openstax.org/r/fns</a> )

**TABLE 1.5** USDA Resources for Food Assistance Programs

The USDA also plays an essential role in regulating food production and distribution to ensure food quality and safety. The Food Safety and Inspection Service is the primary USDA agency that enforces safe processing and packing regulations of meat, poultry, and egg products.

The USDA actively promotes nutrition through educational materials. From the provision of curricula available for school-age children in both English and Spanish, Team Nutrition—an initiative to support child nutrition—utilizes visually appealing materials to promote nutrition various ways.

The *Dietary Guidelines for Americans 2020-2025* are designed for policymakers and health professionals to assist in their efforts to promote a healthy, nutritious diet (USDA & USHHS, 2020). **MyPlate**, a resource directed towards consumers and based on the *Guidelines*, provides practical information on nutritious foods for consumers to use daily. The MyPlate campaign uses the image of a plate colorfully sectioned into recommended proportions of food for a nutritious meal. Fruits and vegetables comprise half of the plate, grains are approximately one-fourth of the plate, and protein occupies the remaining section. Low-fat or fat-free dairy is represented by a glass next to the plate. The MyPlate website encourages everyone to “start simple with MyPlate” and “make every bite count” (USDA, n.d.).

## SPECIAL CONSIDERATIONS

### Cultural Food Traditions

The USDA recognizes the importance of incorporating cultural food traditions when planning a healthy diet. The *Dietary Guidelines for Americans 2020–2025* are meant to be a framework for individuals to use to plan meals that are nutritious yet reflective of their culture/ethnic food preferences. To assist with educating clients from diverse backgrounds, MyPlate educational materials are available in many different languages.

## The U.S. Food and Drug Administration

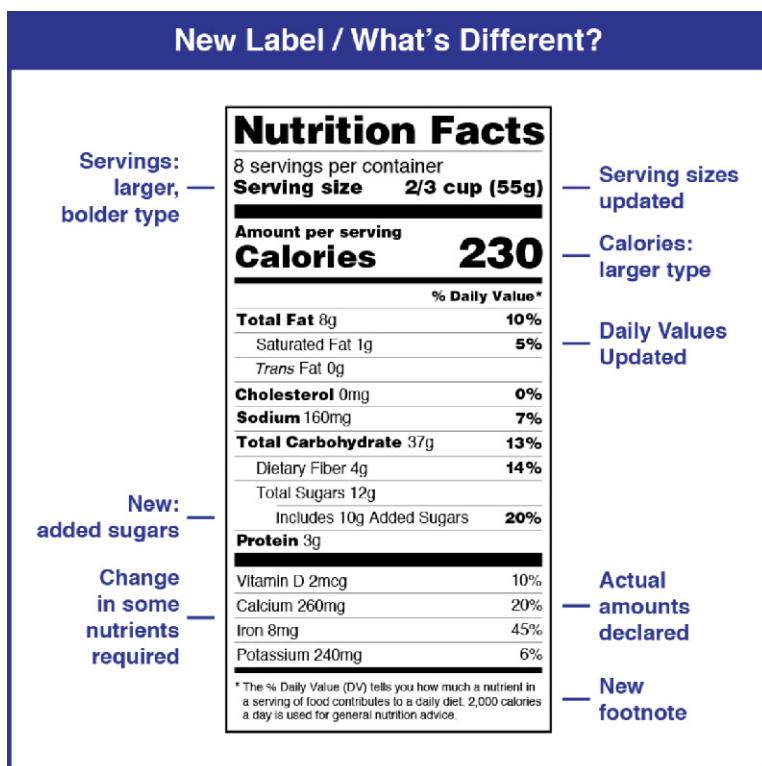
One of the oldest U.S. government agencies is the FDA, which has been the driving force behind labeling. Earlier versions of food labels focused solely on listing accurate ingredients. In recent years, labels have evolved to provide more detailed nutritional information to consumers. The FDA recently updated the Nutrition Facts label on packaged food and drinks to incorporate current research and public input (Figure 1.2). The changes were designed to make it easier for consumers to make good food choices to improve health and wellness. In addition to the new changes, the FDA also engaged in a campaign to strategically support consumer education to decrease poor nutrition that contributes to disease and death.



### NEW NUTRITION FACTS LABEL

[Access multimedia content \(<https://openstax.org/books/nutrition/pages/1-3-nutrition-and-population-health>\)](https://openstax.org/books/nutrition/pages/1-3-nutrition-and-population-health)

This is a 30-second “commercial” designed to highlight key changes in the new Nutrition Facts label. Watch the new nutrition facts label video to see how nutrition information can be presented in an entertaining format.



**FIGURE 1.2** The FDA updated the Nutrition Facts label in 2016. (credit: “On May 20, 2016, the FDA announced the new Nutrition Facts label for packaged foods to reflect new scientific information, including the link between diet and chronic diseases such as obesity and heart disease”/U.S. Food and Drug Administration, Public Domain)



### EDUCATION ON THE NEW NUTRITION FACTS LABEL

Learn more about the FDA’s new Nutrition Facts label using this interactive resource: [Interactive Nutrition Facts](#)

[Label](https://openstax.org/r/label) (<https://openstax.org/r/label>). Select different label components to learn more about each one and how each appears on the new label. Then, test your knowledge of the new label by taking a brief quiz.

In addition to consumer education, the FDA offers professional continuing education on the new Nutrition Facts label. [Visit Healthcare Professionals | FDA](https://openstax.org/r/fdafood) (<https://openstax.org/r/fdafood>) to access educational materials designed to help health care professionals understand the new label and how to incorporate it into their practice.

## U.S. Nonprofit Organizations

Nonprofit organizations work to advance good nutrition through advocacy for pro-nutrition policies and by providing consumer education and wellness promotion. These organizations may focus solely on nutrition or on reducing the effects of illness and disease. For example, in 2006, the American Heart Association promoted health via nutrition by presenting the Diet and Lifestyle Goals for Cardiovascular Disease Risk Reduction. These guidelines, reviewed and updated in 2021, recommend the following nutritional recommendations as part of a comprehensive plan to decrease the risk of cardiovascular disease:

- A variety of fruits and vegetables
- Whole grains
- Healthy sources of protein (mostly plants, nuts, fish and seafood, low-fat or nonfat dairy, and lean unprocessed meat and poultry)
- Liquid non-tropical vegetable oils
- Minimally processed foods
- Minimal added sugar intake
- Foods prepared with little or no salt
- Limited or preferably no alcohol intake (AHA, 2023)

Health care organizations also provide free nutritional resources. For example, Johns Hopkins Medicine offers Health, a vast online resource discussing healthy eating, vitamin use, diets for specific illnesses, and consumer tips. [Table 1.6](#) lists nonprofit websites to explore available information related to nutrition, health, and wellness.

Organization	Website
Action for Healthy Kids	<a href="https://www.actionforhealthykids.org/">https://www.actionforhealthykids.org/</a> ( <a href="https://openstax.org/r/actionforhealthykids">https://openstax.org/r/actionforhealthykids</a> )
American Diabetes Association	<a href="https://diabetes.org/healthy-living/recipes-nutrition/healthy-food-choices-made-easy">https://diabetes.org/healthy-living/recipes-nutrition/healthy-food-choices-made-easy</a> ( <a href="https://openstax.org/r/diabeteshealthy">https://openstax.org/r/diabeteshealthy</a> )
American Heart Association	<a href="https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/nutrition-basics">https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/nutrition-basics</a> ( <a href="https://openstax.org/r/hearthealthy">https://openstax.org/r/hearthealthy</a> )
Johns Hopkins Medicine	<a href="https://www.hopkinsmedicine.org/health/wellness-and-prevention/food-and-nutrition">https://www.hopkinsmedicine.org/health/wellness-and-prevention/food-and-nutrition</a> ( <a href="https://openstax.org/r/hopkinsmedicine">https://openstax.org/r/hopkinsmedicine</a> )
Mayo Clinic	<a href="https://www.mayoclinic.org/healthy-lifestyle">https://www.mayoclinic.org/healthy-lifestyle</a> ( <a href="https://openstax.org/r/mayo clinic">https://openstax.org/r/mayo clinic</a> )
Meals on Wheels America	<a href="https://www.mealsonwheelsamerica.org/">https://www.mealsonwheelsamerica.org/</a> ( <a href="https://openstax.org/r/mealsonwheelsamerica">https://openstax.org/r/mealsonwheelsamerica</a> )
National Alliance for Nutrition and Activity	<a href="https://www.cspinet.org/protecting-our-health/nutrition/national-alliance-nutrition-and-activity">https://www.cspinet.org/protecting-our-health/nutrition/national-alliance-nutrition-and-activity</a> ( <a href="https://openstax.org/r/cspinet">https://openstax.org/r/cspinet</a> )

**TABLE 1.6** Nonprofit Websites Providing Nutritional Information

## Consumer Health Information

The trend toward consumer awareness and personal responsibility has dramatically affected how food and nutrition

are currently promoted. Nurses can use the wealth of available resources to promote a healthy relationship with food for individuals, families, and populations.

Consumer health information is widely available through the Internet and other media sources (television, podcasts, magazines, etc.). When using consumer health resources, first assess the scientific validity of the information (North Dakota State University, 2019). For all media sources, the author or speaker should be qualified to write or speak on the topic, and the research sources supporting the material should be clearly identified. Online information should come from a reputable website. Government websites (ending in .gov), educational organization websites (ending in .edu), and nonprofit agencies (ending in .org) are considered the most reliable sources of online information.

The nurse should instruct clients to review nutritional information with a questioning attitude. Clients should be wary of nutritional information that includes any of the following:

- Strategies that sound too good to be true
- Nutritional recommendations that are too simplistic or dramatic, and unlikely to be supported by scientific evidence
- Identifying specific foods as “good” or “bad”
- Nutritional guidance that is promoted by nonscience-based testimonials or celebrities or that has supporting research “underway”
- Guidance not supported by more than one study and not recommended by reputable scientific organizations (North Dakota State University, 2019).

Of course, even the most accurate information may not be appropriate for a particular client. The nurse should use clinical judgment to determine whether the nutritional information applies to the client’s situation. Additionally, the nurse should consider the client’s literacy level and ability to understand what is being explained.

### Health Literacy

An essential factor in the effectiveness of labeling or any health education is the ability of the client to read and understand the information. **Health literacy** is the ability to “obtain, process, and understand basic health information and services needed to make appropriate health decisions” (USHHS, ODPHP, 2021). In 2010, the USHHS released a National Action Plan to Improve Health Literacy. Fundamental to this plan is the belief that all people have the right to make informed decisions and that health services should be delivered in ways that support this right. Services should be provided in ways that are easy to understand and that promote healthy living (USHHS, ODPHP, 2021). Accordingly, limited health literacy is linked to poor health outcomes (USHHS, ODPHP, 2021).



### CLINICAL TIP

#### Improve Communication with Health Professionals

Helping clients communicate with the health care professionals they work with will improve their care and health-related outcomes. Encourage clients to use these strategies to promote good communication:

- Recommend the client write down or record information during their visit.
- Encourage the client to ask questions if something is not clear. Have the client confirm who to call if questions arise later.
- Advise the client to let the health care team know if the client does not understand what is being said. If the information is confusing or complicated, provide materials written in plain language that does not include medical terminology.
- Suggest that someone accompanies the client to their next appointment (if appropriate). This person can help take notes and ask questions. If the client does not speak the same language as the health care provider, an interpreter credentialed for health care services is needed. Family members should not be expected to act as medical interpreters. (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2010)

### Client Readiness to Learn and Client Teaching Strategies

Nurses should ensure clients have the skills and knowledge they need to participate effectively in their health care (Hendler, 2022). However, attempting to teach clients when they are not interested in learning is challenging.

Accordingly, the nurse's overall client assessment involves determining the client's readiness to learn. The following questions can help the nurse identify cues relevant to learning readiness:

- Does the client express an interest in the subject?
- Does the client ask relevant questions?
- Is the client's body language consistent with someone who is paying attention?
- Does the client appear distracted and disinterested?

To try to increase the client's interest in learning, the nurse should take time to establish rapport. The nurse should ask the client questions to learn more about the client's preferences and needs and explain the benefits of learning the material.

Assessing readiness to learn is part of a more extensive assessment that should occur when preparing to teach clients. Handler (2022) summarizes an approach to effective teaching:

- Assess the client's learning style.
- Determine the client's strengths and weaknesses.
- Identify the client's learning needs.
- Identify any relevant cultural or religious considerations.

During the teaching session the nurse should:

- Use appropriate resources for the client's situation and literacy level. Obtain an interpreter who is credentialed in medical interpretation if needed.
- Involve family or close friends in the session when possible since they are involved in the client's health care and daily living.
- Communicate using plain language that minimizes the use of medical jargon.
- If possible, teach the content over multiple sessions.

#### Evaluation of Effectiveness of Client Teaching

The nurse should evaluate client teaching to determine if the client has understood the information and applied it to their life. Most frequently, client teaching is evaluated using feedback from the client. This can be verbal feedback. For example, can the client answer relevant questions correctly? The nurse could have the client explain in their own words what the nurse has said; the nurse could also demonstrate the material taught, if applicable. If possible, the nurse should check in with the client later to monitor progress and answer any additional questions. Also, the nurse should monitor any relevant client outcomes. For example, have blood glucose levels or hemoglobin A1C (HbA1c) levels improved after instructing a client with newly diagnosed diabetes on diet management of the condition?

### Holistic Assessment of Cultural Considerations

A client's culture is intertwined with their health, requiring providers to continually learn more about their values, beliefs, and ways of life (Gbareen, Barnoy & Theilla, 2021). A cultural assessment involves more than identifying any language barriers. The nurse should seek to understand the client's perspective, preferences, or social norms that are part of the client's life and affect the client's food preparation and consumption.

## 1.4 Vulnerable Populations

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 1.4.1 Assess the impact of food insecurity on health and food choices.
- 1.4.2 Describe ways to promote food security.

### Social Determinants of Health

Nurses must consider that clients' health problems can be affected by nonmedical factors. Individual clients are part of larger groups whose health is affected by social, demographic, and environmental forces. Unfortunately, certain populations are more likely to experience negative health outcomes related to these influences.

**Social determinants of health (SDOH)** are nonmedical factors that affect individuals' health (USHHS, 2021; ODNPHP, n.d.). Examples of SDOH include the following:

- Safe housing, transportation, and neighborhoods
- Racism, discrimination, and violence
- Education, job opportunities, and income
- Access to nutritious foods and physical activity opportunities
- Polluted air and water
- Language and literacy skills

One of the goals of Healthy People 2030 is to address SDOH and create social, physical, and economic conditions that promote health and well-being for all.

## Food Insecurity

**Food insecurity** is access to nutritious foods that is limited or uncertain because of social or economic factors (National Institute on Minority Health and Health Disparities [NIMHHD], n.d.). Clients with food insecurity do not have consistent, reliable sources of nutrient-dense foods. Poverty, long-term health conditions, and racial discrimination are some of the factors that can lead to food insecurity (Feeding America, 2023). In 2020, almost 15% of U.S. households experienced food insecurity at some point in time (NIMHHD, n.d.). Nurses should screen clients for food insecurity as part of a nutritional assessment.

## SPECIAL CONSIDERATIONS

### Food Insecurity

As part of a nutrition assessment, clients should be screened for food insecurity. The USDA has a Household Food Security Survey (HFSS) that can be used. However, researchers have developed a brief two-question tool based upon the HFSS that can be used to quickly screen clients. The Hunger Vital Sign includes two statements that can be read during a client interview; the client should respond to each statement as “often true,” “sometimes true,” or “never true” for their household in the last 12 months. If the client responds “often true” or “sometimes true” to either question, the screening for food insecurity is positive.

1. “We worried whether our food would run out before we got money to buy more.”
2. “The food we bought just didn’t last, and we didn’t have money to get more.”

The Hunger Vital Sign screening is easy to use and is increasingly being built into electronic health record systems (Gattu et al., 2019).

### Impact on Health and Food Choices

Local environments influence food insecurity significantly (NIMHHD, n.d.). For example, **food deserts** are geographic areas that lack access to affordable, healthy food. These can be rural or urban areas that lack grocery stores with healthy food options. In some areas, there may be stores that sell food, but the food is not nutritious. **Food swamps** are areas with stores that sell food, but the food is high in calories, sugar, sodium, and/or fat—often referred to as junk food.

When people do not have reliable, nutritious food sources, they cannot follow recommended diets. As such, food insecurity is associated with poor health outcomes. People with food insecurity are at increased risk for long-term health conditions, including diabetes, obesity, and heart disease (NIMHHD, n.d.).

### Promoting Food Security

**Food security** means having enough food for an active, healthy life (NIMHHD, n.d.). Promoting food security necessitates educating and referring clients to additional resources (Hunger + Health, 2023). **Food literacy**—understanding labels and making good food choices—is critical to improving food security (Devine & Lawlis, 2019). Sometimes the client can access adequate quantities of food, but it is not quality, nutrient-dense food. For example, the client may eat a lot of fast food or junk food from a convenience store. Although education is essential to improving the client’s diet, education alone is not enough. The client needs access to the types of foods recommended through client teaching. Nurse referrals to community agencies for food and other financial assistance are essential.

## Vulnerable Populations

Some groups in the U.S. are considered **vulnerable populations** because nonmedical factors limit their ability to achieve health and wellness (CDC, 2022b). Examples of vulnerable populations include racial or ethnic minority groups, low-income groups, migrants, older adults, and children. When assessing clients, nurses should consider whether they are part of a vulnerable population and plan interventions accordingly.

The County Health Rankings & Roadmaps (CHR&R) provide data to raise awareness of factors that influence health in a community. This information is available for anyone to access. Nurses can use this information to learn more about the clients they treat. Communities can use the information obtained from these rankings to promote health equity and improve the overall health of their citizens. The CHR&R model identifies SDOH and how they relate to citizens' health factors. Communities can develop policies and programs to influence these health factors that influence health outcomes.

### SPECIAL CONSIDERATIONS

#### Connect Health Literacy and Health Equity

Teaching nutrition using resources and strategies that address health literacy needs also promotes health equity. Teach clients in a way that matches their cultural, language, and environmental needs, so they are more likely to understand and accept what is being taught (USHHS, 2021). Health literacy can make information easier to understand and health equity can make the information more inclusive.



### COUNTY HEALTH RANKINGS

How healthy is your community? Review health data for any county in the U.S.—[visit the County Health Rankings & Roadmap website \(<https://openstax.org/r/countyhealthrankings>\)](https://openstax.org/r/countyhealthrankings) and search by state, county, or zip code to obtain health data for a community of interest. Compare health-related metrics in a location of interest with metrics from other locations. The database includes several nutrition-related metrics, including obesity rates, food environment index, excessive drinking, access to health care, and other SDOH.

## 1.5 Evidence-Based Practice and Nutrition

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 1.5.1 Apply EBP to client nutrition education and care.
- 1.5.2 Use EBP to evaluate trending nutritional views.
- 1.5.3 Use EBP to evaluate trending social media influencers.

### Applying Evidence-Based Practice

Health information is readily available via the Internet. Unfortunately, only some of this information is vetted for appropriateness and validity. Nurses should steer clients toward reliable sources of evidence-based information.

EBP is fundamental to nursing practice—whether collaborating with an interdisciplinary team or working individually with clients directly. Throughout the remainder of this educational resource, the nurse will have opportunities to apply EBP to various nutritionally based client scenarios. Working through these scenarios, via unfolding client case studies, will require the nursing student to apply concepts of clinical judgment (introduced from the NCJMM) to foster health and well-being to clients across all body systems and the lifespan. Unfolding case studies will build on prior knowledge and scenarios. When using EBP to navigate the case studies, an understanding of nutrition and body system disorders will be used to develop the best plan of care for the client.

## SPECIAL CONSIDERATIONS

### Diversity Implications

Research on nutrition has traditionally focused on biological relationships between diet and health. Although this is important, researchers must consider other factors. SDOH, health disparities, and health inequities all affect clients' nutritional intake and need to be addressed in research. Doing this will help researchers shift their nutritional recommendations from a "one size fits all approach" to evidence-based recommendations that can be utilized by diverse populations (Mattes et al., 2022).

## Evaluating Trending Nutritional Views

As mentioned earlier, an overwhelming amount of information is available to the consumer through the Internet. Consumers use the Internet to search health-related issues, find health care providers, and explore available resources. New (and sometimes not so new) nutrition trends are always appearing. [Table 1.7](#) lists some of the more prevalent trends in recent years. Encourage clients to use the approaches previously described in [Nutrition and Population Health](#) to review and discuss with their health care provider any trends that they are considering.

Trend	Description
South Beach Diet	Consume nutrient-rich carbohydrates and fats
Raw foods	Eat unprocessed/organic foods at a certain temperature
Fasting/cleanse	Consume liquids designed to eliminate toxins
Organic	Consume food certified as grown without chemical pesticides
NonGMO	Consume food certified as having no genetic modifications
Vegan/vegetarian	Eliminate animal-source protein/products from the diet either completely or selectively depending on specific type of vegetarian diet
Gluten free	Minimize or eliminate the ingestion of gluten found in wheat, barley, and rye
Paleo	Eliminate modern processed foods to focus on vegetables, fruits, nuts, eggs, fish, and lean meats
Atkins/Keto	Consume high-protein, low-carb foods
Calorie counting	Track food intake using calories; lose weight by eating fewer calories than required
Whole 30	Avoid inflammatory foods for better gut health
Probiotics	Eat foods containing probiotics to enhance gut and digestive health
Weight Watchers	Track food intake using point system; lose weight by eating a certain level of points
Diet apps	MyFitnessPal, for example, to quantify exercise and macronutrients
Mediterranean	Focus on fruit, vegetables, beans, nuts, lean meats, fish, and olive oil
Intermittent fasting	Focus on when to eat, not necessarily what to eat

**TABLE 1.7** Nutritional Trends from 2000 to the Present

## Evaluating Social Media Sources for Nutrition Information

Over 4 billion social media users view information on social media sites. Social media can provide 24/7 support from other users or support groups, instant communication, and cost-effective health care options. Social media and other Internet sites also pose security risks, provide false information, promote inappropriate sharing of research findings, and promote self-diagnosis without the benefit of an assessment from a trained, experienced health care provider. A recent study of nutritional information on Instagram found the quality of the content to be extremely low

(Kabata et al, 2022). When looking at social media posts, consumers should consider (Johns Hopkins Sheridan Libraries, 2023):

- The poster—Is this person qualified to post on this topic?
- Network—Do other credible people or organizations follow this account?
- Content—Can other sources validate the information?
- Contextual updates—Is this material they usually post about?
- Age—Is this an established account, or recently created?
- Reliability—Is the information source reliable?

As the American Academy of Nutrition and Dietetics noted, EBP uses scientific evidence rather than anecdotal evidence. This fundamental difference informs the nurse who evaluates trends in nutrition, especially those found on social media, and makes trusted recommendations to clients.

### **Benefits of Social Media Sources**

Several sources channel the benefits of using social media to influence nutrition and nutritional education positively. Food Hero, an online nutrition resource provided by Oregon State University through funding from the USDA, provides an excellent format for social media sources to use. From the inclusion of several cultural resources to videos on demand and gardening tips, their site provides information in a dynamic format. Food Hero is found on Snapchat, YouTube, Twitter, Facebook, and Pinterest and serves as a great example for best practices on social media. Several other examples can be found by following the links in [Table 1.8](#).

Website	URL
Clem & Thyme Nutrition	<a href="https://clemandthyme.com/#">https://clemandthyme.com/#</a> ( <a href="https://openstax.org/r/clemandthyme">https://openstax.org/r/clemandthyme</a> )
kaelyrd	<a href="https://www.kaelyrd.com/about">https://www.kaelyrd.com/about</a> ( <a href="https://openstax.org/r/kaelyrdabout">https://openstax.org/r/kaelyrdabout</a> )
Gathered Nutrition	<a href="https://gatherednutrition.com/">https://gatherednutrition.com/</a> ( <a href="https://openstax.org/r/gatherednutrition">https://openstax.org/r/gatherednutrition</a> )
no food rules	<a href="https://colleenchristensennutrition.com/course/">https://colleenchristensennutrition.com/course/</a> ( <a href="https://openstax.org/r/colleenchristensennutrition">https://openstax.org/r/colleenchristensennutrition</a> )
Christy Harrison	<a href="https://christyharrison.com/foodpsych">https://christyharrison.com/foodpsych</a> ( <a href="https://openstax.org/r/christyharrison">https://openstax.org/r/christyharrison</a> )

**TABLE 1.8** Registered Dietitians with Social Media Platforms

### **Pitfalls of Social Media Sources**

As mentioned earlier, the Internet is full of conflicting information. The nurse should encourage clients to evaluate nutrition information on social media sites in the same way information from websites and the media is scrutinized. Much of the nutrition advice on social media is based on anecdotal findings and experiences rather than scientific inquiry. Non-scientific social media content can promote eating disorders, distorted views of body image, and an unrealistic promotion of diet culture, all of which negatively impact nutrition and wellness.

## Chapter Summary

- Nutrition is the intake of food to meet the body's needs. Analyzing the quantity of food intake is not sufficient; the food consumed must be nutritional.
- Several noninvasive body measurements are needed for a nutritional assessment: weight, BMI, and WHR.
- Nutrition is vital to health promotion, and nutrition plays a prominent role in Healthy People 2030.
- The nurse is but one member of the interdisciplinary team caring for the client. The team must work together to manage the client's nutrition.
- Based on the nursing process, the NCJMM incorporates clinical judgment to make decisions required in current nursing practice.
- The USDA and the FDA are the federal agencies that oversee food production, labeling, and consumption. Nonprofit organizations also play an essential role in promoting nutrition.
- Education is an integral part of nutrition-related interventions for clients. The client must be ready to learn, and the nurse must use an individualized approach to teaching. Evaluate the effectiveness of client education by receiving feedback from the client and tracking health outcomes.
- SDOH are nonmedical factors that affect individuals' health and contribute to food insecurity. The nurse can address food insecurity through client education and referrals to community resources.
- Vulnerable populations are at risk for poor health. Community health needs assessments and community health rankings provide valuable information to address nonmedical factors influencing health.
- EBP is essential to select interventions that can lead to good health outcomes.
- Consumer nutrition information is abundant on the Internet, but not necessarily reliable or accurate.

## Key Terms

**body mass index (BMI)** a tool using weight and height to screen and classify individuals as underweight, healthy weight, overweight, or obese

**calories** the units used to measure the amount of energy needed or ingested daily

**diet** the quantity and quality of food and drinks consumed

**evidence-based practice (EBP)** using critically reviewed, scientifically proven evidence to deliver nursing care

**food** edible substances made of protein, carbohydrates, fat, or other nutrients

**food deserts** areas that lack access to affordable, healthy foods

**food insecurity** limited or uncertain access to adequate and affordable nutritious foods because of social or economic factors

**food literacy** the ability to understand labels and how to make good food choices

**food security** having access to enough food for an active, healthy life

**food swamps** areas that have stores that only sell calorie-dense, non-nutritive food

**health literacy** how much a person obtains, processes, and understands basic health information and services needed to make

appropriate health decisions

**integrative nutrition** combines medical nutritional therapy with functional medicine and other disciplines to provide education and guidance for a personalized diet based on whole foods and lifestyle recommendations

**macronutrients** water and the energy-yielding nutrients (carbohydrates, fats, and proteins) needed in large amounts by the body

**micronutrients** vitamins and minerals

**MyPlate** a resource directed towards consumers, provides practical information for consumers to use daily to consume nutritious foods

**nutrients** substances found in foods that can promote health and minimize illness

**nutrition** the intake of food to meet the needs of the body

**social determinants of health (SDOH)** nonmedical factors that affect individuals' health

**vulnerable population** a group of people whose health is negatively impacted by nonmedical factors

**waist-to-hip ratio (WHR)** the ratio of waist-to-hip circumferences

**wellness** the pursuit of activities, choices, and lifestyles leading to holistic health

## Review Questions

1. While instructing a client on how to read and interpret a food label, which of the following would suggest the food is not a healthy choice?

- a. 1 gram saturated fat
  - b. 10 grams added sugars
  - c. 4 grams dietary fiber
  - d. 3 grams protein
- 2.** According to the MyPlate model, which macronutrient comprises the largest part of the plate for an adult?
- a. Protein
  - b. Fruits and vegetables
  - c. Grains
  - d. Dairy
- 3.** Which of the following clients should be prioritized for referral to a multidisciplinary team to manage an acute nutritional concern?
- a. A new mother who wants guidance on losing weight postpartum
  - b. An adult whose blood glucose levels have increased over the past 6 months
  - c. A client being discharged from the hospital after a myocardial infarction
  - d. A client with a history of colon cancer
- 4.** A new mother needs financial assistance securing nutritious food options for her infant. Which federal agency is the most appropriate resource for this client?
- a. TEFAP
  - b. WIC
  - c. HFMI
  - d. SNAP
- 5.** The nurse is analyzing a popular diet plan with a client. Which of the following information would cause the nurse to question the validity of the presented diet?
- a. It specifies a target calorie range the client is expected to follow.
  - b. The diet's supporting evidence comes from a single physician affiliated with the required meal plan.
  - c. Following it necessitates keeping a detailed journal describing food intake.
  - d. Different nutrients must be consumed in prescribed amounts.
- 6.** Which of the following client statements should prompt the nurse to screen the client for food insecurity?
- a. "I don't have a steady income."
  - b. "My oven does not work well."
  - c. "Sometimes my food expires before I can eat it."
  - d. "I don't know any heart-healthy recipes."
- 7.** Which of the following actions by the nurse would occur during the outcome evaluation phase of the NCJMM?
- a. Educating the client who wants to drastically limit caloric intake
  - b. Recording the client's food intake for the past 24 hours
  - c. Reviewing the client's prescribed diet with a dietitian
  - d. Measuring the client's WHR at a follow-up visit
- 8.** Which of the following is a social determinant of health?
- a. Family history of a disease
  - b. Age
  - c. Employment status
  - d. Number of children
- 9.** The nurse is helping an adult, English-speaking client understand a newly prescribed diet. What is the best approach when selecting appropriate educational materials for the client?
- a. Provide materials designed to accommodate various reading abilities.

- b. Find as many materials as possible related to the diet.
  - c. Provide written materials in a variety of languages.
  - d. Ask the client whether or not they need supplemental materials.
- 10.** A client reports feeling overwhelmed by all the nutrition advice showing up on the client's social media account feed. How should the nurse respond?
- a. "Show me what you are looking at on social media."
  - b. "You cannot believe most of what you see online. You should rely on your health care providers for nutrition information."
  - c. "Try not to spend so much time on social media as it is a sedentary activity."
  - d. "It can be overwhelming. Let's talk about what you should look for to determine if the information is valid and reliable."

## Suggested Reading

Impactful Ninja. (2023). *9 Best Charities That Promote Health and Well-Being (Complete 2023 List)*.

<https://impactful.ninja/best-charities-for-health-and-well-being/>

U.S. Department of Agriculture. *Dietary Guidelines for Americans*. <https://www.dietaryguidelines.gov/>

U.S. Department of Agriculture. *Healthy Food*. <https://www.usda.gov/nutrition-security/healthy-food>

U.S. Food and Drug Administration. *Food*. <https://www.fda.gov/food>

World Health Organization. (2023). *Nutrition*. [https://www.who.int/health-topics/nutrition#tab=tab\\_1](https://www.who.int/health-topics/nutrition#tab=tab_1)

## CHAPTER 2

# A Holistic View of Macronutrients



**FIGURE 2.1** A Hawaiian spirulina bowl is an excellent source of the macronutrient protein. (credit: modification of work “Hawaiian Spirulina Smoothie Bowl” by Jennifer Johnston; NRCS Pacific Islands Area/Flickr, Public Domain)

### CHAPTER OUTLINE

- 2.1 Carbohydrates
  - 2.2 Fats
  - 2.3 Protein
  - 2.4 Hydration
- 

**INTRODUCTION** Macronutrients, or nutrients needed in large amounts, include carbohydrates, fats, and proteins and are critical for cells, tissues, and organs. These macronutrients power cellular energy, prevent disease, and facilitate optimal body function. Without macronutrients, life would cease.

## 2.1 Carbohydrates

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 2.1.1 Describe the nutritional function of carbohydrates.
- 2.1.2 Identify the impact of carbohydrates on wellness promotion and illness prevention.

### Carbohydrate Function and Metabolism

**Carbohydrates** are a large food category containing starches, cellulose, and sugars. They are composed of organic carbon, hydrogen, and oxygen molecules and are found naturally in fruits, vegetables, legumes, grains, and dairy products. The term carbohydrate refers to both simple and complex carbohydrates.

Converting carbohydrates found in food to cellular energy begins with enzyme action in the mouth and is completed

by enzymes formed in the small intestine and auxiliary organs. [Table 2.1](#) lists some enzymes and their breakdown products. The end product of carbohydrate metabolism is a simple sugar; the three main ones involved in human nutrition are glucose, galactose, and fructose. **Glucose**, a simple sugar, provides energy to cells and is the preferred fuel for the brain and nervous system. It is a **monosaccharide**, which is a sugar molecule that cannot be further metabolized.

Enzyme	Produced By	Site of Action	Substrate Acted Upon	Breakdown Product
Salivary amylase	Salivary glands	Mouth	Starch	<ul style="list-style-type: none"> <li>Disaccharides (maltose)</li> <li>Oligosaccharides</li> </ul>
Pancreatic amylase	Pancreas	Small intestine	Starch	<ul style="list-style-type: none"> <li>Disaccharides (maltose)</li> <li>Monosaccharides</li> </ul>
Oligosaccharides	Small intestine	Small intestine	Disaccharides	<ul style="list-style-type: none"> <li>Monosaccharides</li> </ul>

**TABLE 2.1** Some Enzymes and Their Breakdown Products

Monosaccharides link with each other in different formations to create **disaccharides**, compounds made up of two monosaccharide molecules. The disaccharide sucrose is formed from one glucose molecule and one fructose molecule; lactose is formed from glucose and galactose, and maltose is formed from two glucose molecules. Disaccharides are present in a wide variety of foods: lactose in milk products, maltose in molasses and other fermented foods, and sucrose in a variety of foods as table sugar. Once a disaccharide is broken into monosaccharides, a rise in blood glucose can be seen in 10–15 min. These rapid spikes in blood glucose can be dangerous for individuals with diabetes.

### Complex Carbohydrates and Fiber

**Complex carbohydrates**, also called polysaccharides, comprise long chains of glucose molecules, creating starch or fiber. The chains of glucose molecules in starch are digestible and are slowly metabolized to a monosaccharide. Fiber is made up of plant substances, such as cellulose, and moves through the digestive system in an undigested form. Fiber is best known for its gastrointestinal health benefits. Research shows that fiber protects against colorectal cancer, diabetes, diverticulitis, heart disease, inflammatory bowel syndrome, and obesity (Precker, 2022; USDA, 2022). Although the recommended fiber amount varies with age and sex, an estimated 95% of American adults and children do not consume recommended amounts of fiber (Quagliani & Felt-Gunderson, 2016). The most prudent advice on increasing dietary fiber is to increase high-fiber foods gradually to avoid cramping, gas, and bloating, while ensuring adequate fluid intake. [Table 2.2](#) lists some common foods and their fiber content.

Food Item	Standard Portion Size	Fiber Content (Grams)
Guava	1 cup	8.9
Pinto beans	½ cup	7.7
Brussels sprouts, cooked	½ cup	6.4
Sweet potato, cooked	1 cup	6.3
Pumpkin seeds, whole	1 oz	5.2
Green peas, cooked	½ cup	4.4
Spinach, cooked	1 cup	4.3
Baked potato with skin	1 medium	3.9
Orange	1 medium	3.7
Ready-to-eat cereal, toasted oat	1 cup	3.0

**TABLE 2.2** Common Foods and the Amount of Fiber in Standard Portion Sizes (source: USDA, 2022)

Food Item	Standard Portion Size	Fiber Content (Grams)
Crackers, whole wheat	1 oz	2.9
Edamame, cooked	1/4 cup	2.1

TABLE 2.2 Common Foods and the Amount of Fiber in Standard Portion Sizes (source: USDA, 2022)

### Ultraprocessed Foods

Food not eaten in its original state is considered processed. Processed foods can include something as minimally processed as wheat milled into flour or as complex as a hot dog made from five or more ingredients. It is estimated that **ultraprocessed foods** (UPFs), commercially produced food products with a long shelf life and usually high in sodium and fat, provide 50–60% of individuals' total daily energy consumption in some high-income countries (Beslay et al., 2020). During ultraprocessing of grains, they are refined, thereby losing essential nutrients, and sugar and salt are added. Therefore, UPFs are much more likely to have lower amounts of fiber and higher amounts of sugar and salt than their unrefined versions, as well as chemical preservatives, such as nitrates and sulfides, to extend shelf life. [Table 2.3](#) includes examples of how **whole foods**, or foods in their natural state, are transitioned into UPFs. Research studies on UPFs and type 2 diabetes have found that participants with the highest UPF consumption had a higher risk for type 2 diabetes, with a statistically significant dose-response relationship (Llavero-Valero et al., 2021; Seal et al., 2021; Wood et al., 2023).

Whole Food Item	Minimally Processed Food Item	Ultraprocessed Food Item
Peanuts	Natural peanut butter	Peanut butter pretzels
Apple	Natural applesauce	Apple danish
Soybeans	Tofu	Soy-based meat alternatives
Corn	Old-fashioned grits	Corn chips
Grapes	100% grape juice	Grape jelly
Wheat	100% whole wheat bread	White bread

TABLE 2.3 Some Whole Foods and Their Transition to Ultraprocessed Foods

Nurses can help increase food literacy by holding meaningful discussions with clients about where food comes from and how it is changed as it enters the consumer marketplace. Clients should be able to identify UPFs and understand their relationship to health issues such as obesity, hypertension, and cancer (Fiolet et al., 2018). Creating meal plans with whole and minimally processed foods ensures the consumption of more complex carbohydrates instead of simple sugars.

### Carbohydrates and Nutrition-Related Disease

When discussing carbohydrate-related diseases with clients, the nurse should always consider the type of carbohydrate and the amount of sugar, fat, and salt added to carbohydrate-rich foods during processing. Carbohydrates should make up 50–65% of caloric intake. However, there is a significant difference in health impact if 50% of carbohydrates come from sugar-sweetened beverages and salty snacks instead of whole grains, fruits, and vegetables. Individuals with a plant-forward philosophy typically consume less meat and more fresh and minimally processed grains, fruits, and vegetables. A plant-forward meal plan provides more fiber, less sodium, and, consequently, lower spikes in blood glucose. Research suggests that carbohydrates found in whole foods, especially fiber, promotes health by contributing to good gut microbiota (Clemente-Suarez, 2022). Overconsumption of any macronutrient can contribute to weight gain. A regular diet of ultraprocessed carbohydrates has been associated with overweight, obesity, heart disease, and type 2 diabetes (Wood et al., 2023).

Two diets rich in fruits, vegetables, whole grains, and lean meats are the Mediterranean diet and the Dietary Approaches to Stop Hypertension diet (DASH). The Mediterranean diet is an excellent example of a diet high in

complex carbohydrates because it is rich in fruits, vegetables, beans, legumes, nuts, and seeds. The diet also includes fish, seafood, and poultry, as well as dairy products in moderate amounts. This diet is high in omega-3 fatty acids (from fish) and low in fat. The Mediterranean diet can be beneficial because it reduces heart disease, improves serum lipid profiles, and decreases hypertension (Hauser et al., 2022).

Research has shown that the DASH diet can substantially lower blood pressure (Hauser et al., 2022). The DASH diet includes minimally processed foods, and sugary beverages, sweets, and red and processed meats are discouraged. Other research has found that rates of diabetes, cancer, metabolic syndrome, and obesity are lower in individuals following diets like the Mediterranean and DASH diets (Shoaibinobarian et al., 2023).

## SPECIAL CONSIDERATIONS

### Carbohydrates and Athletes

Athletes need increased molecular energy in the form of carbohydrates to sustain their energy supply during exercise. When someone is exercising, circulating glucose is the first source of energy. This energy source is quickly depleted, and the body then relies on stored **glycogen**, a large polysaccharide stored in limited amounts in the skeletal muscle and liver. When these stores are depleted, the body metabolizes fat for additional energy. Fat releases energy slower than carbohydrates do and requires over twice as much oxygen to complete the breakdown. Recent research indicates that manipulating fat intake before an athletic event may further increase endurance (Iwayama et al., 2023). Endurance athletes have practiced “carbohydrate loading” since the 1960s, which means they deliberately maximize the amount of carbohydrate in their diet approximately three days before a competition (Thomas et al., 2016), thereby enlarging their glycogen stores. A diet higher in carbohydrates than usual, coupled with days of no exercise, allows for the maximum buildup of stored energy.

## Milk Carbohydrate and Lactose Intolerance

People are often surprised to discover that dairy products contain sugar. Lactose, often called “milk sugar,” is a disaccharide composed of galactose and glucose. Breaking down lactose into a monosaccharide requires the enzyme lactase. Lactase peaks at birth so that infants can digest breast milk. If lactose intolerance is diagnosed, it is not recommended to change to a completely dairy-free diet, as many intolerant patients can tolerate up to 12–15 g of lactose per day without side effects (Catanzaro et al., 2021). Some people do not have this enzyme due to injury or a defect in the small intestine. Lactose intolerance appears to occur more frequently in Africa and Asia, while northern Europeans show better tolerance of lactose-containing foods. In the United States, it is estimated that about 33% of the population has lactose intolerance (Alzahrani et al., 2022).

Without lactase, individuals will develop lactose intolerance symptoms such as bloating, gas, and diarrhea. They can take steps to help minimize discomfort and still consume milk-based foods by consuming lactose-free dairy products or taking lactase enzymes before meals to aid digestion. Additional calcium and vitamin D sources should be pursued if clients limit their dairy intake. A possible replacement for these nutrients is plant-based dairy products such as calcium- and vitamin D-fortified almond, rice, soy, hemp, and coconut milk if food allergies are not a concern (Katoch et al., 2022).

## Carbohydrates and Blood Glucose

For individuals attempting to stabilize their blood sugar, intentional monitoring of food intake is critical, as sugars, starches, and fiber can affect blood glucose levels. Monosaccharides can cause spikes in blood glucose, requiring the hormone insulin to move it into the cells. Starch and fiber cause a less dramatic rise in blood glucose. For healthy adults, whole or minimally processed carbohydrates should supply 50–65% of daily calories. The American Diabetes Association (ADA, 2019) recommends that the percentage of daily carbohydrates be individualized for those with diabetes. Current recommendations include a focus on self-management of diabetes, including individualization of carbohydrate levels based on food preferences and metabolic goals.

The **glycemic index** is a tool for better understanding the impact of certain foods on blood glucose. More than 4,000 foods have been ranked based on the availability of highly absorbable monosaccharides (Atkinson et al., 2021). For example, processed foods made with refined flour and sugar, including cookies, cakes, and candy, have a high glycemic index, whereas whole foods, such as unrefined grains and nonstarchy vegetables, have a lower glycemic

index. It is important to note that the glycemic index evaluates only individual foods, not entire meals, and no nutrient qualities are included in the glycemic index rankings (Charles, 2022).

The **glycemic load** is a newer and more comprehensive approach for assessing the impact of carbohydrates on blood glucose. The glycemic load uses the glycemic index and the number of total carbohydrates in a food serving to predict the timing and rise of blood glucose. It is a more accurate assessment of healthy food intake than the glycemic index alone (Charles, 2022).

## 2.2 Fats

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 2.2.1 Describe the nutritional function of fats.
- 2.2.2 Identify the impact of fats on wellness promotion and illness prevention.
- 2.2.3 Examine special considerations for individuals who face challenges securing adequate fat intake.

### Fat Function and Metabolism

Fats are found primarily in animal foods such as meat, high-fat dairy products, and fried food, although plants are also sources of fat in the form of oils. Fat is a concentrated energy source, supplying more than double the caloric energy of carbohydrates or protein. See [Table 2.4](#) for the comparison of energy in macronutrients. (Note that alcohol also provides calories, but unlike the macronutrients, it does not provide vitamins, minerals, or fiber. Its calories are commonly referred to as “empty” because they have no nutritional value.)

Fat helps maintain body temperature, is a critical part of fat-soluble vitamin transport, protects body organs by cushioning them, and is an essential component of cell membranes. Hormones secreted by accessory organs assist in fat metabolism. Although an enzyme, lingual lipase, exists in the mouth, the bulk of fat digestion occurs in the small intestine, where ingested **triglycerides** (fats composed of three fatty acids and one glycerol molecule) break down into monoglycerides and glycerol.

Macronutrient	Calories (Energy) per Gram	Primary Food Source
Carbohydrate	4	Grains, fruits, vegetables
Fat	9	Meat and dairy products
Protein	4	Meats, nuts, legumes
Water	0	Municipal supply, well, bottled
Alcohol	7	Beer, wine, hard liquor

**TABLE 2.4** Energy Contribution of Carbohydrates, Fat, Proteins, Water, and Alcohol

Fat adds a smooth taste to foods and contributes to satiety. For instance, fat contributes to the flavor of a well-marbled steak, a loaded baked potato, chicken cooked with skin, cereal with whole milk, coffee with cream, and deep-fried fish with french fries. These foods are high in calories and saturated fats and may take twice as long to digest as carbohydrates, remaining in the stomach and intestine longer and staving off hunger pangs. During fat digestion, the intestinal cells secrete the hormone cholecystokinin, which slows pancreatic function and causes longer gastric emptying, making the person feel full (Borer, 2023).

The fat-soluble vitamins A, D, E, and K are found only in fat-containing foods. They travel through the blood with fat molecules from the small intestine and are stored in the liver until needed. Because the fat-soluble vitamins are stored in the body, there is no need for daily ingestion. The storage mechanism makes deficiencies rare in the United States except for vitamin D deficiency, which has seen a large uptick globally over the last decade. According to Guilbeau and Watson (2022), an estimated 18% of people in the United States have inadequate levels of vitamin D and 5% have vitamin D deficiency. Fat-soluble vitamin deficiencies may occur when fat is restricted or when a client receives total parental nutrition without lipids.

According to the U.S. *Dietary Guidelines for Americans for 2020–2025*, no more than 20–35% of daily calories should come from fat; the exception is toddlers aged 2–3 years, for whom the goal is 30–40% (U.S. Department of Agriculture & U.S. Department of Health and Human Services, 2020). Fat is an essential nutrient critical for metabolic functions including vitamin synthesis, long-term energy storage, and the production of essential fatty

acids. However, given its caloric density, too much fat, like too much carbohydrate or protein, can raise caloric intake above caloric output, causing weight gain.

### Saturated Fat

A saturated fat is usually solid at room temperature and is found in animal-based foods and some plant oils. Saturated fat was first linked with heart disease in the 1950s by Ancel Keys, who proposed the diet–heart hypothesis (Teicholz, 2023). It has been widely accepted that a decrease in saturated fats is protective against the development of cardiovascular disease (MacDonald et al., 2022). The U.S. *Dietary Guidelines for Americans 2020–2025* continue to include the recommendation to lower the intake of saturated fat. The American Heart Association recommends a dietary pattern that achieves 5–6% of calories from saturated fat. For example, if an individual needs about 2,000 calories a day, 120 calories at most should come from saturated fat, or approximately 13 g/day (American Heart Association, 2021). [Table 2.5](#) lists amounts of saturated fat in some everyday foods.

Food Item	Measure of Edible Portion	Saturated Fat Content (Grams)
Dried coconut, raw	1 piece, about 2" x 2"	13.4
Trail mix, tropical	1 cup	11.9
Chimichanga with beef	1 chimichanga	8.5
Butter	1 Tbsp	7.2
Cheddar cheese, cut pieces	1 oz	6.0
Milk, whole (3.3% fat)	1 cup	5.1
Pork salami, dry type	2 3 1/8" x 1/16" slices	2.4
Chicken thigh, roasted	1 thigh	1.6

**TABLE 2.5** Common Foods and Their Saturated Fat Content (source: Gebhardt & Thomas, 2022)

### Monounsaturated Fats

Monounsaturated fats (MUFAs) such as olive oil have become the “go-to” fat, replacing polyunsaturated fats, which received much of the attention in the 1980s. [Table 2.6](#) lists some common oils and their monounsaturated fat content. All fats have the same number of calories per gram (9 g), whether saturated or not.

Oil	Monounsaturated Fat Content (Grams per 1 Tbsp)
Safflower	10.2
Olive	9.9
Almond	9.5
Canola	8.2
Peanut	6.2
Soybean, hydrogenated	5.8
Sesame	5.4
Palm	5.0
Corn	3.3
Sunflower	2.7
Coconut	0.9

**TABLE 2.6** Various Oils and Their Monounsaturated Fat Content (sources: Gebhardt & Thomas, 2022; USDA, 2019)

There is a difference between animal monounsaturated and plant monounsaturated fats. Animal-based monounsaturated fats are present in eggs, poultry, red meat, fish, and full-fat dairy. Evidence demonstrates that research subjects who had “a higher intake of monounsaturated fatty acids from animals had a 21% higher risk of death from any cause” (American Heart Association, 2018). A decrease in mortality was observed when monounsaturated fats such as olive oil were substituted for saturated fats (Guasch-Ferre et al., 2019).

### Polyunsaturated Fats

Two well-known polyunsaturated fats are omega-3 and omega-6 fatty acids. Omega-3 fats play a role in heart

health and are found in eggs, soybeans, flaxseed, canola oil, and fatty fish such as salmon. The role of omega-6 fatty acid in heart health is more complex than that of omega-3. Its greatest effect appears to be strengthening of the immune system. Omega-6 fatty acids are found in sunflower, safflower, soy, sesame, and corn oils.

Polyunsaturated fatty acids are known for their health properties and anti-inflammatory action (Currenti et al., 2022). Polyunsaturated fats should make up no more than about 11% of the 20–35% of daily calories from fat (Liu et al., 2016). [Table 2.7](#) presents a comparison of the polyunsaturated content of common cooking oils.

The majority of daily fat consumption should come from unsaturated sources, i.e., monounsaturated and polyunsaturated fats (Schweichler, 2022).

Oil	Percentage of Polyunsaturated Fats
Flaxseed	73
Soybean	55–58
Corn	59
Cottonseed	52
Peanut	32
Sunflower	29
Canola	32
Safflower	13
Olive*	11
Butter**	3
Coconut**	2

\*High in monounsaturated fat (71%)

\*\*High in saturated fat (butter: 63%, coconut: 87%)

**TABLE 2.7** Percentage of Polyunsaturated Fats in Common Oils (source: Gebhardt & Thomas, 2022; USDA, 2019)

### Trans Fats

Artificially produced trans fats have been used as food stabilizers in baked goods, snacks, and fried fast foods for more than 100 years (Amico et al, 2021). Trans fats make potato chips crisp and margarine spreadable, and they add texture to peanut butter. Trans fats also appear on food labels as partially hydrogenated oils, which are created when food manufacturers take unsaturated oils and mechanically add hydrogen ions, thereby making the liquid oil more saturated and partially firm.

Decades of research associating trans fats with elevated **low-density lipoprotein** (LDL), a significant cholesterol-carrying molecule in the blood, and lowered **high-density lipoprotein** (HDL), a protein/lipid molecule that removes cholesterol from the blood, coupled with much grassroots advocacy, resulted in mandated food labeling of trans fat in 2006. Yet, it took more than 25 years to enact a ban on artificial trans fats in food products from the time they were first noted to be harmful (Amico et al., 2021). Small amounts of naturally occurring trans fats are found in meat and dairy products. However, they do not appear to have the same negative impact as artificial trans fats and are not harmful if consumed in moderation (Bendsen et al., 2011).

### Cooking and Food Preparation Techniques

Fat adds flavor to food, but most Americans consume more daily fat than recommended for heart health. Fat is an essential nutrient, and in a varied meal plan of whole grains, lean meats, and fresh fruits and vegetables, excessive dietary fat is not usually an issue. However, cooking techniques can take the healthiest of foods and add unneeded fat. A common example of a cooking technique that adds fat is deep frying, which can increase a food's caloric content by 50% or more. Vegetables are low in fat, but when breaded and fried, the caloric and fat content climb, significantly reducing the health benefits. For example, battering and frying mushrooms, onion rings, and cauliflower change the nutrition profile by adding a significant amount of fat to a food group with negligible fat.

Alternatives to deep frying have emerged with the widespread marketing of countertop air fryers. This innovative cooking tool “fries” food with hot air and can save 70–80% of calories (Watson, 2021). Other more conventional

ways to eliminate fat include grilling, baking, roasting, or boiling food items and adding flavor with seasonings or with low-fat rather than full-fat sauces. In baking, a 50% reduction of fat can be accomplished by substituting applesauce, canned pumpkin, pureed prunes, or mashed bananas for butter. (Using low-fat margarine in baking is not recommended because these products have added water and will affect the texture of the baked item.) Fat in the form of monounsaturated fatty acids can be added by sautéing vegetables in olive oil or by adding avocado or minimally processed peanut butter to toast.

Food preparation techniques, such as adding heavy dressing to a green salad, can also alter a food's nutrition profile. Loading a baked potato with butter, sour cream, cheese, and bacon can increase its calories dramatically. Eating simple foods without high-fat enhancements is a real starting point for better health.

### Special Considerations for Individuals Who Face Challenges Securing Adequate Fat Intake

Fat intake is a challenge for many people who consume a Western diet. However, the challenge is not securing adequate fat but controlling the overconsumption of fat. For more than 100 years, scientists and researchers have believed that fat plays a role in heart disease. Researchers are widely convinced that saturated fat increases LDL cholesterol and is a significant causal factor in the development of heart disease (Kris-Etherton & Krauss, 2020).

The lack of enzymes or emulsifying agents (i.e., bile) that help digest fat impacts dietary guidance on fat intake. Clients who have their gallbladder removed are encouraged to avoid high-fat, fried, and greasy foods, such as fatty sauces and gravies (Rajan, 2021), for at least a week after surgery.

Today, a “food replacement message” is this: Replacing saturated fat with polyunsaturated fat, or monounsaturated fat, and trading ultra-processed foods for a diet rich in whole, minimally processed foods may lower heart disease. This food replacement message resonates with the U.S. dietary guidelines and the U.S. Department of Agriculture’s MyPlate food guide and should be at the core of food literacy.

## 2.3 Protein

### LEARNING OUTCOMES

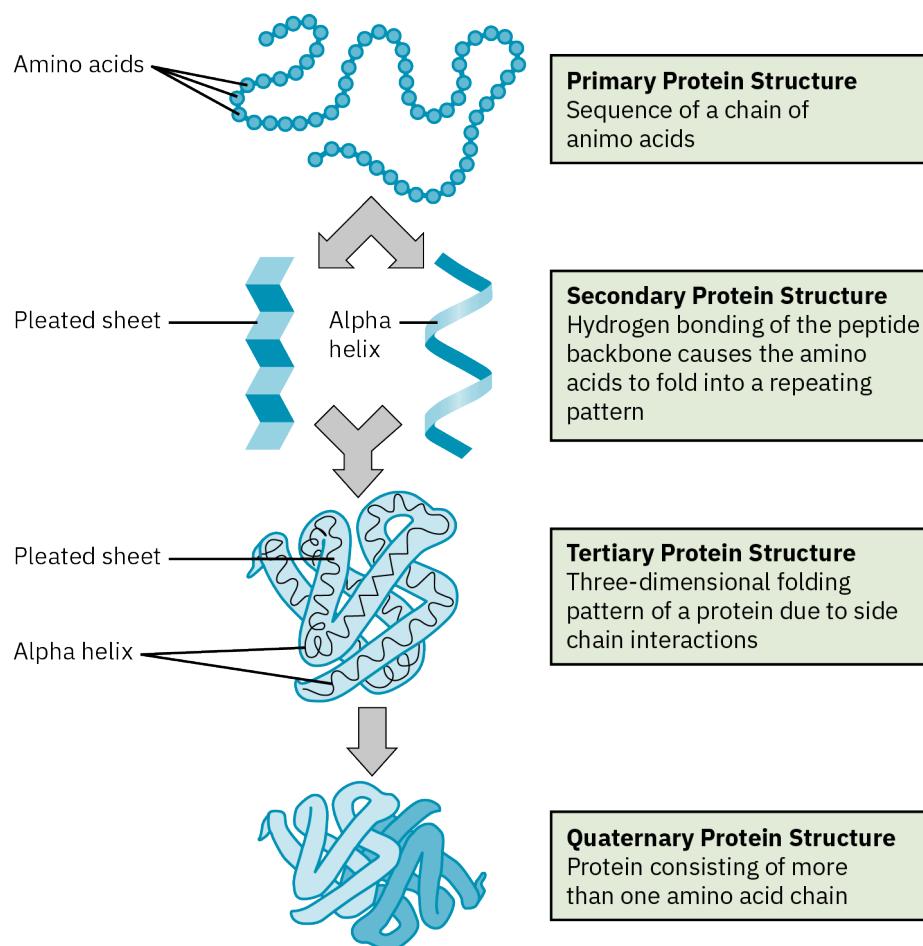
By the end of this section, you should be able to:

- 2.3.1 Describe the nutritional function of proteins.
- 2.3.2 Identify the impact of proteins on wellness promotion and illness prevention.
- 2.3.3 Examine special considerations for individuals who face challenges securing adequate protein intake.

### Nutritional Function of Proteins

Proteins are found in every cell and perform various functions in the human body. The digestion of proteins begins in the stomach with the enzyme pepsin and hydrochloric acid. The acidic environment denatures the proteins, and the enzyme divides the protein into smaller **polypeptides**, which are linear organic molecules consisting of many amino acid residues bonded together in a chain, forming part or all of a protein. The small intestine also releases digestive hormones, including secretin and cholecystokinin, which stimulate the enzymes to break down the proteins into individual amino acids. Accessory organs release additional enzymes and contribute to the breaking of complex proteins into smaller individual amino acids, which are transported across the intestinal mucosa.

In the final stages of metabolism, amino acids remain in the **amino acid pool**, a total number of essential amino acids and nonessential amino acids available for building proteins, which is regulated by the liver. Circulating amino acids recombine to form every protein required for maintenance and growth. In contrast, excess protein is converted to glucose or triglycerides depending on the body's need for energy. The sequence of the amino acids and folding of the protein molecule determines the function ([Figure 2.2](#)).



**FIGURE 2.2** The structure of a protein determines its function. (credit: modification of work from *Biology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Amino acids are classified as essential if they come from food and nonessential if the body can synthesize them. See [Table 2.8](#) for a list of amino acids and their classification. Amino acids are continually needed to replace normal cell breakdown. Each protein has a specific sequencing of amino acids; when one is missing, protein synthesis stops until the muscle breaks down to free up the needed amino acids for the amino acid pool. The intricate folding of the protein molecule is based on the function required. For example, the proteins in nails, when compared to those in the eyes, are very different in structure because the functions are highly diverse.

Amino Acid	Essential/Nonessential
Alanine	Nonessential
Arginine	Nonessential
Asparagine	Nonessential
Aspartic acid	Nonessential
Cysteine	Nonessential
Glutamic acid	Nonessential
Glutamine	Nonessential
Glycine	Nonessential
Histidine	Essential
Isoleucine	Essential
Leucine	Essential
Lysine	Essential

**TABLE 2.8** Essential and Nonessential Amino Acids and Their Classification

Amino Acid	Essential/Nonessential
Methionine	Essential
Phenylalanine	Essential
Proline	Nonessential
Serine	Nonessential
Threonine	Essential
Tryptophan	Essential
Tyrosine	Nonessential
Valine	Essential

**TABLE 2.8** Essential and Nonessential Amino Acids and Their Classification

### Protein Intake for Wellness Promotion and Illness Prevention

Protein is essential for all tissues, and regular protein intake is essential to prevent **proteolysis**, a breakdown of proteins that causes loss of lean muscle mass. Because protein is essential for all tissues, it is a superstar of dietary intake. However, protein myths have elevated this macronutrient to an extreme level. High-protein diets, protein powder, and amino acid supplements are popular as individuals pursue well-muscled bodies. Most adults require only 1–1.2 g of protein per kilogram of body weight daily. For example, a person who weighs 165 lb (75 kg), should consume 75–90 g of protein daily. Protein is not stockpiled in the body. Therefore, a diet high in protein will not make for larger muscles or longer hair and nails, but an excessive amount of protein can contribute to weight gain. Unneeded protein is stripped of its amino group, the nitrogen is excreted in the urine, and the carbon remnant is converted to either glucose or triglyceride for use as energy.

Proteins from animal sources provide the highest quality proteins or “complete proteins” because they contain all the essential amino acids. Meat, fish, poultry, and eggs are complete proteins. However, individuals following a plant-based diet can achieve complete proteins by eating various legumes, grains, and nuts. Interestingly, soy is the only legume classed as “complete” because it contains all the essential amino acids (Metropulos, 2019). However, it is less digestible than animal protein, as humans cannot digest cellulose in the plant cell structure.

All animal proteins contain cholesterol, so a high-protein diet of beef, pork, poultry, and eggs will also be higher in fat and cholesterol. Lean meats cooked without added fat, poultry without skin, and egg whites instead of whole eggs will help control fat and cholesterol and provide adequate, high-quality protein.

Protein supplements are unnecessary if an individual is in good health, moderately active, and knowledgeable about nutrition. A well-balanced diet with lean proteins and necessary fat, carbohydrate, and micronutrients can provide adequate nutrients without purchased supplements. The **bioavailability** (the way food is absorbed) of the macronutrients and micronutrients is better for whole foods. For example, chocolate milk is a “close to perfect” postexercise supplement (Amiri et al., 2019). It contains the ideal ratio of carbohydrates to protein and includes the milk proteins casein and whey, which metabolize at different rates for replenishment in the short and long term (Garden-Robinson & Christenson, 2019).

Nitrogen balance is widely used as an indicator to assess protein loss or gain. This indicator can be especially useful following trauma or prolonged illness (Dickerson, 2016). If dietary nitrogen intake in the form of protein is greater than what is lost, a positive nitrogen balance is achieved, reflecting a gain of total body protein. Positive nitrogen balance is essential for growth and healing.

Conversely, a negative nitrogen balance reflects protein degradation, with protein loss higher than protein retention. A negative protein balance in acute care substantially impacts survival (Dupuis et al., 2022). Healthy adults achieve nitrogen balance when protein intake is the same as protein degradation. [Table 2.9](#) lists the protein content of animal- and plant-based foods.

Food Item	Measure of Edible Portion	Grams of Protein
Beef, lean only (braised, simmered, or pot roasted)	3 oz	26
Chicken, roasted (meat only)	1 cup (diced)	35
Edamame (cooked)	1 cup	19
Egg (scrambled, in margarine with whole milk)	1 large	7
Halibut (baked or broiled)	3 oz	23
Hummus	1 Tbsp	1
Leg of lamb, lean only	3 oz	22
Lentils, dry (cooked)	1 cup	18
Peanut butter (regular, smooth)	1 Tbsp	8
Pork chop loin, lean only (fresh, cooked)	3 oz	27
Quinoa (cooked)	1 cup	8
Skim milk	1 cup	8
Yogurt, plain (made with lowfat milk)	8 oz	12

TABLE 2.9 Protein Content of Selected Foods (sources: Gebhardt & Thomas, 2022; USDA, 2019)

### Special Considerations for Individuals Who Face Challenges Securing Adequate Protein Intake

Negative nitrogen balance occurs in several disease states, ranging from poor protein intake, which can be related to eating disorders or bariatric surgery, to hypermetabolic states requiring increased protein. Concurrently, carbohydrates and fats must meet energy needs to channel proteins specifically for tissue repair and restoration (Munoz & Posthauer, 2022). For example, more calories and protein are needed to repair and restore function during burn or wound healing, especially in children, in whom protein needs can be as high as 2.5–4.0 g/kg/day (Clark et al., 2017). Enteral nutrition within 24 hours of hospital admission is optimal, as oral meals cannot usually meet these metabolic requirements.

Metabolic-associated fatty liver disease has been traditionally treated with protein restriction, resulting in improved liver function. However, malnutrition has been noted in more than 50% of clients following a low-protein diet, contributing to low survival rates. Protein ingestion in liver disease must be individualized because although some clients with cirrhosis may tolerate normal protein intake, others may require targeted amino acid therapy to reduce the breakdown of lean muscle mass (Ampong et al., 2020).

Individuals with chronic renal disease also require protein in lower amounts. The kidneys eliminate protein waste products, so when an individual consumes less protein, the kidneys do not have to work as hard in filtering metabolites. The amount of prescribed protein in clients with chronic renal disease depends on their glomerular filtration rate (GFR). If the client progresses to dialysis, protein should be increased because of protein loss in the dialysate. [Table 2.10](#) illustrates the decrease in recommended protein intake as the GFR decreases. When the GFR level drops below 15, the decision to begin dialysis depends on individual symptoms.

Stages of Kidney Disease	Clinical Indicators	Amount of Protein (g/kg of Ideal Body Weight)
Stage 1	GFR ≥ 90 (normal); abnormal level of protein detected in urine	No more than 0.8
Stage 2	GFR 60–89	No more than 0.8
Stage 3a	GFR 45–59	0.55–0.60
Stage 3b	GFR 30–44	0.55–0.60
Stage 4	GFR 15–29	0.55–0.60

TABLE 2.10 Protein Needs in Kidney Disease and Dialysis (sources: American Kidney Fund, 2022; National Kidney Foundation of Hawaii, n.d.)

Stages of Kidney Disease	Clinical Indicators	Amount of Protein (g/kg of Ideal Body Weight)
Stage 5	GFR < 15	0.55–0.60
Dialysis		1.0–1.2

**TABLE 2.10** Protein Needs in Kidney Disease and Dialysis (sources: American Kidney Fund, 2022; National Kidney Foundation of Hawaii, n.d.)

## 2.4 Hydration

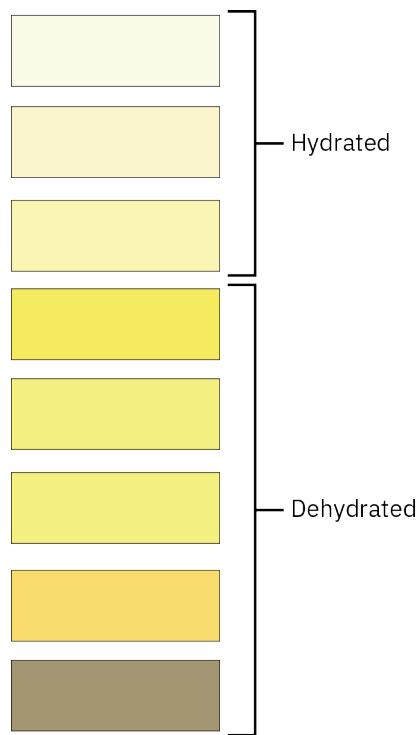
### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 2.4.1 Describe the nutritional function of hydration.
- 2.4.2 Identify the impact of hydration on wellness promotion and illness prevention.
- 2.4.3 Examine special considerations for individuals who face challenges securing adequate hydration.

### Hydration Function

Water is the universal solvent; every cell, tissue, and organ requires water to transport essential substances. Molecules dissolve into the watery blood environment and move through the body, providing cellular support. Blood also carries breakdown products for elimination. Staying hydrated is essential to good health and can be accomplished by responding to thirst and intentionally monitoring fluid intake. See [Figure 2.3](#) for the use of urine concentration as an indicator of hydration status.



**FIGURE 2.3** A color chart indicates the hydration level of urine. A very pale color indicates overhydration, whereas darker colors indicate underhydration. (credit: modification of work from *Anatomy and Physiology* 2e. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Water has zero calories and is readily available. Plain water is best; tea, coffee, and sodas also provide fluids but often contain caffeine and sugar. How much water or other fluids are needed daily depends on body size, disease state, and activity level. According to the Academy of Nutrition and Dietetics, the recommended amount of water consumed per day is about 11.5 cups for women and 15.5 cups for men. This includes fluids consumed from both foods and beverages. Approximately 20% of this water comes from food consumption, which brings the fluid recommendations to about 9 cups per day for women and 13 cups per day for men (Gordon & Klemm, 2022).

## SPECIAL CONSIDERATIONS

### Hydration and Older Adults

Older adults are at risk for dehydration because of diminished thirst and may cut back their fluid intake to avoid trips to the bathroom. Encouraging fluids can help mitigate poor fluid intake.

Both food and fluids help an individual stay hydrated, enabling all body functions to perform optimally. Commercially bottled water is convenient, but given the problem with plastic waste, as well as the lack of fluoride in most bottled water, the use of refillable water bottles is an eco-friendly and bone-healthy alternative. The Centers for Disease Control and Prevention (2020) reports that that bottled water may lack a sufficient amount of fluoride, which is important for oral health and preventing tooth decay.

Other highly advertised beverages include hydration drinks containing electrolytes, sugar, and caffeine. These drinks, sometimes referred to as sports drinks, may be helpful after intense exercise in adults but are not typically needed for children unless they are experiencing nausea and vomiting and require electrolyte replacement (Munoz-Urtuba et al., 2023). The more vigorous and longer the duration of the exercise, the more support research has provided for rehydration beverages containing both carbohydrates and electrolytes (McDermott et al., 2017).

Two simple ways the nurse can check for hydration status include tenting of the skin and the color of urine. The darker the urine, the greater the need for fluid ([Figure 2.3](#)).

### Water Safety

Drinking water piped into homes may come from municipal water supplies or originate from a private well. Whereas municipal water supplies are monitored by the U.S. Environmental Protection Agency, well water is considered “private water,” and the safety is in the hands of the well owner (U.S. Environmental Protection Agency, 2023). Safe drinking water does not receive much attention until a public health emergency occurs. Natural disasters such as hurricanes, floods, and tornadoes can introduce microorganisms or chemicals to municipal water supplies, making it unsafe. The county or state health departments issue notifications for unsafe water. Usually, boiling water can kill microorganisms (Centers for Disease Control and Prevention, 2021); however, a water filter is needed to remove chemicals and heavy metals (Centers for Disease Control and Prevention, 2022).



### HEALTHY WATER

Healthy water is usually taken for granted until sanitation or safety concerns make it a public health issue. The Centers for Disease Control and Prevention (2022) provide education on [a vast array of healthy water topics](#) (<https://openstax.org/r/cdcgovhealthywater>).

## Chapter Summary

- Carbohydrates, fats, protein, and water are essential for all body systems.
- Helping clients manipulate proper energy intake while maintaining dietary recommendations and satisfying personal tastes requires a basic understanding of nutrition.
- Carbohydrates provide easily metabolized sugars contributed by grains, legumes, dairy products, fruits, and vegetables.

## Key Terms

- amino acid pool** molecules of essential and nonessential amino acids regulated by the liver and available for use by the body
- bioavailability** the ability of an organic substance to enter the circulation and produce an active effect
- carbohydrates** large food category that includes starches, cellulose, and sugars
- complex carbohydrates** long chains of monosaccharides such as those found in starch
- disaccharides** compounds containing two monosaccharide molecules
- glucose** simple monosaccharide that is an important energy source and is found in carbohydrates
- glycemic index** system that ranks foods on a scale from 1 to 100 based on their effect on blood glucose levels
- glycemic load** method of indicating the amount of carbohydrate contained in a specified serving of a particular food and its impact on blood glucose
- glycogen** stored form of glucose
- high-density lipoprotein** molecule comprising lipids

## Review Questions

1. Amber County has issued a public health warning because arsenic was found in the drinking water. What is the safest way for community members to address this contamination?
  - a. Obtain water from a neighboring county.
  - b. Boil the water.
  - c. Buy a water softener.
  - d. Purchase bottled water.
2. The nurse is assisting a client to calculate their daily caloric intake. How many calories per gram should the nurse advise the client to assign for water?
  - a. 0
  - b. 4
  - c. 5
  - d. 7
3. The nurse is teaching the client about the Mediterranean diet. Which instruction will the nurse give the client?
  - a. Decrease consumption of complex carbohydrates.
  - b. Increase intake of fish.

- Fats play many essential roles in the body, but because of their caloric density, they can contribute to obesity and cardiovascular disease.
- Protein is critical to cell development; complete proteins (providing all of the essential amino acids) are regularly needed. Protein can contribute to a diet higher in fat.
- Water guidelines cover normal fluid losses but may need to be altered for certain conditions.

and proteins; it removes cholesterol from the blood

**low-density lipoprotein** molecule comprising lipids and proteins; it transports cholesterol throughout the bloodstream

**monosaccharide** sugar molecule that cannot be further metabolized

**polypeptides** linear organic molecules consisting of many amino acid residues bonded together in a chain, forming part or all of a protein

**proteolysis** enzymatic breakdown of proteins or peptides into amino acids

**triglycerides** compounds formed from glycerol and three fatty acid groups; the main constituents of natural fats and oils

**ultraprocessed foods** foods altered by commercial techniques, usually by adding five or more artificial substances

**whole foods** foods that have been processed or refined as little as possible and are free from additives and other artificial substances

- c. Avoid eating legumes.
  - d. Increase intake of dairy products.
4. Which instruction would the nurse give to a client who is lactose intolerant?
- a. Eat lactose-free dairy products.
  - b. Drink milk in small amounts.
  - c. Take a lactase enzyme after consuming a dairy product.
  - d. Drink milk fortified with vitamin D.
5. The nurse is teaching the client about dietary sources of omega-3 fatty acids. Which food source will the nurse include?
- a. Meat
  - b. Poultry
  - c. Vegetables
  - d. Salmon
6. The nurse is assessing a client who describes the color of their urine as pale yellow. Which statement would the nurse give to the client?
- a. "You probably have a urinary tract infection."
  - b. "You need to drink more fluids."
  - c. "You need to decrease your water intake."
  - d. "You are well hydrated."
7. The nurse instructs a client who has been following a vegetarian diet and has asked questions about the quality of protein in grains. After explaining about complete proteins that provide all of the essential amino acids in one food, the nurse presents the following list and asks the client to choose the one that is a complete protein. Which food choice, selected by the client, indicates to the nurse that the client understands the instruction?
- a. Oats
  - b. Barley
  - c. Soy
  - d. Wheat
8. Which food choice indicates to the nurse that a client understands postoperative dietary guidelines for gallbladder surgery?
- a. Fried grouper
  - b. Ribeye steak
  - c. Pasta with marinara sauce
  - d. Green salad with cheese, ham cubes, and ranch dressing
9. The nurse is providing dietary instruction to a team of college athletes. Which source of energy does the nurse explain is used first during exercise?
- a. Circulating glucose
  - b. Stored glycogen
  - c. Skeletal muscle
  - d. Fat stores
10. The nurse is caring for a client with stage 3 chronic kidney disease. What is the maximum protein intake for this client who weighs 75 kg?
- a. 40 g
  - b. 45 g
  - c. 50 g
  - d. 55 g

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# CHAPTER 3

## A Holistic View of Micronutrients



**FIGURE 3.1** Vitamins and minerals are found in vegetables and fruits such as strawberries, which are high in vitamin C and antioxidants. (credit: modification of work “Pike Place Farmers Market Express June 25” by Seattle City Council/Flickr, Public Domain)

### CHAPTER OUTLINE

- 3.1 Vitamins
  - 3.2 Minerals
  - 3.3 Supplements
- 

**INTRODUCTION** Vitamins and minerals are essential for good health yet cannot be isolated from the food that contains these vital substances. When studying the science of nutrition, academics tend to present vitamins and minerals in tidy packages, although stepping back and looking at the bigger picture of food and dietary patterns is quite important. Viewing nutrition holistically can bring focus to the more advantageous practice of consuming minimally processed foods.

Consider this case: Curtis is an elementary school-aged child living in a large generational family home in an urban neighborhood where food choices are limited and higher priced. Curtis’s primary caregiver is his aunt, due to his parents’ unpredictable work hours. Curtis was a selective eater as a toddler, and it was easier to adhere to his preferences than to negotiate and battle at mealtime (Taylor & Emmett, 2019). Now, in third grade and after years of poor food variety, Curtis’s parents have growing concerns about his health and nutritional status.

## 3.1 Vitamins

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 3.1.1 Describe the nutritional function of vitamins.
- 3.1.2 Identify the impact of vitamins on wellness promotion and illness prevention.
- 3.1.3 Examine special considerations for populations that face challenges securing adequate vitamin intake.

### Vitamin Function

The human body obtains **vitamins**—nutrients the body needs in small amounts to function and stay healthy—in two ways: food and supplementation. Vitamins were first referred to as “accessory factors” that were present in food in small amounts but essential for health. It was not until the start of the 20th century that these factors were named vitamins and, at the beginning of the 21st century, became a multibillion-dollar industry, with over 50% of Americans saying they regularly take vitamins of some variety (Mishra et al., 2021).

Vitamins are separated into two classes: fat-soluble and water-soluble. **Fat-soluble vitamins** (A, D, E, and K) are absorbed along with fats in the diet and are stored in the body’s fatty tissue and liver. These vitamins play critical roles in vision, bone health, immune function, and coagulation. **Water-soluble vitamins** (all other vitamins besides A, D, E, and K) are dissolved in water. Excess intake of water-soluble vitamins is excreted in the urine.

All vitamins are found naturally in foods and have specific functions. In general, vitamins play the following essential roles (Fletcher, 2019):

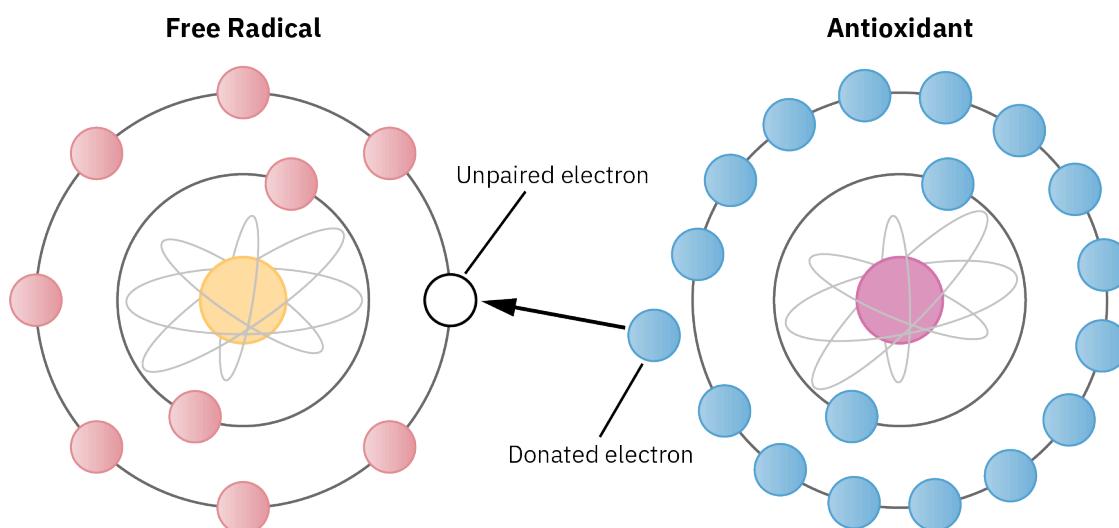
- Boost the immune system
- Decrease the risk for certain cancers
- Strengthen teeth and bones
- Maintain healthy skin
- Help the body metabolize proteins and carbohydrates
- Support healthy blood
- Aid brain and nervous system functions

### Vitamins A, D, E, and K

Fat-soluble vitamins include vitamins A, D, E, and K. Fat-soluble vitamins play essential roles in many physiological processes, such as vision, bone health, immune function, and blood clotting (Reddy & Jialal, 2022). Fat-soluble vitamins, like dietary fat, are absorbed through the lymphatic system and then released into the blood, carried by transport proteins. Because these vitamins are stored, daily intake is not required. Excess intake of fat-soluble vitamins, as found with some supplements, can cause **toxicity**—side effects from taking large doses of supplements or medications.

Absorption of fat-soluble vitamins occurs in the small intestine where they are mixed with bile salts, fatty acids, and phospholipids; absorbed by chylomicrons (microproteins); and carried to the lymphatic system. Since all vitamins require carrier proteins for transportation across the lipid bi-layer, absorption can be affected adversely by a genetic abnormality in the transport molecules (Ofoedu et al., 2021).

Vitamin A is active in the genetic development of retinol pigments and contributes to healthy bones, teeth, and soft tissue. Vitamin A also plays a role in reproduction, facilitating semen production and cell differentiation in fetal development. Vitamin A is critical in immune function, helping to grow the cells that produce the mucus that lines the gastrointestinal tracts, sinuses, and genitourinary tract. This mucus traps and protects the human body from the myriad bacteria it encounters daily. Beta-carotene—a precursor to vitamin A—is an **antioxidant** that protects against certain cancers and aging by stabilizing **free radicals**; a free radical is an unstable molecule made during normal cell metabolism that has one unpaired electron ([Figure 3.2](#)).



**FIGURE 3.2** An antioxidant stabilizes a free radical by donating an electron to the unpaired electron of the free radical. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Vitamin D is a fat-soluble vitamin that closely resembles a hormone’s functions. This vitamin can trigger effects in tissue throughout the body, turning on and off the production of proteins. Vitamin D, like vitamin A, plays a role in immunity by promoting the secretion of infection-fighting substances found in white blood cells (Dimitrov et al., 2021).

Vitamin D naturally occurs in some foods (fatty fish and egg yolks), is added to others (like milk and orange juice), and is available as a vitamin supplement. Vitamin D is unusual because the body can synthesize it from a cholesterol precursor—7-dehydrocholesterol (7-DHC)—in the epidermis with the help of ultraviolet light. In addition, vitamin D assists in promoting calcium uptake in the gut and ensures adequate calcium and phosphorus for bone mineralization. Bones can become thin, fragile, and deformed without sufficient vitamin D. Vitamin D prevents **rickets**, the softening of the bones, which results in bowed legs, and protects against **osteoporosis**, the loss of bone density, which leads to porous structure (National Institutes of Health [NIH], 2023e).

Vitamin E, a fat-soluble vitamin, acts as an antioxidant and stops the development of free radicals during fat **oxidation**. Fat oxidation is a chemical reaction in which a healthy molecule loses or is robbed of one of its electrons, which then produces an unhealthy free radical. In addition to protecting the cell from reactive oxygen species (ROS) (reactive species capable of causing damage to biomolecules), vitamin E helps establish a robust immune system and improves the endothelial cells on the surface of blood vessels, making them more resistant to the adherence of clots (NIH, 2021c).

Many other claims about vitamin E exist; however, due to the difficulty in establishing biomarkers and correlating them with clinical outcomes, recommendations for vitamin E intake continues to emerge (Institute of Medicine [U.S.] Panel on Dietary Antioxidants and Related Compounds, 2000). Recently, the Food and Nutrition Board suggested that vitamin E intake among healthy adults is probably higher than the Recommended Dietary Allowance (RDA) but warns that those following a low-fat diet could experience a deficiency (NIH, 2021c).

Vitamin K, a fat-soluble vitamin, is a **coenzyme** required for blood clotting and bone metabolism. Vitamin K is present in the liver and other body tissues, including the brain, heart, pancreas, and bone. Compared with other fat-soluble vitamins, minimal amounts of vitamin K circulate in the blood due to rapid metabolism and excretion (NIH, 2021d). The clinical status of vitamin K should be regularly evaluated in individuals who take anticoagulants or have bleeding disorders. Infants are injected with vitamin K at birth to decrease the risk of a hemorrhagic event (Hand et al., 2022).

Because fat-soluble vitamins are stored in tissue, higher amounts of these vitamins result in toxicity. In some water-soluble vitamins, high-potency supplementation can also result in adverse health issues ([Table 3.1](#)).

Vitamin	Toxicity Symptoms*
Vitamin A	<ul style="list-style-type: none"> <li>Acute Toxicity: Nausea, vomiting, anorexia, altered mental status, and muscle pain and weakness</li> <li>Chronic Toxicity: Anorexia, hair loss, dry mucous membranes, fever, fatigue, hyperlipidemia, hypercalcemia, bone and joint pain, and epistaxis</li> <li>Note: Isotretinoin has closely related symptoms to that of vitamin A toxicity</li> </ul>
Vitamin D	<ul style="list-style-type: none"> <li>Acute Toxicity: Anorexia, muscle weakness, headache, apathy, bone pain, nausea, and vomiting</li> <li>Chronic Toxicity: Polydipsia, abdominal cramping, polyuria, and back pain</li> </ul>
Vitamin E	<ul style="list-style-type: none"> <li>High doses of vitamin E are usually related to vitamin supplementation</li> <li>Acute Toxicity: Headaches, tiredness, double vision, diarrhea, easy bruising, and muscle weakness</li> </ul>
Vitamin K	<ul style="list-style-type: none"> <li>Toxicity: Jaundice in newborns, hemolytic anemia, and hyperbilirubinemia; toxicity also inhibits the effects of oral anticoagulants</li> </ul>
Thiamine (B <sub>1</sub> )	<ul style="list-style-type: none"> <li>Toxicity: Tachycardia, hypotension, vasodilation, weakness, convulsion, and anaphylaxis</li> </ul>
Niacin	<ul style="list-style-type: none"> <li>Acute Toxicity: Flushing, pruritus, vasodilation, headache, diarrhea, and vomiting</li> <li>Chronic Toxicity: Jaundice, abnormal liver function, and liver toxicity</li> </ul>
Vitamin B <sub>6</sub>	<ul style="list-style-type: none"> <li>Toxicity: Tachypnea, sensory neuropathies, and diminished tendon reflexes</li> </ul>
Vitamin C	<ul style="list-style-type: none"> <li>Toxicity: Nephrolithiasis, diarrhea, nausea, increased estrogen levels</li> </ul>

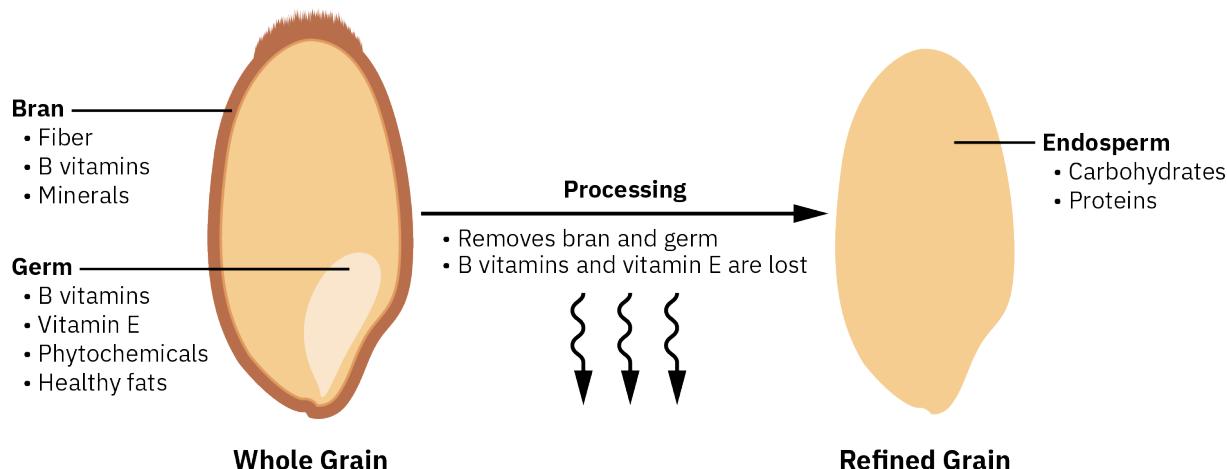
\*Not intended to be comprehensive

**TABLE 3.1** Vitamin Toxicity Symptoms (source: Rosenbloom, 2023)

### B Vitamins

This section outlines water-soluble vitamins, which includes the family of B vitamins and vitamin C. There are eight B vitamins (at times referred to as B complex): thiamine (B<sub>1</sub>), riboflavin (B<sub>2</sub>), niacin (B<sub>3</sub>), pantothenic acid (B<sub>5</sub>), pyridoxine (B<sub>6</sub>), biotin (B<sub>7</sub>), folate (B<sub>9</sub>), and cobalamin (B<sub>12</sub>).

All B vitamins act as coenzymes for catalytic activity and several processes that support every aspect of cellular function, including brain and nervous system functions (Hanna et al., 2022). Although almost all the B vitamins are involved in metabolism, one cannot be substituted for another. Therefore, a specific B vitamin deficiency is associated with a specific disease. In general, deficiency diseases related to B vitamins are rare, partly because of the wide availability of these vitamins in everyday food items, but also because B vitamins that are commonly lost in food processing are added back into the food. For example, when the bran and germ are removed from grains, leaving only the endosperm, B vitamins and vitamin E are also removed (Figure 3.3). Food manufacturers add back the vitamins during food processing. This process is called **food enrichment** and is subject to government oversight by the U.S. Food and Drug Administration (FDA) (Institute of Medicine [U.S.] Committee on Use of Dietary Reference Intakes in Nutrition Labeling [IOM], 2003; Newman et al., 2020).



**FIGURE 3.3** Food processing strips the whole grain of bran and germ and results in a refined grain. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

[Table 3.2](#) illustrates the function of B vitamins as coenzymes, assisting in metabolizing carbohydrates, fat, and proteins, thus producing energy for body cells via the **citric acid cycle**. The citric acid cycle occurs in the cell mitochondria, also known as the cell's powerhouse—this is where the final breakdown for carbohydrates, amino acids, and fatty acids occurs.

Macronutrient	B Vitamin Catalysts	Metabolic Pathway
Carbohydrate	Niacin, vitamins B <sub>1</sub> and B <sub>2</sub> , pantothenic acid	Citric acid cycle in the mitochondria of each cell
Fat	Vitamin B <sub>2</sub> , niacin, pantothenic acid	Citric acid cycle in the mitochondria of each cell
Protein	Vitamins B <sub>2</sub> , B <sub>6</sub> , and B <sub>12</sub> ; biotin; pantothenic acid	Citric acid cycle in the mitochondria of each cell

**TABLE 3.2** Energy Production from the Metabolism of Macronutrients with B Vitamin Catalysts

B vitamins must have macronutrients (carbohydrates, fat, and protein) available for energy production. Taking a vitamin supplement instead of a balanced meal does not provide a substrate for coenzyme action. Instead, obtaining vitamins through foods is preferred. Remember that none of the other B vitamins can cover a deficiency of another.

#### Choline, Biotin, and Folate

Other water-soluble substances that are less known include choline, biotin, and folate. Choline is an essential nutrient, not classified as a vitamin or a mineral, and is naturally present in food. Choline is often grouped with the B vitamins because it has similar functions. Vitamin research continues to improve classification, and in 2022 for the first time, a set amount, or **Daily Value**, for choline intake was included in the **Daily Values** (DVs), the list of all vitamins and minerals needed (FDA, 2022a). This nutrient is a source of methyl groups needed for many steps in lipid metabolism and is required to generate the neurotransmitter acetylcholine. Although the body produces some choline endogenously in the liver, the amount is sometimes insufficient; additional choline must be ingested through food sources. Most people in the U.S. consume less than the recommended choline intake, yet a deficiency in healthy, nonpregnant individuals is rare, possibly because of the contribution of self-synthesized choline (NIH, 2022b).

Biotin is a water-soluble vitamin that works as a cofactor that catalyzes the metabolism of fatty acids, glucose, and amino acids. Biotin is found in many animal and plant foods. There has never been a reported case of biotin deficiency in a healthy individual consuming a Western diet (NIH, 2022a).

Folate (B<sub>9</sub>) functions as a coenzyme in synthesizing ribonucleic acid (RNA) and deoxyribonucleic acid (DNA). Folate is also critical in the metabolism of amino acids required for normal cell division. A lack of folate will result in large red blood cells, which is associated with **megaloblastic anemia**—a condition in which the bone marrow produces unusually large, structurally abnormal, immature red blood cells (NIH, 2022c). Large doses of folate can result in

kidney damage.

The chemical structure of folate differs from the more commonly known folic acid. Folates are naturally found in foods, although folic acid is the fully oxidized form of the vitamin used in fortified foods and most dietary supplements. Since 1998, the FDA has mandated that food manufacturers add folic acid to “enriched breads, cereals, flours, corn meals, pasta, rice, and other grain products to reduce the risk of neural tube defects (NTDs)” (NIH, 2022c). NTDs result from a developmental error in the closure of the neural tube early in pregnancy and are one of the most common congenital disabilities in North America (National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, 2023). The fortification program is estimated to have increased mean folic acid intakes in the U.S. by about 200 mcg/day, a substantial increase. An unintentional consequence of folate fortification is that people consuming the folate-fortified foods receive extra folate, not just women of childbearing age. However, in the older adult, the consumption of folic acid from fortified foods increases the risk of masking megaloblastic anemia caused by a vitamin B<sub>12</sub> deficiency (van Gool et al., 2020).

### Vitamin C (Ascorbic Acid)

Vitamin C or ascorbic acid, a water-soluble vitamin, is best known for its coenzyme and antioxidant properties (Abiri & Vafa, 2021). Vitamin C protects cells from premature aging caused by free radicals. Vitamin C stabilizes the cell by accepting or donating an electron. The body is constantly moving electrons around, so vitamin C is used in almost every tissue in the body. Free radicals are the leading cause of disease and inflammation, so vitamin C’s ability to neutralize those free radicals (acting as an antioxidant) is central to lowering heart disease and cancer risk.

Vitamin C also promotes collagen synthesis. Although collagen synthesis is required for maintaining normal vascular function, it also provides metabolic substrates for new blood vessel development (**angiogenesis**), enhancing blood supply, and bringing more oxygen to the tissues. Vitamin C is necessary for a healthy immune system and increases the absorption of non-heme iron.

The body tightly monitors the plasma concentration of vitamin C. Approximately 70–90% of vitamin C is absorbed in moderate intakes of 30–180 mg/day. Absorption becomes less efficient at doses above 1000 mg/day, with about 50% of the excess excreted in the urine (NIH, 2021b). Most healthy, non-smoking Americans consume enough vitamin C-rich foods to meet the daily requirements of 90 mg/day for males and 75 mg/day for females. According to national nutrition studies, the average vitamin C intake is about 95 mg/day without vitamin supplementation. See [Table 3.3](#) for common fruits and vegetables containing vitamin C.

Food and Serving Size	Milligrams of Vitamin C	% Daily Value
Red pepper (fresh), ½ cup	95	106
Medium orange, 1	70	78
Medium kiwi, 1	64	71
Strawberries, ½ cup	49	54
Broccoli, ½ cup	39	43
Cantaloupe, ½ cup	29	32
Baked potato, 1	17	19

**TABLE 3.3** Vitamin C Levels in Common Foods (source: NIH, 2021a)

Large doses of vitamin C can have an adverse effect in people with a family history of kidney or gallstones. Supplementing vitamin C at a level three times or more of the RDA (approximately 3000 mg) can double the amount of oxalate filtering through the kidney and greatly increases the chance of stone formation.

Most water-soluble vitamins are absorbed in the small intestine through the process of diffusion. Riboflavin, however, requires the assistance of a carrier molecule for it to enter the bloodstream. Many water-soluble vitamins function as coenzymes in other cellular reactions and may require additional chemical action before tissues use them. Differences in ease of absorption or food bioavailability, dosage, and chemical form of the vitamin all influence the amount of the vitamin absorbed in the small intestine (Ofoedu et al., 2021).

## ! SAFETY ALERT

### Smoking and Increased Vitamin C Needs

Clients who smoke should increase their vitamin C by 35 mg/day. They have decreased plasma concentrations of this antioxidant due to an increase in free radicals. According to Lykkesfeldt and Tveden-Nyborg (2019), “Active smoking typically depletes the vitamin C pool by 25–50% compared to never-smokers.”

Certain populations or disease states require vitamin supplementation. In most cases, this is due to an increased need related to disease, aging, pregnancy, and breastfeeding. [Table 3.4](#) displays the water- and fat-soluble vitamins and gives situations where vitamin supplementation may need to occur.

Vitamin	Special Considerations/Reference
<b>Water-Soluble</b>	
Thiamin (B <sub>1</sub> )	<ul style="list-style-type: none"> <li>Chronic alcohol exposure (increase)</li> <li>Older adults (increase)</li> <li>HIV/AIDS (increase)</li> <li>Bariatric surgery (increase)</li> <li>Diabetes (increase)</li> </ul>
Riboflavin (B <sub>2</sub> )	<ul style="list-style-type: none"> <li>Vegan (increase) and vegetarian athletes (increase)</li> <li>Genetic mutation: riboflavin transporter deficiency (increase upon the emergence of symptoms, not effective with long onset)</li> </ul>
Niacin (B <sub>3</sub> )	<ul style="list-style-type: none"> <li><b>Hartnup disease</b>—caused by the body’s inability to absorb amino acids from the diet results in the inability to produce vitamins and proteins—(increase)</li> <li>Carcinoid syndrome (increase)</li> <li>Undernutrition (increase)</li> <li>Inadequate riboflavin, pyridoxine, and/or iron intakes (increase)</li> </ul>
Pantothenic acid (B <sub>5</sub> )	<ul style="list-style-type: none"> <li>Genetic pantothenate kinase-associated neurodegeneration 2 mutation (unclear if supplementation is helpful)</li> </ul>
Pyridoxine (B <sub>6</sub> )	<ul style="list-style-type: none"> <li>Rheumatoid arthritis (increase)</li> <li>End-stage renal disease (increase)</li> <li>People with alcohol dependencies (increase)</li> <li>Celiac disease</li> <li>Crohn’s disease</li> <li>Ulcerative colitis, inflammatory bowel disease, and other malabsorptive autoimmune disorders (increase)</li> </ul>
Biotin (B <sub>7</sub> )	<ul style="list-style-type: none"> <li>Pregnant and breastfeeding (increase)</li> <li>Genetic mutation resulting in biotin enzyme deficiency (increase)</li> <li>Chronic alcohol exposure (increase)</li> </ul>
Folate (B <sub>9</sub> )	<ul style="list-style-type: none"> <li>Chronic alcohol exposure (increase)</li> <li>Pregnant and all women of childbearing age (increase)</li> <li>People with malabsorptive disorders, including tropical sprue, celiac disease, inflammatory bowel disease (increase), genetic mutation that reduces the ability to convert folate to one of its active forms (increase)</li> </ul>

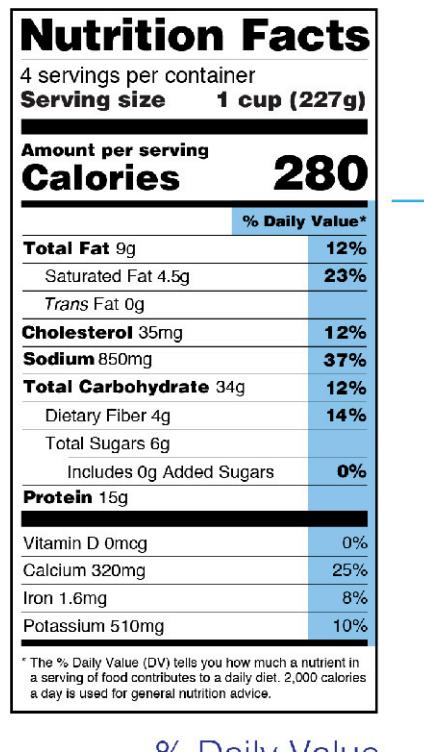
**TABLE 3.4** Recommended Vitamin Supplementation for Various Diseases (sources: NIH, 2021a–d; 2022a–f; 2023a–d)

Vitamin	Special Considerations/Reference
Cobalamin (B <sub>12</sub> )	<ul style="list-style-type: none"> <li>Vegetarians (increase)</li> <li>Surgery of gastrointestinal tract such as in weight loss (increase), pernicious anemia (injections), older adults (increase), breastfed infants of vegan mothers (increase)</li> </ul>
Choline	<ul style="list-style-type: none"> <li>Pregnant women (increase)</li> <li>Genetic alterations (increase)</li> <li>Long-term total parenteral nutrition (increase)</li> </ul>
Vitamin C	<ul style="list-style-type: none"> <li>Smokers and passive “smokers” (increase)</li> <li>Limited food variety (increase)</li> <li>Infants fed evaporated or boiled milk (increase)</li> <li>End-stage renal disease on chronic hemodialysis (increase)</li> </ul>
<b>Fat-Soluble</b>	
Vitamin A	<ul style="list-style-type: none"> <li>Premature infants (increase)</li> <li>Cystic fibrosis (increase)</li> <li>Females and children in lower resourced countries (increase)</li> <li>Long-standing Crohn’s disease and ulcerative colitis (unclear as to the benefit of increase)</li> </ul>
Vitamin D	<ul style="list-style-type: none"> <li>Breastfed infants (increase)</li> <li>Older adults (increase)</li> <li>Reduced sunlight exposure (increase)</li> <li>Darker skin tones (increase)</li> <li>Gastric bypass surgery (increase)</li> <li>Fat malabsorption as found in liver disease, cystic fibrosis, celiac disease, Crohn’s disease, and ulcerative colitis (increase)</li> </ul>
Vitamin E	<ul style="list-style-type: none"> <li>Abetalipoproteinemia (large increase), fat malabsorption (increase)</li> </ul>
Vitamin K	<ul style="list-style-type: none"> <li>Newborns not treated with vitamin K at birth (intramuscular injection)</li> <li>Fat malabsorption as found in cystic fibrosis, celiac disease, ulcerative colitis, and short bowel syndrome (increase)</li> </ul>

**TABLE 3.4** Recommended Vitamin Supplementation for Various Diseases (sources: NIH, 2021a–d; 2022a–f; 2023a–d)

### Vitamin Intake for Wellness

To help consumers make healthy food choices and consume adequate amounts of vitamins, the FDA mandates that foods carry a nutrition facts food label. Although the label does not display every vitamin or mineral, [Figure 3.4](#) is an example nutrition food label, outlining the most important nutrient information deemed by the FDA (2022a).



### % Daily Value

**FIGURE 3.4** This nutrition facts food label shows percent DVs of one serving (1 cup) of a food item. (credit: “Sample Label for Frozen Lasagna”/U.S. Food and Drug Administration, Public Domain)

The nutrition facts food label in [Figure 3.4](#) indicates that this food item is low in added sugars and vitamin D and is considered high in saturated fat, calcium, and sodium. Restated more simply, one serving of this food item provides one-quarter of the daily calcium and saturated fat requirements and over one-third of the daily allowance for sodium, if consuming approximately 2,000 calories daily. Usually, a meal consists of more than one food item, so adding naturally low-sodium and low-fat foods like fresh fruit or vegetables will help to balance this food nutritionally.

Individual food manufacturers create nutrition facts labels based on the amount of nutrients in a standard serving size of that food. The **percent Daily Value** (DV) is the percentage of the nutrient the food item provides for an adult consuming about 2,000 calories daily. FDA guidance states that 5% DV or less of a nutrient per serving is considered low, and 20% DV or more of a nutrient per serving is considered high (FDA, 2022). Note that reaching 100% of the DV for sugar, fat, saturated fat, and sodium should not be a target or goal.

▶

### NUTRIENT DAILY VALUES REFERENCE GUIDE

The FDA recently updated their reference guide of DVs. A [review of the U.S. Food and Drug Administration website \(<https://openstax.org/r/fdagovfood>\)](https://openstax.org/r/fdagovfood) shows how nutrient recommendations increased or decreased since the last review.



### UNFOLDING CASE STUDY

#### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Curtis, a third grader who has a long history of being a picky eater, does not like getting up early, so most days he does not eat breakfast before leaving for school. He also does not like the school-provided lunch, so his aunt sends

him to school with a commercially packaged and processed lunch of cheese and meat with crackers. After school, Curtis has a two-pack of toaster pastries with a glass of water, and his aunt usually makes him a box of macaroni and cheese for supper—they know he will eat it without a complaint. During his last visit to the pediatrician, Curtis's caregivers voiced frustration with Curtis's eating habits and wondered if he was getting all his vitamins and minerals. After checking Curtis's height and weight, the pediatrician explained that Curtis was at the 95<sup>th</sup> percentile for weight and advised his family to serve more fruits and vegetables and monitor his weight.

To answer the following questions, search the Internet for food label information on a combo lunch pack (such as Lunchables), boxed macaroni and cheese, and toaster pastries.

1. What micronutrient does the nurse assess is over the recommended amount in Curtis's diet?
    - a. Folate
    - b. Vitamin D
    - c. Biotin
    - d. Sodium
  
  2. What micronutrients would be increased with the addition of the fruits and vegetables as advised by the nurse?
    - a. Vitamins B<sub>1</sub> and B<sub>2</sub>
    - b. Vitamins B<sub>6</sub> and niacin
    - c. Vitamins A and C
    - d. Biotin and pantothenic acid
- 

## Meal Planning

Cooking techniques can impact the retention of water-soluble vitamins. The best cooking techniques for preserving water-soluble vitamins in vegetables include stir-frying, microwaving, and steaming. Each of these limits the amount of water and shortens cooking time, which decreases lost vitamins.

Vitamins B<sub>1</sub>, B<sub>2</sub>, and folate are sensitive to heat or light. Exposure to heat for as few as 5 minutes can decrease the content of the vitamin by as much as 90%. Vitamin C is degraded by heat and can begin to decrease within 5 minutes of exposure to a high temperature. For the best retention of a vitamin, cook for a shorter time, use less water, and lower the temperature.

Another way of maximizing vitamin intake is through intentional meal planning. MyPlate from the U.S. Department of Agriculture (USDA) is a simple tool for building a meal rich in vitamins and minerals that focuses on nuts, legumes, fruits, vegetables, complex carbohydrates, lean meat, and dairy. Another effective way to present a balanced and nutrient-rich meal is to create a plate of one-quarter protein, one-quarter high carbohydrate or starchy food, and one-half fruits and vegetables.

## 3.2 Minerals

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 3.2.1 Describe the nutritional function of minerals.
- 3.2.2 Identify the impact of minerals on wellness promotion and illness prevention.
- 3.2.3 Examine special considerations for populations that face challenges securing adequate mineral intake.

### Mineral Function

Minerals are common in cereals, bread, meat, fish, milk, dairy, nuts, fruit (especially in dried form), and vegetables. About 20 minerals are essential for body function, all in varying amounts depending on their role. The macrominerals are needed at levels higher than 100 mg/day, and trace minerals are needed in amounts less than 100 mg/day (Farag et al., 2023). [Table 3.5](#) lists the macro (M) and trace (T) minerals and their functions.

Mineral	Function
Calcium (M)	Contributes to the structure of bones and teeth and controls blood vessel contraction and dilation, muscle function, blood clotting, nerve transmission, and hormone secretion
Phosphorus (M)	Contributes to the structure of bones and teeth and to the genetic material of DNA and RNA
Potassium (M)	Maintains intracellular fluid volume and is important for muscle contraction, specifically heart contractions
Sodium (M)	Maintains extracellular fluid volume and plays a crucial role in normal nerve and muscle function
Chloride (M)	Plays a role in acid–base homeostasis, contributes to maintenance of urine and plasma electroneutrality, and may even effect neurohormonal activation (Soliman et al., 2022)
Magnesium (M)	Responsible for activation of enzymes, membrane function, intracellular signaling, and muscle contraction
Sulfur (M)	Operates as a cofactor involved in regulating oxidative processes and is an endogenous metabolite of the amino acid, methionine
Iron (T)	Helps develop red blood cells, metabolize cellular energy metabolism, and develop the immune system
Zinc (T)	Performs the role of antioxidant by protecting cell membranes from free radical damage as a coenzyme of more than 300 enzymes
Iodine (T)	Serves as a necessary component of thyroid hormones
Chromium (T)	May facilitate the metabolism of carbohydrates, lipids, and proteins by increasing the effectiveness of insulin—the precise mechanism for this activity has yet to be identified
Copper (T)	Operates as a cofactor in the process of cellular oxidation and is required for the oxidation of iron
Fluoride (T)	Promotes remineralization of bones and teeth
Molybdenum (T)	Aids in the metabolism of sulfur-containing amino acids and is an enzyme cofactor
Manganese (T)	Serves as a cofactor for enzyme productions related to protein, fat, and carbohydrate metabolism; functions as antioxidant
Selenium (T)	Removes excess hydrogen peroxide from thyroid and is also needed for DNA synthesis

**TABLE 3.5** Essential Minerals and Their Functions

Minerals work synergistically. For example, the sodium-to-potassium ratio is essential in maintaining normal blood pressure and impacts blood pressure more than sodium or potassium alone. Likewise, the proper relationship between calcium and phosphorus is vital in maintaining normal bone structure. As with vitamins, one mineral cannot assume the function of another mineral, and a shortage or deficiency of any mineral will impact body function.

Mineral absorption takes place primarily in the small intestine. For some minerals, absorption efficiency depends on specific needs such as calcium absorption in pregnancy. During pregnancy, calcium absorption takes place actively, which requires energy to transport across the cell membrane. In times of plentiful serum calcium, the body switches to a passive diffusion method of absorption.

Mineral absorption can be helped or hindered by other dietary components that occur naturally in food. For example, iron is best absorbed in an acid environment, so health professionals recommend taking an iron supplement with orange juice. Juxtaposed is the absorption of minerals in the presence of phytates (found in whole grains) that interfere with calcium, iron, magnesium, and zinc absorption.



## NATIONAL INSTITUTES OF HEALTH

The NIH provides [thorough information on their website \(<https://openstax.org/r/odsod>\)](https://openstax.org/r/odsod) about dietary supplements, herbs, vitamins, probiotics, and more.

## Mineral Intake for Wellness

Minerals play an essential role in various metabolic and physiologic processes. A deeper dive into cellular nutrition reveals that minerals are critical for the metabolism of every cell in the body. A well-balanced mineral intake is essential throughout the human life cycle, although specific needs may vary based on age and sex (Farag, et al., 2023). For example, the iron needs of premenopausal clients are higher than postmenopausal clients because of the iron loss during menstruation. A diet comprised of vegetables, legumes, nuts, lean meats, and seafood provides all the essential minerals needed throughout a person's life.

**Food fortification** (the practice of intentionally increasing the content of one or more micronutrients) makes meeting the required mineral DV easier. For example, in the mid-1920s, in response to an increase in **goiter**, iodine was added to table salt (Leung, Braverman, and Pearce, 2012). Goiter is an increase in thyroid size resulting from either iodine deficiency or hyperthyroidism. Vitamin D was first added to milk in 1933 in response to the presence of childhood rickets (IOM, 2003; United Nations, 2019). Today, food fortification continues. Two more current examples are the addition of calcium to orange juice and iron and folate to breakfast cereals. Even though some breakfast cereals are fortified with essential vitamins and minerals, many should not be considered nutritionally sound because they are high in added sugar. Fortification does not guarantee nutritional excellence.

### MINERAL DAILY VALUES

As with vitamins, there are also mineral DV percentages. You can [find vitamin and mineral information \(\)](https://openstax.org/r/factsheets) on the NIH website, which contains a list of vitamins and minerals with hyperlinks to more detailed information on each (select the mineral of interest and then proceed to the option of health professional).



### TRENDING TODAY

#### Micronutrients

*As you work through this Trending Today feature, recall that nurses should rely on evidence-based practice (EBP), which uses scientific evidence rather than anecdotal evidence, to inform their practice and care of clients. Nurses should encourage clients to evaluate nutritional information on social media with the same scrutiny.*

Research indicates an increasing use of micronutrient supplements, specifically single-nutrient supplements (Cowan et al, 2020). Is it better to take a supplement to ensure you have an adequate supply of micronutrients, or is it possible to get the micronutrients your body needs via food sources?

On social media, influencers promote awareness of micronutrient consumption in a person's diet as a way to assess their individual levels. TikToker @TheWellnessPharm suggests that individuals use a micronutrient testing kit to help determine if they have consistently low levels of specific nutrients. Similarly, Instagram hosts several forums dedicated to the discussion of obtaining daily micronutrient requirements from specific foods, often promoting intuitive or mindful eating practice.

Take some time to review the following social media content and think critically about the information provided and its appeal to clients:

- [@TheWellnessPharm \(\)](https://openstax.org/r/tiktok) (TikTok)
- Any Instagram forum dedicated to the discussion of obtaining daily micronutrient requirements from specific foods (Instagram)
- [Nutrition for Resilience – Micronutrient Forum \(\)](https://openstax.org/r/mnforum) (Website)

Now answer the following questions:

1. Which account did you prefer when viewing or reading? Explain.
2. What is the purpose of the content you viewed or read?
3. How would you evaluate these sources for use of EBP, and which sources used EBP?
4. If a client came to you with this information, how would you educate them to critically use these sources?

5. What alternative sources would you recommend to clients to educate them about this topic?

## 3.3 Supplements

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 3.3.1 Describe vitamin and mineral supplements' role in nutrition and wellness.
- 3.3.2 Evaluate vitamin and mineral supplements as part of a nutritional plan, including the potential for interactions.
- 3.3.3 Examine special considerations for the nutritional needs associated with vulnerable populations and across the lifespan.

### Regulations and Recommendations for the Use of Supplements

Eating a diet with fresh and minimally processed foods is the best source of vitamins and minerals. However, even people with healthy eating habits sometimes need help to bridge occasional nutrient gaps, and supplements may help.

Deciding on the right vitamin-mineral supplement can be difficult, considering that hundreds of different types are available and no real guidance is provided at the point of sale (NIH, 2018). With almost 60% (Mishra et al., 2021) of the population taking multiple vitamin and mineral supplements, guidance is important. People who are more likely to need a supplement include those with the following characteristics (Weyh et al., 2022):

- With restricted diets
- Who are pregnant
- With loss of appetite due to sickness, injury, or surgery—note that vitamin/mineral supplements alone do not provide calories or protein needed for healing
- With severe food allergies resulting in a restricted diet
- With a depleted immune system

Broadly, vitamin-mineral supplements are divided into three main groups: basic, high-potency, and specialized ([Table 3.6](#)). Examples of when each group would apply include:

- Basic—Individuals needing to bridge occasional vitamin and mineral gaps.
- High-potency—Pregnant women have higher iron and folate needs and need a diet formulated for prenatal care.
- Specialized—Clients with age-related macular degeneration (AMD) may need to supplement with specific vitamins and minerals: vitamin C (500 mg), vitamin E (400 IU), beta-carotene (15 mg), zinc (80 mg), and copper (2 mg), which is effective in slowing AMD (NIH-National Center for Complementary and Integrative Health, 2018; NIH, 2023).

Vitamin-Mineral Category	Description
Basic (broad spectrum)	These vitamins have a usual daily dosage and contain a variety of vitamins and minerals in amounts that do not exceed the DVs. Many of the vitamins in this group are developed for specific populations such as males, females, seniors, and children to better meet the unique needs of age and sex.
High-potency	These multivitamin/minerals (MVMs) contain amounts of some vitamins and minerals that are well over 100% of the percent DV. They might also include other nutrients and botanical ingredients. These high-potency vitamins may be marketed in multiple packages for convenience and daily use.
Specialized (condition-specific)	These MVMs are used for different needs like immune function, eye health, or athletic performance. They are often combinations of vitamins, minerals, botanicals, probiotics, and coenzymes. Some of these products include nutrients much higher than the percent DV.

**TABLE 3.6** Categories of Vitamin and Mineral Supplements (source: NIH, 2023a)

Vitamin-mineral supplements fall under the regulatory powers of the FDA. However, the weak regulation and the vast array of supplements can confuse the consumer. The Dietary Supplement Health and Education Act (DSHEA) of 1994 altered the FDA's authority to regulate dietary supplements (NIH Office of Dietary Supplements, 1994). Under DSHEA, the FDA does not authorize or evaluate dietary supplements for safety or effectiveness before reaching store shelves; unfortunately, this makes a "buyer beware" situation. Vitamin manufacturers can lawfully introduce dietary supplements without even notifying the FDA. Since DSHEA was enacted, the dietary supplement market has exploded, with the number of products multiplying nearly 20 times since 1994 (FDA, 2022).

## Supplements and Nutritional Plans

Nurses should take a food-first approach to vitamins and minerals as the most prudent advice for clients. Food has multiple advantages over a manufactured pill by providing complex carbohydrates, fiber, protein, unsaturated fats, and antioxidants.

[Table 3.7](#) is an example of a food-first approach with a diet full of vitamins and minerals from dairy, legumes, lean meat, nuts, fish, fruits, and vegetables. A vitamin- and mineral-rich daily menu could be as simple as the following meals:

- **Breakfast**—cereal with 5 g or less of added sugar, low-fat animal or plant milk (fortified with calcium and Vitamin D), and a banana
- **Lunch**—carrot sticks, a tuna sandwich on whole wheat bread, and orange sections
- **Snack**—roasted almonds
- **Dinner**—broiled pork chop, collards, and lightly salted sweet potato fries (air-fried)

Vitamin/Mineral	Food Source/Serving Size
Vitamin A	1 small carrot provides 6000 IU of vitamin A (100% of DV)
Vitamin B <sub>3</sub> (niacin)	3 oz of tuna has 11 mg of niacin (about 50% of DV)
Vitamin B <sub>6</sub>	1 medium banana contains about 0.4 mg vitamin B <sub>6</sub> (about 25% of DV)
Vitamin E	1 oz of almonds has over 7 mg vitamin E (about 50% of DV)
Vitamin B <sub>1</sub>	1 3-oz pork chop provides 0.4 mg of thiamin (33% of DV)
Vitamin C	1 medium orange provides 70 mg of vitamin C (78% of DV)
Vitamin D	8 oz of fortified milk contains 100 IU vitamin D (25% of DV)
Selenium	1 slice of whole wheat bread contains 10 mcg of selenium (about 20% of DV)
Calcium	1 cup of boiled collard greens contains 266 mg of calcium (about 26% of DV)
Zinc	3 oz of lean beef contains 5 mg of zinc (about 50% of DV)

**TABLE 3.7** Examples of Vitamins and Minerals Found in Common Food Sources (Note that all of the above-mentioned foods contain multiple vitamins and minerals.)

According to the National Institutes of Health (NIH-National Center for Complementary and Integrative Health, 2018), supplement manufacturers can make three health-related claims on their labels:

- **Health**—describes a relationship between a food, food component, or dietary supplement ingredient and reducing the risk of a specific disease or health-related condition
- **Nutrient**—describes the relative amount of a nutrient or dietary substance in a product
- **Structure or function**—describes how a product may affect the organs or systems of the body and cannot mention any specific disease

The dosage of specific vitamin and mineral supplements a client should consume will vary because the **Recommended Dietary Allowance (RDA)** differs based on age and sex. For example, note the differences in recommended daily iron intake for each of these groups:

- Adolescent (age 12 to 18 years) female: 15 mg
- Adolescent (age 12 to 18 years) male: 11 mg
- Adult (age 18 plus years) female: 18 mg
- Adult (age 18 plus years) male: 8 mg

Because of specific needs, vitamin-mineral supplements are customized and marketed to population segments based on activity and age. For example, vitamins for children sport bright and catchy labels, gummy textures, and fruity tastes. Prenatal vitamins often have labels with pastel colors. Supplements for older adults are packaged in silver labeled bottles. Vitamin-mineral supplements can also be found as liquid drinks, including water, milk, and coffee.

Clients may ask if they need a vitamin-mineral supplement. There is little scientific support for taking a vitamin-mineral supplement when no deficiency signs and symptom exist (Seres, 2023); foods provide many vitamins, minerals, and phytochemicals and are more bioavailable than those found in supplements (Harguth, 2022). In some situations, vitamin-mineral supplements are essential for good health, but promoting food as the first line of health defense is strongly supported by science and health professionals.

### Recommended Dietary Allowance

The RDAs are published by the Food and National Academies of Sciences every 5–10 years. RDAs were developed during World War II for nutritional guidance in feeding soldiers and food relief in the U.S. and internationally. They were set at the minimum level for good health and not every nutrient has an RDA (Murphy et al., 2016). The nutrients listed in the RDA are used as a goal for healthy individuals at every age. They are preventative in nature and not meant to be treatment for disease.

Dietary Guidelines are updated every 5 years; they help interpret and apply the RDAs to dietary patterns. In 1985, the Dietary Guidelines scientific report supporting their recommendations totaled 19 pages. In the 2020 version, the total was over 800 pages, demonstrating the prolific research occurring over the past 40 years on vitamins and minerals, dietary patterns, and health. The 2020–2025 Dietary Guidelines’ call to action “Make Every Bite Count” includes four overarching values:

- Follow a healthy dietary pattern at every life stage.
- Customize and enjoy nutrient-dense food and beverage choices to reflect personal preferences, cultural traditions, and budgetary considerations.
- Focus on meeting food group needs with nutrient-dense foods and beverages and stay within calorie limits.
- Limit foods and beverages higher in added sugars, saturated fat, and sodium, and limit alcoholic beverages (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020).

These Dietary Guidelines are reflected throughout this chapter as nutrient-dense foods are emphasized over supplements.



### DIETARY GUIDELINES

Read more on the history of dietary guidelines from 1980–2020; of special note is the expansion in guidance over the last 30 years and the incorporation of recommendations into the overarching guideline. [Review this website for a look](https://openstax.org/r/dietaryguidelines) (<https://openstax.org/r/dietaryguidelines>) at how the guidelines have emerged over the last three decades and [this website for free materials](https://openstax.org/r/dietaryguidelinesresources) (<https://openstax.org/r/dietaryguidelinesresources>) related to the *Dietary Guidelines for Americans 2020–2025*.



### UNFOLDING CASE STUDY

#### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

After Curtis’s last visit to the pediatrician, his aunt tries to introduce Curtis to some of her favorite Haitian dishes, such as rice with a pork sauce, beef and pumpkin soup, and banana fritters. Curtis refuses to taste any of the native Haitian foods. His aunt is now watching several other children after school in addition to Curtis, and Curtis’s parents continue to work rotating shifts and extra hours. Curtis spends most of the school year eating the same limited number of foods for lunch, snacks, and dinner. He rejects all attempts to include fruits and vegetables in his diet; it is

cheaper, easier, and faster to adhere to Curtis's food preferences.

Curtis is sick more often than his classmates, which causes him to miss many days of school and fall behind in his work. His mom is concerned and asks the school nurse what she should do about his inability to fight infections. The school nurse indicates Curtis's picky eating habits were contributing to frequent illness.

3. How could Curtis "Make Every Bite" count?
    - a. Increase consumption of toaster pastries since they are vitamin B fortified.
    - b. Add another powdered cheese packet to his macaroni and cheese.
    - c. Provide a vitamin gummy daily.
    - d. Experiment with fruit and vegetable smoothies for an after school snack.
  
  4. Which vitamins should the nurse recommend to help build Curtis's immune system?
    - a. Vitamin C and vitamin E
    - b. Vitamin K and vitamin C
    - c. Choline and biotin
    - d. Vitamin D and vitamin K
-

## Chapter Summary

- A well-rounded, varied diet of mostly unprocessed foods will provide many of the DVs recommended by the FDA.
- High doses of water-soluble vitamins are excreted in the urine, although fat-soluble vitamins are stored in the tissues. High doses of fat-soluble vitamins can lead to toxicity and even death.
- Certain disease states require higher vitamin and mineral intake, supplemented beyond dietary

## Key Terms

- angiogenesis** new blood vessel development
- antioxidant** artificial or natural substances that may prevent or delay some types of cell damage
- citric acid cycle** final oxidation of protein, fat, and carbohydrate
- coenzyme** a non-protein compound that binds with an enzyme to speed up a cellular reaction
- Daily Value** one value for each nutrient selected for the labels of dietary supplements and foods
- Daily Values** a list of the vitamins and minerals that an individual should consume each day
- fat-soluble vitamins** vitamins that are absorbed along with fats in the diet and are stored in the body's fatty tissue and liver
- food enrichment** the practice of adding back nutrients that were lost in food processing
- food fortification** the practice of intentionally increasing the content of one or more micronutrients (i.e., vitamins and minerals)
- free radicals** a type of unstable molecule that is made during normal cell metabolism
- goiter** an increase in thyroid size resulting from either iodine deficiency or hyperthyroidism
- Hartnup disease** a condition caused by the body's inability to absorb amino acids from the diet resulting in the inability to produce vitamins and

- sources.
- Vitamin-mineral supplements should be selected based on age, sex, and specific need.
- Coenzyme and antioxidant properties are critical functions of vitamins and minerals.
- Nutrition facts food labels and MyPlate can assist in choosing foods high in vitamins and minerals.
- RDAs and DVs reflect current nutrient research.

proteins

**megaloblastic anemia** a condition involving a vitamin B<sub>12</sub> and/or folate deficiency in which the bone marrow produces very large, structurally abnormal red blood cells

**osteoporosis** loss of bone density resulting in porous, fragile bone

**oxidation** a chemical reaction in which a "healthy" molecule loses or is robbed of one of its electrons, producing an unhealthy free radical

**percent Daily Value** the contribution of a vitamin or mineral in a food portion based on the standard benchmark of a total daily 2,000-calorie diet

**Recommended Dietary Allowance (RDA)** average daily nutrient intake level necessary to meet the bodily requirements of nearly all (97–98%) healthy individuals

**rickets** softening of the bone due to vitamin D deficiency resulting in bowed legs

**toxicity** side effects from taking large doses of supplements or medications

**vitamins** nutrients the body needs in small amounts to function and stay healthy

**water-soluble vitamins** vitamins that dissolve in water

## Review Questions

1. Which vitamin has the greatest chance of toxicity if taken in large doses?
  - Vitamin A
  - Riboflavin (B<sub>2</sub>)
  - Vitamin C
  - Pantothenic acid
2. The nurse provides dietary instruction to a client who is having difficulty controlling their blood glucose level. Which mineral deficiency should the nurse anticipate?
  - Chromium
  - Calcium
  - Copper
  - Iron

3. The nurse is teaching a client how to read a supplement label. Which of the following statements by the client about what information can be included in a supplement label indicates additional instruction is needed?
  - a. "It will describe how the ingredients can affect my body."
  - b. "It will list the amount of the ingredients in the supplement."
  - c. "It will describe how much of the supplement I should take."
  - d. "It will describe how the supplement will cure my high blood pressure."
4. The nurse is assessing a child with bowed legs. Which vitamin deficiency should the nurse anticipate is related to this disorder?
  - a. Vitamin C
  - b. Calcium
  - c. Vitamin D
  - d. Riboflavin
5. Which information should the nurse give to a client taking high doses of water-soluble vitamins?
  - a. Excess water-soluble vitamins are stored in fatty tissue.
  - b. Excess water-soluble vitamins are stored in the liver.
  - c. Excess water-soluble vitamins quickly reach toxic levels.
  - d. Excess water-soluble vitamins are excreted in the urine.
6. Which vitamin supplement should the nurse recommend to a client who is trying to conceive?
  - a. Thiamin
  - b. Niacin
  - c. Folate
  - d. Choline
7. Which minerals should the nurse instruct parents to include in the diet of preschool-aged children for the development of healthy bones and teeth?
  - a. Phosphorus and potassium
  - b. Iron and zinc
  - c. Calcium and phosphorus
  - d. Chloride and calcium
8. Which mineral deficiency should the nurse anticipate in the client diagnosed with goiter?
  - a. Iron
  - b. Iodine
  - c. Potassium
  - d. Sodium
9. Which food preparation technique should the nurse advise a client to use to prevent loss of water-soluble vitamins from the food?
  - a. Use less water in food preparation.
  - b. Cook food for a longer time.
  - c. Cook at a higher temperature.
  - d. Cut food into larger pieces.
10. Which vitamin deficiency should the nurse anticipate in the client with chronic alcohol use?
  - a. Riboflavin
  - b. Niacin
  - c. Vitamin C
  - d. Thiamin

## Suggested Reading

Choosing a vitamin/mineral supplement: <https://myhealth.alberta.ca/Health/Pages/conditions.aspx?hwid=ud3713>

Dietary Guidelines for Americans 2020-2025: <https://www.dietaryguidelines.gov/resources/2020-2025-dietary-guidelines-online-materials>

Do you need a dietary supplement?: <https://newsinhealth.nih.gov/2021/12/do-you-need-dietary-supplements>

Evolution of Dietary Guidelines: <https://www.dietaryguidelines.gov/media/799>

My Plate: <https://www.myplate.gov/>

Vitamin and Mineral Supplement Fact Sheets: <https://ods.od.nih.gov/factsheets/list-VitaminsMinerals/>



# CHAPTER 4

## The Digestive Process



**FIGURE 4.1** The digestive process breaks down food and fuels the body for function. (credit: modification of work "Chef Salad" by Gesalbe/Wikimedia Commons, CC0 1.0)

### CHAPTER OUTLINE

- 4.1 Digestion
  - 4.2 Physical Assessment of Digestive Organs
  - 4.3 The Function of Digestive Organs
  - 4.4 The Nurse's Role in the Promotion of Gut Health
- 

**INTRODUCTION** Eating food can be enjoyable, but it is also necessary for survival. When food is consumed, the body breaks it down, and it becomes the fuel for energy and function. The level of nutrition in food impacts the amount of energy gained in the body. The greater the nutritional value of food, the better for the body. The chapter will explore the digestive process and will review the role the nurse plays in promoting nutrition for gut health.

### 4.1 Digestion

#### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 4.1.1 Describe the digestive process.
- 4.1.2 Describe the organs of digestion.
- 4.1.3 Identify congenital anomalies within digestive organs.

#### The Digestive Process

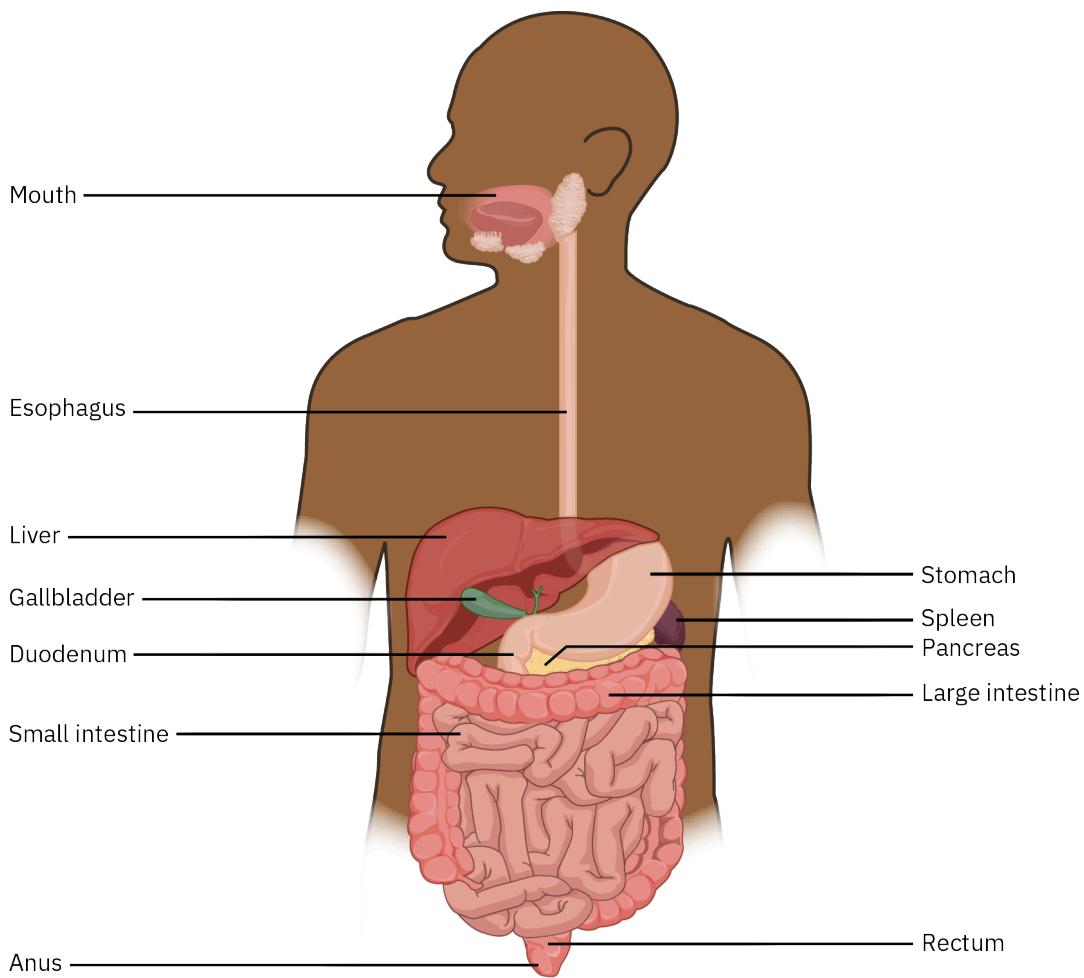
The digestive process includes four steps: ingestion, digestion, absorption, and metabolism. **Ingestion** is the first step and involves the process of bringing food and liquids into the body through the mouth. Next is **digestion**, in

which the body breaks down solid food through a process that includes both mechanical and chemical actions to form smaller, more absorbable substances for the gastrointestinal tract (Patricia & Dhamoon, 2022). **Absorption** is when cells take in the broken-down substances, and **metabolism** is when those absorbed substances are converted to energy.

Digestion occurs as an integrated process between the body's upper and lower gastrointestinal tract and accessory organs. The body needs to have proper digestive processes to ensure correct function. Common end products of digestion are amino acids, simple carbohydrates, lipids, vitamins, and minerals.

## Digestive Organs

The main organs of digestion, known as the gastrointestinal system, begin at the mouth and end at the anus. This system is divided into the upper gastrointestinal system, which starts at the mouth and ends at the duodenum (the start of the small intestine), and the lower gastrointestinal system, which starts at the small intestine and includes the large intestine (the colon, rectum, and anus). Other organs in the digestive system that aid in digestion but are not part of the main gastrointestinal system and don't come in direct contact with food are the accessory organs: the pancreas, liver, and gallbladder (Figure 4.2).



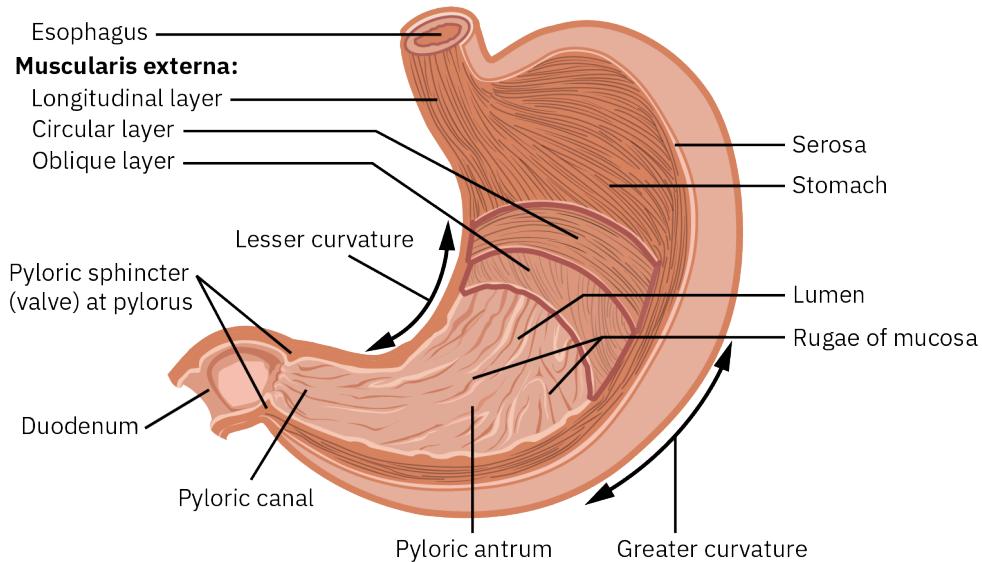
**FIGURE 4.2** The digestive system consists of the upper and lower gastrointestinal tract and accessory systems and is responsible for processing food. The main digestive organs, known as the gastrointestinal system, begin at the mouth and end at the anus. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

The purpose of the digestive system, and all the systems that work in harmony with it, is to receive food, release nutrients and water from the food, and transport these nutrients to the bloodstream for energy production. The digestive system is also responsible for absorbing water from the colon and for excreting nondigestible solid waste from the anus (National Institute of Diabetes and Digestive and Kidney Diseases, 2022).

## Upper Gastrointestinal System

The upper gastrointestinal system comprises the mouth, esophagus, stomach, and duodenum. The teeth, tongue, and salivary glands, which are all accessories for digestion, are in the mouth and facilitate the breakdown of food through mechanical (chewing) and chemical (enzymes) digestive processes. All of these components are required for the mouth to effectively complete its role in the digestive process.

After this initial breakdown, food then travels out of the mouth, through the upper esophageal sphincter, down the esophagus, through the lower esophageal sphincter, into the stomach, out of the stomach through the pyloric sphincter, and into the duodenum (Figure 4.3). The process of digestion through this upper gastrointestinal tract, starting at the mouth and ending in gastric emptying, can take 2–5 hours to complete (Readman, 2022).



**FIGURE 4.3** Food journeys from the esophagus to the duodenum. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

## Lower Gastrointestinal System

The lower gastrointestinal system comprises the small intestine, large intestine, rectum, and anus. Food entering the lower portion of the gastrointestinal system comes from the duodenum as **chyme**, a mixture of gastric juices and digested food. After digestive processes are complete in the duodenum, chyme moves through the small intestine, large intestine, and rectum, then out the body through the anus in the form of stool. Digestion through the lower gastrointestinal tract can take from 12 to 65 hours (Readman, 2022).

## Accessory Organs and Systems

The pancreas, liver, and gallbladder are organs outside of the main gastrointestinal tract but are part of the digestive system (GI Associates and Endoscopy Center, 2022b). They directly aid in digestion by releasing enzymes and digestive fluids. **Cholecystokinin**, a hormone produced by the small intestine, triggers the pancreas and gallbladder to contract when fats and proteins enter. The pancreas, while also responsible for other body functions, produces **amylase**, **lipase**, **trypsinogen**, **chymotrypsinogen**, **elastase**, **carboxypeptidase**, **nucleases**, and **protease**. These enzymes break down sugars, fats, and starches (GI Associates and Endoscopy Center, 2022b). When sugar enters the bloodstream, the pancreas produces **insulin**, a hormone that assists in the absorption of glucose into cells to use for energy.

The liver produces **bile**, a digestive fluid that is stored in the gallbladder. When fatty foods enter the duodenum, the gallbladder releases bile to break down the fat into fatty acids. If the gallbladder is removed, the bile will instead travel directly from the liver to the small intestine.

Other accessory organs and tissues that assist in digestion include the salivary glands, tongue, nerves, and blood (University of Rochester Medical Center, 2022). When food enters the mouth and chewing begins, teeth break down the food into smaller parts, and saliva is released. Saliva is released by the sensory system, which is stimulated by

sight, smell, and taste. Glands and mucosal membranes of the intestinal walls secrete small amounts of digestive enzymes and lubricating mucus to assist with waste movement and nutrient absorption.

## Congenital Anomalies of the Gastrointestinal System

While rare, congenital anomalies can affect the digestive system. Most congenital anomalies result from undeveloped or incorrectly positioned organs, causing blockages that prevent food passage or the exit of waste products (Columbia University Irving Medical Center, n.d.).

### Atresia, Stenosis, and Malformations

Congenital abnormalities include atresia, stenosis, and malformations. Some of these abnormalities can be detected in utero or soon after birth, while others remain undetected through childhood until they cause physical symptoms (Ludwig et al., 2022). Atresia is a condition in which a passage in the body is blocked. For example, esophageal atresia is when a baby's esophagus has not developed correctly, and aural atresia is when the ear canal is underdeveloped. Stenosis, or narrowing, is a partial blockage of an area, and a malformation is an abnormal formation of a specific body part.

Anorectal anomalies can include an anus that is very narrow or totally enclosed by a layer of tissue or skin, a rectum that does not connect to the anus (imperforate anus), or a rectum that connects to a part of the urinary or reproductive tract through a **fistula**, an abnormal connection (Boston Children's Hospital, 2022). Depending on which anomaly is present, the client may experience symptoms such as difficulty passing stool and constipation, total inability to have a bowel movement, or stool that exits through the urinary system or another system in the body, causing infection and incontinence (Boston Children's Hospital, 2022).

Biliary anomalies affect the bile ducts. They can involve a progressive narrowing effect and/or a complete blockage, cystic formations that result in blockages in the biliary system, or biliary ducts that are malformed and do not properly connect to the pancreaticobiliary junction (Columbia University Irving Medical Center, n.d.; Stanford Medicine Children's Health, 2023b). These anomalies fall into two main types, cystic and non-cystic. Cystic anomalies are caused by saclike structures filled with pus or other fluid that form and block different parts of the biliary system, whereas non-cystic anomalies are actual structural defects of the biliary system (Stanford Medicine Children's Health, 2023). Common symptoms of these anomalies include jaundice, abdominal pain, pale or clay-colored stools, dark urine, enlarged liver margins, hyperamylasemia, enlarged splenic margins, and difficulty gaining weight.

### Malrotation and Volvulus

Malrotation most often occurs in the small intestine and involves an incorrect rotation that happens during fetal development (Columbia University Irving Medical Center, n.d.). Volvulus is a severe complication of a malrotation in which blood flow is blocked to the digestive tract, causing ischemia, and/or to the intestines, causing stool blockage (Columbia University Irving Medical Center, n.d.). While malrotation can be the cause of volvulus, it can also occur in the absence of malrotation (Johns Hopkins Medicine, 2022).

Malrotations alone are usually asymptomatic. It is not until volvulus develops that a client experiences symptoms (Johns Hopkins Medicine, 2022) such as sudden and severe nausea and vomiting, dark red or bloody stools, severe constipation or difficulty expelling stools, abdominal distention, bilious vomiting (vomiting that contains bile), and shock.

## 4.2 Physical Assessment of Digestive Organs

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 4.2.1 Outline the assessment process of the digestive organs.
- 4.2.2 Analyze and prioritize assessment findings.

### Mouth, Oropharynx, and Lips

Because digestion is responsible for fueling the body, proper assessment of the digestive system is imperative to prevent disease, maintain wellness, and promote nutritional health. Both a physical assessment and a review of the client's health history should be completed. In reviewing the client's health history, the nurse should inquire about

dietary practices, dietary intolerances or allergies, eating and bowel patterns, changes in eating or bowel patterns, recent unintentional weight loss or gain, and medical diagnoses or surgical history. The nurse should obtain the client's weight and height to calculate the client's body mass index (BMI).

An assessment of the mouth and the oropharynx (the middle part of the throat) begins with the lips. The nurse should begin with the outer lips to judge for symmetry, color, texture, and contouring. The client should be asked to smile so that the nurse can judge lip symmetry. If the client is unable to lift both sides of the lips equally, they are not symmetrical, and this should be reported.

## SAFETY ALERT

### Lip Asymmetry

If the client is exhibiting asymmetry in their lips that is new, especially in conjunction with new symptoms such as facial drooping or asymmetry, arm weakness, numbness, paralysis, or speech difficulty such as slurring or aphasia, the nurse should immediately alert the provider, as this could indicate an acute stroke (American Stroke Association, n.d.).

Next, the inner lips and buccal mucosa (the inner lining of the cheeks) should be inspected for color, texture, moisture, and presence of abnormalities. To best visualize these structures, the nurse should direct the client to relax their mouth. The nurse should then pull the bottom lip outward and away from the client's teeth by grasping the lip between the thumb and index finger on each side and carefully pulling outward (Villa, 2022). Drooling may be seen in young infants and toddlers up to age 2, but it should not be excessive.

Nurses should watch for numerous abnormalities, some more urgent than others. Assessment findings that the nurse should report immediately include cyanosis, a bluish discoloration of the skin that can indicate low oxygen levels, and new unilateral asymmetry with movement, as this could indicate a cerebrovascular accident.

### Gums, Buccal Mucosa, Tongue, and Teeth

The inspection of the inside of the mouth will include the gums, buccal mucosa, tongue, and teeth. To begin, the client should open their mouth. The nurse should then use a penlight and a tongue depressor or blade to retract each cheek to complete a visual exam of all internal surfaces, looking for any abnormalities. To evaluate the teeth in the back of the mouth, the nurse should place both index fingers into one side of the mouth to retract the cheek. The client will then slowly open and close their mouth while the cheek is retracted so that tooth alignment can be visualized. This should be completed on both sides of the mouth.

Nurses should inspect the gums in this same manner. If the client has dentures, bridges, or other removable dental appliances, they should be removed if possible, and the nurse should repeat the evaluation for the gums separately. Check gums for retraction or recession, color, reddened inflammation, soreness, bleeding, edema, or lesions (Cleveland Clinic, 2022c).

## SAFETY ALERT

### Tongue Depressor or Blade Contradictions

If the epiglottis (the small cartilage that covers the windpipe) is swollen, the nurse should not examine with a tongue depressor, blade, or flexible laryngoscope. Further, the nurse should not manipulate the oral cavity because this could trigger laryngospasm and close off the client's airway, causing a life-threatening emergency (Guerra & Waseem, 2022). Symptoms of epiglottitis include hyperthermia, sore throat, stridor (noisy breathing), dysphagia (trouble swallowing), and drooling (Mayo Clinic, 2022). Children may also act anxious and irritable and may sit up or lean forward to ease breathing, while adults may also have a muffled or hoarse voice or difficulty breathing.

To facilitate inspection of the tongue, the client should open their mouth and stick out their tongue to allow the nurse to inspect for position, color, texture, and moisture. The nurse should ask the client to curl their tongue upward and move it from side to side to assess mobility. Lastly, the nurse should instruct the client to push the tip of

their tongue to the roof of their mouth and should inspect the base of the tongue, the mouth floor, and the **frenulum** (the small tissue beneath the tongue that provides support) for color, texture, bleeding, moisture, and lesions.

The hard and soft palates at the roof of the mouth should be inspected for color, shape, texture, and the presence of bony prominences. The nurse should instruct the client to open their mouth widely while tilting their head backward. The nurse should use a tongue depressor or blade to depress the tongue if needed and use a penlight to see the structures. The nurse should then ask the client to say “ah” and should inspect the **uvula**, the fleshy extension that hangs at the back of the throat and at the end of the soft palate, for position and mobility after inspecting the soft palate.

### Palates, Uvula, Oropharynx, and Tonsils

The final steps of the assessment cover the palates, uvula, oropharynx, and tonsils. To begin, the nurse should use a tongue depressor or blade to push downward against the tongue halfway back on the same side of the tongue of the oropharynx that is being inspected. While holding the tongue out of the way, the nurse should use a penlight to examine the color, size, and discharge of the oropharynx and tonsils. The inspection should be repeated on the opposite side. Lastly, the nurse should elicit the gag reflex by using the tongue depressor or blade to stimulate the back of the throat (Sivakumar & Prabhu, 2023).

As with the teeth and gum assessment, abnormal findings that the nurse should report immediately include cyanosis and any suspicious lesions. Additional findings that the nurse should immediately report include a uvula that is not midline or freely movable (this could be a sign of a tumor, trauma, or nerve damage), a uvula in a newborn that is forked or bifurcated (a possible indication of an undetected cleft palate), plaques or drainage in oropharynx (this could indicate acute infection), or swelling or drainage of tonsils (possible sign of an acute infection).

## Abdomen

The assessment of the abdomen includes the upper gastrointestinal system (stomach and duodenum), the accessory organs of the digestive system (pancreas, liver, and gallbladder), and most of the lower gastrointestinal system (large and small intestines). This assessment must occur in a specific order: inspection, auscultation, percussion, and then palpation. This is important because auscultating before percussing and palpating ensures the nurse is listening to undisturbed bowel sounds.



### CLINICAL TIP

#### Positioning the Client for Abdominal Assessment

When preparing the client for abdominal assessment, position them so that their abdominal wall musculature is relaxed. To achieve this, the nurse should have the client lie supine and support the client’s head and behind the knees with pillows.

#### Step 1: Inspection

Inspection should be the first step in the abdominal assessment (Roscoe, 2022). The nurse should do this with the client in a completely supine position with the abdomen exposed (Mealie, Ali, & Manthey, 2022). The nurse should inspect the skin integrity, abdomen contour, symmetry, and vascular patterns and visually inspect the abdominal movement associated with respirations, aortic blood flow, and peristalsis (the muscle contractions that move food through the digestive tract).

#### Step 2: Auscultation

Auscultation is the process of listening to the sounds of the body using a stethoscope. The process of auscultating the abdomen is to assess the bowel and vascular sounds and peritoneal friction rubs. To auscultate the abdomen, the nurse should:

- With the diaphragm of the stethoscope, listen for bowel sounds in each of the four quadrants of the abdomen. Calculate the amount of time in between bowel sounds after listening for at least two and no more than 5 minutes in each quadrant.
- With the bell of the stethoscope, listen for the absence of bruits (the sound of blood flowing through a narrowed portion of an artery) in the aorta, renal arteries, femoral arteries, and iliac arteries in the abdomen. If the nurse

suspects a delay in gastric emptying, place the stethoscope on the abdomen near the stomach, hold the client's hips, and gently shake them from side to side while listening to their abdomen for a **succussion splash**, a sloshing or splashing sound caused by excessive fluid remaining in the stomach (Mealie, Ali, & Manthey, 2022). This may be uncomfortable for the client, so the nurse should inform the client what to expect.

- With the diaphragm of the stethoscope, listen for the absence of peritoneal friction rubs over the spleen and liver as the client breathes in deeply.

### Step 3: Percussion

Percussion, or tapping, of the abdomen is an assessment technique to determine the presence of gas, fluid, or masses. The systematic process of percussion is to start in the lower-right quadrant of the abdomen and proceed to the upper-right quadrant, move to the upper-left quadrant, and finish in the lower-left quadrant. The nurse should percuss several areas of each quadrant to listen to the quality of the sound. **Tympany**, or a resonant, hollow sound, relates to gas, or flatus. Dullness, decrease, absence, or flatness of sound relates to fluid or solid masses.

Percussion is also used to best judge the size of the liver and may be helpful in identifying splenic enlargement (Mealie, Ali, & Manthey, 2022). To percuss for splenic size, the nurse should percuss the most inferior interspace on the left anterior axillary line, or the Castell's point, as the client breathes in deeply, to listen for the start of dullness from tympany to discover the splenic edge. On the right side, the nurse should percuss down from the lung and up from the bowel to discover the change from tympany to dullness to locate the liver margins.

### Step 4: Palpation

The last step in the abdominal assessment is palpation. There are three palpation stages: superficial or light palpation, deep palpation, and organ palpation. For superficial palpation, the nurse should hold their palm slightly above the client's abdomen with their fingers parallel and then use their finger pads to depress the abdominal wall lightly at only about 1 cm (0.39 in), which is about the level of the subcutaneous tissue (Mealie, Ali, & Manthey, 2022). The nurse should move their finger pads in a circular motion over all the quadrants while noting any areas of tenderness, masses, crepitus (a grinding or crunching sound), irregularity in contour, or muscle guarding. If a known area of pain is already present on the abdomen, start farthest from the area of maximal pain with any form of palpation and end in that area last (Mealie, Ali, & Manthey, 2022).

After light palpation is complete, the nurse should move on to deep palpation. This is done slowly with the same hand position and in the same manner, except the depth of pressing is increased with firmer and more steady pressure to explore deeper. While palpating deeply in the periumbilical, inguinal, and suprapubic regions, the nurse should have the client cough while feeling for a mass to ensure there is no hidden hernia.

After palpation of the abdomen, the nurse should palpate the digestive organs. To palpate the liver, the nurse should place a hand below the lower-right rib margin and ask the client to exhale and then inhale deeply while the nurse feels for the margins and any nodularity. The nurse should then palpate the gallbladder by placing their palpating hand under the lower-right rib margin at the midclavicular line and asking the client to exhale deeply. The nurse then pushes in deeper and slowly, asking the client to inhale while watching for a sudden cessation of inhalation due to pain. The spleen is palpated by placing a hand in the lower-right quadrant and moving it toward the splenic flexure until the hand reaches the lower-left rib margin, at which time the client should be asked to exhale and then inhale deeply.



### SAFETY ALERT

#### Deep Palpation Contraindications

The nurse should not do deep palpation on clients with suspected abdominal aortic aneurysm, appendicitis, polycystic kidney disease, kidney transplant history, or a tender spleen because it could cause severe damage (Roscoe, 2022). For example, deep palpation may rupture an aneurysm, the appendix, or a cyst, or it may damage a newly transplanted kidney.

The nurse should report immediately abnormal findings that can indicate serious health problems within the lower gastrointestinal tract and accessory organs. Refer to [Table 4.1](#) for a summary of possible abnormal findings and their causes.

Assessment Finding	Abnormality	Sign/Symptom/ Syndrome
Ecchymosis (discoloration) of flank and groin	Pancreatic hemorrhage	Grey Turner's sign
Perumbilical ecchymosis	Retroperitoneal and intra-abdominal hemorrhage	Cullen's sign
Purple-pink striae in the absence of pregnancy	Cushing's syndrome	"Stretch marks"
Visible vascular pattern	Portal hypertension or vena cava obstruction	Vein dilation
Very marked aortic pulsations	Aortic aneurysm (Shaw et al., 2023)	Pulsations
Surrounding erythema, induration, and tenderness	Omphalitis (specific to infants) (Gantan & Wiedrich, 2022)	Deviation in umbilical stump appearance
Combined with abdominal distention: jaundice and/or caput medusae (swollen veins)	Cirrhosis and liver failure (Mealie, Ali, & Manthey, 2022)	Abdominal distention

TABLE 4.1 Abnormal Abdominal Findings and Possible Causes



## SAFETY ALERT

### Follow-up Testing

While physical assessment can aid in identifying potential nutritional deficiencies, it is not diagnostic, and other follow-up testing is necessary to determine the best treatment needs and options.

## Rectum and Anus

Assessment of the anus and rectum is the final step of the lower gastrointestinal system assessment. To assess the anus, the nurse should visually evaluate the outer tissue for color, integrity, and absence of lesions. The nurse should then ask the client to bear down as if defecating. With gloves on and the index finger lubricated, the nurse should feel the rectal sphincter and slowly dilate it by sliding the lubricated finger into the rectum. Palpate inside the rectum for masses, fissures, or other foreign bodies. After removal of the finger, inspect the finger for any signs of bleeding or **melena** (dark, black, or sticky feces). If present, or if internal bleeding is suspected, the nurse should perform a **guaiac test**, which will confirm if blood is present.



## CLINICAL TIP

### Important Newborn Assessment

For a newborn, the nurse should establish anal patency. This is done by two means: first, the nurse should insert a lubricated rectal thermometer 1 cm to 2 cm (0.39 in to 0.78 in) into the newborn's rectum to record temperature, and second, the nurse should identify and document the passage of their first stool, called the **meconium** (Gantan & Wiedrich, 2022).

## 4.3 The Function of Digestive Organs

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 4.3.1 Describe the function of digestive organs in ingestion, digestion, absorption, and elimination.
- 4.3.2 Describe the pathophysiology associated with digestive organs.
- 4.3.3 Identify the impact of aging on digestive organs.

## Normal Function of the Digestive Organs

Before food ever enters the body, the sensory system starts the digestive process. The sight, smell, feel, and taste of food influences the desire to eat. These senses trigger the salivary glands to begin releasing saliva in the anticipation of eating, which helps break down food once it enters the oral cavity. When food enters the mouth, chewing, also known as **mastication**, starts the breakdown of food. The tongue secretes mucins and lingual lipase to help break down lipids. At the same time, the parotid, sublingual, and submandibular salivary glands release a mixture of buffers, glycoproteins known as mucins, and salivary amylase to lubricate the food for swallowing and to begin the digestion of complex carbohydrates and starches (National Institute of Diabetes and Digestive and Kidney Diseases, 2022; Ogobuiro, Gonzales, & Tuma, 2022).

Food then passes to the pharynx. To swallow food into the esophagus and not the trachea, the swallowing center in the brain stem of the central nervous system triggers certain actions:

- The nasopharynx is closed off by the rise of the soft palate when the tongue initiates swallowing by pushing food to the back of the mouth.
- The larynx is closed in the pharynx to prevent food from entering the trachea (Mealie, Ali, & Manthey, 2022; Ogobuiro, Gonzales, & Tuma, 2022).
- Once this swallowing reflex is initiated, it cannot be stopped until completed.

Once food is swallowed, it enters the esophagus by passing through the upper esophageal sphincter. The food travels down the esophagus body involuntarily by way of a series of muscular contractions known as peristalsis. It then exits the esophagus through the lower esophageal sphincter into the stomach (National Institute of Diabetes and Digestive and Kidney Diseases, 2022).

While in the stomach, food is temporarily stored while mechanical and chemical processes break it down further into chyme. The stomach uses its three muscular layers (the inner oblique, middle circular, and external longitudinal layers) to contract and relax in a mixing and churning action to help mechanically break down food. To assist with the chemical breakdown of food, the stomach releases hydrochloric acid secreted by its parietal cells, enzymes such as **pepsin**, and hormones such as **somatostatin** and **gastrin** (Ogobuiro, Gonzales, & Tuma, 2022). The stomach is also responsible for secreting an **intrinsic factor** (a glycoprotein that is necessary for the absorption of vitamin B<sub>12</sub>) from the parietal cells.

The food, in the form of chyme, exits the stomach through the pyloric sphincter into the first of the three segments of the small intestine, the duodenum. While in the duodenum, the pancreas (by way of the pancreatic duct) and liver (by way of the gallbladder and biliary tree) empty enzymes into the duodenum through the sphincter of Oddi. The liver secretes bile that is stored and concentrated in the gallbladder before it is released to aid in digestion (National Institute of Diabetes and Digestive and Kidney Diseases, 2022; Ogobuiro, Gonzales, & Tuma, 2022). The pancreas's exocrine glands generate various enzyme precursors and enzymes that play a crucial role in the process of digestion (Ogobuiro, Gonzales, & Tuma, 2022).

The food continues to the second segment of the small intestine, the jejunum, by way of peristalsis. This is where the bulk of chemical digestion and nutrient absorption will occur before it moves into the last segment, the ileum, which has some digestive and absorptive duties as well (Ogobuiro, Gonzales, & Tuma, 2022). Absorption in the small intestine is done through nutrient exchange in extensive capillary networks that are located on the walls of the small intestine. The surface area of the small intestine is increased to promote increased absorption through the use of villi and microvilli that cover the walls and are home to the extensive capillary networks. There are also multiple exocrine and endocrine glands that assist in the absorptive process by producing and releasing hormones, alkaline mucinous materials, and enzymes.

Undigested food materials that pass through to the end of the small intestine through the ileocecal valve end up as feces in the cecum, which is the first of the five segments of the large intestine (Ogobuiro, Gonzales, & Tuma, 2022). While peristalsis moves the food through the large intestine, water and electrolytes are absorbed from the feces. Final digestion of undigested food particles in the feces is completed by microbes that live in the large intestine. Nutrients like vitamin K are produced and absorbed in the large intestine as well (Cleveland Clinic, 2022a; Ogobuiro, Gonzales, & Tuma, 2022). The feces travel through the cecum, ascending colon, transverse colon, descending colon, and sigmoid colon before moving into the rectum, where stretch receptors signal the brain to defecate.

From the rectum, the stool exits the body through the anal canal by passing through the internal and then external anal sphincters. Relaxation of the internal anal sphincter is a reflexive action in response to the activation of the stretch receptors, and the relaxation of the external anal sphincter is a conscious process that allows for stool to exit the anus (Ogobuilo, Gonzales, & Tuma, 2022).

### Pathophysiology Associated with Digestive Organs and Function

Many causes of diseases and disorders that impact the gastrointestinal system are linked with nutrition, as are many of their treatments. [Table 4.2](#) lists several organs impacted by nutritional deficit and the corresponding disease(s).

Organ	Nutritional Link	Disease or Disorder
Salivary gland	Deficiency of vitamin B <sub>12</sub> (cobalamin)	Salivary gland tumors
Gums	Deficiency of vitamin B <sub>12</sub>	Gingivitis
Mouth	Deficiency of vitamin B <sub>12</sub>	Periodontal disease/cancers
Lips	Maternal deficiency of vitamin B <sub>12</sub>	Cleft lip
Oral palate	Maternal deficiency of vitamin B <sub>12</sub>	Cleft palate
Esophagus	Food allergies	Eosinophilic esophagitis
Stomach	Deficiency of vitamin B <sub>12</sub> /lack of intrinsic factor	Pernicious anemia
Intestine	Low fiber intake, low water intake, and high dairy intake	Constipation
Anus/rectum	Low fiber intake, low water intake, and high dairy intake	Hemorrhoids, fissures, and fistulas
Gastrointestinal system	Low fiber intake, low water intake, high fat intake, and high cholesterol intake	Cancers
Intestine	Gluten	Celiac disease
Stomach/esophagus	Worsened by food that contains caffeine, spicy foods, acidic foods, and dairy products	Gastroesophageal reflux disease (GERD)

**TABLE 4.2** Diseases and Disorders of the Gastrointestinal System Linked with Nutrition (sources: Cleveland Clinic, 2022b; Cochran, 2022a-f; Munger et al., 2021; Ogobuilo, Gonzales, & Tuma, 2022)

### Aging of the Digestive System

The nurse should be aware of considerations for aging clients in connection with the digestive system and the role of nutrition. Older adults tend to have a decrease in appetite over younger adults due to comorbidities and/or medications that decrease the desire to eat, cause nausea, or create dietary food restrictions due to drug interactions. Older adults may experience the following issues:

- Appetite can decrease due to a loss in smell or taste or changes in the release of the hormones that control appetite (e.g., ghrelin, peptide tyrosine, tyrosine, cholecystokinin, insulin, and leptin) (Nigam & Knight, 2017).
- Food may appear less attractive or appetizing due to changes made to food consistency for safety reasons (Bartel, 2022; Nigam & Knight, 2017).
- The feeling of being full may happen faster or last longer due to the stomach wall losing elasticity, resulting in a loss of hydrochloric acid secretion into the stomach, making food accommodation more difficult and gastric emptying slower.
- Esophageal reflux may occur, and food may backflow more easily into the esophagus (Austin Gastroenterology, 2019).
- Hyposecretion of hydrochloric acid and protective mucus that occurs with age can result in chronic atrophic gastritis, increased peptic ulcer disease, and decreased vitamin B<sub>12</sub> absorption.
- An increase in the bacterial populations in the small intestine may lead to increased bloating and abdominal pain as well as decreased absorption of calcium, folic acid, and iron (Bartel, 2022; Nigam & Knight, 2017).
- Decreases in digestive enzymes from the pancreas result in a reduction in the digestion of proteins and fats.
- The liver decreases bile production, rate of protein synthesis and metabolism, and its ability to detoxify substances (Nigam & Knight, 2017).
- Risk for constipation increases because in the large intestine, there are reductions in neurotransmitters and

neuroreceptors, atrophies of mucosa and muscle layers, formations of diverticula, declines in the rate of cell division in the digestive epithelium, and increases in inflammatory conditions due to the increase in facultative anaerobes. The increase in constipation increases the risk for hemorrhoid development.

Biological changes due to age make it important for an older client to be educated so that they eat nutrient-dense options for adequate nutritional intake. With a lower caloric intake demand due to a slower metabolic rate from aging, older adults' need for calories will likely decrease, so the nutritional value of the foods they ingest is important.

## 4.4 The Nurse's Role in the Promotion of Gut Health

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 4.4.1 Describe the homeostasis of gut health.
- 4.4.2 Describe the impact of diet on gut health.
- 4.4.3 Identify the impact of pharmacology on gut health.
- 4.4.4 Identify pathophysiology and gut health.

### Gut Health Homeostasis

For healthy digestion and absorption of food and nutritional health, the gut must maintain a healthy **homeostasis**, the equilibrium maintained in the body through physiological processes and evidenced by intestinal microbiota growth. The nurse plays an important role in client education that leads to optimal nutritional health.

The composition of the gut's microbial growth has a strong impact on the homeostasis of the gut. When the gut is not in a state of homeostasis, the imbalance that results can cause **dysbiosis**, a disruption to the gut microbiome. Many diseases have been linked to dysbiosis, including anxiety, depression, hypertension, cardiovascular disease, cancer, inflammatory bowel disease, obesity, and diabetes, so the impact of an unhealthy gut surpasses just gastrointestinal health (Afzaal et al., 2022).

To maintain proper gut homeostasis, bacterial growth requires energy in the form of adenosine triphosphate and oxygen (Lee et al., 2022). Dietary factors, antibiotics, and underlying host conditions can reduce oxygen consumption in the colonic epithelium, thereby reducing the available oxygen to the indigenous microbes.

The microbiota of the gut has many functions in the body. These bacterial residents help control nutrient metabolism, defend against pathogens, contribute to carbohydrate digestion, synthesize methane from hydrogen processed by bacterial metabolism, neutralize carcinogens, and synthesize biotin, folate, and vitamin K (Afzaal et al., 2022).

### Diet and Gut Health

Diet directly impacts the health of microbial growth (Lee et al., 2022). There are numerous foods that have a positive impact on gut health. For example, fiber, water intake, fruits and vegetables, whole grains, and an overall well-balanced diet have shown positive effects. Yogurt is known to have a positive impact because it contains active bacterial cultures, which have been shown to be supportive of the gut microbiome environment (Stanford Medicine Children's Health, 2023a). High-fat diets, in contrast, have been shown to have a negative impact. They tend to contribute to diabetes, obesity, metabolic syndrome, and colon cancer (Afzaal et al., 2022; Baton Rouge General, 2023). In addition, high sodium intake and alcohol use can contribute to dysbiosis and have been linked to hypertension.

A nurse can make a direct impact on client health by educating clients on why diet, gut microbiota, and homeostasis are important. The nurse should speak to the specific reasons why fiber, water, probiotics, and whole grains are valuable in a diet and why saturated fats, alcohol, and sodium are areas of concern. The nurse should discuss with the client so they understand which types of food to increase or decrease. [Table 4.3](#) lists common foods and their impact on the gastrointestinal system.

Food	Impact on Gastrointestinal System
Fresh fruits and vegetables, lentils, kidney beans, split peas, chickpeas, quinoa, oats, popcorn, almonds, chia seeds, sweet potatoes, and dark chocolate	These foods are high in fiber and help maintain gut homeostasis, reduce cholesterol, promote healthy weight through satiety, reduce constipation by adding bulk to stool, and possibly reduce gastrointestinal cancer risks due to potential antioxidant properties (Gunnars, 2020; Moffitt Cancer Center, 2023).
Water	Increasing fiber requires increasing water in the diet to ensure there is sufficient water in the stool to account for the added bulk.
Saturated fats (found in fatty cuts of meat, pies, sausage, butter, lard, cheddar cheese, ice cream, sour cream, biscuits, cakes, pastries, milk chocolate confectionaries, palm oil, coconut oil, and coconut cream)	Saturated fats can lead to gut imbalance (Afzaal et al, 2022), raise bad cholesterol levels (NHS, 2023), and increase colon cancer risks (Baton Rouge General, 2023).
High-sodium foods (breads; pizza; sandwiches; deli meats and cured meats; cheese; soups; burritos and tacos; snacks like chips, popcorn, and pretzels; chicken; and omelets)	High amounts of sodium can upset the homeostasis of the gut by increasing dehydration.

**TABLE 4.3** Common Foods and Liquids and the Gastrointestinal System

## Pharmacology and Gut Health

Pharmacology and nutrition are interdependent because they rely on the same body processes. When the body lacks nutrients, the body's ability to utilize certain drugs is impacted (Bhupathiraju & Hu, 2023). A lack in nutrients also impacts the body's ability to properly dispose of toxins from drugs and digestion waste. The nutritional state of a client greatly impacts the ability of their medications to be properly metabolized, used, and excreted.

Probiotics, such as *Lactobacillus*, are supplements that are known to have positive impacts on the gut microbiome. These are useful in helping clients with dietary restrictions or who are taking certain medications that interfere with gut health. These supplements should be taken in combination with a healthy diet because they do not prevent gastrointestinal issues on their own but rather support healthy practices.

There are medications that can help and hurt the microbiota of the gut. Antibiotics are a well-known culprit for altering microbial growth. Long-term antibiotic use has been linked to *Clostridium difficile* (*C. diff*) infection and colon cancer. When a client needs antibiotics for longer than three days, it is common practice that they also be given a probiotic to counteract some side effects and the possibility of infection.

There are other medications that are lesser known for being harmful. They include:

- Proton pump inhibitors to treat gastroesophageal reflux disease, which can cause enteric infections like *C. diff* (Weersma et al., 2020)
- Metformin, used to treat diabetes, which can increase *Escherichia coli* (*E. coli*) in the intestines and lower other bacteria, causing imbalances in the microbiome
- Statins to treat hyperlipidemia, which can cause constipation or diarrhea, upsetting the homeostasis in the gut
- Antidepressants, which can kill off beneficial gut bacteria and alter the normal microbiome of the gut
- Opioids to treat chronic pain, which can cause severe bouts of constipation, upsetting the microbiome and preventing the excretion of wastes from the body
- Laxatives, which can cause disruption of the microbiome through electrolyte disturbances, dehydration, and mineral deficiencies

## Pathophysiology and Gut Health

Gut health and its impact on the body are often discussed in relation to bidirectional crosstalk at an axis point (the two-way communication that is focused at a specific intersection) between body systems that regulate health relative to one another (Tilg et al., 2022). The gut has many of these axes that connect it to the liver, brain, lung,

nervous system, sensory system, etc. The following section will look at the gut and its connection with the liver, brain, and lung.

### Gut-Liver, Gut-Brain, and Gut-Lung Axis

Gut-liver axis communication happens between nutrients, metabolites, microbial antigens, and bile acids within a microbial community (Ding et al., 2020; Tilg et al., 2022). A disturbance in this gut-liver network has been linked to an increase in hepatic inflammation and hepatic encephalopathy and decompensation of liver cirrhosis (Klein, 2022).

The gut-brain axis has been shown to have many devastatingly negative effects. The gut has been shown to produce neuroactive compounds that modulate metabolism and immunity (Benakis & Liesz, 2022), which are essential components to healing after a stroke. Because a stroke leads to intestinal dysmotility and permeability of the intestinal barrier, and thus decreased metabolism and depressed immunity, stroke victims often have impaired healing. [Table 4.4](#) outlines some other diseases connected to the gut-brain connection.

Disease	Impact
Parkinson's disease	Overgrowth of intestinal bacteria results in an increase in opportunistic pathogens, causing the neurotransmitter L-dopa to be decreased (Wallen et al., 2022). Parkinson's disease is directly impacted by the availability of L-dopa, and symptoms are worsened when the availability is decreased.
Multiple sclerosis	Overgrowth of certain gut bacteria causes an imbalance in homeostasis; exacerbations and advancement of the disease can be affected (eBioMedicine, 2022; French, 2022).
Alzheimer's disease	Clients with Alzheimer's disease are shown to demonstrate excessive production and aggregation of amyloid-beta peptides that lead to extracellular plaque formation (Sidharthan, 2022). Gut microbiota health impacts the disease because when it is unbalanced, it releases more of certain by-products that can alter inflammatory cytokine-signaling pathways, leading to amyloid-beta peptide accumulation.
Mental health	A link has been found between systemic inflammations and anxiety, depression, and other mental illnesses (GI Associate and Endoscopy Center, 2022a). The health of the gut has a large impact on the inflammatory state of the body. It also has a key function in the release of many neurotransmitters, one of which is serotonin, an important mood neurotransmitter.
Huntington's disease	When the gut microbiota is unbalanced, there is an influence on mood, cognition, and sleep, which are already negatively impacted by this disease (Wasser et al., 2020).

**TABLE 4.4** Diseases Known to Be Linked to the Gut-Brain Axis Connection

Due to the recent COVID-19 pandemic, the gut-lung axis has been more recently explored. Overall, the gut's role in the health of the body's overall immunity and the reduction of systemic inflammation has been applied to COVID-19 infection. The resulting acute respiratory distress syndrome that is a life-threatening effect of the virus is caused by an autoimmune-response-mediated inflammation in the lungs. Overall rates of mortality with COVID-19 are markedly higher for those admitted to the intensive care unit, and those who have gastrointestinal symptoms in conjunction with their respiratory symptoms are much more likely to need intensive care, making gastrointestinal issues a determinant of prognosis (Chen et al., 2020; Cleveland Clinic, 2022b; Ye et al., 2020; Ouali et al., 2021). Long-haul COVID-19 has also become more prevalent. Because clients who have gastrointestinal symptoms with COVID-19 infection have a longer detoxification time after infection, they are at a higher risk for developing long-haul COVID than those without gastrointestinal symptoms.

## Chapter Summary

- The gastrointestinal system contains the upper gastrointestinal system (mouth, teeth, tongue, salivary glands, pharynx, esophagus, stomach, and duodenum), the lower gastrointestinal system (small intestine, large intestine, rectum, anal canal, and anus), the accessory digestive organs (liver, gallbladder, and pancreas), and the accessory systems (nervous and sensory systems).
- While physical assessment of the client is required, the nurse should also obtain a history of the client's dietary practices, dietary intolerances or allergies, typical eating and bowel patterns, changes in normal eating or bowel patterns, recent unintentional weight loss or gain, and any medical diagnoses or surgical history for proper assessment.
- Digestive organs ingest, digest, and absorb the food that is taken into the body to convert it to usable energy.
- The body removes all usable nutrients and water from food intake and then eliminates the rest as a waste product, stool.
- The nurse's role is to educate the client on the proper dietary practices that will help maintain gut homeostasis and to evaluate steps the client can take to prevent gut issues when they must take medications that can upset that homeostasis.

## Key Terms

- absorption** the process of cells taking in digested substances
- amylase** an enzyme that helps to break down carbohydrates
- bile** a fluid created in the liver that aids in digestion of food in the duodenum
- carboxypeptidase** an enzyme that helps to breakdown fats
- cholecystokinin** a hormone produced by the small intestine that triggers the pancreas and gallbladder to contract when fats and proteins enter
- chyme** a mix of gastric juices and digested food
- chymotrypsinogen** an enzyme that breaks down proteins into smaller particles
- digestion** the breakdown of solid food that includes both mechanical and chemical actions to form smaller, more absorbable substances in the body's gastrointestinal tract
- dysbiosis** a disruption to the microbiome resulting in an imbalance in the microbiota of the intestines
- elastase** an enzyme that helps break down fats, proteins, and carbohydrates
- fistula** a condition in which two body parts are abnormally connected
- frenulum** the small tissue beneath the tongue that provides support
- gastrin** a peptide hormone that regulates gastric motility, gastric secretion of stomach acid, and gastric mucosal growth
- guaiac test** a test that confirms the presence of blood in stool

**homeostasis** a balanced state in the body that allows for proper function

**ingestion** the first step of the digestive process that involves bringing food and liquids into the body through the mouth

**insulin** a hormone that assists in the absorption of glucose into cells for energy usage

**intrinsic factor** a glycoprotein required for vitamin  $B_{12}$  absorption in the small intestine

**lipase** an enzyme that helps to break down fats

**mastication** chewing action of the mouth

**meconium** the first stool passed by a newborn

**melena** dark, black, or sticky feces

**metabolism** the part of digestion in which the body converts absorbed substances into energy

**nucleases** an enzyme that breaks down nucleic acid chains

**pepsin** an enzyme that begins to break down proteins in the stomach

**protease** an enzyme that breaks down proteins

**somatostatin** a hormone that regulates stomach acid secretion during digestion

**succussion splash** a sloshing or splashing sound heard on auscultation of the abdomen due to excessive fluid remaining in the stomach

**trypsinogen** an enzyme that helps break down fats into amino acids

**tympany** a resonant, hollow sound potentially heard during percussion

**uvula** the fleshy extension that hangs at the back of the throat and at the end of the soft palate

## Review Questions

- The nurse is caring for a client with a small bowel obstruction. The client asks why they are experiencing vomiting of stool. What response by the nurse is appropriate?

- a. The gastrointestinal tract is one long tube, so a blockage will cause contents to move backward.
  - b. The pyloric valve prevents stool from flowing into the stomach when the intestines are blocked.
  - c. Peristaltic movement prevents the backflow of contents when the intestines are blocked.
  - d. Obstruction of the small bowel will not cause vomiting of stool.
- 2.** The nurse is assessing a client who has flatus. What finding would the nurse expect to assess in this client?
- a. Scaphoid abdomen
  - b. Jaundice of the abdomen
  - c. Tympany on percussion
  - d. Dullness on percussion
- 3.** The nurse is assessing a 3-year-old client who has been brought in by their parents due to refusal to eat and seems to choke on fluids easily. The nurse assesses that the client has uncontrolled drooling, is hyperthermic, and has a very muffled cry. What precaution should the nurse take when assessing the gastrointestinal system of this client?
- a. Avoid use of tongue blade/depressor.
  - b. Avoid deep palpation of the abdomen.
  - c. Avoid percussion of the abdomen.
  - d. Avoid assessment of liver margins.
- 4.** The nurse is educating a client on the normal function of the digestive system. The nurse teaches the client that which organ is responsible for the most water absorption?
- a. Esophagus
  - b. Stomach
  - c. Small intestine
  - d. Large intestine
- 5.** The nurse is caring for a client with lower gastrointestinal bleeding. What test would the nurse anticipate being ordered for this client?
- a. Comprehensive metabolic panel
  - b. Guaiac test
  - c. Ovum and parasite stool test
  - d. White blood cell count
- 6.** The nurse is assessing the nutritional status of a healthy older client. Which finding would the nurse anticipate in this client?
- a. Decreased stomach size
  - b. Decreased vitamin B<sub>12</sub> absorption
  - c. Increased esophageal motility
  - d. Increased diarrhea
- 7.** The nurse is educating a client on gut homeostasis. Which instruction would the nurse give the client?
- a. Reduce intake of palm oil.
  - b. Increase sodium intake.
  - c. Limit fluids.
  - d. Reduce fiber intake.
- 8.** The nurse is caring for a client on long-term antibiotic therapy. Which food should the nurse recommend the client include in the diet to maintain gut homeostasis?
- a. Fish
  - b. Yogurt
  - c. Broccoli
  - d. Carrots

9. The nurse is caring for a client taking multiple medications. Which should the nurse teach as supportive to the microbiome of the gut?
  - a. Gentamycin
  - b. Pantoprazole
  - c. Lactobacillus
  - d. Lovastatin
10. The nurse is caring for a client with multiple health problems. Which finding in the client's history supports the client's gut homeostasis?
  - a. Metformin use for type 2 diabetes
  - b. Increased intake of saturated fats
  - c. Regular use of laxatives
  - d. High intake of whole grains

## Suggested Reading

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## CHAPTER 5

# Applying Clinical Judgment to Promote Nutrition for Neurological Wellness



**FIGURE 5.1** Nutrients from foods such as chili peppers impact brain function. (credit: modification of work “[Chilli Pepper And Onion Mix](#) (<https://openstax.org/r/wuestenigel>)” by Marco Verch/Flickr, CC BY 2.0)

## CHAPTER OUTLINE

- 5.1 Assess and Analyze the Impact of Nutrition on the Neurologic System
  - 5.2 Plan Nutritional Strategies to Impact Neurologic Wellness
  - 5.3 Implement Nutritional Strategies to Impact Neurologic Wellness
  - 5.4 Evaluate Nutritional Strategies to Impact Neurologic Wellness
- 

**INTRODUCTION** The neurologic system coordinates and manages nearly all activities of the human body in response to internal and environmental influences by regulating specific cellular and tissue functions. Because of the unique structure and functions within the brain, consideration of the specific nutrients that dramatically impact normal operations is an important part of the nursing assessment.

Consider this case: Jamal Powell is a 68-year-old client being seen at the neurology care clinic. The client was brought in by their spouse for evaluation of recent cognitive status changes. Jamal is concerned and fearful about these cognitive changes because of the close family history of developing dementia in the middle to late 60s. The client states that they smoked cigarettes for 3 years in their early 20s but quit and have not resumed smoking. There is no history of toxic chemicals or other exposures and no history of head trauma, seizures, or stroke.

## 5.1 Assess and Analyze the Impact of Nutrition on the Neurologic System

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 5.1.1 Recognize the normal function of the neurologic system.
- 5.1.2 Recognize cues of nutritional impact on the neurologic system.
- 5.1.3 Analyze cues of nutritional impact on the neurologic system.

### Normal Function of the Neurologic System

The neurologic system is defined by its two major components: the central nervous system (CNS), consisting of the brain and the spinal cord, and the peripheral nervous system (PNS), consisting of all neurons outside of the CNS. The PNS includes the **somatic nervous system**, which facilitates movement and muscle control in the body; the **neuromuscular junctions**, which are located at the terminal end of motor nerves and conduct impulses to target muscles; and the **autonomic nervous system**, which regulates involuntary body processes such as blood pressure, heart rate, respiration, digestion, and sexual arousal.

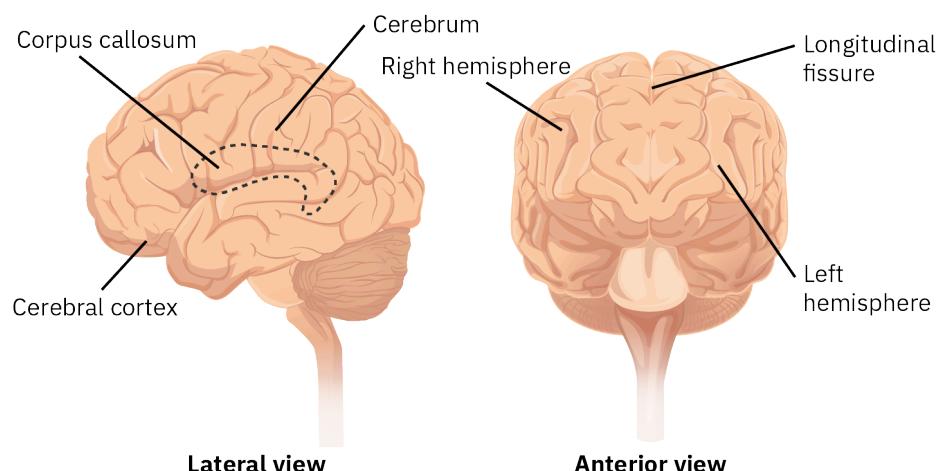
The autonomic nervous system is composed of the sympathetic and parasympathetic nervous systems. The **sympathetic nervous system** identifies impending danger and stimulates motor activity to either stay put and defend against the danger or to run away from the danger, known as the fight-or-flight response. The **parasympathetic nervous system** signals the body to rest and recover, as well as to digest food intake, known as the “rest-and-digest” response.

While the CNS is responsible for regulating cardiac, skeletal, and visceral smooth muscle activity, the PNS relays sensory input to the CNS for processing and then relays this information via motor responses to various effector organs and cells of the body. The PNS has two components: The **afferent** (sensory) component transmits impulses from peripheral organs to the CNS, and the **efferent** (motor) component transmits impulses from the CNS out to peripheral organs to initiate an active response or action.

The brain requires approximately 20% of the body’s total oxygen delivery and about 15% of the cardiac output. Because the brain cannot store glucose, it must rely on a constant supply of nutrients from the arterial blood flow, at a rate of 50–55 mL/g/min (Norris, 2019).

### Normal Brain Structure and Function

The brain conducts the most complex functions in the human body and is responsible for a person’s intelligence, memory, speech, behavioral responses to stress, heart rate regulation, breathing rates, and movement. However, it weighs approximately 3 lb ([Figure 5.2](#)). Approximately 60% of the brain is composed of fat, and the remaining 40% is made up of water, carbohydrates, protein, and various salts. The brain contains nerves (neurons and glial cells) as well as blood vessels, which supply the nutrients required for effective brain function. The tissue of the brain is composed of cells referred to as white matter, located in the central part of the brain, and gray matter, located on the external portion of the brain.



**FIGURE 5.2** The regions of the brain are shown in lateral and anterior views. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

The internal white matter of the brain is composed of **axons**, the long slender projections of neurons, which conduct electrical impulses across nerve cells. Axons are wrapped in **myelin**, a white fatty protein coating that protects and insulates the axon and increases the speed of impulse conduction to other sensory and motor cells of the nervous system. The gray matter is composed mainly of the round cell bodies (**soma**) of the neurons, which give it its grayish color; it is responsible for interpreting and processing information as it is received. As information is processed, the gray matter sends and receives chemical and electrical signals to control various processes such as movements and sensations. The cerebrum is the largest part of the brain, weighing 1.5–3 lb or about 2% of the total body weight. It is responsible for initiating, coordinating, and regulating movement, body temperature, speech, judgment, thinking, learning, reasoning, and emotions, as well as functions of the senses, such as vision, hearing, and touch. The various lobes of the cerebrum include the frontal, temporal, parietal, and occipital lobes, each controlling specific functions.

The protective outer layer of the cerebrum is the **cerebral cortex**. It facilitates memory, thinking, learning, reasoning, problem-solving, emotions, consciousness, and sensory functions. It is divided into two hemispheres, with the corpus callosum providing a pathway for communication between these two sides of the brain.

The brainstem has three components: the midbrain (responsible for hearing, movement, and other responses to the environment), the pons (responsible for blinking, vision, balance, hearing, facial expression, chewing, and tear production), and the medulla (responsible for heart rhythm, regulation of oxygen and carbon dioxide levels, blood flow, and reflexive responses such as coughing, swallowing, sneezing, and vomiting). The spinal cord carries sensory and motor messages to and from the brain to the effector organs to control bodily functions and environmental responses.

The cerebellum is responsible for posture, equilibrium, and balance, as well as playing a role in emotions and social behavior. The cerebellum may also have a role in addiction, autism, and some psychiatric conditions.

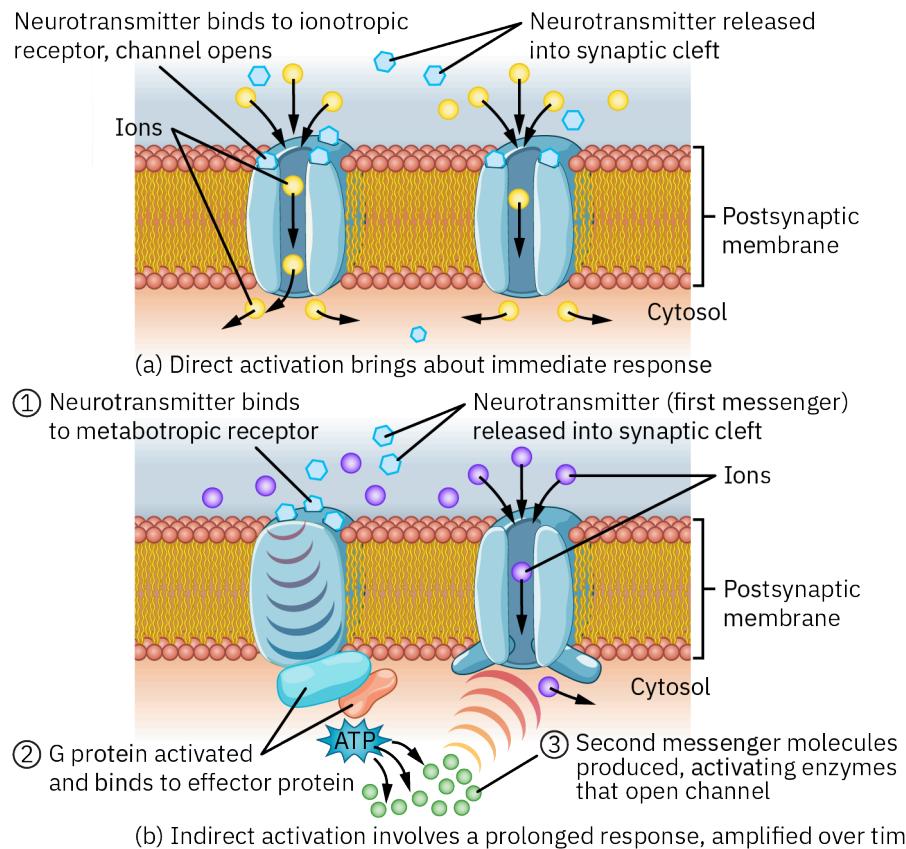
### Neurotransmitters

The neurons (nerve cells) are the functional cells of the neurologic system and relay all sensory and motor information via a complex system of chemicals produced by the body called **neurotransmitters** (Figure 5.3). They can be categorized into three groups:

- Amino acids that function in the CNS synapses (gamma-aminobutyric acid [GABA], glycine, and glutamic acid)
- Peptides that perceive pain and various sensations (endorphins and enkephalins)
- Monoamines that transmit in the autonomic nervous system (epinephrine and norepinephrine)

Neurotransmitters allow neurons to communicate by relaying excitatory or inhibitory messages at the synapse of the neuron to perform a wide range of functions via action potentials. Neurons have the capability to open the sodium channels along the cell membranes, allowing sodium to move into the cell, thus creating cellular depolarization, and subsequently moving potassium out of the cell in a process called the action potential. In turn, the cell then repolarizes, producing a resting state called the resting membrane potential. These actions enable the nervous system to rapidly transmit messages to and from the brain and tissues of the body, allowing changes for

adaptation to the external or internal environment.



**FIGURE 5.3** Neurotransmitters communicate at designated receptors to allow sensory and motor responses. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

## Assessment of Nutrition and the Function of the Neurologic System

A comprehensive nutrition assessment is performed as a routine component of neurologic assessment during the intake assessment. All clients require initial and ongoing screenings by nurses to determine any nutritional risk factors related to proper functioning of the neurologic system. When performing a general neurologic assessment, the nurse should begin by determining the client's level of consciousness, mental status, motor abilities and balance, and sensation. The nurse should take a detailed history of medical conditions directly affecting the client or the client's biological family. Any history of alcohol intake, medications, and dietary supplements, either prescribed or over the counter, should be included. A history of pain, both recent and past, should be explored. Pain related to chewing or swallowing, gastrointestinal pain, or pain that interferes with feeding may be pertinent to a nutritional problem, and mealtime observations can provide information regarding overall nutritional risk. Any history of visual disturbances, disequilibrium, dizziness, vertigo, vomiting, or changes in weight are significant and could be related to dehydration or the quantity and quality of caloric and nutritional intake.

Guidelines for assessing weight, height, and body mass index (BMI) have been published by the National Heart, Lung and Blood Institute (2023). A weight loss of more than 10% over the past year or 5% within the previous 6 months is significant and should be explored. Specifically, the nurse should ask for details of the client's self-management practices, including dietary, urinary, and bowel patterns; allergies; exercise and activities; and usual sleep cycle. A BMI of 30 or higher is associated with greater risks for neurologic and cardiovascular diseases (Centers for Disease Control and Prevention, 2022; Held et al., 2022). If the client is not critically ill, anthropometric measurements, midarm muscle circumference, and skinfold thickness measurements should be recorded because these may be helpful for estimating percentages of body fat and lean body muscle as a measure of nutritional status and general health. For clients who are determined to be at nutritional risk, a referral should be established with a registered dietitian.

An evaluation of mental health is an important component of neurologic health and should include an expression of

the client's self-concept and perception, as well as a summary of patterns related to adaptation to daily life stressors and relationships. This evaluation should also include specific beliefs or cultural norms as they relate to nutritional health practices. A history of diseases, health conditions, and medications is extremely useful for determining possible nutritional deficiencies. Given the sensitive nature of dietary habits, it is helpful for the nurse to maintain a nonthreatening and consistent approach to nutritional screening as it relates to neurologic health.



### CLINICAL TIP

#### Therapeutic Conversation

When performing evaluations, the nurse should conduct conversation using therapeutic conversation, such as the five As (assess, advise, agree, assist, and arrange). Motivational interviewing is another strategy that is helpful in engaging clients who may be hesitant.

Small changes are generally advised when considering behavioral changes that can seem overwhelming to the client. Dietary changes such as reducing or increasing the intake of certain foods slowly can have a dramatic effect over the long term. It is important to allow small substitutions that allow for individualized treats that satisfy food cravings while reducing trans fats and ensuring adequate intake of vegetables and healthy foods. A nursing assessment of nutrition should include a food diary that includes specific questions regarding the client's dietary habits over the previous few days and months—specifically, the number of meals and snacks consumed each day, the amount of fruit consumed, fluid intake, and fat and sugar intake (Lee, 2022). Nutrition counseling cannot be successfully completed in one meeting. The nurse should plan for subsequent meetings when adjusting a client's diet and should share the counseling efforts with other members of the health care team.

#### Controlling Nutrition Status Score

The Controlling Nutritional Status (CONUT) score is an instrument to measure nutrition (Ulibarri, 2005). A CONUT score is correlated to serum **albumin** level, the main protein in plasma. Albumin, which is synthesized in the liver, transports hormones and enzymes throughout the body and maintains equilibrium by stabilizing the capillary membrane. Albumin levels may be elevated in individuals who are dehydrated, consume a high-protein diet, or have an acute infection. Albumin levels may also be elevated in clients taking certain medications, such as insulin, steroids, or hormones. Individuals who are malnourished or have liver, kidney, or inflammatory diseases will have low albumin levels. Fasting can rapidly diminish albumin levels by up to one-third within 24–48 hours. Low albumin levels have been linked to increased mortality and longer hospital stay among clients with traumatic brain injury (TBI) because of increased levels of stress, blood loss, and dysphagia (Wang et al., 2020).

The CONUT score presents albumin, lymphocyte, and cholesterol levels as an overall nutritional score ([Table 5.1](#)). The formula for the CONUT score is a calculated value: 10 multiplied by the serum albumin value in g/dL, plus 0.005 multiplied by the total lymphocyte count in the peripheral blood in cubic milliliters, plus the total cholesterol score (Wang et al., 2020). The CONUT score may be an indicator of in-hospital mortality and 90-day outcomes in persons with traumatic brain injury (Wang et al., 2020). However, it is important to remember that among clients with acute illness, infection or injury, albumin levels may be reduced due to the acute nature of these pathophysiologic events rather than a nutritional problem. Relying solely on albumin as a marker of nutrition may be inaccurate (Smith, 2017).

Nutritional Levels in Adults	Normal	Light Deficiency	Moderate Deficiency	Severe Deficiency
Serum albumin (g/dL)	3.5–4.5	3.0–3.49	2.5–2.99	< 2.5
Score	0	2	4	6
Total lymphocytes/mL	> 1600 ≥ 1.600×10 <sup>9</sup> /L	1200–1599 1.200–1.599×10 <sup>9</sup> /L	800–1199 0.800–1.199×10 <sup>9</sup> /L	< 800 < 0.800×10 <sup>9</sup> /L
Score	0	1	2	3

**TABLE 5.1** Controlling Nutritional Status (CONUT) Score (source: Wang et al., 2020)

Nutritional Levels in Adults	Normal	Light Deficiency	Moderate Deficiency	Severe Deficiency
Cholesterol (mg/dL)	> 180	140–180	100–139	< 100
Score	0	1	2	3
<b>Total score</b>	<b>0–1</b>	<b>2–4</b>	<b>5–8</b>	<b>9–12</b>

TABLE 5.1 Controlling Nutritional Status (CONUT) Score (source: Wang et al., 2020)

### Required Nutrients for Brain Function

The cells of the brain cannot store glucose or other nutrients; as a result, the brain can function for only approximately 10 seconds without depleting the oxygen supply via the cerebral circulation. Glucose is considered a macronutrient and is the main fuel for the brain. Because the neurons in the brain have no capability to store glucose, a continuous supply is required to ensure adequate brain function. Death to brain cells begins when they are deprived of oxygen for only 4–6 minutes. Any disruption in blood flow will lead to a buildup of toxic metabolic byproducts that will damage vulnerable cells in the brain. Other macronutrients that supply the brain with fuel include proteins and fats, which can also act as energy sources.

Micronutrients are vitamins and minerals that are critical for optimal brain function in very small amounts. They include omega-3 fatty acids (important components of the membranes that surround the cells of the body), **polyphenols** (micronutrients that have health-promoting properties and are found in many fruits and vegetables), vitamins (especially certain B vitamins: B<sub>1</sub> [thiamine], B<sub>6</sub> [pyridoxine], B<sub>9</sub> [folate], and B<sub>12</sub>), and minerals (zinc, magnesium, iodine, iron).

Zinc is a trace metal ion that contributes to brain health by supporting the immune system and the function of the pituitary hormones, such as the secretion of growth hormone. Zinc has also been shown to increase insulin-like growth factor, which fosters the genesis of neural stem cells, and it has strong antioxidant properties that support immune function (Choi et al., 2020). In addition, zinc accelerates the production of cells that provide nonspecific immunity protection, such as neutrophils and natural killer cells (Choi et al., 2020).

Iodine is a vital mineral micronutrient that stimulates the production of thyroid hormones T<sub>3</sub> and T<sub>4</sub>, which are responsible for brain development and control of cellular metabolism. Iodine is critical to fetal development, as it facilitates neuronal multiplication, migration, and organization; brain development; and nerve cell myelinization. This process continues in the first few years of life. The effect of iodine on the brain continues throughout childhood and adulthood, fostering the ability to learn and the desire and motivation to improve performance (Khattak et al., 2017).

Vitamin B<sub>6</sub> is known to reduce levels of homocysteine (an amino acid that can increase inflammation); it stimulates the biosynthesis of certain neurotransmitters such as GABA, dopamine, and serotonin; and it is required for normal development of the CNS during the perinatal period (Smith & Refsum, 2021). Ensuring that the body sustains adequate blood levels of vitamins B<sub>6</sub> and B<sub>12</sub> has been shown to reduce feelings of stress and depression, improve concentration and memory, and prevent stroke events (Berkins et al., 2021; Smith & Refsum, 2021).

Iron is another essential mineral micronutrient. It facilitates oxygen transportation, DNA synthesis, mitochondrial respiration, myelin production, and the development and metabolism of various neurotransmitters. Iron is received in the brain mainly bound to transferrin on endothelial cells. It crosses the blood–brain barrier and is then released into the extracellular compartments in the brain (Ward et al., 2014).

Magnesium is a dietary micromineral with many roles in the body. A strong body of evidence supports its role in supporting optimal nerve transmission and neuromuscular coordination (Kirkland et al., 2018). Moreover, magnesium has a protective effect against the development of chronic pain, migraine headaches, depression, anxiety, and stroke (Kirkland et al., 2018).

Selenium is a micronutrient that plays an important role as an antioxidant, protecting cells from damage. It is involved in the production of immunoglobins that aid in cellular immunity, as it has anti-inflammatory effects (Farag et al., 2021). During pregnancy, selenium is crucial to mitigate the stress associated with a growing fetus, and selenium deficiency is associated with low birth weight because of restricted intrauterine growth. Clients who are

obese before becoming pregnant may have low levels of selenium during the first trimester of pregnancy. The risk of hypertension during pregnancy is increased in clients with selenium deficiency.

Although micronutrients are required in smaller amounts than the macronutrients are, they are essential for most metabolic, biochemical, and regulatory responses of the nervous system (Reddy et al., 2018). See [Table 5.2](#).

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
Vitamin B <sub>1</sub> (thiamine)	<ul style="list-style-type: none"> <li>Myelin sheath maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Indirect assay of the transketolase enzyme (0–15%)</li> </ul>	<ul style="list-style-type: none"> <li>Symptoms include loss of sensation in the hands, feet, and toes, combined with burning pain, paresthesia, or muscle weakness.</li> <li>Deficiencies may occur in individuals with chronic alcohol use disorder, Wernicke's encephalopathy, or Korsakoff's syndrome.</li> </ul>	<ul style="list-style-type: none"> <li>10 mg/day for 7 days, then 3–5 mg/day for 6 weeks for mild deficiency</li> <li>50–100 mg/day may be provided in severe deficiency among adults until proper nutrition is delivered naturally.</li> <li>Neurologic improvement in deficient individuals may not be evident for 3–6 months.</li> </ul>
Vitamin B <sub>3</sub> (niacin)	<ul style="list-style-type: none"> <li>Carbohydrate metabolism</li> </ul>	<ul style="list-style-type: none"> <li>No reliable measure of serum B<sub>3</sub></li> </ul>	<ul style="list-style-type: none"> <li>Deficiency causes neuropsychiatric symptoms such as an apathetic, inattentive, ill-tempered, or depressed affect; left untreated, coma or stupor can result.</li> <li>Pellagra is a B<sub>3</sub> deficiency that causes dermatitis, dementia, and diarrhea.</li> </ul>	<ul style="list-style-type: none"> <li>14–16 mg/day</li> </ul>

**TABLE 5.2** Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
Vitamin B <sub>6</sub> (pyridoxine)	<ul style="list-style-type: none"> <li>Converts pyridoxine into pyridoxal phosphate, a cofactor in numerous metabolic reactions</li> </ul>	<ul style="list-style-type: none"> <li>3.4–65.2 mcg/L or 13.76–263.81 nmol/L</li> </ul>	<ul style="list-style-type: none"> <li>Deficiencies are seen with some medications (isoniazid, phenelzine, hydralazine, and penicillamine) and in pregnancy, chronic alcohol use disorder, and clients undergoing hemodialysis.</li> <li>Deficiencies can present as numbness, weakness, loss of sensation, paresthesia, or foot, hand or leg pain. An ataxic gait and loss of or decreased reflexes may be present. Deficiencies in infants may manifest as seizures.</li> <li>Toxicity can occur with excessive supplementation (<math>\geq 100</math> mg/day). Symptoms of toxicity include ataxic gait, loss of reflexes, loss of sensation, and tingling or burning sensations.</li> </ul>	<ul style="list-style-type: none"> <li>1.3–2 mg (maximum) daily</li> </ul>

**TABLE 5.2** Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
Vitamin B <sub>12</sub> (cobalamin)	<ul style="list-style-type: none"> <li>Formation of methionine</li> <li>Formation of the myelin sheath</li> </ul>	<ul style="list-style-type: none"> <li>Serum level: &gt; 200–250 pg/mL</li> </ul>	<ul style="list-style-type: none"> <li>Deficiencies can manifest as neuropathies (especially sensory problems in the feet), changes in affect and behavior, or peripheral and optic neuropathy.</li> <li>Deficiencies may be seen in individuals with malabsorption issues, pernicious anemia, gastrointestinal surgeries, or past weight-reduction surgery. Supplementation is recommended for individuals eating vegan diets.</li> <li>Metformin and proton pump inhibitors can worsen a deficiency.</li> </ul>	<ul style="list-style-type: none"> <li>8–12 mcg/day</li> <li>Adults older than 50 years may need to supplement dietary consumption if deficient.</li> <li>If deficient: 1000 mcg orally daily</li> <li>In severe deficiency, injections may be recommended.</li> </ul>
Vitamin E	<ul style="list-style-type: none"> <li>Protein transport via very low-density lipoproteins; stored in adipose tissue</li> </ul>	<ul style="list-style-type: none"> <li>Serum level: not routinely assessed</li> </ul>	<ul style="list-style-type: none"> <li>Some people with rare lysosomal storage disorders will experience a slowly progressing (5–10 years) degeneration of sensation, deep tendon reflexes, reduced proprioception, and ataxia.</li> </ul>	<ul style="list-style-type: none"> <li>15 mg/day</li> <li>Deficiency: 400 units twice a day, with a gradual dose increase until serum vitamin E level is as expected.</li> </ul>

**TABLE 5.2** Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
Copper	<ul style="list-style-type: none"> <li>Balances hormones that make nerve cells</li> </ul>	<ul style="list-style-type: none"> <li>Serum level: not routinely assessed</li> </ul>	<ul style="list-style-type: none"> <li>Deficiencies can manifest as neuropathies (upper and lower motor neuron signs).</li> <li>Excessive intake can cause headaches, diarrhea, and kidney failure and can prevent copper from accumulating. Chelation therapy (as with the drugs Cupramine, Depen, and Syprine) binds copper into a compound that can effectively be eliminated.</li> <li>Wilson's disease, a rare genetic disorder, prevents the elimination of copper. Copper excess is detected via blood tests and 24-hour urine collection.</li> </ul>	<ul style="list-style-type: none"> <li>900 mcg/day</li> <li>Deficiency: Intravenous doses of 2–4 mg/day</li> </ul>

**TABLE 5.2** Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
Iodine	<ul style="list-style-type: none"> <li>Synthesis of thyroid hormones T3 and T4</li> <li>Fetal and infant development, childhood cognitive function</li> </ul>	<p>Urinary concentrations:</p> <ul style="list-style-type: none"> <li>Adults and children: 100–199 mcg/L</li> <li>During pregnancy: 150–249 mcg/L</li> <li>During lactation: &gt; 100 mcg/L</li> </ul>	<ul style="list-style-type: none"> <li>A deficiency of iodine is a global concern, as it is the leading cause of intellectual deficits in the world. Thyroid deficiencies can result from a deficiency of iodine because it is required to produce thyroid hormones. Goiter and elevations of thyroid-stimulating hormone (TSH) may be signs of deficit.</li> <li>Deficiency during pregnancy and infancy can cause irreversible effects.</li> <li>Excessive intake can cause goiter in adults, TSH elevation, thyroiditis, and thyroid papillary cancer.</li> <li>Iodine supplementation can interact with certain medications: <ul style="list-style-type: none"> <li>Concurrent use with antithyroid medications can cause hypothyroidism.</li> <li>Concurrent use with angiotensin-converting enzyme (ACE) inhibitors and</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>150 mcg/day for persons ages 14 years and older</li> <li>Infants receive adequate iodine from formula, breast milk and food intake and do not require supplementation.</li> <li>Acute poisoning is rare.</li> </ul>

**TABLE 5.2** Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
			potassium-sparing diuretics increases the risk for hyperkalemia.	
Magnesium	<ul style="list-style-type: none"> <li>Controls oxidative stress and inflammation</li> <li>Supports adequate blood flow</li> <li>Essential role in nerve transmission and neuromuscular conduction</li> </ul>	<ul style="list-style-type: none"> <li>Serum level: 0.75–0.95 mmol/L</li> </ul>	<ul style="list-style-type: none"> <li>Deficiencies are rare but may be due to certain health conditions, medications, or chronic alcohol use disorder.</li> <li>Early signs of deficiency may include anorexia, nausea and vomiting, fatigue, weakness, numbness, tingling, muscle contractions, cramps, seizures, personality changes, abnormal heart rhythms, and coronary spasm.</li> <li>Severe deficiency may cause hypocalcemia or hypokalemia.</li> <li>Medication interactions: bisphosphonates, antibiotics, diuretics, and proton pump inhibitors.</li> </ul>	<ul style="list-style-type: none"> <li>Adult females: 310–320 for adult females (higher amounts for pregnant/lactating females)</li> <li>Adult males: 400–420</li> <li>Abundant in the diet: spinach, nuts, seeds, whole grains, lean meats, poultry, eggs, seafood, beans, peas, lentils, other legumes, soy</li> </ul>

TABLE 5.2 Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
Selenium	<ul style="list-style-type: none"> <li>Essential role in reproduction, thyroid hormone metabolism, and DNA synthesis</li> <li>Protection from oxidative damage and infection</li> </ul>	<ul style="list-style-type: none"> <li>Serum level: Plasma or serum selenium concentrations of 8 mcg/dL</li> </ul>	<ul style="list-style-type: none"> <li>Serum concentrations drop with aging and are related to a decline in brain function, possibly due to decreases in selenium's antioxidant activity.</li> <li>Excessive intake can cause hair and nail loss or brittleness, nausea, diarrhea, skin rashes, mottled teeth, fatigue, irritability, and CNS abnormalities.</li> </ul>	<ul style="list-style-type: none"> <li>55–70 mcg/day for persons 14 years and older including pregnant and lactating clients</li> <li>Supplementation: 100 mcg</li> <li>Food sources: Brazil nuts, seafood, organ meats, muscle meats, cereals and other grains, dairy products</li> </ul>

**TABLE 5.2** Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Micronutrient	Expected Effect on Neurologic System	Defined Level	Significance of Abnormal Values	Recommended Daily Allowance and Treatment Dosages
Zinc	<ul style="list-style-type: none"> <li>Cellular metabolism, enhances immune function, protein and DNA synthesis, wound healing, and cell signaling and division</li> <li>Can reduce the duration of the common cold</li> <li>Can delay age-related macular degeneration</li> </ul>	<ul style="list-style-type: none"> <li>80–120 mcg/dL</li> </ul>	<ul style="list-style-type: none"> <li>Deficiency interrupts the senses of taste and smell. In older adults, deficiency can cause delays in wound healing and changes in cognitive and psychological function.</li> <li>Excessive intake can cause nausea, dizziness, headaches, gastric distress, vomiting, and loss of appetite.</li> <li>Doses of 50 mg or more from supplements or excessive use of denture adhesive creams containing zinc can interfere with copper absorption, reduce immune function, and lower high-density lipoprotein cholesterol levels.</li> <li>High doses from supplements (142 mg/day) interfere with magnesium absorption.</li> </ul>	<ul style="list-style-type: none"> <li>8–12 mg/day</li> <li>Food sources: meat, fish, and seafood (oysters contain the most zinc of all foods); other foods such as eggs, dairy, beans, nuts, and whole grains contain zinc but are not fully metabolized.</li> </ul>

**TABLE 5.2** Micronutrients and Neurologic Function (source: National Institutes of Health, 2023a–j)

Given that nearly 60% of brain tissue is composed of fat and that the omega-3 and omega-6 fatty acids account for 20% of the overall brain weight, it is important to understand the role of fats in brain function at all stages of human life. These fatty acids promote cognition, preservation of neurons, and protection against neurodegeneration. This is because omega-3 fatty acids facilitate production of oxyhemoglobin and hemoglobin in the blood, which improve cerebral circulation and subsequently improve overall mental performance (Dighriri et al., 2022).

Another micronutrient group is the polyphenols, which are metabolites of plants. They are potent antioxidants and have long been shown to reduce cardiovascular risk by providing antiplatelet and anti-inflammatory functions. In addition, they may offer some protection from neurodegenerative diseases; recent evidence supports the theory that cognitive decline may be prevented and Alzheimer's disease may be slowed by the consistent intake of polyphenols (D'Angelo, 2020; Luo et al., 2021). Most plant-based foods contain polyphenols, which can be found in vegetables, fruits, legumes, olive oil, and nuts. Some of the richest sources are colored berries, nuts (especially

walnuts, almonds, and hazelnuts), seeds, vegetables, black and green tea, and certain spices. A polyphenol that has received considerable attention over the past decade is curcumin, the root of the turmeric plant (used in many Indian dishes, such as curry), which has shown a dramatic protective effect on the neurologic system. Red wine and dark chocolate have also been shown to contain polyphenols and may be consumed in moderation (Fekete et al., 2023). See [Figure 5.4](#).



**FIGURE 5.4** Polyphenols, which can be found in foods like almonds and pepitas (pumpkin seeds), may help prevent cognitive decline. (credit: "This image is in a set called the 'Daily Picture Parade'" by Dennis Sylvester Hurd/Flickr, Public Domain)

#### Omega-3 Fatty Acids, Protein, and Cholesterol

Various nutrients are critical for ensuring brain health and cerebral blood flow; among the most important are protein, omega-3 fatty acids, and cholesterol. The impact of these nutritional requirements on the neurologic system begins during the prenatal period and extends throughout the lifespan. Omega-3 fatty acids are found in fish, seafood, nuts, seeds, seaweed, spinach, broccoli, and avocados and other colorful fruits and vegetables, as well as in fortified cereals and beverages. They are vital for brain function and can counteract some of the deterioration that can result from brain or spinal cord injury. Recommendations for intake of omega-3 fatty acids range from 0.5 g/day for infants to 1.1–1.6 g/day for persons 51 years of age and older.

Protein is a combination of linked amino acids and is the building block of skeletal muscle. In the neurologic system, protein is required for the adequate function of mitochondria within the nerve cells. Protein deficiency results in leakage of the cell membranes, creating electrolyte disturbances, and has been shown to contribute to neurodegenerative diseases such as stroke, Alzheimer's disease, and Parkinson's disease. The current recommendation for adult protein intake is 1.2–1.5 g/kg/day. In the presence of severe illness or injury, more protein intake may be recommended. However, with specific regard to cognition, there are no absolute recommendations for protein intake (Glenn et al., 2019). As mentioned earlier, protein levels in the body are measured by albumin. **Prealbumin** is the precursor to albumin in the liver and is used by the body to produce other proteins as well. With a half-life of 2–4 days, prealbumin is a highly sensitive indicator of nutritional status. Higher serum levels of albumin have been associated with improved cognitive function in individuals with Parkinson's disease (Sun et al., 2022). However, stress and inflammation can reduce prealbumin levels and lead to poor outcomes following various neurologic events such as TBI, especially in the presence of an active infection.

The brain maintains the highest level of cholesterol in the body, requiring approximately 20% of the body's total cholesterol, but the cholesterol level in the brain is independent of cholesterol levels in the peripheral tissues. Cholesterol is a key building block for the creation of myelin. It is found in the astrocytes and other glia cells and is taken up by the neurons as a critical building block to produce hormones (Li et al., 2022). Dietary intake of foods rich

in omega-3 fatty acids raise the high-density lipoprotein levels above 40 mg/dL and has been shown to be helpful in preventing dementia, fatigue, “brain fog,” memory loss, depression, and other cognitive problems (Li et al., 2022). Because of the independence of cholesterol metabolism in the brain, measurement of the cholesterol level specifically inside the brain could be an important marker of neurologic health (Jin et al., 2019; Li et al., 2022). For optimal brain health, the current general recommendation is to maintain a total cholesterol level of 160–200 mg/dL (Lee & Siddiqui, 2023).

### Assessment of Cerebral Perfusion and Nutrition

Cerebral blood flow is a measured volume of blood flowing per unit of mass over time through the vertebral arteries and internal carotid arteries and is measured as an indirect marker of neuronal function. Although the brain requires a continuous supply of nutrients, it does not have the ability to store them. Therefore, evaluating how well the brain is perfused is an important way to determine brain health. Cerebral perfusion is measured with positron emission tomography (PET) technology to determine the adequacy of blood flow (Chugani, 2021).

### Analysis of Nutrition and the Neurologic System

**Neuroplasticity**, or “the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections” (Mateos-Aparicio & Rodríguez-Moreno, 2019), refers to the brain’s ability to adapt to threats such as brain injury following traumatic or atraumatic injuries and to repair itself. This has led to an increase in studies to explore dietary modifications in neurologic conditions, with a focus on whole foods or food-derivative supplements in the diet.

Although various diet trends—such as paleo, keto, gluten-free, low-carbohydrate, low-cholesterol, pescatarian, low-fat, and vegan diets—have shown benefits in reducing the development of neurologic conditions, these options are discussed less than 12% of the time with health care professionals (Bhat et al., 2019; Roser et al., 2022). Also, because obesity is not considered a disease, many insurance plans do not cover charges for obesity medications or counseling for clients with a BMI of 30 or greater (Dowis & Banga, 2021; Roser et al., 2022).

The adequacy and frequency of dietary nutrition can also affect the blood supply to the brain. For example, the sensation of hunger has been shown to increase cerebral blood flow (CBF) in the hypothalamus, thalamus, amygdala, cerebellum, and other key areas of the brain (Wierenga et al., 2017). Conversely, food intake produces a decrease in CBF in the thalamus, insula, temporal cortex, and cerebellum, but eating causes an increased CBF in the prefrontal cortex, the area that signals satiety of hunger (Wierenga et al., 2017). Some foods have been shown to increase cerebral blood flow in this region, as well as athletic performance, such as beets, red spinach, tart cherries, pomegranate, citrus fruits, walnuts, berries, cinnamon, leafy green vegetables, and other nitrate-rich vegetables (Morris et al., 2018).

Deficiencies of certain fats or toxic levels of some nutrients have been shown to have negative effects on brain health, and dietary intake of trans fats—found in foods such as margarine, fried foods, and commercially prepared cakes, pies, and cookies—has been shown to lead to hypertension and, ultimately, to negatively affect brain health (Harlyjoy et al., 2019).

### Nutritional Deficits of Protein, Albumin, and Prealbumin

Malnutrition results from an inadequacy of certain macronutrients and micronutrients and can delay neurologic rehabilitation, leading to increased morbidity and mortality. The deleterious effect of malnutrition is inflammation, which is a precursor to many diseases and conditions. Therefore, an important consideration in the nutritional assessment of neurologic clients is the etiology of any inflammatory process due to any acute or chronic diseases.

An assessment of nutritional status of the neurologic system often includes anthropometric measurements, a nutritional risk assessment, and biomarkers. Specific indicators of malnutrition, such as changes in weight, food intake, loss of body fat or muscle, accumulation of body water, and strength are assessed. Malnutrition is likely if any of these indicators is present. Although no specific nutritional screening tool has been recommended for clients with neurologic disorders, several screening tools that have been successfully used for older clients are suggested for use in persons with neurodegenerative conditions such as dementia, stroke, and Parkinson’s disease (Lee, 2022). Among these tools, the Mini Nutritional Assessment-Short Form (MNA-SF) and the Controlling Nutritional Status (CONUT) tool have been used to assess nutrition in clients with neurologic conditions (Power et al., 2018).

It is estimated that up to 60% of individuals who experience stroke show evidence of malnutrition (Yuan et al.,

2021), which contributes to challenges in rehabilitation and readmissions, as well as to overall morbidity and mortality risk. Among clients with neurologic conditions, movement disorders, dysphagia, gastroparesis, cognitive impairment, and depression can all contribute to malnutrition because of decreased oral intake despite an increase in the body's metabolic needs. Following a stroke or other neurologic event, **dysphagia** (swallowing difficulty) is common and often results in a delay in resuming nutritional support as the client's ability to protect their airway during feedings is evaluated. In some cases, enteral feedings are provided via a nasogastric tube or an implanted gastric tube 48–72 hours after the stroke. However, metabolic needs are often accelerated during this period, and early identification of malnutrition can result in improved outcomes (Joundi et al., 2019).

The role of protein in the body is critical in the evaluation of neurologic disorders. The most abundant plasma protein in the body is albumin, which has various antioxidant, anti-inflammatory, and neuroprotective effects. Specifically, albumin has been shown to suppress amyloid formation. **Amyloids** are proteins that tend to accumulate as tangles and clusters and are associated with a number of conditions, including Alzheimer's disease. As previously discussed, traditional laboratory markers of malnutrition include the measurement of visceral proteins, namely prealbumin. Prealbumin is protein in the plasma and cerebrospinal fluid that is mainly manufactured in the liver. Prealbumin is considered a transport protein because it carries thyroid hormone and retinol to the liver. It is the precursor of albumin, a transport protein found in the serum, which helps remove small molecules such as bilirubin, calcium, and progesterone in the blood and has a half-life of 20–22 days. Decreased prealbumin levels are linked to protein-calorie malnutrition. Decreased prealbumin levels are often discovered in association with infections and gastrointestinal hemorrhage. Low serum albumin levels in individuals experiencing TBI and other neurologic conditions have been shown to be indicators of poor long-term outcomes, especially among older adults (Liu et al., 2021).

### **Abnormal Findings Related to Nutrition**

The deleterious effects of poor dietary patterns on human cognition continue to plague humans. Neurodegenerative conditions are causing health care costs to soar; for instance, 6.5 million Americans are living with Alzheimer's disease, and the prevalence is expected to double over the next 30 years (Borshchev et al., 2019). Cognitive deterioration is a concern in many diseases and conditions, and nutrition options, combined with exercise, have been explored as noninvasive strategies to reduce the consequences of neuronal damage. Modifiable risk factors account for 40% of risk factors for Alzheimer's disease, and diet has been shown to be one of the predominant factors in the development of cognitive decline (Borshchev et al., 2019). Avoidance of some foods, specifically those rich in saturated fats and sugar (often referred to as junk foods), is recommended because they have been shown to contribute to cognitive decline (Borshchev et al., 2019). Other nutritional factors, such as the number of calories consumed per meal and the frequency of food consumption, have been shown to affect cognitive health.

Metabolic syndrome presents a major risk factor for neurologic compromise and is defined as the presence of obesity, dyslipidemia, arterial hypertension, and diabetes. A person is considered obese if their BMI is greater than 30. Dyslipidemia is diagnosed if the total cholesterol level is greater than 200 mg/dL. A total cholesterol level between 200 and 239 is considered borderline high, and a level greater than 240 mg/dL is considered high (CDC, 2022). Arterial hypertension (blood pressure greater than 130/80 mm Hg) has been shown to cause abnormal shifts in **cerebral autoregulation**, which is the ability of the cerebral vessels to maintain stable blood flow to the brain despite changes in arterial blood pressure (Borshchev, 2019). These shifting patterns seen in persons with metabolic syndrome lead to hypoperfusion and reduced blood flow in the brain and can damage the brain's white matter (Borshchev, 2019). Although metabolic syndrome is well established as a precursor for diabetes and various cardiovascular ischemic conditions, poor diet combined with obesity has also been associated with cognitive impairment and increased risk for dementia as the individual ages.

Recent evidence has shown that even without metabolic dysfunction, adiposity alone has been shown to potentially accelerate a decline in thought processes, such as attention, intelligence, memory, cognitive flexibility, processing speed, and executive function (Farruggia & Small, 2019; Leigh et al., 2020). Adiposity may also result in reduced brain volume and reduced white matter connectivity, especially in the temporal lobe structures (Leigh et al., 2020). High intake of red meat, processed meat, and fried food and low intake of whole grains have been associated with a reduced level of function in the temporal and frontal lobes, such as memory and executive functions (Leigh et al., 2020). The traditional high-fat Western diet can trigger the advent of Alzheimer's disease and vascular dementia by triggering inflammation, the development of cerebral vascular atherosclerotic lesions, and a dismantling of the

blood–brain barrier (Borshchev et al., 2019; Więckowska-Gacek et al., 2021).

When abnormal **cerebral blood flow** (the volume of blood that moves through the blood vessels in the brain over a given unit of time) is seen on PET scanning, this can signal overactive or underactive metabolism and can indicate seizure activity, or it can be a marker of ischemic brain injury or degenerative conditions. Food supplementation with polyphenols and omega-3 fatty acids in concert with a supervised nutrition program has been shown to improve cerebral perfusion (Roberts et al., 2020).

Dietary patterns and stress can affect the immune system. As a result, the body may initiate an autoimmune process in which the body perceives normal cells as foreign and attempts to rid the body of a perceived invading substance. In the neurologic system, myelin-producing cells can become affected by this autoimmune process. Myelin can be damaged when the body's immune cells perceive myelin as a foreign substance and kill the cells that make myelin. The most well-known condition in which myelin is destroyed is multiple sclerosis. Other conditions in which myelin is attacked are optic neuritis and transverse myelitis. Myelin is attacked in the PNS of individuals with Guillain-Barré syndrome, Charcot–Marie–Tooth disorder type 1 or type X, or copper or vitamin B<sub>12</sub> deficiency, as well as individuals with infectious processes, excessive alcohol consumption, or intake of certain drugs.

A diet high in saturated fat and sugar is known to produce changes in the gut microbiome, triggering inflammatory processes that alter the immune system, and can lead to cognitive impairment (Leigh et al., 2020). These alterations in the microbiome increase the permeability of the gut and lead to formation of bacterial amyloids (abnormal proteins) and tangles of **tau proteins**. Tau proteins normally stabilize the tubelike internal skeleton of nerve cells, but when the inflammatory process ignites in the gut, the tau proteins instead become tangled due to phosphorylation in the gut. This phosphorylation then blocks the neuronal transport system and damages vital communication between the neurons, eventually resulting in cell death (Więckowska-Gacek et al., 2021). The most typical neuropathologic changes in the brains of persons with Alzheimer's disease are these amyloid and tau protein tangles.



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

The nurse completes a nutritional assessment of Jamal Powell. The client's past medical history is positive for hypertension, high cholesterol, and obesity.

Vital Signs		Laboratory Values
Temperature:	98.5°F (36.94°C)	Jamal had blood work drawn the week prior to this visit:
Blood pressure:	148/90 mm Hg	<ul style="list-style-type: none"> <li>• Total cholesterol: 240 mg/dL</li> <li>• Low-density lipoprotein (LDL): 160 mg/dL</li> <li>• High-density lipoprotein (HDL): 30 mg/dL</li> <li>• Triglycerides: 250 mg/dL</li> </ul>
Heart rate:	97 beats/min	
Respiratory rate:	14 breaths/min	
Oxygen saturation:	97% on room air	
Height:	5'9"	
Weight:	230 lb (104.33 kg)	
BMI:	34 (Class 1 obesity)	

TABLE 5.3

1. The nurse is evaluating Jamal's nutritional intake and symptoms. Which aspect of the client's dietary intake could be associated with these cognitive changes?
  - a. Increased vegetable intake
  - b. Increased whole grain intake
  - c. Increased dairy product intake

- d. Increased intake of processed foods
2. When assessing the nutritional impact on cognitive function, what should the nurse anticipate the health care provider to prescribe to evaluate the client further?
- a. Spiral computed tomography
  - b. Positron emission tomography
  - c. Computed tomography of the head with contrast
  - d. Cerebral angiography
- 

## Alterations in Micronutrients and Neurologic Health

Deficiencies in micronutrients can contribute to neurologic deterioration. For example, deficiencies in ferrous sulfate and zinc have been associated with ineffective sleep and neurobehavioral problems in young adolescents (Ji et al., 2021). Zinc deficiencies have also been associated with epilepsy, seizures, and deficiency of growth hormone.

Alterations in other micronutrient levels can result in specific neurologic changes. For example, although magnesium serves to promote optimal nerve transmission, low magnesium levels can lead to the death of neurons and contribute to the development of psychiatric problems and other conditions, including depression, anxiety, chronic pain, epilepsy, Alzheimer’s disease, Parkinson’s disease, and stroke.

Selenium improves immunity because of its antioxidant properties, and low levels are associated with tumors, skin conditions, and cardiovascular, neuropsychiatric, and age-related diseases. Iodine deficiency can lead to hypothyroidism, goiter, and mental developmental delays. An iron deficiency can result in worsening heart failure symptoms because iron is key to erythropoietin production. A deficit of iron often results in fatigue and activity intolerance. Copper is essential for maintaining the health of neurons, and an imbalance is associated with neurodegeneration and a variety of neurologic disorders.

Toxic exposure to various substances can also lead to neurologic decline. In someone with a TBI, excessive zinc accumulation can present in the postsynaptic neurons, and this can result in brain damage due to the death of neurons. Therefore, modulation of zinc accumulation may be an important aspect of TBI treatment (Choi et al., 2020).

Heavy metals are minerals with a high molecular weight and are natural elements found in the earth. Due to the nature of these molecules, they cannot be destroyed or degraded. Some of these minerals (including mercury, cadmium, arsenic, chromium, thallium, and lead) can enter the air and the human food and drinking water supply. Heavy metals can accumulate in the body, causing deleterious neurologic effects over time (Choi et al., 2020). The long-term effects of this accumulation can lead to Alzheimer’s disease, Parkinson’s disease, epilepsy, accelerated cognitive decline, and behavioral problems. Mercury exposure can result from eating fish or shellfish that is contaminated or from breathing air contaminated by toxic chemical spills, coal plants, industrial incinerators that burn materials containing mercury, or natural sources such as volcanic eruptions. Exposure to toxic levels of mercury can result in mood swings, tremors, headaches, motor dysfunction, and insomnia.

Cadmium is another heavy metal that may stay in the body for years, although it is eventually excreted. Cadmium may be ingested by inhaling smoke from the burning of industrial metals, but cigarette smoke is also a main source of cadmium inhalation and is the most harmful method of ingestion. Cadmium may also be found in coffee, tea, and crop fertilizers. Neurologic effects of cadmium toxicity include the loss of smell, but a more significant effect is anemia, which can contribute to cerebral hypoperfusion.

Aluminum can be harmful to the neurologic system because it accumulates in the body and can contribute to cognitive impairment and memory loss. Aluminum can be found in food emulsifiers, antiperspirant deodorants, hair spray, baking powder, toothpaste, and drinking water, as well as on cookware surfaces. Moreover, fluoride in drinking water can make aluminum more bioavailable (Russ et al., 2020).

## 5.2 Plan Nutritional Strategies to Impact Neurologic Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 5.2.1 Prioritize hypotheses of nutritional habits that optimize neurologic wellness.
- 5.2.2 Generate solutions to optimize neurologic wellness using nutritional habits.

### Planning Nutritional Goals

For individuals with neurologic conditions, management of blood glucose, sodium, and protein is critical to promote healing and cognitive performance. The brain requires a consistent supply of nutrients to function optimally, and any deficiencies can affect the brain negatively as well as other parts of the neurologic system and cause illness. Illness can also occur when these nutrients are at levels that are too high, so maintaining a healthy balance is important for preventing neurologic illness.

#### Blood Glucose

Control of blood glucose is a key aspect of brain health. High blood glucose levels are associated with accelerated cognitive decline compared with individuals who maintain normal blood glucose levels, independent of a diagnosis of diabetes. High blood glucose is more common among individuals with excessive body fat because fat releases hormones, proteins, and cytokines that ignite inflammation in the body, worsening brain function. Refined sugars are highly processed, often derived from white sugar, brown sugar, coconut sugar, palm sugar, or high-fructose corn syrup, and most Americans consume about 163 g (652 calories) of refined sugars each day. Refined sugars contained in candies, baked goods, pastries, white bread, crackers, pasta, and white rice contain no nutrients and can dramatically raise blood glucose. Therefore, foods containing processed sugar and other processed ingredients should be limited or eliminated from the diet to ensure optimal long-term cognitive performance.

The dietary recommendations for neurologic health largely mirror those of the American Heart Association for heart health. A normal blood glucose level after a period of fasting is generally between 70–100 mg/dL. An elevated level (100–125 mg/dL) can indicate prediabetes, with higher levels (greater than 125 mg/dL) signaling a possible diagnosis of diabetes. Blood glucose trends over a period of 2–3 months can be evaluated using the hemoglobin A1c (HbA1c) test. The normal range for HbA1c is less than 6%, and 6.0–6.4% is considered prediabetes. A person is considered to have diabetes if the HbA1c is 6.5% or greater.

A ketogenic diet has been shown to be beneficial for people with epilepsy (Kossoff, 2017). A ketogenic diet contains a high percentage of fat and few carbohydrates and has been successfully used in children with seizures that are intractable with medications alone. In this diet, ketones are formed as the body uses fat for energy rather than carbohydrates. Although there are many theories regarding why this type of diet is beneficial for individuals with seizures, the high levels of ketones in conjunction with antiseizure medications appear to increase the seizure threshold, resulting in fewer seizures (Kossoff, 2017).

Complex carbohydrates contain more nutrients than simple refined sugars do. They are found in brown rice, oats, quinoa, farro, barley, fruits, and vegetables, and they also contain more fiber, which slows the rise in blood glucose. However, in the absence of a diabetes diagnosis, small doses of natural sugars (honey, maple syrup, or stevia) are generally well tolerated and do not have a significant effect on brain function. Artificial sugars (such as aspartame, saccharin, and sucralose) are not recommended for brain health because they affect the gut microbiome, leading to insulin resistance and diabetes, and subsequently have been shown to contribute to decline in cognitive function (Pase et al., 2017).

#### Sodium

Disruptions in sodium balance are a concern for clients with neurologic conditions, especially when they are critically ill. The balance of water in the body is monitored by the osmoreceptors in the hypothalamus, as well as by baroreceptors in the right atrium, great veins, and carotid sinus. The total water volume in the body is controlled by regulation of sodium by the kidneys. Any change in sodium and water balance can dramatically affect the cells of the brain. Sodium levels may be disrupted due to various conditions such as renal dysfunction, cirrhosis, lung disease, certain cancers, congestive heart failure, diarrhea, vomiting, blood loss, or excessive sweating or can be the result of diuretic medications. Neurospecific conditions, such as subarachnoid hemorrhage, TBI, meningitis, encephalitis, and brain tumors, can disrupt sodium balance and result in **hyponatremia**, a serum sodium level less than 135

mEq/L, which can cause various neurologic symptoms. Such disruptions are sometimes caused by failure in the brain to release antidiuretic hormone (ADH), as is the case in central diabetes insipidus, or by urinary sodium loss without water loss, as is the case in **syndrome of inappropriate antidiuretic hormone secretion (SIADH)**. SIADH is caused by an unsuppressed release of ADH from the pituitary gland or other nonpituitary sources that signals the body to retain fluid (Yasir & Mechanic, 2023). Therefore, nurses should evaluate the sodium and water balance of all clients with neurologic conditions as a routine part of the nutritional assessment.

### Omega-3 Fatty Acids

**Omega-3 fatty acids** are specific unsaturated fatty acids that are often referred to as “good fats” because they have a significant positive impact on brain function. However, many Americans consume a disproportionate quantity of omega-6 fatty acids, found in corn and vegetable oils in processed foods. Although not routinely tested for, the omega-3 index is a measure of the percentage of certain fatty acids in the red blood cell membranes: eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The omega-3 index is an assessment of the percentage of total fatty acids in the body and is a marker that identifies cardiovascular and cerebrovascular risk for death (Swanson et al., 2012). An omega-3 index of less than 4% indicates a high risk for death, whereas a level greater than 8% represents a low risk for stroke or other cardioembolic events in the future (Swanson et al., 2012; von Schacky, 2020). Fatty fish, such as salmon, mackerel, and sardines, and wild meat, such as venison, buffalo, and other hunted game animals, contain omega-3 fatty acids. They are abundant in many plant sources as well, such as nuts, seeds (chia, pumpkin, sunflower), and flaxseed, olive, and canola oils.

### Dietary Percentages of Carbohydrates, Fats, and Protein

The macronutrients (carbohydrates, fat, and protein) are the building blocks for optimal neurologic health. The recommended dietary allowance for carbohydrates is approximately 45–65% of a person’s daily calories, whereas protein should account for 10–35% of daily caloric intake, and fats should make up the remaining 20–35% of daily food intake (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020).

For optimal brain health, current recommendations include daily intake of fresh vegetables, leafy green vegetables, berries, fish and other seafood, healthy fats (virgin olive oil, whole eggs, avocados), as well as nuts and seeds. Other foods that are recommended in moderate amounts are beans; legumes; whole fruits (in addition to berries); low-sugar, low-fat dairy products (plain yogurt and cottage cheese); poultry; and whole grains.

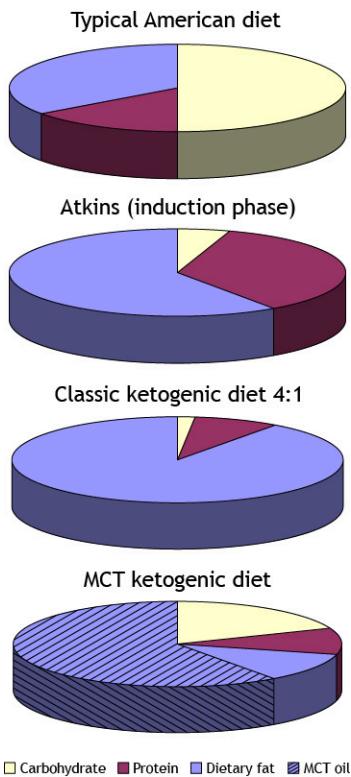
To prevent cognitive decline, fried foods, pastries, sugary and processed foods, red meats and meat products, and whole-fat dairy products (such as butter and full-fat cheese) should be limited or eliminated from the diet. Although margarine was once touted as a healthy alternative to butter because it contains no cholesterol, it may contain saturated fats, which have been shown to contribute to a decline in brain health. In one publication from the Nurses’ Health Study, replacing margarine or butter with the same quantity of olive oil resulted in a 5–7% lower risk for cardiovascular and coronary heart disease, both of which are risk factors for stroke (Guasch-Ferré et al., 2020).

The **Mediterranean diet** is well established to prevent or reduce cardiovascular- and age-related cognitive decline (Leight & Morris, 2020). It is low in saturated fat and plentiful in olive oil, legumes, broccoli, squash, whole grain cereals, fruits, vegetables, and fish. It includes moderate consumption of dairy products and wine and low consumption of nonfish meat products. The Mediterranean diet is recommended for neurologic health more than any other diet strategy and is particularly recommended for neurologic conditions, including multiple sclerosis, Alzheimer’s disease, and Parkinson’s disease (Leight & Morris, 2020).

An emphasis on fresh whole foods can also provide an effective path toward steady weight loss, as healthy eating habits are formed over time. Because the plan focuses on choosing fruits, vegetables, legumes, and snacks such as low-fat popcorn over potato chips, calorie-rich desserts, and other less healthy foods, and on choosing water over sugary drinks, this diet generally reduces the caloric intake.

The foods included in the Mediterranean diet are largely plant based and include healthy fats. Because the foods are filling, overall caloric intake generally decreases, although portion size remains a consideration if weight loss is desired. The fiber in the foods results in a diversity of gut bacteria, which is beneficial because a healthy gut microbiome has been shown to positively impact nutrient metabolism and energy expenditure. In some people, especially those with irritable bowel syndrome, bowel discomfort may result from the high fiber content in this diet. It is important to monitor potassium levels of clients with comorbid kidney disease because the Mediterranean diet is often rich in potassium.

For reasons still unknown, maintaining low glucose levels can help reduce the number of seizures in people with epilepsy. A ketogenic diet is sometimes recommended for these clients because it consists primarily of high-fat and high-protein foods and includes few carbohydrates. This causes a breakdown of fats, rather than glucose, for energy, which mimics a fasting state and has been shown to decrease seizure episodes. The ketogenic diet is commonly recommended for children with epilepsy and some adults. The diet is rich in butter, mayonnaise, and heavy cream; it includes small portions of fruit, cheese, and bacon, and other meats, fish, and poultry are allowed ([Figure 5.5](#)).



**FIGURE 5.5** The macronutrients in the typical American diet compared with those in the Atkins diet, a classic ketogenic diet, and a therapeutic medium-chain triacylglycerides (MCT) ketogenic diet. The therapeutic ketogenic diet is typically prescribed for clients with epilepsy. (credit: “A series of pie charts depicting the calorific contributions from carbohydrate, protein and fat in four diets” by Colin, vectorized by Fvasconcellos (talk contribs)/Wikimedia Commons, Public Domain)



## SAFETY ALERT

### Sugar and the Ketogenic Diet

Because even small amounts of sugar can reverse the effects of the ketogenic diet and lead to a seizure, sugar is prohibited on this diet. When on this diet, clients must be aware of the potential addition of sugar or sugar substitutes in some medications and supplements, such as gummy vitamins.

A modified Atkins diet is sometimes recommended for clients with epilepsy instead of a ketogenic diet. As with the ketogenic diet, the Atkins diet contains foods that are high in fat (bacon, eggs, beef, mayonnaise, butter, heavy cream, oil). Although some carbohydrates are allowed, the total amount of carbohydrates allowed is low (20–25 g/day).

### Daily Eating Patterns

Many Americans do not follow a healthy diet, and studies show that adherence to healthy eating guidelines occurs only about 50–60% of the time across the lifespan (Wambogo et al., 2022). The appropriate amount of food to consume each day is based on a person’s age, sex, height, weight, and physical activity level. A calculator is available on the MyPlate website to assist in determining the appropriate number of calories that should be consumed to maintain normal weight, based on activity level. One successful strategy to reduce overall caloric intake among persons desiring to shed pounds is to use smaller plates.

## Identifying Challenges to Nutritional Goals

To maintain a brain-healthy diet, planning is required. Generally, the healthiest meals are those prepared at home because they allow for control of portions and ingredients. In addition, using a cooking style that does not require additional fat is preferred (e.g., slow cooking or sautéing is preferred over deep-frying foods). The process involved in frying food generates chemicals that may create inflammation in the gut and facilitate limited cognitive function. Unfortunately, many commercially made fast foods incorporate highly processed, high-calorie foods with artificial ingredients and fried foods that are not in concert with brain health. The wide availability and low cost of these foods can make it challenging to change eating habits. Supplements of fish oil have come under recent scrutiny, as some studies show that these supplements may increase the risk for bleeding, diarrhea, and acid reflux and provide no significant protective effect against cardiovascular disease or stroke (Manson et al., 2019).

### The Difference Between Food and Supplements

Although many supplements are available over the counter, they are not meant to replace a healthy diet. Both the macronutrients and micronutrients that are found in food are easier for the body to absorb than supplements. Moreover, the variety of nutrients available in fresh foods has been shown to provide a higher nutritional value than consuming an unhealthy diet and taking supplements.

### The Difference Between Thirst and Hunger

There is a strong link between hydration status and cognitive ability and mood. Water is the body's principal component, making up 50–70% of total body weight (Tobias et al., 2022). The amount of daily water intake that the body requires varies by age, body size, activity level, and environmental temperature. It is recommended that most adults drink 6–8 8-oz glasses of water daily. The body loses water through urination, breathing, and sweating. However, as a person ages, the ability to distinguish thirst from hunger diminishes. Because of this, dehydration among older adults is a common problem. In many cases, by the time a person perceives thirst, moderate dehydration has already occurred, and cognitive abilities may be slowed. Moderate dehydration has been shown to cause headaches and can have a deleterious impact on mood, short-term memory, attention, focus, and numeric and psychomotor function.

Because many older adults are chronically dehydrated, moderate intake of coffee and tea, in addition to hydration from other liquids, can reduce cognitive decline and dementia because of the antioxidant effect of caffeine. However, caffeine intake should be limited because it can impact sleep, especially if consumed late in the day. Water is the best liquid to maintain hydration, and caffeinated liquids such as coffee and tea have a mild diuretic effect. Although caffeine increases diuresis, the amount of fluid in the drink is thought to balance this diuretic effect. Many people rely on drinking coffee or tea containing caffeine to increase alertness, as well as cognitive and athletic performance. According to the U.S. Food and Drug Administration (FDA), adults should consume no more than 400 mg of caffeine per day, and no intake of caffeine is recommended for children. Very high daily doses of caffeine (750 mg) have been linked to serious health conditions such as chest pain, irregular heartbeat, and stroke, as well as problems with sleep, loose stools, and gastrointestinal upset. The long-term effect of caffeine intake is not well understood.

Alcohol is not a source of hydration but can have both positive and negative impact on brain function; however, deleterious effects on brain function are more commonly reported for individuals consuming excessive amounts of alcohol (Grant et al., 2017). Moderation in alcohol intake may be the key to optimal brain health. Current recommendations cite safe alcohol use as only 1 drink/day for men and women. The type of alcohol intake may also be considered. Red wine contains polyphenols, micronutrients that can positively impact blood pressure, and 1 glass/day may reduce stroke risk (Grant et al., 2017).

## 5.3 Implement Nutritional Strategies to Impact Neurologic Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 5.3.1 Assess the client for readiness to learn.
- 5.3.2 Teach nutritional strategies to optimize neurologic wellness.

## Holistic Nursing Assessment of the Client

When the nurse is considering changes to a client's diet to facilitate adequate functioning of the neurologic system, it is critical to evaluate how these changes will be affected by the client's lifestyle and relevant socioeconomic factors. The nurse must also consider the client's culture, beliefs, attitudes, daily eating patterns, and health conditions that may impact their approach to eating.

### Daily Pattern of Food Intake and Sleep

The time of day that meals are taken can improve neurologic health. For example, recent studies suggest that narrowing the window of time during which food is consumed during the day may positively impact cognitive function (Gudden et al., 2021). Intermittent fasting, defined as either eating only between certain hours of the day (e.g., between 11 a.m. and 5 p.m.) or consuming few calories on certain days and eating normally on other days, has been shown to improve neurologic health among persons with Parkinson's disease, ischemic stroke, mood and anxiety disorders, and epilepsy (Gudden et al., 2021). Maintaining regular hours for meals and sleep has also been associated with positive cognitive performance, and avoiding food intake in the hours before bedtime has been shown to improve cognitive performance and sleep quality (Gudden et al., 2021).

### Challenges in Healthy Nutrition

For many Americans, the availability and cost of healthy foods are major concerns. Soaring prices of weekly groceries are concerning, and many Americans rely on food banks or other forms of public assistance to feed their families than ever before. In addition, food preferences and dietary patterns are often influenced by cultural norms, beliefs, family traditions, and long-term habits; therefore, changing one's dietary intake is often challenging. Dietary preferences are very personal for many people, so making changes may be fraught with high levels of resistance. It is thus important for the nurse to ensure that changes in a client's diet are feasible and in synergy with the client and their family.

### Client Teaching

Given the complexities of dietary habits, it is critical to first understand the client and family's health state (cognitive state and motivation, swallowing difficulties, mobility concerns), dietary history, allergies, or sensitivities to certain foods, as well as food availability and financial concerns when planning a dietary lifestyle. Client teaching should be part of an interprofessional plan of care involving the nurse, a registered dietitian, and the health care provider. The health care team will be best able to create dietary adaptations that will meet specific criteria that will allow the client to adhere to the plan of care.

### Recommended Diet Plans for Comorbid Conditions

For many clients, comorbid conditions can complicate the ability to manifest a comprehensive diet plan. For example, although the Mediterranean diet and ample fluid intake may improve cognitive status, for clients in heart or kidney failure, specific modifications will be required to consider the effect of excess fluid or the correct percentage of protein intake.



## UNFOLDING CASE STUDY

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### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Jamal Powell has a normal PET scan result and is advised to follow up with the clinic regularly. The client is referred to a dietician but misses 6 separate appointments over 2 years.

Jamal is visiting the clinic today for a routine follow-up 2 years after the initial clinic visit. During this time, Jamal's memory has progressively worsened. Jamal believes these deficits have not been obvious to friends.

The client describes a recent problem of forgetting where they put things and confusing things in their memory. However, the client's relationship to time, as well as their skills in math and literacy, have not changed. Jamal is independent with regard to basic activities of daily living, but complex tasks are becoming more challenging.

The client states that they have started to feel less confident about driving over the past few months. Jamal appears to be irritable and becomes distressed when discussing the symptoms and recent events they have been dealing with. The client discusses their fears and frustrations surrounding these changes and feels they are becoming depressed about the situation.

The nurse discusses Jamal's diet and activity and plans to work with the client to improve their nutritional state. Jamal's diet is high in saturated fats and low in fresh vegetables and fruits. The client's spouse mentions that they read that polyphenols are good for brain health and asks which foods would be best to include in their diets.

Jamal also asks why everyone keeps saying that sugar in the diet is bad, stating that they have enjoyed sweets their whole life. This is apparent with the recent HbA1c test result, which is 6.3%. (The expected range for nondiabetic clients, such as Jamal, is less than 5.7%).

The nurse explains that the combination of Jamal's high BMI of 40, HbA1c of 6.3%, total cholesterol level of 250 mg/dL, and diagnosis of chronic hypertension (today's blood pressure was 156/98 mm Hg) classifies them as having a condition called metabolic syndrome. The nurse sets up another appointment with the dietitian to help Jamal correct the nutritional issues identified. Because the dietitian's earliest appointment is 2 months away, the nurse teaches Jamal and their spouse about some basic nutritional changes they can make before the next appointment.

3. How much omega-3 fatty acid content should the nurse instruct Jamal to include in his diet each day?
  - a. 1.1–1.6 g
  - b. 3.5–6.6 g
  - c. 0.1–0.16 g
  - d. 11–16 g
  
4. The nurse is teaching Jamal and their spouse how to choose foods high in omega-3 fatty acids. Which food choices would indicate understanding by the client?
  - a. Dairy and eggs
  - b. Fatty fish and oils
  - c. Colorful fruits and vegetables
  - d. Peanut butter and almond butter

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## 5.4 Evaluate Nutritional Strategies to Impact Neurologic Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 5.4.1 Evaluate a nutritional plan for its effect on neurologic wellness.
- 5.4.2 Modify a nutritional plan to promote neurologic wellness.

### Evaluating the Client's Adherence to the Nutritional Plan

Changing nutritional intake can be extremely challenging for clients because it often involves factors such as culture, habits, and preferences that are formed over time. To ensure optimal health, the nurse should evaluate the effectiveness of the plan. The nurse should not only review subjective data provided by the client but also incorporate it with objective data to gain the entire picture. Data such as laboratory test results, weight loss or gain, and vital signs can aid in evaluating the effectiveness of the plan and the client's adherence to it.



### UNFOLDING CASE STUDY

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#### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Jamal and their spouse attended the appointment with the dietitian. Jamal is now back in the clinic 6 months after the last visit. The nurse is evaluating the client's adherence to the new nutritional plan (meal plan) that was formulated with Jamal, their spouse, and the dietitian 3 months previously. The client has gained 10 lb (4.54 kg)

over this time.

Vital Signs		Laboratory Values
Temperature:	98.6°F (37.0°C)	Jamal had blood work drawn the previous week:
Blood pressure:	187/86 mm Hg	<ul style="list-style-type: none"> <li>• Total cholesterol: 254 mg/dL</li> <li>• LDL cholesterol: 170 mg/dL</li> <li>• HDL cholesterol: 30 mg/dL</li> <li>• Triglycerides: 270 mg/dL</li> </ul>
Heart rate:	99 beats/min	
Respiratory rate:	14 breaths/min	
Oxygen saturation:	97% on room air	

TABLE 5.4

Jamal's spouse assisted the client in completing a 3-day diet history, which revealed an absence of fruits and vegetables, a high intake of foods containing processed sugar, and a minimal amount of fiber. Even though the client did not have an issue in any other prior visits, Jamal had become more depressed and started to drink alcohol. The client's alcohol intake for the 3-day diet history was approximately a 6-pack of beer daily and a couple of bottles of wine over the 3 days.

As a follow-up study, the health care provider ordered an amyloid PET scan. The results revealed tau proteins consistent with early Alzheimer's disease.

To optimize all aspects of possible treatments for this diagnosis, the health care provider recommends a Mediterranean diet and a weight loss regimen and prescribes donepezil 5 mg once by mouth daily at bedtime. The nurse provides Jamal and their spouse educational materials about the medication, the Mediterranean diet, and MyPlate recommendations. The nurse also advises the client to engage in a moderate exercise routine by walking for 30 minutes at least 3 times a week.

5. Based on the assessment findings, which of the following clinical findings indicates compliance with the prescribed nutritional plan?
  - a. Alcohol intake of 3 glasses wine per day
  - b. Total cholesterol level remains 240
  - c. Dietitian appointment scheduled
  - d. Body mass index > 35
  
6. The client's spouse asks the nurse to explain a little more about tau proteins and why they are an issue. What should the nurse say?
  - a. "Jamal has too many tau proteins in his brain."
  - b. "Tau proteins are genetic mutations that are causing dysfunction."
  - c. "The tau proteins are tangled and accumulate in the brain, causing dysfunction."
  - d. "There is no relationship between the tau proteins and Jamal's symptoms."

## Evaluating the Effectiveness of the Nutritional Plan

When evaluating the effectiveness of a nutritional plan (meal plan), there are several considerations to evaluate once the client is shown as being adherent. The ability to change dietary habits is gradual, and as such, subsequent appointments with the health care provider, nurse, and dietitian will help the client continue adjusting strategies to improve their health and change any negative habits. Setting goals for weight loss and for blood pressure and HbA1c reduction as needed can provide later evidence as to the effectiveness of the nutritional plan. Discussing these changes with the client and any appropriate family members will help ignite diet changes that can be permanently employed and can help improve blood flow in the brain, which will slow cognitive decline.

### Nutritional History

When obtaining a neurologic nutritional history, the nurse should evaluate specific considerations such as availability, budget, cultural aspects of nutrition, and specific dietary practices. The nurse needs to identify which resources are available to the client in terms of food availability and any limitations in food preparation practices, as well as identify any food intolerances or preferences. A 3-day diet history is helpful to determine the adequacy of the client's current diet. The nurse should also determine any recent weight gain or loss, as well as the client's

typical bowel and urinary elimination patterns and any history of problems in the intestinal tract.

### Physical Assessment

During the physical assessment of nutritional status, the nurse should identify the client's hydration status and any aspects of overnutrition or undernutrition. Skin tone and color should be evaluated, the mucosal membranes should be assessed for hydration status, and the client should be weighed. An oral examination will identify any loose teeth, oral pain, swallowing difficulty, or any other barriers to food intake. The nurse should assess the abdomen for any pain, auscultate for bowel sounds, and complete a focused assessment based on information gleaned during the history.



## UNFOLDING CASE STUDY

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### Part D

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A, B, and C.

Jamal returns for a follow-up appointment 2 months later so the nutritional plan can be evaluated and changed if necessary. The check-in revealed a weight loss of 4 lb over the previous 2 months. Jamal states that they like and are following the currently prescribed diet because it is easier than eating separate meals. However, Jamal and their spouse still have some questions regarding food preparation and meal planning. Jamal has been very adherent but is having a hard time giving up fried foods.

Jamal's spouse reveals that the expense of groceries has risen recently, and they were trying to adjust their monthly budget to accommodate this change. The client states that they have even decreased their alcohol intake to 1 glass of red wine a day, not only for health reasons but also due to increases in grocery prices.

The nurse discusses the situation more with the client and their spouse to get all the data in order to best help them. The nurse discovers that the client retired and is living on retirement income and Social Security. The client's spouse has not worked in 10 years and receives disability and Social Security checks each month as income.

The client has stopped driving because they felt it was unsafe, and the couple continues to live at home. Jamal's neurologist has ordered additional diagnostic exams to further evaluate the Alzheimer's diagnosis, as well as cognitive tests to evaluate the client's safety.

7. When evaluating ways to help improve Jamal's nutritional intake based on the information obtained, what is the best suggestion to cost-effectively improve the nutritional plan?
    - a. Buy more fresh fruits and vegetables.
    - b. Use an air fryer to cook foods without breading.
    - c. Eat more microwaved meals to make meal preparation easier.
    - d. Increase the number of daily servings of fruit juice.
  
  8. The nurse educates Jamal about abstaining from alcohol and suggests a few other nutritional modifications. Based on the client's case, what studies or tests should the nurse expect the health care provider to prescribe to investigate other potential changes needed in treatment?
    - a. Magnetic resonance imaging of the head
    - b. PET scan
    - c. Computed tomography scan of the head with contrast
    - d. Cerebral angiogram
-

## Chapter Summary

- The nurse plays a critical role across the spectrum of care by assessing clients' dietary habits to improve neurologic health.
- The brain is composed of 60% fat, and the remaining 40% is made up of water, carbohydrates, protein, and various salts.
- The brain is responsible for all essential activities of the body but cannot store energy.
- The traditional Western diet can promote gut inflammation, which can lead to cognitive decline.
- Adequate hydration is a key element of neurologic health.

## Key Terms

- afferent** transmits impulses from peripheral organs to the central nervous system
- albumin** a common protein in plasma that carries hormones and helps maintain the integrity of the blood vessels.
- amyloids** proteins that tend to accumulate in clusters that are insoluble; amyloid proteins are associated with a number of conditions, including Alzheimer's disease
- autonomic nervous system** regulates involuntary body processes such as blood pressure, heart rate, respiration, digestion, and sexual arousal
- axons** the long slender projections of neurons that efficiently and rapidly conduct electrical impulses across nerve cells
- cerebral autoregulation** the inherent ability of blood vessels in the cerebrum to maintain homeostatic cerebral blood flow despite a wide range of changes in mean arterial pressure
- cerebral blood flow** the volume of blood that moves through the vessels in the brain
- cerebral cortex** the protective outer layer of the cerebrum
- dysphagia** difficulty swallowing
- efferent** carrying outward or away; in reference to the nervous system, transmitting impulses from the central nervous system outward to peripheral organs to initiate an active response or action
- hyponatremia** a serum sodium level less than 135 mEq/L
- Mediterranean diet** a diet low in saturated fat and rich in other nutrients, commonly consumed Greece and Southern Italy
- myelin** the fatty protein membrane that provides a protective coating for nerve cells
- neuromuscular junctions** locations at the terminal

- Micronutrients are essential for adequate neurotransmission.
- Diet modifications can support brain health in individuals of all ages.
- Metabolic syndrome can lead to cognitive decline.
- Diet modifications can slow the decline of some neurodegenerative conditions, including Parkinson's disease, Alzheimer's disease, and multiple sclerosis.
- Long-term effective diet modifications cannot be made in a single health care encounter.

end of motor nerves, where action potential impulses are conducted to various muscles

**neuroplasticity** the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections

**neurotransmitters** chemicals within the body that allow neurons to communicate with each other to enable the brain to execute a wide range of functions through the process of chemical synaptic transmission

**omega-3 fatty acids** a group of polyunsaturated fatty acids that the human body requires but does not synthesize

**parasympathetic nervous system** the part of the nervous system that relaxes the body after stress and danger and facilitates the body's "rest-and-digest" response

**polyphenols** micronutrients that have health-promoting properties and are present in many fruits and vegetables

**prealbumin** a protein synthesized by the liver that transports various thyroid hormones in the blood

**soma** the body of a neuron

**somatic nervous system** facilitates movement and muscle control in the body

**sympathetic nervous system** a division of the autonomic nervous system that is responsible for the body's "fight or flight" response

**syndrome of inappropriate antidiuretic hormone release (SIADH)** an unsuppressed release of antidiuretic hormone from the pituitary gland or other nonpituitary sources that signals the body to retain fluid

**tau proteins** present in nerve cells, proteins that stabilize microtubules

## Review Questions

1. The nurse is caring for a client who had a stroke 2 days ago and is experiencing continued dysphagia. Which of the following nutritional therapies will likely be prescribed?
  - a. Nothing by mouth until the dysphagia subsides
  - b. Supplements given via a nasogastric tube
  - c. Initiation of total parenteral nutrition
  - d. Initiation of a soft diet
2. A client admitted with traumatic brain injury develops syndrome of inappropriate antidiuretic hormone (SIADH). The nurse should prioritize which intervention to improve the client's nutritional status?
  - a. Infuse intravenous fluids rapidly.
  - b. Perform a dysphagia screen.
  - c. Restrict fluids.
  - d. Check the client's blood glucose level.
3. The nurse is caring for a client who is in the early stage of Alzheimer's disease. The client and family inquire about meal choices. Which food choice would be most appropriate for the nurse to discuss with the client?
  - a. Colored berries
  - b. Fried fish
  - c. Margarine
  - d. Zero-calorie sweeteners
4. A client with multiple sclerosis asks the nurse about the best foods to fight fatigue and enhance nerve cell conduction. Which food choices would be appropriate for this client?
  - a. Nuts, seeds, and salmon
  - b. Cheese, milk, and margarine
  - c. Lean red meats, potatoes, and white bread
  - d. Eggs, lamb, and zero-calorie beverages
5. A child is diagnosed with epilepsy and is being seen for intractable seizures. Which diet(s) would the interprofessional team potentially recommend?
  - a. Mediterranean diet
  - b. Ketogenic diet
  - c. DASH diet
  - d. Vegan diet
6. A 67-year-old woman presents to the urgent care center with a headache and dizziness following a 5-mile running event for charity. Which of the following findings would be most concerning?
  - a. Seizure history
  - b. Limited fluid intake
  - c. History of kidney stones
  - d. Recent vaccination for influenza
7. A client asks the nurse about taking supplements for improving memory. Which would be the nurse's best response?
  - a. "You should start taking fish oil immediately to improve blood flow to your brain."
  - b. "You should start taking a potassium supplement because this will help with nerve conduction."
  - c. "You should start taking zinc because this will help regenerate myelin to help your nervous system."
  - d. "You should review the content of your current diet with the nutritionist."
8. A client with Parkinson's disease asks the nurse about possible benefits of intermittent fasting. Which reply would be appropriate?

- a. "There is no clear evidence of a benefit of intermittent fasting with your condition."
  - b. "Although evidence supports a benefit in people with epilepsy, there is no clear evidence of a benefit with Parkinson disorder."
  - c. "Yes, there is. Let's talk with your health care provider to see if this is right for you."
  - d. "You will need to discuss this issue with your health care provider."
- 9.** What is the recommendation for daily omega-3 fatty acid intake for a 52-year-old adult?
- a. 0.5–1 mg
  - b. 1.1–1.6 mcg
  - c. 1.1–1.6 g
  - d. The daily recommendation is not yet established.
- 10.** Nutrition can impact the development of neurofibrillary tangles that are found in individuals with Alzheimer's disease. Which of the following provides structural strength to microtubules in the neuron?
- a. Beta-amyloid
  - b. Amyloid precursor protein
  - c. Tau protein
  - d. Microglia

## Suggested Reading

Kahan, S., & Manson, J. E. (2017). Nutrition counseling in clinical practice: How clinicians can do better. *Journal of the American Medical Association*, 318(12):1101–1102. <https://doi.org/10.1001/jama.2017.10434>

Yu, Y., Borshchev, Y., Uspensky, P., & Galagudza, M. (2019). Pathogenetic pathways of cognitive dysfunction and dementia in metabolic syndrome. *Life Sciences*, 237, 116932. <https://doi.org/10.1016/j.lfs.2019.116932>

## CHAPTER 6

# Special Nutritional Considerations for Neurological Health



**FIGURE 6.1** Specific nutrients from healthy food, like green beans with almonds, support neurological health in a variety of special conditions. (credit: modification of work “Yummy Green Beans with almonds” by Colorado State University Extension/Flickr, Public Domain)

### CHAPTER OUTLINE

- 6.1 The Impact of Nutrition on Neurological Wellness Across the Lifespan
  - 6.2 Nutrition and Chronic Neurological Illnesses
  - 6.3 Neurologic Condition Treatments, Medications, and Nutrition
- 

**INTRODUCTION** There are many specific nutritional requirements to consider across a client’s lifespan that affect their neurologic health. This chapter highlights many of the nutritional considerations that promote optimal neurologic function at various ages and developmental stages, as well as important nutritional considerations in special situations, such as pregnancy, or among clients being treated with certain medications or receiving other medical treatments. For clients being treated for a neurological disease or condition, nutritional considerations should be included in the plan of care.

Consider this case: A nurse working at an internal medicine clinic is caring for a client suspected of having dementia. In this chapter, key elements of neurological nutrition across the lifespan will be provided, as well as specific recommendations for clients with neurologic conditions. These key elements will be utilized in the case study to apply evidence-based practice care to the clients presented.

## 6.1 The Impact of Nutrition on Neurological Wellness Across the Lifespan

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 6.1.1 Describe the impact of nutrition on the neurological system during pregnancy.
- 6.1.2 Describe the impact of nutrition on the neurological system during infancy.
- 6.1.3 Describe the impact of nutrition on the neurological system during childhood.
- 6.1.4 Describe the impact of nutrition on the neurological system during adolescence.
- 6.1.5 Describe the impact of nutrition on the neurological system during adulthood.
- 6.1.6 Describe the impact of nutrition on the neurological system during later adulthood.

### Pregnancy

Diet during pregnancy has been shown to have a significant impact on fetal neurodevelopment in a number of ways. Several nutrients and micronutrients have been shown to impact neural tube formation and other aspects of neurological development (Cortés-Albornoz et al., 2021). The developing brain of the fetus consumes more than half of the available nutrition delivered via the placenta, mainly in the form of glucose. The developing fetal brain is vulnerable to insufficient macronutrients and micronutrients, especially in the first stages of pregnancy. Nutrition during pregnancy is of critical importance to both the developing fetus and the mother. This section will discuss the effect of specific nutrients on healthy brain function for both the mother and the developing fetus. Specific vitamins and minerals, such as vitamins A, B<sub>9</sub> (folate), B<sub>12</sub> (cobalamin), D, E, and K, as well as certain minerals, such as copper, iron, creatine, choline, zinc, and iodine, are required to prevent a host of neurological conditions in the fetus. They can also impact rates of maternal preeclampsia and postpartum depression.

[Table 6.1](#) outlines the recommended daily allowances for micronutrients for women and men.

Vitamin	Recommended Daily Allowance (RDA)	Food Sources
Vitamin A	700–900 µg/day	Sweet potato, cantaloupe, carrots, liver, eggs, mango, spinach, pumpkin, butternut squash
Vitamin C (ascorbic acid)	Adult females: 75 mg/day	Citrus fruits, kiwi, broccoli, strawberries, Brussels sprouts, cantaloupe, tomatoes, tomato juice
	Adult males: 90 mg/day	
Vitamin D (calciferol)	600 IU/day	Fish liver oil, salmon, swordfish, tuna, fortified foods, sardines, beef liver
Vitamin E (d-alpha-tocopherol)	15 mg/day	Red bell pepper, pumpkin, beets, collard greens, spinach, sunflower seeds and oil, almonds, peanut butter, peanuts
Vitamin K (phylloquinone)	90–120 mg/day	Canola and soybean oils, leafy green vegetables
Biotin (vitamin B <sub>7</sub> )	30 mcg/day	Eggs, peanut butter, mushrooms, avocados, almonds
Calcium	Adult females: 1000–1200 mg/day	Dairy (cheese, yogurt), winter squash, edamame, sardines, salmon, almonds
	Adult males: 1000–1200 mg/day	
Chromium	10 µg/day	Grape juice, meat, Brazil nuts, whole wheat, mussels, broccoli

**TABLE 6.1** Micronutrient Daily Allowances and Sources for Adult Females and Males (sources: CDC 2020, CDC, 2021; CDC, 2022; NIH, 2021; NIH, 2022a; NIH, 2022b; USDA, 2019)

Vitamin	Recommended Daily Allowance (RDA)	Food Sources
Cobalamin (vitamin B <sub>12</sub> )	2.4 mg/day	Dairy products, eggs, poultry, fish, meat, fortified cereals, nutritional yeast
Copper	0.9 mg/day	Organ meats, shellfish, fish, nuts, seeds, whole grains, chocolate
Folate (vitamin B <sub>9</sub> )	400 µg/day	Fresh fruits, whole grain, peanuts, beans, dark green leafy vegetables
Fluoride	3 mg/day	Brewed tea, coffee, fluoridated water, shellfish, potatoes, oatmeal, raisins
Iodine	220 µg/day	Fish, dairy (milk, yogurt, cheese), iodized salt
Iron	18–8 mg/day	Nuts, dried fruit, whole grain pasta, bread, legumes, tofu, oats, various meat sources
Magnesium	Adult females: 310–320 mg/day  Adult males: 400–420 mg/day	Whole grains, dark green leafy vegetables, dried beans, legumes
Niacin (vitamin B <sub>3</sub> )	14–16 mg/day	Red meat, poultry, bananas, legumes, nuts, seeds, brown rice, fortified cereals, breads
Phosphorus	700 mg/day	Dairy (milk, cheese, yogurt), fish, eggs, nuts legumes, vegetables, grains
Pyridoxine (vitamin B <sub>6</sub> )	1.3 mg/day	Salmon, avocado, chickpeas, dairy, milk, sunflower seeds, spinach, beef, bananas
Riboflavin (vitamin B <sub>2</sub> )	1.1–1.3 mg/day	Salmon, chicken breast, organ meats, lean beef, eggs, cheese, yogurt, dairy, milk
Thiamin (vitamin B <sub>1</sub> )	Adult females: 1.1 mg/day  Adult males: 1.2 mg/day	Salmon, eggs, pork, fish, liver, sunflower seeds, beans, nutritional yeast
Selenium	55 mg/day	Brazil nuts, bananas, eggs
Zinc	8–11 mg/day	Meat, seafood

**TABLE 6.1** Micronutrient Daily Allowances and Sources for Adult Females and Males (sources: CDC 2020, CDC, 2021; CDC, 2022; NIH, 2021; NIH, 2022a; NIH, 2022b; USDA, 2019)

### Nutrition and Fetal Neurologic Development

Undernutrition during pregnancy, especially too little protein (46–71 g of protein per day generally recommended during the first and second trimesters of pregnancy), can result in miscarriage, poor fetal neuronal growth (Murphy et al., 2021; Stean et al., 2023), and improper development of the hypothalamus (Sun, et al., 2020). Altered nutritional states such as maternal obesity, high-fat diet, and undernutrition, as well as caffeine intake (less than 200 mg/day recommended) can have a substantial impact on the developing fetal neurological system and can predispose the child to a variety of disorders not only in the early postpartum period, but also in adulthood. A pregnant person's intake of approximately 650 mg of long-chain polyunsaturated fatty acids is essential for the development of the fetal brain and retina, and an absence of these essential nutrients can lead to pregnancy complications and compromised fetal outcomes (Duttaroy & Basak, 2020; Murphy et al., 2021).

Altered nutritional states among pregnant clients in low- and middle-income countries has been shown to increase the risk for preterm and low-birth weight infants, perinatal infant death, and an increase in both mental and physical developmental problems throughout the lifespan (Chea, et al., 2023). Undernutrition may result in impaired brain growth, visual memory problems, and delayed speech, and possibly a lower IQ in the child (Georgieff, et al., 2018). The health of the male parent can also impact fertility and fetal health. The quality and quantity of sperm produced,

as well as sperm mobility, can be related to the male parent's general health, weight, and volume of alcohol consumed.

### Micronutrients

Several requirements for micronutrients increase during pregnancy, especially iron. The development of gray matter in the brain, as well as the structure of dendrites, motor functioning, language ability, and academic performance, are correlated to adequate iron intake (30–40 mg/day). Iron is available in meats (including organ meats such as heart, liver, kidney, and tongue), poultry, fish, and eggs and generally requires maternal supplementation to reach the recommended daily intake (Georgieff, et al., 2020). Choline, another micronutrient (450 mg/day is recommended), plays an important role in cognitive function, especially neural tube development, intelligence, and sensory gating ability. Choline is available in chicken, beef, eggs, and dairy (Steane, et al., 2023). Zinc (11 mg/day recommended) is associated with appropriate movement, normal heart rate variability, and stability of autonomic nervous system. It is available in red meat, shellfish, poultry, pork, and dairy, as well as in fortified cereal, beans, and nuts. Because zinc is essential to carbohydrate and protein metabolism, a deficiency of zinc can be associated with brain degeneration and a decrease in memory and learning, and can lead to a host of neurological disorders (Choi, et al., 2020).

Vitamin A facilitates the patterning of neurons, the development of axons, and the development of the body's main organs. The pregnant client requires approximately 600 mg/day of vitamin A. Milk and yogurt are rich in vitamin A ([Figure 6.2](#)), which is also found in eggs; oily fish; many orange and yellow fruits and vegetables, such sweet potatoes; and leafy green vegetables, such as spinach (Carazo et al., 2021). Given the abundance of vitamin A in the diet, and storage supply of about 4 months in the tissues, supplementation is generally not recommended, because high doses of vitamin A can cause liver toxicity and increase the risk for birth abnormalities.



**FIGURE 6.2** Yogurt is not only rich in vitamin A, but also is a source of calcium, iodine, phosphorus, and riboflavin. (credit: "Yogurt with Blueberries and Granola" by Alabama Extension; ACES | Margaret Barse & Aimee Lewis/Flickr, Public Domain)

Several B vitamins are critical to the normal development of the fetal neural tube. For example, vitamin B<sub>12</sub> (cobalamin) and vitamin B<sub>9</sub> (folate) support the development of neurons and myelination of the axons, which carry neurologic messages throughout the body. Folate is integral in fetal brain development, especially during periods of rapid growth and development (Li et al., 2019). Requirements for the B vitamins increase by 50% during pregnancy. For pregnant clients, the requirement is approximately 400 mcg/day of B vitamins.

Vitamin D has a role in regulating gene expression and brain development as well as several other functions, such as the regulation of calcium, the development of dopamine, skeletal regulation, and language development (Larqué, 2018). The maternal requirement of vitamin D during pregnancy is approximately 1500–2000 UL and may be

consumed in the diet by eating fatty fish, eggs, beef, and fish liver oil (Chauhan et al., 2023). A deficiency of vitamin D may result in attention deficit hyperactivity disorder and poor language development (Tous, et al., 2020).

Iodine plays an important role in thyroid hormone synthesis and is therefore essential for neurologic development of the fetus. During the first half of pregnancy, a deficiency of thyroid hormone (specifically T4) can disrupt the development of neurons, synapses, and myelin formation. A client with severe iodine deficiency is more likely give birth to a baby with decreased IQ scores or possibly **cretinism** (altered intellectual disability, small stature, and thickening of the facial features). Supplementing a normal diet with 250 mg/day of iodine is recommended for pregnant clients. Clients contemplating pregnancy may be encouraged to begin iodine supplementation prior to conception. Iodine is available in the diet in most sea fish, especially shellfish, and is fortified in many cereals and grains, in addition to iodized salt. Prenatal supplementation with each of these micronutrients (except vitamin A) is generally recommended. The requirements for each of these are met in daily intake of a prenatal vitamin, so additional supplementation is not recommended.

The **phospholipids** (fats that contain phosphorus) in the plasma membrane, called **gangliosides** (lipids that carry sialic acid residues), are essential for fetal brain maturation and can determine normal neural repair and apoptosis, neurotransmitter release, and transmission of signals across cells (Sipione et al., 2023). Severe neurodevelopmental and neurodegenerative problems can result from decreased levels of gangliosides. Clients who carry a rare autosomal recessive gene mutation, such as Tay-Sachs disease (a rare disease that destroys nerve cells in the brain and spinal cord), cannot synthesize gangliosides due to the deficiency of an enzyme (hexosaminidase A). These clients will develop an accumulation of these fatty substances, primarily in the brain and spinal cord. Symptoms include slowed development in the infant, and stiff muscles and seizures may manifest. A similar gene mutation affecting gangliosides can result in spastic paraparesis and intellectual disabilities, due to a deficit of gangliosides in the hippocampus (Okuda, 2019). Egg yolks, meat, and milk are the dietary sources of gangliosides (Okuda, 2019).

While a deficiency of nutrients has been shown to have a negative impact on fetal brain development, a high-fat maternal diet and obesity during pregnancy have been correlated to autism and attention deficit disorder among newborns, behavioral disorders in children, and a propensity for obesity in adulthood (Cortés-Albornoz, et al., 2021). Also, high consumption of sugar during pregnancy, especially fructose, has been associated with altered development of the prefrontal cortex and subsequent autism spectrum disorder (Rivell, et al., 2019). Obesity among pregnant clients has been associated with infants exhibiting altered immunity, higher rates of attention deficit hyperactivity disorder, and autism or intellectual developmental delays than children born to mothers with a normal weight (Sanchez et al., 2018). The nature of the maternal diet has been shown to impact the bacterial colonization in the infant's gut in the early postpartum period, which can impact subsequent neurodevelopment across the lifespan (Al Rubaye, et al., 2020).

As shown in [Applying Clinical Judgment to Promote Nutrition for Neurological Wellness](#), omega-3 fatty acids are required for healthy brain function. A deficiency of these essential brain-building blocks results in brain inflammation and possibly brain injury and stroke. Approximately 1 in every 3,500 full-term infants in the United States will develop an ischemic stroke when expecting mothers do not consume adequate amounts, especially in the first trimester of pregnancy (Dunbar & Kirton, 2018).

Prenatal alcohol intake in any amount has been shown to have a detrimental effect on congenital cognitive impairment, including fetal alcohol spectrum disorder and, if severe, fetal alcohol syndrome (Oei, 2020). Maternal caffeine intake crosses over to the placenta and is associated with altered sleep and movement as well as the ability to learn, because the developing fetus does not possess the enzymes to metabolize caffeine. Maternal caffeine intake of more than 200 mg/day has been associated with shorter stature in early childhood (Gleason et al., 2022).

### Impact on the Client's Health During Pregnancy

The impact of pregnancy on the neurological health of the client is of great concern. Pregnant people's rates of morbidity and mortality have risen dramatically in recent years, especially in non-Hispanic Black and Hispanic individuals (Hoyert, 2023). Hormones change during pregnancy, and particularly the rise in progesterone can affect maternal health. Current nutritional recommendations for neurologic health during pregnancy include a diet rich in fresh fruits and vegetables, whole-grain cereals, milk, and dairy products, as well as meat, fish, and eggs as they are rich in vitamins A, C, and D as well as calcium and phosphorus.

During the antepartum period, many people have an increased interest in eating carbohydrates, and if toothbrushing does not occur as often, dental caries and plaque are more likely. Dental infections and caries have long been associated with the development of a stroke, but dental inflammation has also been associated with premature contractions, placing the fetus at risk for premature birth, low birth weight babies (Alrumayh et al., 2021). While regular oral care during pregnancy (toothbrushing and flossing at least twice a day) require diligence during pregnancy, dental procedures such as extractions and root canals, if required, are performed with caution during pregnancy, and may be delayed until after the first trimester.

Sugars, dried fruits, and chewy candy should be avoided to promote optimal dental health, as this can also impact the neurologic health of the pregnant client. Gingivitis and tooth decay are more likely during pregnancy, and this is thought to be associated with hormonal changes, especially estrogen and progesterone. Those who develop morning sickness with vomiting during pregnancy are more likely to have gingivitis, which can lead to an acidic environment in the mouth and, consequently, tenderness and minor bleeding can occur, making toothbrushing uncomfortable.

High levels of fat in the maternal diet and an inactive lifestyle are associated with high cholesterol and high blood pressure. A significant portion of people who consume a high-fat diet and are inactive during pregnancy develop preeclampsia, placing them at a five-times higher-than-average risk for stroke, not only in the peripartum period, but also in later life (de Havenon et al., 2021). Pregnant clients who develop frequent migraine headaches are more likely to develop preeclampsia during pregnancy (Zambrano & Miller, 2019). Clients who develop an infection such as a urinary tract infection or sepsis during their pregnancy are more likely to be readmitted to the hospital for a stroke after the delivery (Zambrano & Miller, 2019). Approximately 7.4% of maternal deaths are a result of stroke. Stroke is now the second-leading cause of maternal death in Japan among women older than 40 years, and many of these are considered preventable (Zambrano & Miller, 2019). A large percentage of maternal deaths in the United States are associated with inadequate prenatal care and preeclampsia (Elgendi et al., 2021). In addition to preeclampsia and stroke during pregnancy, Bell's palsy can develop during delivery, and a temporary paralysis of one side of the face can last up to 6 months postpartum.

## SPECIAL CONSIDERATIONS

### Risk for Stroke During Pregnancy or Delivery

Black clients with a history of hypertensive disorders of pregnancy (HDOP) are at a 66% higher risk for experiencing a stroke (Sheehy et al., 2023). Their risk for stroke during pregnancy or delivery is doubled due to the possibility of a hypercoagulable state, eclampsia, or preeclampsia (Richardt et al., 2023), and this may be in part related to poor prenatal nutrition.

### The Client Without Neurological Illness

The consequences of chronic conditions may undermine pregnancy or aggravate the maternal condition, and nutritional requirements may exceed the recommendations of a normal pregnancy. Demyelinating polyneuropathies, inflammatory muscle disease, and myasthenia gravis may become more extreme during pregnancy. Although there are no specific nutritional recommendations for these conditions during pregnancy, an interprofessional approach of physicians, scientists, nurses, dieticians, and other specialists are often required to best manage symptoms and to optimize nutritional support.

Although a variety of chronic conditions can impact maternal nutrition in pregnancy and lactation, type 1 diabetes, type 2 diabetes, gestational diabetes, and systemic lupus erythematosus (SLE) can have a profound effect on maternal and fetal health. These conditions are discussed next.

### Type 1 Diabetes, Type 2 Diabetes, and Gestational Diabetes

Recent improvements in the monitoring of blood glucose have dramatically increased a pregnant client's ability to maintain normal blood glucose levels. Glucose is an osmotic diuretic and because of this effect, diabetic clients may be subject to dehydration. Diabetic ketoacidosis is more common in type 1 diabetes than in other types of diabetes. The dietary requirements for a pregnant or lactating client with type 1 diabetes are essentially the same as those for a client without a chronic disease or condition, with a few recommendations. Normal blood sugar should always be maintained. This can be managed using continuous blood glucose monitoring, and an insulin pump for type 1

diabetes may be recommended for type 2 diabetes and gestational diabetes as well. In some cases, metformin may be used for gestational diabetes and type 2 diabetes. The effect of insulin type 1 diabetes and metformin type 2 diabetes are similar in that they both produce normoglycemia and optimize fetal neurologic outcomes. Although metformin crosses the placental barrier, it was shown to be slightly superior in preventing maternal weight gain and hypertension (Newman et al., 2023). Maternal weight gains of 11–18 kg (24.25–39.68 lb) are generally recommended. Diet should consist of 50% unprocessed carbohydrates (no concentrated sweets), 20% protein, and 30% polyunsaturated fats (Newman et al., 2023). Although a short-term drop in blood glucose is generally well tolerated by a developing fetus, long-term hypoglycemia can have devastating effects on fetal brain development.

### **Systemic Lupus Erythematosus (SLE)**

Systemic lupus erythematosus (SLE) is associated with several pregnancy-related complications, especially during delivery. Although diet alone is insufficient to manage SLE, the gut is affected by SLE. A diet that maintains a healthy gut microbiome should include each of the food groups and food from all the colors of the rainbow, such as blueberries, strawberries, corn, oranges, eggplant, broccoli, and tomatoes, to increase phytonutrients. The presence of any allergies must be carefully considered when selecting foods. Antepartum clients are often advised to avoid fatty red meats, refined sugar and flour, fried foods, alcohol, gluten, and processed foods. Bananas are recommended because they are high in magnesium, which helps to protect the fetal brain, promotes normal fetal growth, and helps prevent preeclampsia. Dark green vegetables, such as kale and spinach, are rich in iron and can mitigate the side effect of anemia resulting from some anti-inflammatory medications that may be used for maternal treatment of SLE.

### **Clients with Chronic Neurological Illness**

Clients with neurologic conditions can generally experience a healthy pregnancy. However, research is ongoing to study the impact of multiple sclerosis, migraines, aneurysms, myasthenia gravis, and epilepsy during pregnancy (Xu, 2019). Some medications to treat seizures can be successfully administered during pregnancy. Caution should be employed when considering the effect of medications to treat the neurologic condition of the mother. Headaches can be sign of preeclampsia, so the pregnant client with a history of migraines should be closely monitored. Medications to treat headaches or other neurologic conditions must be carefully planned to avoid those that cross the placental barrier. The risk for stroke is highest in clients with preeclampsia, so blood pressure must be carefully monitored and treated.

Conditions such as Guillain-Barré syndrome can be potentially lethal. This nervous system condition presents with acute ascending weakness and may progress to acute respiratory failure if left untreated with respiratory support. Treatment of Guillain Barré syndrome is the same for pregnant and nonpregnant clients (Leonhard et al., 2019).

In terms of nutritional support, diets that are rich in macronutrients and micronutrients for a client without a neurologic condition are considered safe for the pregnant client with a chronic neurologic condition.

### **Infancy**

The development of the brain and nervous system is the most rapid in the first two years of life. Given the known benefits of breastfeeding over infant formula, nutritional support with human breast milk is critical to neurological development during infancy. Specifically, the development of visual function and other cognitive domains are improved when babies are breastfed throughout infancy (Nieto-Ruiz, 2019). A deficiency of a host of macronutrients and micronutrients, such as protein, carbohydrates, certain fats, iron, zinc, copper, iodine, selenium, vitamin A, choline, folate, and vitamin B<sub>12</sub> (cobalamin), have been shown to be essential in preventing certain neurologic disorders, such as anorexia, irritability, growth retardation, and developmental regression (Nawaz, et al., 2020). Iron deficiency alters myelin formation in infancy as well as the development of the **hippocampus** (brain structure responsible for emotion, memory, and autonomic nervous system) and neurotransmitters. The impact of maternal iron deficiency includes a reduction in memory, motor, and behavioral affect in the infant. A zinc deficiency interferes with both hippocampal and cerebellar development. Polyunsaturated fatty acids also affect membrane function and the development of appropriate synapses.

### **Lactating Clients**

To ensure the adequacy of breast milk for infant nutrition, lactating clients should include protein-rich foods, such as meat, poultry, fish, eggs, dairy, beans, nuts, and seeds, 2–3 times a day (CDC, 2023a). Three servings of vegetables

that include dark greens should also be consumed, as well as 2 servings of fruit. Whole-grain foods such as cereals, breads, pastas, and oatmeal are also recommended. Seafood is recommended if it is low in mercury. A healthy diet should include most of the macronutrients and micronutrients that are required for lactating clients, but a multivitamin and mineral supplement may also be recommended to ensure adequate nutrition for both the mother and infant. Caloric intake should increase by approximately 330–400 calories per day to produce high-quality breast milk (CDC, 2023).

## Childhood

The brain reaches 80% of its adult weight by age 3 (Bethlehem et al., 2022) and is exceptionally sensitive to any nutritional deficiencies. Glucose metabolism in the brain continues to accelerate from birth to 4 years. At age 4 years, glucose metabolism occurs at approximately twice the rate as that of an adult. This accelerated metabolic rate continues until age 9 or 10 years and then begins to slow to the adult level during late adolescence. Because the brain cannot store glucose, a continuous supply of glucose by eating frequent meals is paramount. The effect of overnight fasting can have an adverse effect on children; therefore, breakfast is an extremely important meal to nourish the brain and improve cognitive function.

A breakfast that is rich in low glycemic carbohydrates is known to result in optimal cognitive performance. Different types of breakfast may impact the development and performance of various gray and white matter in the brain (Arora, 2022). The effect of long-chain polyunsaturated fatty acids (LCPUFA) is essential for brain function, especially in the brain's gray matter. Given the rapid brain development, especially in early childhood, it is critical to ensure adequate micronutrients intake, which can be challenging. Deficiencies of micronutrients such as iron, folate, and vitamin B<sub>12</sub> may become evident around age 5–6 years, as deficiencies are associated with poor cognitive performance, especially in the school setting (Arora, 2022).

Micronutrient deficiency may be more apparent among children whose mothers had experienced inflammatory bowel diseases, celiac disease, or ulcerative colitis, as these vitamins are poorly absorbed in the intestines in these conditions. For children who are deficient, dietary supplementation with micronutrients can improve cognitive performance, especially if the breakfast is low in sugar (Arora, 2022).

The prevalence of pediatric obesity climbed to 19.7% between 2017 and 2020 in the U.S. (CDC, 2023b). Some studies suggest that there is a biological link between childhood obesity and lower cognitive function and that this effect is related to insulin resistance. However, these studies are inconclusive, especially when sociodemographic factors are considered. For healthy children, the **Mediterranean diet** is an example of a diet that can provide the essential nutrients required for the development of a healthy neurologic system.

## Adolescence

Multiple studies of the diets of adolescents have shown that there is a direct relationship between diet and brain development (Arora, 2022). Diet is associated with various aspects of mood, anxiety, depression, and other mental health disorders. A disproportionate percentage of teens are known to have an eating disorder (i.e., anorexia nervosa or bulimia), and this has a direct result on neurotransmission within the brain (Aurora, 2022). A poor diet during adolescence can result in structural changes in the brain, causing poor cognitive function, mood changes, and emotional imbalances. These structural changes may become permanent, as the brain is still developing in adolescence, and the processes of neurotransmission in the brain is still evolving during this period. For example, dopamine is a neurotransmitter in the brain that is responsible for pleasure and reward responses, and if the brain interprets a message that a cheeseburger or ice cream is a reward, dopamine is released. This dopamine effect is much more pronounced in an adolescent brain than in an adult, because adolescents have more dopamine receptors than adults. When the adolescent brain is rewarded with poor diet choices, this impact carries over into adulthood.

Healthy food choices, including a moderate intake of low-fat dairy and meats with low levels of refined sugars, promote the development of healthy bacteria, acting as natural probiotics. Bacteria in the stomach influence the production of serotonin and create a lining of the stomach that protects against harmful bacteria, limiting inflammation and improving the absorption of nutrients. Serotonin is produced in the intestine and regulates sleep, appetite, mood, and pain inhibition. The creation of healthy bacteria in the gut is critical, because bacteria activate the pathway between the brain and GI tract.

A poor diet during adolescence creates a disruption in healthy gut bacteria, resulting in an inability to absorb nutrients or produce serotonin. The neurologic impact of a poor diet during adolescence is a reduced attention span, an inability to learn or remember new information, and an inability to regulate one's mood. The typical teenage diet in the U.S. often includes sugary drinks, processed sugars, fried foods, and an imbalance in healthy nutrients. A poor diet in adolescence also contributes to the development of depression, sleep disturbances and mood disorders. It can also contribute to an early development of heart disease, type 2 diabetes, memory disturbances, and brain inflammation (Griebsch et al., 2023; Moscatelli et al., 2023). Some teens have tried to reduce processed sugar intake by switching to sports drinks containing aspartame. However, aspartame contains phenylalanine, which increases brain inflammation and can worsen brain function, increasing the risk for developing Alzheimer's disease and other forms of neurodegeneration (Czarnecka et al., 2021). Conversely, many children and adolescents have moved toward a health-conscious lifestyle that includes vegetarian or vegan diets ([Figure 6.3](#)). Although nutritional needs can generally be met with a plant-based diet, the nutrient requirements of adolescents are higher per kilogram of body weight than adults, and this consideration is important in diet planning. Nutritional deficiencies, especially of omega-3 fatty acids, iron, zinc, and B<sub>12</sub>, are more common among vegetarians and vegans, requiring close monitoring by health care professionals (Rudloff et al., 2019).



**FIGURE 6.3** Poor diet choices can be improved by replacing unhealthy ingredients, such as those found in all-meat pizzas, with healthier plant-based options such as bell peppers or mushrooms. (credit: "Tonight's Pizza" by Alan Levine/Flickr, Public Domain)

## Adulthood

The needs of adults change as aging occurs. While adulthood begins at 18 years, the needs of adults change as a person enters their 30s, 40s, 50s and 60s due to changes in metabolic rate, activity levels, the physical demands by occupation, hormonal changes, and a wide range of other factors. Moreover, nutritional needs may vary based on a person's sex. For example, health and nutrition for females must consider important factors across the lifespan, such as pregnancy, breastfeeding, and menopause. As females age, they are at a higher risk than males of cardiac disease, breast cancer, and osteoporosis.

Specific recommendations for macronutrients to maintain neurologic health can also vary depending on a range of factors, including a person's sex, environment, and other characteristics or circumstances. The degree of physical activity alters protein requirements. Physical body size and weight alter caloric needs. Carbohydrates provide the main source of energy. In general, 130 g/day of carbohydrates are recommended, and these should be consumed from high-fiber whole grains, fruits, vegetables, and legumes, as well as low-fat yogurt and other dairy products. A dietary intake of polyunsaturated fats, which can be found in vegetable oils, nuts, seeds, and fish oil, should comprise around 15% of the adult diet.

While caloric needs are higher in early adulthood, this need often declines as a person ages. Because many adults do not adjust their diet as they age, overconsumption of calories coupled with a decline in physical activity often results in adult-onset obesity, which can be associated with poor cognitive status. Some estimates report that 42.5% of adults in the U.S. are overweight or obese, and it varies by race and ethnicity (Fryar, et al. 2021). Due to the inadequacies of the traditional Western diet, many adults are also nutrient deficient, especially in micronutrients, even if their caloric intake exceeds the body's needs.

### Older Adults

The changing nutritional requirements in older adults are more relevant than ever before. In 2019, estimates show that there were more than 703 million people globally over age 65, and more than 50 million were diagnosed with dementia. By the year 2050, it is projected that 1.5 billion people will be over age 60, and 153 million will be living with dementia (Alzheimer's Disease International, 2023). Nutritional strategies, including the intake of specific macronutrients and micronutrients, such as those rich in B vitamins, long-chain polyunsaturated fatty acids, and flavonoids (foods that have antioxidant properties due to their variable phenolic composition, like fruits and vegetables, tea, wine, and whole grains), have been shown to delay or slow the onset of age-related conditions. Supplementing the diet with micronutrients has been shown to improve cognition in some studies of clients with Alzheimer's disease, but the best health benefits have been verified with a varied multinutrient-rich diet rather than supplements alone (Fei et al., 2022).

The process of aging is associated with a loss of muscle mass. While a variety of food sources are recommended to support brain health, those containing foods rich in iron, folate, calcium, and vitamins A, C, and D, are particularly important for supporting muscle mass as well. Adequate intake of vitamin B<sub>12</sub> among older adults is recommended to maintain the integrity of nerve cells. Foods high in vitamin B<sub>12</sub> include eggs, fortified breakfast cereal, and certain fish, such as tuna. However, the absorption of some vitamins may be reduced due to both age-related and other changes in the gut, as well as the effect of medications like metformin, proton pump inhibitors, vitamin C supplements, colchicine, and medications that are used to treat peptic ulcers and other gastrointestinal problems. The tendency of older adults to become dehydrated can also affect the ability to absorb nutrients, and an increase in water intake as well as fresh fruits and vegetables can help to overcome dehydration. Special nutritional considerations for older adults should include an understanding of maintaining adequate nutrient and fluid intake, the client's sensitivities to certain foods, and any challenges with chewing or swallowing.



### UNFOLDING CASE STUDY

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#### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

A nurse working in an internal medicine clinic is assessing John Everett, a 77-year-old Black male. His daughter accompanies him for this routine exam. The nurse asks about John's appetite and recent food intake. He reports that he eats "ok," but his daughter says that he is not eating very well. The nurse reviews John's record and notes that he has lost 10 lbs since his last visit. John lives alone, and his daughter is concerned he is not eating enough nutritious food.

1. Which of the following age-related findings is associated with older adults?
  - a. Increased appetite
  - b. Decreased muscle mass
  - c. Increased caloric intake
  - d. Decreased hydration requirements
  
2. Which of the following statements by the client indicates that he is at risk for impaired nutrient absorption?
  - a. "I don't drink much water."
  - b. "I eat canned vegetables."
  - c. "I take my blood pressure medicine with food."

- d. “I eat a lot of snacks and small meals.”

## 6.2 Nutrition and Chronic Neurological Illnesses

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 6.2.1 Discuss the impact of nutrition on neurological illness.
- 6.2.2 Discuss the impact of nutrition on psychiatric illness.

### Nutritional Requirement for Optimal Neurological Health

Although the development of neurologic conditions varies in process, there are several common threads in reduced cognition and other neurologic functions. Neurologic chronic conditions are associated with a variety of factors, such as increased **oxidative stress**, neuroinflammation, and a disruption in energy metabolism. Each of these factors can be influenced and modified by dietary intake.

The nurse should screen all clients with neurologic illness for malnutrition in conjunction with the health care team, using the tools described in [Applying Clinical Judgment to Promote Nutrition for Neurological Wellness](#). This screening is especially important because clients with neurological conditions may have difficulty chewing or swallowing. Aphasia, apraxia, depression, or altered cognitive states may further challenge adequate intake. Key nutritional recommendations for preventing neurologic deterioration in neurodegenerative conditions are provided in this section.

The effect of specific diets (such as ketogenic and Mediterranean diet) among clients with neurologic conditions, such as epilepsy, traumatic and atraumatic brain injury, multiple sclerosis, autism, and various neurodegenerative conditions, such as Alzheimer’s disease, Parkinson’s disease, and amyotrophic lateral sclerosis (ALS), have been explored in various clinical trials and are described in this section. While the type of diet is important, it is fundamental that the nurse assess the client’s physical ability to eat. The nurse should assess the client’s current food intake, signs of fatigue, loss of movement, and evidence of dry mouth as these findings can make eating challenging. Meeting the nutritional requirements of clients who have difficulty swallowing (dysphagia) secondary to a stroke or other condition can be particularly challenging because these clients require additional diet modifications so that foods can be consumed safely to decrease the risk for choking or aspiration.

Meeting the nutritional requirements of clients with a stroke can be challenging, given the potential for difficulty swallowing (dysphagia). Although the ideal diet for a client who has had a stroke is generally similar to a cardiac diet (low salt, low fat, high fiber), this may be challenging.

#### Ketogenic Diet

The **ketogenic diet** is high in fat and low in carbohydrates, and has been used to facilitate treatment for clients with drug-resistant epilepsy. The impact of the ketogenic diet, as well as variations like a modified Atkins diet or low glycemic diets is to promote the formation of ketone bodies. The brain uses ketones to generate energy, and this type of diet reduces the magnitude of glycolysis. Although the science is still somewhat unclear, it is thought that this generation of ketone bodies alters the metabolism of certain neurotransmitters and improves mitochondrial function in a fashion that reduces oxidative stress, improves mitochondrial function, and activates certain signaling pathways (Francis & Stevenson; Miller, et al., 2020).

The beneficial impact of ketogenic diets in clients with epilepsy is well known to be a reduction in seizures that have been previously intractable to drug therapy. In addition, the impact of a ketogenic diet in children with epilepsy often includes an improvement in cognitive function and a reduced rate of developmental delays, if initiated very early. However, the impact on cognition may be directly related to the diet or to a brain injury associated with uncontrolled seizures.

The ketogenic diet shows some promise in other conditions as well, such as multiple sclerosis, autism, and Alzheimer’s disease (Li, 2021). In a study of clients with multiple sclerosis, a ketogenic diet may improve concentration, attention, and memory (Francis & Stevenson, 2018). Although limited data exists due to small sample sizes and difficulty with blinding procedures, a ketogenic diet has been shown to improve autistic behavior, but individual food preferences and the gastrointestinal impact of this diet may impact feasibility (Francis &

Stevenson, 2018). The effect of the ketogenic diet is to produce a state of ketosis, and among individuals with Alzheimer's disease, a modest improvement of cognitive function occurs when ketosis is achieved. However, among individuals with Alzheimer's disease, cognitive improvement was observed only when clients engaged in a ketogenic diet achieved ketosis, even among those with severe Alzheimer's disease (Tabaie, et al., 2022). Among individuals with ALS, a high-fat diet, such as the ketogenic diet, has been shown to slow disease progression, while a calorie-restricted diet has been shown to reduce survival rates (Jiang et al., 2022).

### Mediterranean Diet

While the Mediterranean diet ([Figure 6.4](#)) has shown effectiveness in preventing heart disease, the antioxidant and anti-inflammatory benefit of this diet can help prevent stroke events and slow cognitive decline in clients with Alzheimer's disease, in part because of the long-chain polyunsaturated fatty acids and olive oil. Moreover, the polyphenols obtained from fresh fruits and vegetables have been shown to mitigate the phosphorylation of tau protein, preventing tangle formation, and to negate beta-amyloid aggregation in the brain. The net effect of reducing oxidative stress and neuroinflammation is to enhance neurogenesis, improve transmission across synapses, and reduce neuronal death (Román et al., 2019).



**FIGURE 6.4** The long-chain polyunsaturated fatty acids and olive oil in the Mediterranean diet may help prevent stroke events and slow cognitive decline in clients with Alzheimer's disease. (credit: "photo of restaurant, dish, meal, food, salad, green, Greek, mediterranean, pepper, produce, vegetable, menu, fresh, healthy, lunch, cuisine, delicious, dairy product, onion, lettuce, cheese, tomato, dinner, oil, diet, olive, brunch, appetizer, sense, feta"/PxHere, Public Domain)

### Alternative Food and Supplement Options

While the ketogenic and Mediterranean diets have shown promise in the prevention and management of neurologic conditions, the metabolism of lipids in the brain are dramatically disrupted when there is an excessive intake of carbohydrates, particularly those found in processed foods such as high-fructose corn syrup and artificial sweeteners. However, complex carbohydrates, such as those found in fresh fruit, vegetables, and high-fiber cereal grains, are recommended for the management of cognitive decline (Román et al., 2019).

### Client Teaching

In general, a diet rich in fruits and vegetables, whole grains, nuts, seeds, fish, meats, eggs, dairy products, healthy fats (olive oil, avocado, coconut, and flaxseed oils), and probiotic-rich foods (yogurt, kimchi, kefir, sauerkraut), as well as fresh herbs and spices are neuroprotective.

For clients with neurologic conditions, preventing further brain inflammation can mitigate or slow degenerative processes. Resveratrol is a polyphenolic compound that is present in grapes, mulberries, tea, seeds, some cereals,

and red wine consumed in moderation. It can protect the body from developing increased levels of triglycerides and cholesterol and can have a positive effect in the early stages of neurodegenerative disorders (Oppedisano et al., 2020).

Ensuring optimal intake or supplementation of vitamins and certain minerals, such as magnesium, can prevent acute episodes of brain fog and fatigue in persons with MS. When supplementing clients with deficiency of vitamins A, B<sub>12</sub>, and D<sub>3</sub>, it is helpful to administer these supplements with magnesium, as they do not compete with one another during for absorption. Reducing carbohydrate intake can also help to mitigate the fatigue of MS. **Coenzyme Q10** (CoQ10) has been shown to have a significant antioxidant effect to produce energy and is well known for the prevention of heart disease, but it also has neuroprotective effects. CoQ10 is not available in foods but is synthesized by the body. In clients who have experienced ataxia because of neurologic conditions, supplementation of CoQ10 has been shown to improve both gait and posture (Oppedisano et al., 2020).

A diet high in antioxidants and fiber can help fight inflammation in clients with MS and will slow further demyelination and prevent constipation. Some sources suggest that a ketogenic diet prevents or slows symptom to manifest in clients with MS (Dynka et al., 2022).



## UNFOLDING CASE STUDY

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### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

During John's visit it becomes apparent that he is experiencing some cognitive decline. The health care provider is recommending further neurological evaluation for possible dementia. The provider is also concerned about the client's weight loss and wants the nurse to work with John to improve his food intake.

3. Which of the following dietary recommendations should the nurse make to John?
    - a. Limit all carbohydrate intake.
    - b. Increase intake of complex carbohydrates.
    - c. Switch to drinking diet beverages with artificial sweeteners.
    - d. Limit fluid intake and focus on solid food intake.
  
  4. John's daughter asks why he can't just take a vitamin to meet his nutritional needs. Which of the following is the best response by the nurse?
    - a. Vitamins and supplements are used as a last resort.
    - b. Vitamins and supplements do not contain adequate amounts of needed nutrients.
    - c. Taking vitamins and supplements may be confusing for the client and difficult to remember to take.
    - d. Research shows that eating a nutrient-rich diet is the best source of micronutrients to support cognition.
- 

## 6.3 Neurologic Condition Treatments, Medications, and Nutrition

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 6.3.1 Identify drug–food interactions for their impact on treatments utilized for neurological disorders.
- 6.3.2 Identify treatments and medications that can cause nutritional deficiencies in clients with neurological disorders.

Specific dietary needs change over the course of a client's lifespan, and certain neurologic conditions may benefit from a diet that contains specific key nutrients that promote health and delay symptoms. **Anticonvulsants** are medications used to prevent or treat epileptic seizures and can also cause nutritional deficiencies ([Table 6.2](#)). Clients who have experienced a stroke or who have Parkinson's disease, myasthenia gravis, or ALS should be screened for dysphagia before offering oral meals and then must be monitored when eating for symptoms of choking, watery eyes, or coughing. While dysphagia symptoms among clients with ALS may present with slowly progressive symptoms that lead to a malnourished state, clients with Parkinson's disease or myasthenia gravis may

develop symptoms suddenly and may quickly develop exacerbations in which oral intake is not possible. The nurse should assess the client, perform a dysphagia screen, and withhold any oral intake until oral intake is safe. The risk for aspiration pneumonia can preclude oral feeding in clients with several neurologic conditions. If these symptoms are present, the nurse should consult with a speech pathologist and dietitian for the best treatment plan. Liquids may need to be thickened if dysphagia is present, and this can lead to dehydration. The nurse should follow fluid intake and urinary output closely to ensure adequate fluid status. In some cases, supplemental nutrition may be required temporarily or permanently via enteral feeding to ensure adequate nutrient and fluid intake.

Medication	Nutritional Considerations
<b>Anticonvulsant/Antiepileptic Medications</b> (Alcohol should be avoided with all antiepileptic medications.)	
• Phenytoin • Barbiturates • Carbamazepine	• Can cause deficiencies in vitamin D and biotin
• Valproic acid (VPA)	• Can decrease L-carnitine, cause hypoglycemia in neonates, reduce zinc in the bloodstream, and cause hair loss • Absorption of VPA diminished with soy • Hepatotoxicity occurs when high-fat diet is consumed
• Gabapentin • Pregabalin • Carbamazepine	• Increase in body weight by increasing appetite
<b>Monoamine Oxidase Inhibitors</b>	
• Phenelzine	• May block vitamin B <sub>12</sub> , cause an increase in body weight and appetite, and reduce activity
<b>Tricyclic Antidepressants</b>	
• Nortriptyline • Amitriptyline • Imipramine • Desipramine	• Dietary high fiber, legumes, fish, meat, and vitamin C may decrease drug absorption • May cause a decrease in plasma tryptophan serum concentration but an increase in brain concentration of tryptophan and the risk for serotonin syndrome • May increase body weight by stimulating hunger and carbohydrate intake
<b>Antipsychotic Drugs</b>	
• Chlorpromazine	• Can cause deficiency of riboflavin and vitamin B <sub>12</sub>
<b>Sleep Medications</b> (Do not take with alcohol.)	
• Zolpidem • Triazolam	• May interact with St. John's wort • May interact with grapefruit juice

**TABLE 6.2** Common Food and Medication Interactions in Clients with Neurologic Conditions (source: FDA, 2020a–b)

### Drug–Food Interactions with Treatments for Neurological Disorders

Many clients with neurologic conditions require treatments and medications that can affect their nutritional status. It is important for the nurse to identify potential nutritional risks and help plan dietary adjustments with clients. This section familiarizes the nurse with some of the more common treatments and medications used for these clients.

A person's genetic background strongly influences food and drug interactions, and certain nutritional deficiencies alter the gut microbiome, which can alter future medication absorption. Excessive intake of some vitamins can reduce the effectiveness of certain drugs, especially those used to treat epilepsy. Understanding the interactions between food and medications used for neurologic conditions among the health care team can ensure appropriate use and promote efficacy and client safety.

Nurses must consistently monitor clients for drug–food interactions; this is a collaborative effort involving the client

reports, pharmacists, physicians, nurses, and dieticians. The ongoing assessment of clients receiving neurologic medications is critical. For example, identifying changes in body weight or nutritional deficits is key in promoting medication effectiveness and improving health ([Table 6.3](#)).

Increased Body Weight	Decreased Body Weight
Antidepressants: <ul style="list-style-type: none"> <li>Mirtazapine</li> <li>Fluvoxamine</li> <li>Phenelzine</li> <li>Citalopram</li> <li>Amitriptyline</li> <li>Doxepin</li> <li>Imipramine</li> </ul>	Amphetamines: <ul style="list-style-type: none"> <li>Phenifuramine</li> <li>Phentermine</li> </ul>
Neuroleptics: <ul style="list-style-type: none"> <li>Clozapine</li> <li>Olanzapine</li> <li>Risperidone</li> <li>Quetiapine</li> <li>Haloperidol</li> </ul>	Antipsychotics: <ul style="list-style-type: none"> <li>Phenothiazines</li> </ul>
Benzodiazepines: <ul style="list-style-type: none"> <li>Alprazolam</li> <li>Diazepam</li> <li>Clonazepam</li> </ul>	Psychostimulants: <ul style="list-style-type: none"> <li>Methylphenidate</li> <li>Glucagon-like protein-1 (GLP-1) receptor agonists</li> </ul>
Antiepileptics: <ul style="list-style-type: none"> <li>Valproic acid</li> <li>Gabapentin</li> </ul>	

**TABLE 6.3** Neurologic Medications That Affect Body Weight (sources: FDA, 2022a; Verhaegen et al., 2019)

#### Medications Used to Treat Parkinson's Disease

One of the main medications used to treat Parkinson's disease is levodopa, a dopaminergic agent. As the body metabolizes levodopa, elevated **homocysteine** levels (an amino acid) can present. This elevation can cause greater stiffness of the aorta and a lower bioavailability of CoQ10, placing the individual at a higher risk for cardiovascular events such as stroke. Therefore, due to the given the nature of the breakdown of levodopa, an adequate intake of folate, niacin, and vitamins B<sub>6</sub> and B<sub>12</sub> is recommended to prevent increased homocysteine levels, mitigating an increased cardiovascular risk. Alternatively, too much protein when taken with levodopa can inhibit its action, so medication should be taken 30–60 minutes before a meal and is not recommended in conjunction with a high-protein diet (Gezmen-Karadag, 2018). Sugar or fat can worsen Parkinson's symptoms as these foods can inhibit absorption of levodopa, while a high-carbohydrate diet will increase the effect of levodopa (Gezmen-Karadag, 2018). In addition, clients with Parkinson's disease who have a high levodopa requirement will often present with constipation and may require stool softeners.

#### Medications Used to Treat Epilepsy

Many of the anticonvulsant drugs (i.e., phenobarbital, carbamazepine) used to prevent seizures can also cause an increase in vitamin D metabolism in the liver and reduced bioavailability of vitamin D, which decreases calcium absorption in the intestine. This signals an increase in calcium uptake away from the bones. Low levels of vitamin D, serum calcium, and serum phosphate have been seen among children with epilepsy who receive these medications (Kija et al., 2019).

Other nutritional deficiencies that can result from taking antiepileptic drugs include low levels of biotin, an increase in homocysteine levels, and a deficiency of several B vitamins (Samahan et al., 2020). Therefore, it is recommended

that clients taking anticonvulsant medications take calcium and vitamin D supplements. It was also noted that high folate levels can increase homocysteine concentrations and, therefore, folate levels should be monitored (Safahani et al., 2020). Hypocalcemia, reduced serum L-carnitine, zinc, and copper levels have been associated specifically with administration of phenytoin or valproic acid, but the supplementation of calcium has been shown to improve both cognition and function (Kija et al., 2019).

Nutrition education is recommended for clients prescribed valproic acid, as the intended action may be inhibited among people who consume large amounts of soy, as seen in vegan and vegetarian diets. Moreover, while some anticonvulsant medications, such as topiramate, may reduce total body weight, valproic acid has been associated with weight gain because of decreased serum glucose levels, which increase appetite. Clients who receive valproic acid should be closely monitored, as **hepatotoxicity** (injury to the liver or impaired liver function) may result. Clients taking any anticonvulsant medications should not consume alcohol, because these medications weaken the tolerance to alcohol, increasing the risk for intoxication. [Table 6.4](#) provides a list of common medications used to treat seizures.

Generic Name	Nutritional Effect
Carbamazepine	<ul style="list-style-type: none"> <li>Can cause deficiency in vitamins B and D</li> <li>Can cause bone loss, hyperhomocysteinemia</li> </ul>
Clonazepam	<ul style="list-style-type: none"> <li>Can decrease appetite but cause weight gain as it slows the metabolism</li> </ul>
Diazepam	<ul style="list-style-type: none"> <li>Do not take with grapefruit or grapefruit juice, kava, or St. John's wort</li> </ul>
Ethosuximide	<ul style="list-style-type: none"> <li>Can cause loss of appetite and weight loss</li> </ul>
Levetiracetam	<ul style="list-style-type: none"> <li>Can deplete biotin, calcium, L-carnitine, and vitamins A, B<sub>12</sub>, D, and E</li> </ul>
Midazolam	<ul style="list-style-type: none"> <li>Do not take with grapefruit or grapefruit juice</li> </ul>
Oxcarbazepine	<ul style="list-style-type: none"> <li>Can increase appetite and cause weight gain</li> <li>Can reduce sodium levels and cause nausea, upset stomach, and indigestion</li> </ul>
Phenobarbital	<ul style="list-style-type: none"> <li>Causes vitamin D deficiency</li> <li>Can cause bone loss</li> <li>Increases biotin breakdown</li> <li>Can cause loss of appetite and weight loss</li> <li>Can deplete calcium and vitamins A, B<sub>9</sub> (folate), and D</li> </ul>
Phenytoin	<ul style="list-style-type: none"> <li>Vitamins B and D deficiency</li> <li>Can cause bone loss</li> <li>Hyperhomocysteinemia</li> <li>Do not mix with enteral tube feedings</li> </ul>
Pregabalin	<ul style="list-style-type: none"> <li>Can increase appetite and cause weight gain</li> <li>Can lower vitamin B<sub>12</sub> levels</li> </ul>
Primidone	<ul style="list-style-type: none"> <li>Can cause loss of appetite and weight loss</li> <li>Can lower vitamin B<sub>12</sub> levels</li> </ul>
Topiramate	<ul style="list-style-type: none"> <li>Can suppress appetite, causing weight loss</li> <li>Can cause ketosis and increase risk for kidney stones</li> </ul>
Valproic acid	<ul style="list-style-type: none"> <li>Vitamin D deficiency</li> <li>Can cause bone loss, as well as hyperammonemia and L-carnitine deficiency</li> </ul>

**TABLE 6.4** Common Medications Used to Treat Seizures (sources: Dhaliwal et al., 2023; Epilepsy Foundation, 2023)

### Medications Used to Treat Multiple Sclerosis (MS)

Several medications and treatments may be used to treat clients with MS, depending on the type and severity of the condition and considering potential risks and benefits. One group of medications is immunomodulators. Interferon beta-1a is an injectable immunomodulator that is often prescribed to clients with MS, as it acts to reduce inflammation and halt nerve damage through the destruction of certain cells. While flu-like symptoms may be common, liver damage is a critical side effect of this medication. A loss of appetite as well as nausea, clay-colored stools, dark urine, and jaundice may indicate that the liver is failing and should be reported to the provider immediately (Filipi & Jack, 2020). One of the newest medications that prevent MS relapses is ofatumumab, which can also cause nausea, and if this occurs, the nurse should report it to the health care provider. A rare adverse and potentially lethal effect of this medication is brain infection, which could cause speech, vision, or muscle movement abnormalities. The ketogenic diet can reduce the need for medication in people with MS.

### Medications Used to treat Depression, Psychosis, and Sleep

Several classes of medications are used routinely to treat depression, such as selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants, and monoamine oxidase inhibitors (MAOIs). One commonly prescribed medication to treat depression is fluoxetine, which may be associated with increased insulin levels and subsequent short-term weight gain in some individuals. Other common antidepressants, such as sertraline and paroxetine, have been linked to high LDL cholesterol, and long-term use may increase the risk for cardiovascular disease. Some of the tricyclic antidepressants, such as amitriptyline, may also cause weight gain, as they can increase appetite. A high intake of fiber foods, such as legumes, fish, and meat, and foods rich in vitamin C, may decrease absorption of these medications. Tyramine is a trace monoamine found in aged cheeses and cured meats and should be avoided if the client is taking a monoamine oxidase inhibitor. Some antipsychotic medications, such as chlorpromazine and clozapine, can cause a vitamin B<sub>12</sub> deficiency and/or constipation. Therefore, supplemental B vitamins and minerals are recommended, as well as adequate fluid and fiber intake.

For clients with sleep disturbances, medications like zolpidem rapidly decelerate brain activity and can help them fall asleep and asleep. Clients taking sleeping medications should avoid caffeine and alcohol and should take them on an empty stomach to ensure adequate absorption. Zolpidem interacts with St. John's wort, and the two should not be administered together. Another medication prescribed to treat insomnia, triazolam, should not be taken with grapefruit juice, as this has been shown to increase blood levels of the drug, causing excessive drowsiness.

## Chapter Summary

- For proper functioning of the neurologic system, specific nutrients are required across the client's lifespan.
- The health of the client and fetus is optimized by ensuring that the client consumes adequate protein and has a diet rich in micronutrients including vitamins A, B<sub>9</sub> (folate), B<sub>12</sub> (cobalamin), D, E, and K as well as minerals such as copper, iron, creatine, choline, zinc, and iodine.
- Specific nutrients for infants, children, and adolescents offer optimal neural development.
- The nutrient needs for adults change with the aging process; ensuring adequate intake of key macronutrients and micronutrients prevents cognitive decline.

- Weight management is important throughout the client's lifespan and can promote neurological health.
- Neurologic conditions and subsequent treatment and medications can alter the client's nutritional state.
- Nurses should be aware of the potential nutritional challenges that could present and teach their clients about specific nutritional strategies to prevent rapid declines related to neurologic diseases and conditions.

## Key Terms

**anticonvulsants** medications used to prevent or treat epileptic seizures; many anticonvulsants are also used to treat certain psychiatric conditions

**Coenzyme Q10** a nutrient that the body produces and can be found in many foods; CoQ10 facilitates the conversion of food to energy and is a powerful antioxidant that can promote health in cardiovascular and neurologic conditions

**cretinism** altered intellectual disability, small stature, and thickening of the facial features

**gangliosides** glycosphingolipids that are highly available in a healthy nervous system and carry most of the sialic acid residues in the brain

**hepatotoxicity** injury to the liver, or impaired liver function, due to the exposure to certain drugs, food additives, alcohol, solvents, some plants, and other environmental toxins

**hippocampus** a brain structure located just below the ventricles of the brain that is a focal point for

emotion, memory, and the autonomic nervous system

**homocysteine** an amino acid that can be found in meat; high levels are associated with the development of heart and neurologic conditions

**ketogenic diet** a diet that is high in fat with adequate protein and low in carbohydrates to produce ketosis; has been used successfully to treat certain neurologic conditions, such as pediatric epilepsy

**Mediterranean diet** a diet that emphasizes foods that are plant based and contain healthy fats, such as vegetables, fruits, whole grains, and olive oil as the main source of fat

**oxidative stress** an imbalance in the body's production of free radicals and antioxidant defense that can set the stage for a variety of neurologic conditions

**phospholipids** a type of fat (lipid) that also contains phosphorus

## Review Questions

- The nurse is providing dietary instruction to a client who is in the first trimester of pregnancy. Consuming which of the following foods should the client prioritize to facilitate fetal neurological development?
  - Apples and grapes
  - Whole wheat bread
  - Fruit juice
  - Chicken and lentils
- A 54-year-old client, recently diagnosed with multiple sclerosis, presents to the clinic for a follow-up appointment. The client asks the nurse if there is any special diet that might help their symptoms. The nurse advises which diet as an option for the client to discuss with the neurologist?
  - Mediterranean diet
  - DASH diet
  - Ketogenic diet
  - Diabetic diet
- A client is prescribed phenytoin for epilepsy. Which of the following nutritional deficiencies is the client at risk

for?

- a. Vitamin D deficiency
  - b. Iron deficiency
  - c. Hypoglycemia
  - d. Hypercalcemia
4. A 15-year-old client has decided to try a vegetarian diet. Which of the following nutritional deficiencies is this client at risk for developing?
- a. Vitamin C
  - b. Omega-3 fatty acids
  - c. Calcium
  - d. Potassium
5. The patient care technician is assisting a client with Parkinson's disease during mealtime and reports the client began to drool and cough while eating. Which action is the most appropriate from the nurse?
- a. Perform a bedside swallow evaluation.
  - b. Tell the patient care technician to watch the client carefully for the rest of the meal.
  - c. Show the patient care technician how to suction the mouth orally.
  - d. Place a nutrition consult for tomorrow morning to initiate tube feedings.
6. The nurse is educating a client's family about the addition of polyphenols to the client's diet. Which foods should be recommended by the nurse?
- a. Chicken
  - b. Fish
  - c. Whole-fat milk
  - d. Spinach
7. A client diagnosed with epilepsy asks the nurse if nutritional changes could potentially help control their seizures. Which diet would the nurse tell the client about?
- a. DASH diet
  - b. Ketogenic diet
  - c. Mediterranean diet
  - d. Vegetarian diet
8. The nurse is educating a client who is breastfeeding about maternal dietary habits that can promote the infant's health. Which of the following statements by the client indicates the need for additional instruction?
- a. "I will be sure to eat some leafy green vegetables."
  - b. "I will drink plenty of fluids throughout the day."
  - c. "I need to eat fewer carbohydrates."
  - d. "I need to eat 300–400 extra calories each day."
9. A diet rich in flavonoids, which are found in tea, red wine, certain fruits, and vegetables is often recommended in neurodegenerative conditions, due to which of the following benefit of flavonoids?
- a. Antioxidant effect
  - b. They cross the placental barrier.
  - c. They cross the blood-brain barrier.
  - d. Anticoagulant effect
10. The nurse is providing discharge instructions to a client who has been prescribed an antidepressant. What nutritional recommendations are appropriate for this client?
- a. Drink a glass of orange juice when taking your medication.
  - b. Eat a high-fiber meal when taking your medication.
  - c. Switch to a high-carbohydrate diet to decrease the risk for weight loss.

- d. Follow a balanced diet to decrease the risk for weight gain.

## Suggested Reading

Alzheimer's Disease International (2023, June 19). <https://www.alzint.org/news-events/news/new-data-predicts-the-number-of-people-living-with-alzheimers-disease-to-triple-by-2050/>

Cortés-Albornoz, M. C., García-Guáqueta, D. P., Velez-van-Meerbeke, A., & Talero-Gutiérrez, C. (2021). Maternal Nutrition and Neurodevelopment: A Scoping Review. *Nutrients*, 13(10), 3530. <https://dx.doi.org/10.3390/nu13103530>

Gezmen-Karadag, M., Çelik, E., Kadıyifçi, F., Yesildemir, Ö., Öztürk, Y. E., & Agagündüz, D. (2018). Role of food-drug interactions in neurological and psychological diseases. *Acta Neurobiologiae Experimentalis*, 78(3), 187–197.

Zambrano, M., Miller, E. (2019). Maternal Stroke: An Update. *Current atherosclerosis reports*, 21(9), 33. <https://doi.org/10.1007/s11883-019-0798-2>

## CHAPTER 7

# Applying Clinical Judgment to Promote Nutrition for Endocrine Wellness



**FIGURE 7.1** Endocrine wellness is connected to a healthy diet full of vegetables. (credit: modification of work “Vegetables” by Scott Bauer/Wikimedia Commons, Public Domain)

## CHAPTER OUTLINE

- 7.1 Assess and Analyze the Impact of Nutrition on the Endocrine System
  - 7.2 Plan Nutritional Strategies to Impact Endocrine Wellness
  - 7.3 Implement Nutritional Strategies to Impact Endocrine Wellness
  - 7.4 Evaluate Nutritional Strategies to Impact Endocrine Wellness
- 

**INTRODUCTION** Endocrine disorders, such as diabetes and thyroid disease, require careful diet and lifestyle management. Accordingly, nurses play a critical role in promoting nutrition for endocrine wellness. For example, nurses instructing clients with diabetes on proper nutrition can significantly improve their clients' glycemic control (Martos-Cabrera et al., 2021). Nurses can collaborate with other health care professionals to develop comprehensive treatment plans for clients with endocrine disorders. Multidisciplinary interventions can improve glycemic control and reduce hospitalizations in clients with type 2 diabetes (Ni et al., 2019).

Consider this case: Meena, a 44-year-old Indian American female was recently diagnosed with hypothyroidism and type 2 diabetes. Meena develops some concerning symptoms and comes to the clinic for evaluation.

## 7.1 Assess and Analyze the Impact of Nutrition on the Endocrine System

### LEARNING OUTCOMES

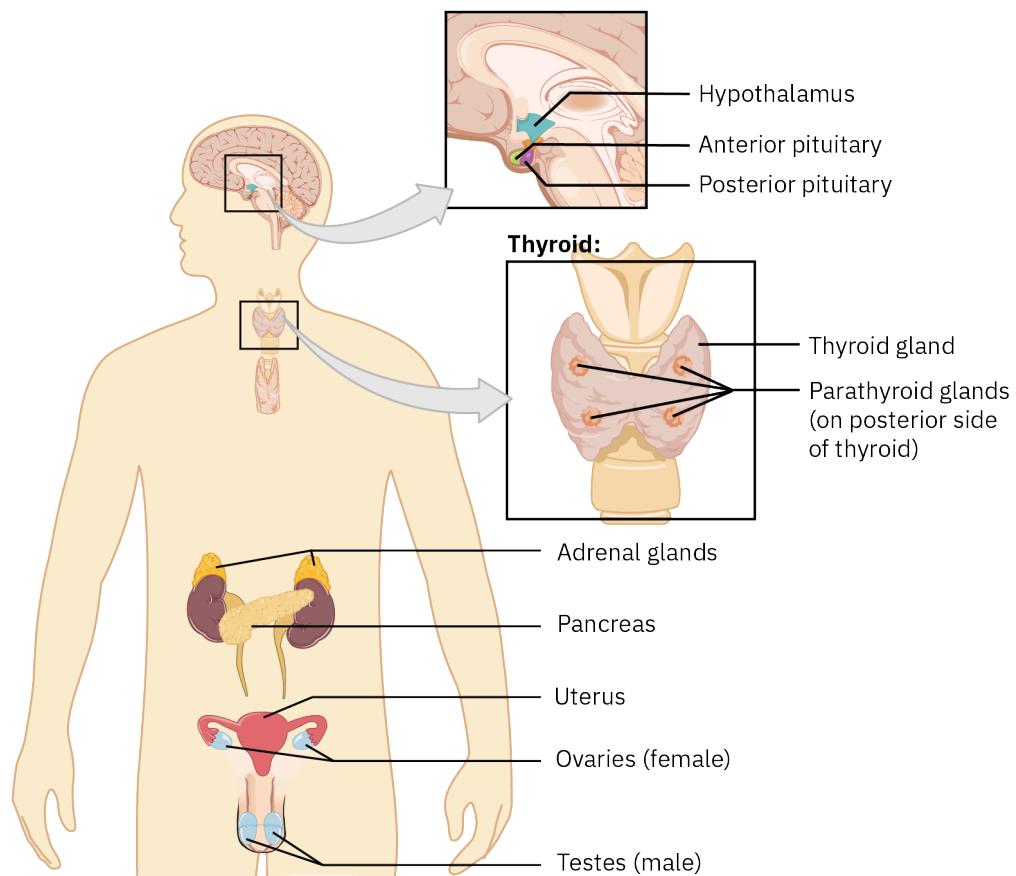
By the end of this section, you should be able to:

- 7.1.1 Recognize the normal function of the endocrine system.
- 7.1.2 Recognize cues of nutritional impact on the endocrine system.
- 7.1.3 Analyze cues of nutritional impact on the endocrine system.

### Normal Function of the Endocrine System

The **endocrine system** is a network of cells, tissues, and organs that regulate and control all processes using **hormones**. Hormones are secretions that help regulate organ function by exerting their effects on certain cells in the organ. They coordinate biological functions like metabolism, sexual reproduction, blood pressure, body temperature, heart rate, growth, development, and sleeping. Related to nutrition, the endocrine system regulates appetite and how nutrients are used.

The **hypothalamus** is a region in the brain that regulates the endocrine system through its connection and coordination with the nervous system. The **pituitary gland**, also located in the brain, regulates other glands like the adrenal, thyroid, and testicles. These glands include the thyroid, parathyroid, adrenal, pineal, and pancreas which play critical roles in regulating calcium levels in the body, metabolism, sexual development, and blood pressure, and insulin production, respectively. [Figure 7.2](#) shows the pituitary gland and other key parts of the endocrine system. The goal of regulating hormone levels in the blood is to reach a state of balance or **homeostasis**. Imbalances can lead to health problems like high blood pressure, changes in mood and behavior, and weight gain (Betts et al., 2022).



**FIGURE 7.2** The endocrine system is comprised of the central glands, found in the brain, and peripheral glands found in other parts of the body. (credit: modification of work from *Anatomy and Physiology* 2e. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Nutrition plays a vital role in maintaining homeostasis and affecting hormone functions. Overall, a balanced diet with limited ultra-processed food, a variety of fruits and vegetables, whole grains, and lean protein sources is important

for endocrine health. This diet helps individuals maintain a healthy weight and decrease the risk for hormonal imbalances. [Table 7.1](#) lists the glands that play a key role in secreting and regulating hormones and related nutritional factors.

Gland	Role	Related Nutritional Factors
Adrenal glands	Release <b>cortisol</b> (steroid hormone) commonly referred to as the “stress hormone”	Adequate protein intake (5–7 oz eq/day for adults) as part of a balanced diet
Hypothalamus	Instructs the pituitary gland when to release hormones	Diet low in ultra-processed foods which decreases inflammation
Ovaries	Produces sex hormones including estrogen and progesterone	Balanced diet with limited red meat and poultry
Pancreas	Controls the release of insulin and glucagon, which are involved in regulating blood glucose levels and affecting digestion	Limited added sugar, refined grains, overall calories
Pineal gland	Produces melatonin, which helps regulate sleep	Foods containing melatonin have not been found to affect pineal gland function
Pituitary gland	Known as the “master gland,” it influences many other endocrine glands, including the thyroid. It affects various bodily functions such as blood pressure, metabolism, and growth.	(< 2300 mg/day); diet low in ultra-processed foods which decreases inflammation
Testes	Produces the sex hormone testosterone	Foods or supplements containing omega-3 fatty acids
Thyroid	Controls metabolism, heart and digestive function, mood, and muscle and bone development	Adequate iodine intake through iodized salt, fish, shellfish, dairy, seaweed

**TABLE 7.1** Key Endocrine Glands and Their Role in Regulating Hormones (sources: Betts et al., 2022; Salas-Huetos A., 2020; Samodien, E. et al., 2019; Tan, D. X. et al., 2018; U.S. Department of Agriculture & U.S. Department of Health and Human Services, 2020; Xenou, M., & Gourounti, K., 2021.)

## Alterations in Endocrine System Function

Endocrine disorders develop in one of two ways. **Primary endocrine disorders** result from problems with the peripheral glands, while **secondary endocrine disorders** result when the pituitary gland is either overstimulated or understimulated by the hypothalamus causing an alteration in the peripheral gland’s function. The result of all endocrine disorders is either hyper-functioning or hypo-functioning of the affected gland.

### Alterations in Endocrine System Function – Diabetes

The most prevalent endocrine disorder is diabetes (Agency for Healthcare Research and Quality, n.d.). It is estimated that 37.3 million Americans have diabetes, with approximately 8.5 million cases (23%) undiagnosed (National Institute of Diabetes and Digestive and Kidney Diseases, 2023). Diabetes develops when the body is not able to maintain adequate blood glucose control (Sapra & Bhandari, 2023). **Type 1 diabetes** typically develops early in life and occurs when insulin producing cells (beta cells) are destroyed in the pancreas resulting in low to non-existent levels of insulin. **Type 2 diabetes** results from insulin resistance that develops gradually from obesity and aging. The insufficient amount of insulin (type 1 diabetes) and/or functionally ineffective amounts of insulin (type 2 diabetes) result in elevated blood glucose levels.

**Glycemic control**, which is the maintenance of optimal blood glucose levels, is essential to manage potential complications of diabetes effectively. Poorly controlled blood glucose levels lead to vascular and neurological complications including myocardial infarctions, cerebral vascular accidents, renal disease, neuropathies, and

retinopathy (Sapra & Bhandari, 2023). These complications result from several different mechanisms triggered by elevated blood glucose levels that either cause buildup within vessels that impede blood flow, reduce the ability of the vessels to autoregulate, or trigger altered biochemical processes that hinder the vessel's functionality (Brutsaert, 2022). The risk for these conditions developing is increased in clients who have co-morbid conditions.

## SPECIAL CONSIDERATIONS

### Differences in Insulin Sensitivity Among Diverse Populations

Members of US racial/ethnic minority groups have higher rates of insulin resistance than non-Hispanic White members of the population. This is most likely attributed to both genetic and lifestyle factors (Caballero, 2018).

### Alterations in Endocrine System Function – Other Endocrine Disorders

Other endocrine disorders commonly seen are hypo/hyperthyroidism and adrenal disorders. Hypothyroidism results from the decreased levels of **thyroid hormones T4 and T3**. Accordingly, thyroid stimulating hormone (TSH) is increased, indicating that the thyroid gland is not functioning properly. It usually results from autoimmune causes, but it could also occur after radioactive iodine therapy or surgery for hyperthyroidism or **goiter** (Braunstein, 2022). Hyperthyroidism is caused by increased secretion of **T4 and T3** caused by **Graves' disease**, goiter, or thyroiditis. Adrenal insufficiency is caused by **Addison's disease** or a disorder regulating the pituitary gland and results in low cortisol levels in the body (Grossman, 2022). In an effort to stimulate the adrenal glands, adrenocorticotrophic hormone (ACTH) is released. Conversely, **Cushing's disease/syndrome** develops when corticosteroid levels in the body are high either from taking corticosteroid medications or from overproduction by the adrenal glands.

### Assessment of Nutrition and the Function of the Endocrine System

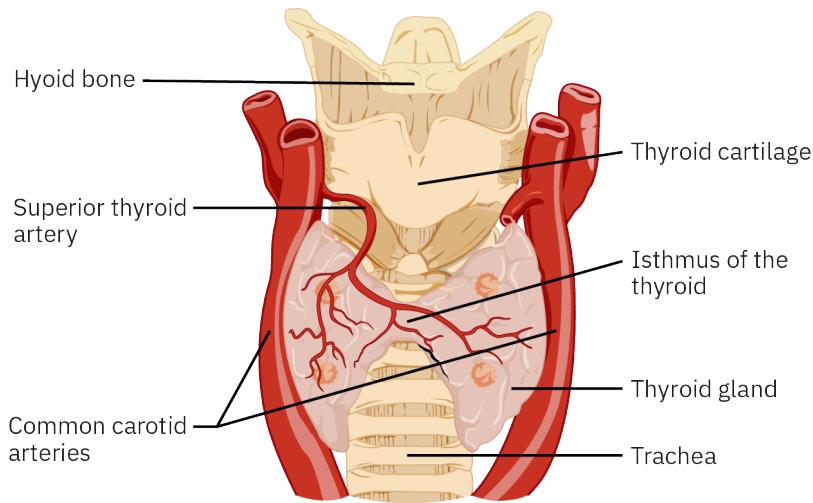
Endocrine disorders can be difficult to diagnose. Frequently these conditions develop over time, and clients present with symptoms that are non-specific. A thorough history and physical is essential.

#### Health History and Physical Assessment

Taking a client's health history is the first step when assessing the client's endocrine system. In addition to general health history questions, it is important to identify conditions for which the client may be at risk and to assess the need for genetic testing (Bickley et al., 2021). When collecting information on the client's nutritional status for potential effects on the endocrine system, the nurse should ask about changes in appetite, thirst and fluid intake, and bowel function. It is also important to know if the client has experienced any changes in weight or energy levels.

After obtaining a thorough health history, a physical assessment should be performed to look for signs of endocrine dysfunction:

- Inspect the body, looking for abnormal hair growth, skin changes, and abnormal body proportions.
- Auscultate heart sounds for rate and rhythm as some endocrine disorders cause tachydysrhythmias. Also listen over the carotid arteries and directly over the thyroid gland for any bruits.
- Palpate the thyroid gland ([Figure 7.3](#)), adrenal glands, and testes for tenderness, size, symmetry, and shape, looking for any nodules, enlargement, or changes in texture.
- Assess weight, height, and body mass index (BMI) for any changes in body composition.
- Assess sexual development, including secondary sex characteristics, and menstrual cycles.
- Evaluate the client's mood and behavior for any changes.
- Perform point-of-care blood glucose testing (Bickley et al., 2021).



**FIGURE 7.3** As part of the physical assessment, the nurse should palpate the thyroid gland and adjacent structures, shown here in anterior view. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Laboratory Tests for Endocrine Functioning

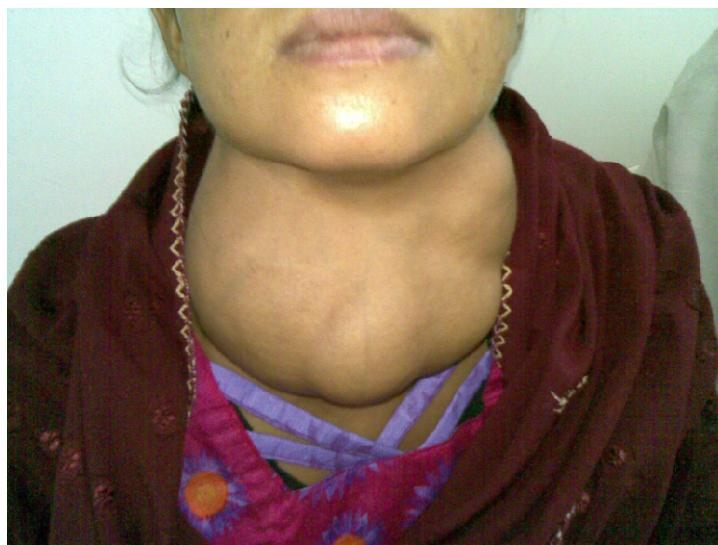
Laboratory testing for endocrine disorders includes tests measuring hormones, vitamin levels, electrolytes, and kidney function among others. [Table 7.2](#) lists the commonly ordered laboratory tests specific to endocrine disorders.

Laboratory Test	Normal Range	Indication
Adrenocorticotrophic hormone (ACTH)	9–52 pg/mL (picograms/milliliter)	Elevated level consistent with Addison's disease
Cortisol	8–20 mcg/dL (micrograms/milliliter; drawn in am)	Decreased level consistent with Addison's disease
Glucose	70–105 mg/dL (milligrams/deciliter; fasting)	Elevated level consistent with diabetes
Hemoglobin A1C (HbA1c)	4.7–8.5%	Elevated levels consistent with diabetes
T4	0.9–2.4 ng/dL (free; nanograms/deciliter) 5–12 mcg/dL (total; micrograms/deciliter)	Increased level consistent with hyperthyroidism
Thyroid-stimulating hormone (TSH)	0.5–5.0 mciU/mL (microinternational units per milliliter)	Decreased level consistent with hypothyroidism; increased level consistent with hyperthyroidism
Urinary free cortisol measurement	< 90 mcg (micrograms)/24 hours	Elevated levels consistent with Cushing's syndrome

**TABLE 7.2** Laboratory Tests for Endocrine Disorders (source: Merck Manual Professional Version, 2022)

### Analysis of Nutrition and the Endocrine System

The endocrine system requires adequate nutrition to function. Nutritional deficits or imbalances can cause various endocrine abnormalities. For example, the most common cause worldwide for goiter, or an enlarged thyroid ([Figure 7.4](#)), is iodine deficiency as **iodized salt** is not consistently used worldwide (Can & Rehman, 2023). However, in the United States, its use has significantly reduced goiter development (Can & Rehman, 2023). Instead, goiter formation in the United States is usually caused by Hashimoto's thyroiditis or Graves' disease. Clients who primarily consume other types of salt (kosher, sea, etc.) need to obtain iodine in their diet through other means.



**FIGURE 7.4** Iodine deficiencies can lead to goiter, an enlarged thyroid. (credit: “Goitre” by Almazi/ Wikimedia Commons, Public Domain)

A thorough analysis of the client’s nutrition status can help identify potential endocrine-related issues. The nurse should review the nutritional assessment to identify any nutrient-related deficiencies. For example, a client with limited fruit and vegetable consumption is at risk for vitamin C deficiency. Vitamin C deficiency is associated with multiple health problems. Specifically related to the endocrine system, vitamin C affects the regulation of several important hormones including insulin growth factor and sex steroids (Shi, Rath, & Niedzwiecki, 2021). Conversely, when evaluating the client’s nutrition status, there is potential to find excessive intake of nutrients. For example, a diet with excessive carbohydrate intake can increase blood glucose levels in individuals contributing to the development of insulin resistance and diabetes. Once nutritional imbalances are identified, the nurse can work with the client to make dietary changes and reduce the risk for developing endocrine disorders (Bickley et al., 2021).

[Table 7.3](#) lists signs and symptoms of common endocrine disorders and their corresponding nutritional factors.

Endocrine Disorder	Signs and Symptoms	Related Nutritional Factors
Diabetes	Increased thirst and urination, unexplained weight loss, increased hunger, blurred vision, slow-healing sores or infections, fatigue	Excessive intake of added sugar, refined grains, or overall calories can cause or worsen this condition
Hypothyroidism	Fatigue, weight gain, constipation, dry skin and hair, sensitivity to cold, depression, joint pain	Deficient iodine intake can cause or worsen this condition
Hyperthyroidism (Graves’ disease)	Weight loss, increased appetite, rapid heartbeat, trembling hands, nervousness or anxiety, sweating, heat intolerance	Excessive iodine intake can cause or worsen this condition
Adrenal insufficiency (Addison’s disease)	Fatigue, weakness, weight loss, nausea and vomiting, low blood pressure, darkening of the skin	High sodium diet is beneficial for clients with low aldosterone; adequate calcium and vitamin D intake is essential for clients taking corticosteroids
Cushing’s disease/syndrome	Weight gain, especially in the face, neck, and abdomen, thinning skin, easy bruising, slow healing of wounds, muscle weakness, fatigue	Controlled sodium diet and low-carbohydrate diet is beneficial

**TABLE 7.3** Common Endocrine Disorders with Signs and Symptoms and Related Nutritional Factors (sources: Braunstein, 2022; Brutsaert, 2022; Grossman, 2022; Hoffman & Sullivan, 2020; National Institute of Diabetes and Digestive and Kidney Diseases, 2021a–c and 2–18 a–b)

## SPECIAL CONSIDERATIONS

### Obtaining Adequate Iodine through Diet Sources

Dozens of countries, including the United States, add iodine to table salt. Despite this practice, there are still groups who are at risk for iodine deficiency:

- People who do not use iodized salt including people in Southeast Asia, sub-Saharan Africa, and Eastern Europe
- Pregnant women
- Vegans and people who eat few or no dairy products, seafood, and eggs
- People living in areas with iodine-deficient soils – primarily mountainous areas (Himalayas, Alps, and Andes regions) or river valleys prone to flooding (South and Southeast Asia)
- People who consume foods that interfere with iodine uptake including soy, cassava, and cruciferous vegetables

Alternative sources of dietary iodine for these groups include:

- Seaweed (kelp, nori, kombu, and wakame) (traditionally consumed in China, Japan, and Korea)
- Fish and other seafood
- Dairy products

Fruits and vegetables, although they have a lot of other health benefits, are not a good source of iodine.

(source: NIH, 2023)



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Meena, a 44-year-old Indian American female was recently diagnosed with hypothyroidism and type 2 diabetes. She has a history of class 1 obesity, with a BMI of 33. Meena lives alone and works as an office administrator. Her hobbies include reading, watching movies, and cooking. Meena presents to the clinic complaining of fatigue and feeling cold even in warm temperatures.

1. Which of the following assessment questions is the most important for the nurse to ask this client to obtain more information about their nutritional status?
  - a. Have you experienced any changes in your weight or appetite?
  - b. Do you have trouble sleeping?
  - c. Are you able to track what you eat?
  - d. Do you like to cook?
2. Based on the client's chief complaint, which of the following questions should you ask the client about her diet?
  - a. How much protein do you eat?
  - b. Do you consume a lot of sugar?
  - c. What type of salt do you use on food?
  - d. Do you eat hot meals?

## 7.2 Plan Nutritional Strategies to Impact Endocrine Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 7.2.1 Understand nutritional habits that optimize endocrine wellness.
- 7.2.2 Generate solutions to optimize endocrine wellness utilizing nutritional habits.

### Planning Nutrition Goals

It is important to set nutritional goals with individuals with endocrine disorders as diet plays a crucial role in managing these conditions and promoting overall health and well-being. Research has shown that dietary modifications can significantly improve outcomes and reduce the risk for complications associated with various endocrine disorders, particularly diabetes. For example, research has shown that dietary interventions, including reducing simple carbohydrate and added sugar intake and increasing protein and fiber intake, can improve blood glucose control and reduce the risk for cardiovascular disease in individuals with type 2 diabetes (Gray & Threkeld, 2019).

The American Diabetes Association (2019) has identified a framework for nutrition therapy goals that reflect the importance of using a holistic approach to working with clients with diabetes. Their broad goals of nutrition therapy are to:

- Promote and support healthful eating patterns, emphasizing a variety of appropriately portioned nutrient-dense foods.
- Consider personal and cultural preferences, health literacy, willingness to change, and access to healthy foods.
- Not judge clients about their food choices so that their eating can continue to be enjoyable.
- Provide practical tools for developing good eating practices rather than focusing too much on a particular food item or food type.

Clients with diabetes should follow the prescribed diet which typically includes a limited number of calories and carbohydrates. General guidelines for meal planning with diabetes include (CDC, 2023b):

- Limiting added sugars and refined grains such as white bread, rice, and pasta
- Including more non-starchy vegetables
- Limiting intake of highly processed foods

Setting nutritional goals for clients with endocrine disorders can be difficult. Endocrine disorders are complex conditions that can seem overwhelming to the client to manage. In addition to considering the nutritional components of the diet, the nurse must consider cultural, socioeconomic, and psychological factors affecting food intake. The goal-setting process is only successful if it is collaborative. The nurse should encourage the client to explain how their family, culture, and beliefs influence how and what they eat. These influences should be incorporated into the goals set.

When setting nutritional goals, both short-term and long-term goals are needed. Short-term goals may be necessary to help stabilize and manage acute changes in hormone levels that have occurred. Short-term goals may require more stringent meal planning and food consumption that is not realistically sustainable over time. Long-term goals are necessary to help the client manage their condition on an ongoing basis. Ideally, these goals incorporate the changes needed to stabilize the client's endocrine health in a realistic and practical manner. [Table 7.4](#) lists common endocrine disorders and related nutritional goals.

Endocrine Disorder or Lab Value	Nutritional Goals
Diabetes (high blood glucose)	Balance carbohydrate intake with insulin requirements, limit simple sugars and refined carbohydrates, increase fiber intake, promote weight management
Polycystic ovary syndrome (PCOS)	Promote weight loss if overweight or obese, reduce intake of refined carbohydrates and sugars, increase intake of fiber and omega-3 fatty acids, monitor iron and vitamin D levels
Thyroid disorders (e.g., hypothyroidism)	Monitor iodine and selenium intake, limit consumption of goitrogens (e.g., soy, cabbage), increase intake of iron and vitamin B <sub>12</sub> , promote weight management
Cushing's disease/syndrome	Limit sodium intake, increase potassium and calcium intake, promote weight management
Adrenal insufficiency	Ensure adequate protein and carbohydrate intake, monitor sodium intake, increase potassium and calcium intake
Hypoglycemia	Balance carbohydrate intake with insulin requirements, eat frequent small meals throughout the day, avoid skipping meals or fasting
Low iron	Increase iron-rich foods such as lean red meat, poultry, fish, beans, and fortified cereals
Low vitamin D	Increase intake of vitamin D-rich foods such as fatty fish, egg yolks, and fortified foods; consider supplementation if necessary
Low vitamin B <sub>12</sub>	Increase intake of vitamin B <sub>12</sub> -rich foods such as lean meat, fish, poultry, and fortified foods; consider supplementation if necessary
Low potassium	Increase intake of potassium-rich foods such as bananas, potatoes, tomatoes, spinach, and avocado
Low calcium	Increase intake of calcium-rich foods such as low-fat dairy, leafy greens, and fortified foods

**TABLE 7.4** Examples of Endocrine Disorders and Abnormal Lab Values Associated with Nutritional Goals (sources: Brutsaert, 2022; Hoffman & Sullivan, 2020; Centers for Disease Control and Prevention, 2022b; Cushing syndrome, 2023; Kiani et al., 2022; National Institute of Diabetes and Digestive and Kidney Diseases, 2018b; National Institute of Diabetes and Digestive and Kidney Diseases, 2021c; National Institutes of Health, 2023; Xenou & Gourounti, 2021).

Adequate intake of vitamins and minerals is important for the endocrine system as they play a role in hormone synthesis, regulation, and metabolism (Hoffman & Sullivan, 2020; Kiani et al., 2022; Lewis, 2022; Shrimanker & Bhattarai, 2023). These include:

- Vitamin A is important for vision, immune function, and cell growth and differentiation. It also plays a role in regulating gene expression and hormone synthesis. Vitamin A is found in green, leafy vegetables and dairy products.
- B vitamins, including thiamin, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid, and cobalamin, are important for energy metabolism and neurotransmitter synthesis. Vitamin B is found many foods including leafy green vegetables, enriched grains, and cereals.
- Vitamin C is an antioxidant that helps protect against oxidative stress and inflammation. It also plays a role in collagen synthesis and wound healing and has been linked to improved insulin sensitivity and glucose metabolism. Fruits and vegetables are important sources of Vitamin C.
- Vitamin D plays an essential role in calcium metabolism, which is critical for bone health. It also plays a role in regulating insulin secretion and glucose metabolism, and deficiency has been linked to an increased risk for type 2 diabetes. Sources for vitamin D include orange juice and dairy products fortified with vitamin D.
- Vitamin E is an antioxidant that helps protect against oxidative stress and inflammation, which are linked to the development of chronic diseases such as diabetes, heart disease, and cancer. Nuts and seeds are a key source of vitamin E.
- Calcium is important for bone health and muscle contraction, but it also plays a role in hormone secretion and metabolism. It is involved in the regulation of parathyroid hormone (PTH), which regulates calcium balance in the body. Dairy products are a primary source of calcium. For clients who do not eat dairy products, soy

products and dark leafy green vegetables are also good sources of calcium.

- Chloride is an important electrolyte that plays a role in fluid balance and the regulation of pH. It is also involved in the production and secretion of gastric acid, which is important for digestion and the absorption of nutrients. It is found in food sources with salt.
- Magnesium is important for muscle and nerve function, but it also plays a role in hormone metabolism and signaling. It is involved in the regulation of PTH and insulin secretion, and deficiency has been linked to an increased risk for diabetes. Magnesium is found in whole grains and dark-green leafy vegetables.
- Phosphorus is important for bone health and mineralization, and it is a key component of hydroxyapatite, which is the mineral matrix of bones. Several hormones, including parathyroid hormone (PTH) and calcitonin, are involved in the regulation of phosphorus metabolism and bone mineralization. Also, involved in the regulation of glucose metabolism, and several hormones, including insulin and glucagon. Dairy products, meats, nuts, and whole grains are good sources of phosphorus.
- Potassium is an important electrolyte that is involved in muscle contraction and nerve function. It also plays a role in insulin secretion and glucose metabolism. Potassium is also found in leafy green vegetables as well as starchy vegetables.
- Sodium is an important electrolyte that plays a role in regulating blood pressure and fluid balance. It also plays a role in the regulation of hormone secretion, particularly in the **renin-angiotensin-aldosterone system (RAAS)**, which regulates blood pressure and fluid balance. Sodium is readily found in processed foods including chips, pizza, and sandwiches.



### SAFETY ALERT

#### Managing Hypoglycemia

Hypoglycemia (a blood glucose level below 70 mg/dL) must be treated immediately to avoid serious complications. The 15-15 Rule can be used to treat mild hypoglycemia which occurs when blood glucose levels decrease to 55–69 mg/dL. Clients with blood glucose levels in this range should consume 15 g of carbohydrates and then recheck their blood glucose level after 15 minutes. Repeat these steps until their blood glucose is greater than 70 mg/dL. Examples of food items that have approximately 15 g of carbohydrates include:

- 4 oz of juice
- 1 tbsp of sugar, honey, or syrup
- Small portions of candy (hard candy, jellybeans, etc.)

Blood glucose levels that do not respond to these interventions require immediate attention at a health care facility (CDC, 2022b).

### Identifying Challenges to Nutritional Goals

Developing and maintaining healthy eating practices can be difficult for any client. For the general population, a healthy diet involves eating nutrient-dense foods across all food groups while staying within calorie limits and minimizing intake of added sugars, saturated fat, and sodium (Departments of Agriculture and Health and Human Services, 2020). Meeting nutritional goals can be especially challenging for individuals with endocrine disorders as these conditions often require specific dietary modifications to manage these conditions.

For example, individuals with adrenal insufficiency may struggle with electrolyte balance and carbohydrate intake. Individuals with diabetes often struggle with carbohydrate intake and blood glucose management (American Diabetes Association, 2019). Additionally, there are different types of diabetes. Although the nutritional requirements for clients with diabetes are generally the same, clients with type 1 diabetes must take insulin to regulate their blood glucose levels. Clients with type 2 diabetes can manage their blood glucose levels through diet. Similarly named, but unrelated to diabetes is diabetes insipidus. Clients with this condition may be able to decrease urine output by eating a low-protein or a low-salt diet, but otherwise nutrition does not cause or prevent this condition (National Institute of Diabetes and Digestive and Kidney Diseases, 2021).

Following any dietary recommendations depends on more than just understanding them. Clients must also have access and means to obtain and prepare nutritious foods. A client's culture and norms can also affect dietary

behaviors and subsequent health risks (Brown et al., 2022). The nurse should consider the client's cultural background when recommending food choices. Asking the client about their favorite foods and foods that are typically served at family or community gatherings is one way to learn more about the client's culture.

A recent study determined that overall diet quality has improved in the United States (Orr et al., 2019). However, there are still disparities among socioeconomic groups. These health disparities can stem from lack of access to or means to obtain healthy foods. For example, clients may live in rural or inner-city areas that have few grocery stores and instead must purchase food primarily from convenience stores or fast-food restaurants. Clients with limited incomes may have to choose lesser quality food to ensure they can purchase enough food. Accordingly, differences in diet quality may also explain differences in diabetes health-related outcomes among socioeconomic groups (Orr et al., 2019). The relationship between overnutrition and socioeconomic status is complex, as individuals from lower socioeconomic groups may also develop obesity due to limited access to fresh and nutrient-dense food and easy availability of energy-dense food.

### TRADITIONAL FOODS PROJECT

One example of a population-health based approach to reducing the risk for diabetes is the Traditional Foods Project. This was a 6-year cooperative project involving the CDC and 17 native U.S. tribal programs with the goals of supporting cultural traditions that could decrease the risk for type 2 diabetes among Native American and Alaska Native communities (CDC, 2022c). This project demonstrated how to incorporate culture and history into current day health interventions. Brochures with examples of the [traditional food stories they documented can be found on their website \(<https://openstax.org/r/diabetesndwp>\)](https://openstax.org/r/diabetesndwp).

Clients' lifestyles also must be considered. Inadequate physical activity, poorly managed stress, and inadequate sleep can interfere with healthy eating patterns (Kesari & Noel, 2022). Skipping meals and eating late at night has been linked to hormone imbalances (Gherasim et al., 2020).

Eating disorders, mental illnesses, and unhealthy diet trends can also affect nutritional status and increase the risk for malnutrition. Alcohol and substance use are significant factors that can affect a client's nutritional status. In addition to the physical damage caused by alcohol or substance use, the consumption of these substances can affect dietary habits. Intake of both can alter client's appetites and potentially displace the consumption of nutrient-dense food. Frequently, overconsumption of alcohol or substances is associated with disrupted, sometimes chaotic lifestyles that can further impact nutritional intake (Mahboub et al., 2021).

### MANAGING DIABETES THROUGH NUTRITION

[Access multimedia content \(<https://openstax.org/books/nutrition/pages/7-2-plan-nutritional-strategies-to-impact-endocrine-wellness>\)](https://openstax.org/books/nutrition/pages/7-2-plan-nutritional-strategies-to-impact-endocrine-wellness)

It can be challenging for clients with diabetes to incorporate all the nutritional changes needed to manage their condition. To learn more about the principles of healthy eating with diabetes watch this video from the National Institute of Diabetes and Digestive and Kidney Diseases.

### UNFOLDING CASE STUDY

#### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

After the initial health history and assessment, further testing is performed. Meena's vital signs are:

Vital Signs		Laboratory Results
Temperature:	97.6°F	
Pulse:	90 beats/min	
Respiratory rate:	18 breaths/min	
Blood pressure:	145/95 mm Hg	<ul style="list-style-type: none"> <li>• Elevated TSH level: 10.5 µIU/mL</li> <li>• Decreased free T4 level: 0.5 ng/dL</li> <li>• Elevated fasting blood glucose level: 210 mg/dL</li> <li>• Elevated HbA1c: 8.2%</li> </ul>

TABLE 7.5

Meena expresses a strong desire to improve her “hormone health” through lifestyle changes, particularly focusing on nutrition. However, she is feeling a little overwhelmed. Her diet recall includes foods with a lot of added sugar and salt. She tries to cook at home whenever possible to save money. When cooking at home she uses kosher or sea salt because she believes these types of salts “are healthier.” Her favorite dishes to prepare are Indian dishes she enjoyed with her family growing up. She is concerned she will no longer be able to enjoy these foods.

3. Which of the following nutritional strategies should be included in the client education for Meena's hypothyroidism management?
  - a. Recommend a low-protein, high-carbohydrate diet.
  - b. Encourage increased consumption of iodine-rich foods.
  - c. Advise her to avoid goitrogenic foods, such as cruciferous vegetables.
  - d. Promote a diet high in saturated fats and processed foods.
  
4. Which of the following actions would be most appropriate for the nurse to address Meena's elevated blood pressure?
  - a. Initiate a sodium-controlled diet and educate Meena on sodium reduction strategies.
  - b. Provide instruction on calcium sources in her diet.
  - c. Encourage her to increase her fluid intake.
  - d. Initiate a low-carbohydrate diet and instruct Meena on how to obtain adequate protein in her diet.

### SPECIAL CONSIDERATIONS

#### Incorporating Cultural Foods into a Diabetes Diet

Clients with diabetes may still be able to incorporate some of their favorite culture-specific foods into their diet. For example, leafy greens including collards, kale, and spinach are a traditional part of African American diets. Eating these foods can help control blood glucose levels (CDC, 2022a). The Latin American staple quinoa is a good source of fiber. Lastly, legumes and lentils, commonly used in African American, Hispanic, and Latin dishes, can also help manage cholesterol and glucose levels.

## 7.3 Implement Nutritional Strategies to Impact Endocrine Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 7.3.1 Assess the client for readiness to learn.
- 7.3.2 Teach nutritional strategies to optimize endocrine wellness.

### Holistic Nursing Assessment of the Client's Readiness to Learn

A holistic nutritional evaluation of the client involves assessing not only the client's physical symptoms and medical history, but also their educational, emotional, social, and spiritual needs. Socioeconomic conditions, cultural norms, and religious beliefs affect a person's nutritional intake and learning ability.

Assessing a client's readiness to learn involves identifying the client's strengths and barriers relative to learning as well as their motivation to learn and receptiveness to the instruction. Health literacy is a fundamental consideration when teaching clients. Health literacy refers to how well an individual can find, understand, and use information to make informed health-related decisions (Centers for Disease Control and Prevention, 2023c). Education goals and strategies should be formulated consistent with the client's health literacy level.

## Client Teaching

Effective education helps clients improve their overall health, manage chronic diseases, and lower the risk for complications (Ardoine, 2022). Teaching clients how to follow their prescribed diet requires time, client engagement, and a variety of resources and strategies (Agency for Healthcare Research and Quality, 2023). Once the nurse has assessed the client's education needs, the nurse needs to work with the client to set learning goals and objectives and select appropriate learning resources (National Library of Medicine, 2021). Client education should be structured around the methods of learning best suited for the client. Examples of educational resources include written materials, models, and videos. Be realistic regarding the amount of content that needs to be covered and respect the client's limits. Use an organized but flexible approach to be able to adjust to the client's response. If possible, involve family members or caregivers in the process as these individuals can provide additional support to the client.

The nurse should cover the following items as part of monitoring carbohydrate intake for clients with diabetes (CDC, 2023a):

- Clients with diabetes should track their carbohydrate intake to better manage their blood glucose levels.
- Keeping blood glucose levels stable and as close to normal as possible will help the client feel well and prevent or delay the development of diabetes-related complications.
- There are three types of carbohydrates:
  - Sugars: naturally found in fruit or milk, or added to many foods (added sugars are identified on the food label)
  - Starches: grains and starchy vegetables such as corn or potatoes
  - Fiber: indigestible part of plants that do not elevate blood glucose levels
- Carbohydrates are measured in grams and listed on food labels or found in resources listing nutritional information for nonpackaged food items.
- One serving of carbohydrates = 15 g of carbohydrates.
- The client should follow their prescribed diet indicating how many servings of carbohydrates to consume.
- The client should try to consume a consistent amount of carbohydrates at each meal to maintain consistent blood glucose levels.



### MEASURING PORTION SIZES

[Access multimedia content \(<https://openstax.org/books/nutrition/pages/7-3-implement-nutritional-strategies-to-impact-endocrine-wellness>\)](https://openstax.org/books/nutrition/pages/7-3-implement-nutritional-strategies-to-impact-endocrine-wellness)

The portion sizes of food served by restaurants have increased over time. This can make it difficult for clients to accurately measure food servings and follow their prescribed diet. This video demonstrates how portion sizes can be measured using your hands – no measuring tools required.

## 7.4 Evaluate Nutritional Strategies to Impact Endocrine Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 7.4.1 Evaluate a nutritional plan for its effect on endocrine wellness.
- 7.4.2 Modify a nutritional plan to promote endocrine wellness.

### Evaluating the Client's Compliance with the Meal Plan

It is important to determine how well the client has followed the prescribed diet. Self-monitoring of food intake through a food diary (either paper-based documentation or through an app) is one way to determine this. Diet recalls and food frequency questionnaires are other diet assessment tools that rely upon self-reported data. The nurse should consider that self-kept food records are not always accurate as self-reported food consumption is likely to be misreported in some way (Ravelli & Scholleller, 2020). However, reviewing the food diary with the client is still beneficial because it can encourage discussion and provide an opportunity for additional instruction on food choices and portion control. For clients with diabetes, an additional method of monitoring compliance is maintaining

and reviewing home blood glucose checks to determine if they are within the recommended ranges for the client.



### CLINICAL TIP

#### Food Journals

Despite potential inaccuracies, it is still helpful to review a client's food journal as part of their assessment to learn more about dietary patterns, food preferences, and issues. To promote consistency with the journaling task, help the client select the method of journaling that is most feasible for them to use—either a paper journal (notebook, diary, or single pages like the journal sample here developed by the CDC [My Food Diary](#) (<https://openstax.org/r/healthyweight>) or electronic method (phone application, spreadsheet, or other software). This will make the process easier for the client and increase the client's likelihood of following through.

### Evaluating the Effectiveness of the Nutritional Plan

The plan's effectiveness is evaluated by measuring expected clinical outcomes. If the nutritional plan (meal plan) has been effective, the client should report an improvement in their symptoms. There are objective measures that can be evaluated as well. Clients with endocrine disorders typically have laboratory tests performed regularly to measure the relevant electrolyte and hormone levels. For example, clients with diabetes will have HbA1c levels drawn that indicate the client's glucose control over time. Clients with thyroid conditions will have thyroid panel drawn. A thyroid panel is a group of laboratory tests that measure hormones and proteins that indicate thyroid functioning. Noninvasive means of measuring effectiveness include measuring the client's weight and vital signs to determine if there have been improvements. If the goals were not met, the plan needs to be adjusted. Perhaps the plan was too difficult for the client to follow and involved too many dietary changes all at once. The updated plan could focus on prioritizing and managing fewer nutrients initially and then expand as the client is able to manage the changes. If the client followed the plan but did not see the expected outcomes, work with the health care provider and dietician to adjust the plan.



### CLINICAL TIP

#### Assessing Blood Glucose Levels

Measuring blood glucose levels is a routine part of evaluating the effectiveness of the treatment plan for a client with diabetes. When measuring a client's blood glucose level, either by performing a point-of-care fingerstick glucose measurement or a venous lab drawn, always note the last time the client ate. This is important to know when interpreting the result as glucose levels fluctuate with meals.



### UNFOLDING CASE STUDY

#### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

To improve her endocrine health, the nursing team encourages Meena to engage in regular physical activity and provides education on a balanced diet and portion control. They also refer her to a registered dietitian for personalized nutritional guidance. In addition to these lifestyle changes, Meena is advised to monitor her blood glucose levels regularly to help manage her type 2 diabetes and maintain better glycemic control.

For her hypothyroidism management, the nursing team educates Meena about incorporating iodine-rich foods, such as seafood, dairy products, and iodized salt, into her diet to support thyroid function. Meena is receptive to this but is concerned because her family traditionally has not eaten much meat or seafood. She has eaten some fish, but reports she has a limited grocery budget, and she does not think she can afford to eat it regularly. The team works with Meena to identify budget-conscious ways to incorporate seafood consistent with her cultural practices into her diet. They also collaborate with an endocrinologist to ensure that Meena receives appropriate thyroid hormone

replacement therapy and ongoing monitoring.

Through this comprehensive care plan, Meena is supported in her efforts to improve her endocrine health and overall well-being. The nursing team continues to follow up with Meena and assess her progress, adjusting the care plan as needed.

5. Which of the following statements would indicate that Meena has successfully incorporated the recommended dietary changes for her endocrine health?
    - a. "I've been eating more fruits and vegetables and have reduced my intake of processed foods."
    - b. "I've started skipping breakfast to reduce my overall calorie intake."
    - c. "I only eat low-fat foods now and have completely eliminated carbohydrates from my diet."
    - d. "I drink diet soda instead of regular soda to reduce my sugar intake."
  
  6. Which of the following outcomes would indicate an improvement in Meena's endocrine health after implementing the care plan?
    - a. Decreased TSH level and improved blood glucose control
    - b. Increased TSH level and decreased T4 level
    - c. Increased appetite and weight gain
    - d. Decreased heart rate and increased blood pressure
-

## Chapter Summary

- The endocrine system plays a crucial role in regulating many bodily functions. Accordingly, endocrine disorders can manifest themselves through a wide range of signs and symptoms.
- Proper nutrition is essential for its optimal functioning of the endocrine system. Tailored meal plans can help minimize symptoms and facilitate disease management.
- Assessing client nutrition from a holistic perspective is necessary to address not only

- physical needs, but psychological, social, and cultural needs as well.
- Nutritional strategies should be realistic and manageable for the client to follow.
- Evaluation of nutritional interventions is based upon subjective information from the client regarding how well the client is adhering to the diet and symptom improvement as well as laboratory values related to the specific endocrine disorder.

## Key Terms

**Addison's disease** inadequate secretion of hormones by the adrenal glands causing low blood pressure, weakness, and skin discoloration

**cortisol** a steroid hormone that helps regulate the body's response to stress

**Cushing's disease/syndrome** weight gain, bruising, and weakness caused by excessive cortisol in the body

**endocrine system** a network of glands that regulate and control all body processes through hormones

**glycemic control** maintaining optimal blood glucose levels

**goiter** enlarged, abnormal growth of the thyroid gland

**Graves' disease** hyperthyroidism causing eye protrusion, heat intolerance, and anxiety

**homeostasis** state of balance in the body

**hormones** body substances that coordinate biological functions like metabolism, sexual reproduction, blood pressure, body temperature, heart rate, growth and development, and sleeping

**hypothalamus** a critical gland found in the brain that works with the nervous system to control the endocrine system

**iodized salt** table salt fortified with iodine

**pituitary gland** gland in the brain that regulates growth and development as well as the function of other glands

**primary endocrine disorders** caused by dysfunction in the affected peripheral endocrine gland

**renin-angiotensin-aldosterone system (RAAS)** system of hormones that regulates blood pressure and fluid balance

**secondary endocrine disorders** develop when the pituitary gland is either overstimulated or understimulated by the hypothalamus causing an alteration in the peripheral gland's function

**T3** triiodothyronine hormones released by the thyroid gland to help regulate weight, energy levels, and metabolism

**T4** tetraiodothyronine (thyroxine) long-acting hormone released by the thyroid gland that can be converted to T3

**type 1 diabetes** develops when insulin producing cells (beta cells) are destroyed in the pancreas resulting in low to non-existent levels of insulin

**type 2 diabetes** results from insulin resistance that develops gradually from obesity and aging

## Review Questions

- A client has been diagnosed with Cushing's syndrome. Which of the following dietary recommendations are appropriate for this client?
  - Low-protein diet with added salt
  - Low-fat diet with added potassium
  - Low-carbohydrate diet with limited salt
  - High-carbohydrate diet with limited salt
- The nurse is providing diet instruction to a client with a vitamin D deficiency. Which of the following statements by the client indicates the need for further instruction?
  - "I should avoid eating tuna and salmon."
  - "I should eat fortified cereal for breakfast."
  - "My diet plan may not be enough. I may need to take a vitamin D supplement."
  - "I should try to eat more spinach."

3. A nurse is caring for a client with diabetes. Which of the following nutritional habits would be most likely to optimize endocrine wellness for this client?
  - a. Eating a diet high in saturated fats
  - b. Consuming complex carbohydrates
  - c. Eating a low-fiber diet
  - d. Consuming refined carbohydrates
  
4. A client presents with symptoms of polycystic ovary syndrome (PCOS). Which nutritional plan would be most likely to optimize endocrine wellness for this client to regulate hormonal imbalances?
  - a. Consuming a diet high in refined carbohydrates
  - b. Limiting complex carbohydrates
  - c. Consuming a diet low in fiber
  - d. Eating a diet low in processed and packaged foods
  
5. A client presents with symptoms of hypoglycemia. Which nutritional strategy would be most effective in optimizing endocrine wellness for this client to maintain blood sugar levels?
  - a. Consuming a low-fiber diet
  - b. Consistently eating refined carbohydrates
  - c. Consuming a diet high in protein and unsaturated fats
  - d. Eating a low-fat diet
  
6. Which nutritional strategy would be most beneficial for a client with Addison's disease?
  - a. Limiting salt intake
  - b. Limiting potassium intake
  - c. Increasing calcium intake
  - d. Increasing vitamin C intake
  
7. A client with newly diagnosed diabetes presents for education on dietary modifications. Which of the following is an appropriate method for the nurse to assess the client's readiness to learn?
  - a. Ask the client to recite the appropriate dietary modifications for diabetes.
  - b. Ask the client about their prior knowledge of diabetes and dietary modifications.
  - c. Provide the client with written materials on diabetes and dietary modifications.
  - d. Ask the client to demonstrate how to administer insulin.
  
8. Which of the following indicates the diet plan for the client with diabetes type 2 needs to be adjusted?
  - a. The client reports weight loss.
  - b. The client's hemoglobin A1C level has remained at 5.2%.
  - c. The client's hemoglobin A1C has increased to 9.5%.
  - d. The client has not experienced hypoglycemia.
  
9. The nurse is reviewing the dietary recall of a client recently diagnosed with hypothyroidism. Which of the following foods the client documented they ate frequently indicates the need for additional diet instruction?
  - a. Shrimp
  - b. Low-fat milk
  - c. Nuts
  - d. Cabbage
  
10. A client with hyperthyroidism is prescribed a nutritional plan to optimize endocrine wellness. Which of the following food choices align with the recommended diet?
  - a. Canned tuna
  - b. Canned meats
  - c. Shellfish
  - d. Unsalted nuts

## Suggested Reading

- Centers for Disease Control and Prevention. (2023). Diabetes. <https://www.cdc.gov/diabetes/index.html>
- National Institute of Diabetes and Digestive and Kidney Diseases. (n.d.). *Diabetes for health professionals*. <https://www.niddk.nih.gov/health-information/professionals/clinical-tools-patient-management/diabetes>
- Office on Women's Health. (2021). *Thyroid disease*. A-Z Health Topics. <https://www.womenshealth.gov/a-z-topics/thyroid-disease>
- Young, W. (2022). *Overview of endocrine disorders*. Merck Manual Professional Version. <https://www.merckmanuals.com/professional/endocrine-and-metabolic-disorders/principles-of-endocrinology/overview-of-endocrine-disorders>

## CHAPTER 8

# Special Nutritional Considerations for Endocrine Health



**FIGURE 8.1** Nutrition from colorful fruits and vegetables plays a role in endocrine function. (credit: modification of work “Colors and vitamins!” by Julien Lehuen/Flickr, CC BY 2.0)

## CHAPTER OUTLINE

- 8.1 The Impact of Nutrition on Endocrine Wellness Across the Lifespan
- 8.2 Nutrition and Chronic Endocrine Illnesses
- 8.3 Treatments and Nutrition

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**INTRODUCTION** Eight major hormone-secreting glands make up the complex endocrine system. The hormones control growth, development, metabolism, reproductive function, and state of mind. Because nurses are responsible for assessing clients as part of the initial stages of the nursing process, an understanding of normal endocrine physiology will alert the nurse to any deviations when assessing endocrine function during the head-to-toe client assessment. The nurse must also understand how nutrition plays a role in reparative processes and optimum endocrine function throughout the lifespan and when clients have chronic endocrine conditions.

Consider this case: Sarah Yellowhorse is a 30-year-old Native American woman beginning the third trimester of her first pregnancy. She has arrived at the clinic for her 24–26-week checkup. Her vital signs are within defined limits, and her weight gain is as expected for this stage of her pregnancy. She has no history of diabetes or significant medical or surgical conditions. However, she has a family history of diabetes types 1 and 2. Her mother was diagnosed at 3 years old with type 1 diabetes, and last year her father was diagnosed at age 56 with type 2 diabetes. Sarah is concerned about her risk for developing gestational diabetes due to her ethnicity and family history. She consumes some vegetables, such as squash and corn, but she has been eating more potatoes and processed foods.

## 8.1 The Impact of Nutrition on Endocrine Wellness Across the Lifespan

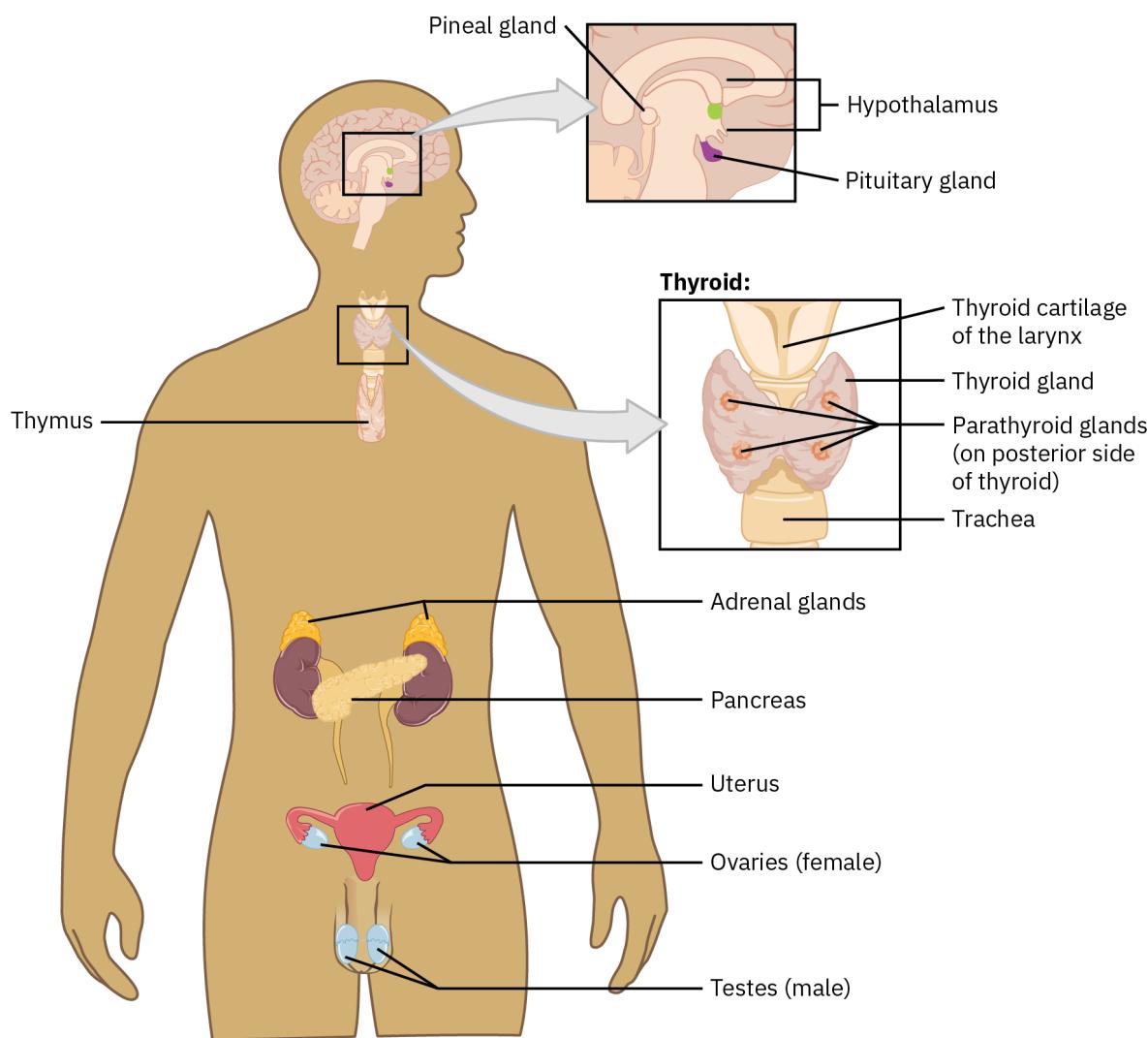
### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 8.1.1 Describe the impact of nutrition on the endocrine system during pregnancy.
- 8.1.2 Describe the impact of nutrition on the endocrine system during infancy.
- 8.1.3 Describe the impact of nutrition on the endocrine system during childhood.
- 8.1.4 Describe the impact of nutrition on the endocrine system during adolescence.
- 8.1.5 Describe the impact of nutrition on the endocrine system during adulthood.
- 8.1.6 Describe the impact of nutrition on the endocrine system during later adulthood.

### Pregnancy

A cascade of endocrine-related changes occurs during pregnancy. Many of these physiologic changes occur in the endocrine system ([Figure 8.2](#)) to prepare the pregnant individual for fetal growth and bodily changes during pregnancy. The placenta drives these changes by producing **human chorionic gonadotropin (HCG)** (Kepley et al., 2023). This hormone stimulates the corpus luteum to produce the progesterone necessary for growing and maintaining a fetus, and it changes the pregnant individual's immune function to protect the fetus from immune rejection. HCG also stimulates the ovaries to increase estrogen and progesterone production until weeks 10–12 of pregnancy, when the maturation of the placenta is complete (Herrick & Bordoni, 2023). The placenta then takes over the production of those hormones throughout the pregnancy. In addition, the pregnant individual's hypothalamus creates and releases thyrotropin-releasing hormone (TRH) to stimulate thyroid-stimulating hormone and prolactin from the pituitary gland (sometimes called the master gland).

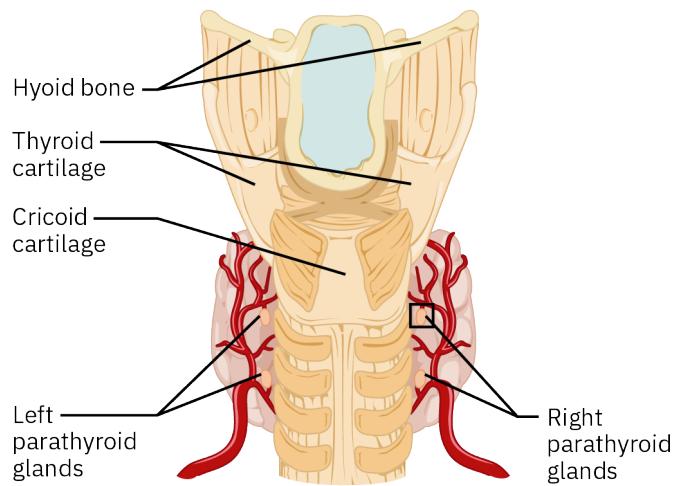


**FIGURE 8.2** The endocrine system is made up of eight major glands: the adrenal glands, hypothalamus, pineal gland, pituitary gland, pancreas, ovaries or testes, thyroid gland, and parathyroid glands. (credit: modification of work from *Anatomy and Physiology 2e*, attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

The placenta increases TRH, thus stimulating the pituitary gland, which then increases **thyroid-stimulating hormone (TSH)**, a hormone that triggers secretion of thyroid hormones by the thyroid gland. Thyroid hormone production increases by 50% throughout pregnancy (Singh & Sandu, 2023). These hormones include **triiodothyronine (T3)** and **thyroxine (T4)**, which regulate weight, energy levels, and metabolism. The influx of thyroid hormones is required for fetal brain development and thyroid function (Kepley et al., 2023). The parathyroid gland ([Figure 8.3](#)) secretes parathyroid hormone (PTH) to generate and maintain sufficient calcium levels for fetal growth (Hysaj et al., 2021). PTH allows adequate calcium absorption during pregnancy by maintaining ionized blood calcium phosphate levels by monitoring extracellular calcium concentrations (a lower calcium concentration triggers the release of PTH). Other functions of PTH include conserving calcium, decreasing phosphate reabsorption, and stimulating vitamin D production needed for the intestinal absorption of calcium. Vitamin D deficiency in pregnant clients is associated with elevated PTH levels (Hysaj et al., 2021). PTH concentration during the first trimester is in the lower normal range, but during the pregnancy, PTH levels increase to reach mid-normal range by the third trimester (Hysaj et al., 2021). The pituitary gland increases by approximately 136% because of lactotroph hyperplasia, which results in an influx of prolactin (Nana & Williamson, 2022). Prolactin levels increase by 10 times during pregnancy to promote breast tissue development for later milk production.

The corpus luteum and placenta release a peptide called **relaxin**, which affects the connective tissue in the body. It has several effects in pregnancy (Kepley et al., 2023). Relaxin softens the birth canal, supports growth of mammary

glands, and prevents premature uterine contractions. Relaxin also facilitates the release of nitric oxide, which promotes systemic vasodilation resulting in decreased maternal blood pressure. In addition to the changes caused by relaxin, cortisol levels increase during pregnancy, which is vital for fetal brain development (Kepley et al., 2023). However, excessively elevated glucocorticoid levels impair neurodevelopment in the fetus. To combat pain during labor, endorphin and enkephalin levels increase.



**FIGURE 8.3** The parathyroid glands are small oval glands located next to the thyroid gland in the neck. (credit: modification of work from *Anatomy and Physiology* 2e. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Impact of Nutrition on the Endocrine System During Pregnancy

Nutrition during pregnancy is vital for the health of both the pregnant client and the fetus. Normal hormonal changes cause disruptions in the pregnant individual's body, and nutritional requirements change throughout the pregnancy with the need to support the nutrition of both the client and the fetus. A balanced diet, micronutrients, and intake of omega-3 fatty acids promote a healthy pregnancy during hormonal changes. To prevent a vitamin D deficiency, the National Institutes of Health (2022c) recommends a daily intake of 15 mcg during pregnancy and lactation.

Pregnancy requires proper nutrient-rich foods to support optimal endocrine function and ensure the health of both the pregnant client and the fetus (Jouanne et al., 2021). The pregnant client needs carbohydrates to fuel the increased energy demands of the growing fetus (U.S. Department of Agriculture, 2020). These carbohydrates support proper hormone production, including insulin, which regulates blood glucose levels. The growing fetus needs adequate protein to develop and to produce hormones. Healthy fats play a role in hormone synthesis, fetal development, and absorption of fat-soluble vitamins (Jouanne et al., 2021). [Table 8.1](#) lists macronutrient intake ranges for the pregnant client. A registered dietitian specializing in prenatal nutrition can guide the pregnant client to support the fetus, client, and the endocrine function of both.

Macronutrient	Percentage of Total Daily Calories	Food Sources
Complex carbohydrates	45–65%	Whole grains, fruits, and vegetables (preferred carbohydrate source)
Protein	10–35%	Lean meats, poultry, fish, eggs, legumes, and dairy products
Healthy fats	20–35%	Avocados, nuts, plant-based oils, fatty fish, flaxseed, and walnuts

**TABLE 8.1** Macronutrient Intake to Support Pregnant Client and Fetus (sources: Jouanne et al., 2021; U.S. Department of Agriculture, 2020)

### Pregnancy Complications: Hyperemesis Gravidarum

Some pregnant clients experience **hyperemesis gravidarum**, a condition during pregnancy characterized by extreme, persistent nausea and vomiting. Although the exact cause is unknown, genetic predisposition and hormonal and gastrointestinal changes may play a part. The hormonal change theory involves the dramatic increase

in HCG because some correlational studies show elevations in HCG with hyperemesis gravidarum. Estrogen is also believed to be a contributing factor. As estrogen levels rapidly increase, so does vomiting. Estrogen-containing medications are known to cause nausea and vomiting as a side effect, which supports this theory. Lower esophageal sphincter relaxation during pregnancy is the basis for the gastrointestinal change theory. Even though the basis for this theory is structural, hormones still play a role. It is theorized that the increased levels of progesterone and relaxin hormones circulating in the bloodstream contribute to the relaxation of the lower esophageal sphincter. The lower esophageal sphincter closes to prevent acid from traveling back up the esophagus, as occurs during acid reflux. However, the relaxin hormone limits the functionality of the esophageal sphincter, contributing to heartburn.

Hyperemesis gravidarum complicates pregnancy because it can prevent the client and fetus from absorbing vital nutrients. Nutritional recommendations for a client with hyperemesis gravidarum include switching the prenatal vitamins to folic acid supplements only and the inclusion of a ginger supplement. There is limited research on diets changes that can minimize nausea and vomiting during pregnancy. One correlational study found fewer symptoms among women who consumed vegetables, fruits, and beans or legumes. However, women with elevated HCG levels in the same study who consumed increased amounts of processed white bread had a higher incidence of hyperemesis gravidarum (Tan et al., 2021).

### Pregnancy Complications: Gestational Diabetes

Pregnant clients may have preexisting diabetes (either type 1 or type 2) or may develop diabetes during pregnancy, which is known as **gestational diabetes** (GD). GD is a disorder that occurs as the result of changes caused by human placental lactogen, a hormone that helps regulate insulin secretion, which leads to dysfunction or delayed response of the beta cells to blood glucose, thereby producing glucose intolerance (Quintanilla Rodriguez & Mahdy, 2022; Rasmussen et al., 2020). Other hormones associated with GD include corticotropin-releasing hormone and progesterone because these hormones are associated with insulin resistance and elevated blood glucose levels. These changes typically occur around the 24th to 28th week of pregnancy, with some individuals having complete resolution after childbirth. However, clients who experience GD have an increased risk for type 2 diabetes later in life.

Risk factors for GD include obesity, family history, a history of GD with previous pregnancy, polycystic ovary syndrome, and high-risk race or ethnicity (Quintanilla Rodriguez & Mahdy, 2022). A recent study of live births in the U.S. found that the rates of gestational diabetes among pregnant women with their first live birth increased across all race and ethnicity groups between 2011 and 2019 (Shah et al., 2021). However, rates were significantly higher among most non-Hispanic Asian and Hispanic/Latina subgroups compared to non-Hispanic White individuals.

## SPECIAL CONSIDERATIONS

### Greater Risk for Gestational Diabetes

In the U.S., American Indian and Alaska Native (AI/AN) women have higher rates of GD compared to non-Hispanic white women (Stotz et al., 2021). A recent study found AI/AN women were aware of the role of nutrition for maintaining a healthy weight during pregnancy and decreasing the risk for type 2 diabetes, but they were not aware that these principles could be applied to reduce their risk for GD. These findings highlight the need for culturally relevant diet instruction and interventions to address this disparity.

Nutritional considerations are the main factors for glucose control (Rasmussen et al., 2020). Pregnant clients with GD should receive recommendations from their obstetrician and counseling from a registered dietitian and diabetes expert. The nurse maintains sacred relationships with their clients, and this opportunity gives the nurse an advantage in educating them on the correct micronutrient and macronutrient consumption before diabetes counseling occurs. Many clients believe that blood glucose is solely related to sugar consumption and do not understand that the body breaks down carbohydrates to glucose, thus affecting blood glucose levels (Chen et al., 2020; Rasmussen et al., 2020). In addition, when individuals consume insufficient carbohydrates and increase their fat intake, they can develop elevated levels of serum fatty acids. This increase in serum fatty acids results in increased insulin resistance as well as higher than expected fetal fat accumulation and infant adiposity (Rasmussen et al., 2020).

Low-glycemic, high-fiber foods such as vegetables, legumes, nuts, fruits, and whole grains are recommended

(Rasmussen et al., 2020). Other healthy diet options include lean proteins such as chicken, turkey, and salmon (which contains omega-3 fatty acids) and healthy fats such as avocados and nuts. Pregnant clients also need to consider portion control when consuming carbohydrates. The California MyPlate for Gestational Diabetes provides a visual example of recommendations for the pregnant client (California Department of Public Health, 2018).

Pregnant clients should consume the recommended amounts of folic acid, vitamin D, iron, and calcium. Currently, there is no evidence to suggest that taking additional amounts of these micronutrients affects GD (Rasmussen et al., 2020).

The **glycemic index** is a system that ranks carbohydrate-containing foods based on their ability to raise blood sugar levels quickly or significantly (Rasmussen et al., 2020). Different carbohydrates vary in their ability to raise blood sugar levels based on the chemical structure of the food and their digestibility and absorbability. The scale goes from 0 to 100, with higher values indicating faster and higher blood sugar levels. Although this tool is valuable, it does not consider the amount of carbohydrates consumed, only the number of carbohydrates per serving size. In contrast, glycemic load considers a food item's glycemic index and total carbohydrate content. It accurately represents how specific foods in specific quantities affect blood sugar levels.

Nurses should instruct clients to consume foods on the lower end of the glycemic index spectrum because these foods will help them manage their blood glucose properly. Nurses should also advise clients to check the glycemic load before consuming a meal to know how those foods will impact their blood glucose. Pregnant clients with GD also need to be advised on the frequency and consistency of meals. Three main meals and 2 or 3 smaller meals or snacks eaten at the same time each day are recommended to avoid excessive food intake and ensure steady blood glucose levels throughout the day. Rasmussen et al. (2020) suggest carbohydrate intake at breakfast of 30 g maximum (equivalent to 2 slices of bread or 1 bowl of cereal), based on limited research that shows elevated blood glucose levels in the morning.



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Sarah goes to the laboratory before her 24–28-week check for her oral glucose tolerance test (OGTT). Her results show an elevated level, indicating a need for further testing, so a second OGTT is ordered for confirmation. Following the second OGTT, Sarah is diagnosed with GD. Sarah is referred to a registered dietitian who specializes in GD. Sarah and the dietitian develop a personalized meal plan:

- Morning: 30 g of carbohydrates—2 slices of toast with poached eggs
- Snack: a serving of vegetables and hummus
- Lunch: 60 g of carbohydrates—sandwich on whole grain bread with lean shredded chicken and vegetables such as lettuce; she eats a serving of fruit such as an apple, and drinks mainly water
- Snack:  $\frac{1}{4}$  cup of almonds
- Dinner: Lean protein with vegetables and 60 g of brown rice

Sarah is taught to monitor her blood glucose levels and to engage in some physical activity. Her health care provider started her on a low dose of 500 mg metformin twice daily. Her subsequent examination will occur at 32 weeks' gestation. The nurse encourages Sarah to call the office if she has any questions or concerns before her next appointment and to adhere to the treatment plan. The nurse also encourages her to communicate openly with her health care team throughout the pregnancy.

1. The consumption of which nutrient should Sarah most closely monitor to manage her blood glucose levels?
  - a. Water
  - b. Fats
  - c. Proteins
  - d. Carbohydrates

2. The nurse asks Sarah about her protein intake. Sarah reports that she has been regularly craving and eating cheeseburgers. Why should the nurse be concerned about this finding?
- Sarah is not choosing lean protein sources.
  - Sarah is eating too much cheese.
  - Eating a lot of red meat can indicate anemia.
  - This is not a concerning finding as long as Sarah is consuming adequate amounts of food.

### Chronic Pregnancy Complications: Thyroid Disease

Thyroid hormones change during pregnancy, especially when the pregnant individual already has a chronic thyroid condition (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDK], 2017; Singh & Sandhu, 2023). Long-term thyroid disorders such as **hypothyroidism** (the thyroid gland does not produce enough thyroid hormone) or **hyperthyroidism** (the thyroid gland produces and excretes too much thyroid hormone) require careful management and oversight during pregnancy to ensure proper fetal growth and overall well-being of both the pregnant client and fetus. Proper thyroid hormone levels ensure the baby's brain and nervous system develop correctly. As previously discussed, during normal pregnancy T4 levels remain unchanged; during hypothyroidism, T4 levels register as low, and TSH levels elevate as the pituitary gland attempts to trigger the thyroid to release more T4. Sometimes, T4 can remain within normal limits, and only TSH is elevated (NIDDK, 2017; Singh & Sandhu, 2023). Some signs of hypothyroidism include exhaustion, cold intolerance, muscle cramps, constipation, and memory or concentration problems.

The goal of treatment during pregnancy is to maintain maternal hyperthyroidism at the expected upper limits using the lowest effective prescribed dose of medication while avoiding fetal hypothyroidism. The treatment modality remains based on the etiology of hyperthyroidism. Graves' disease is treated with antithyroid, beta blockers, and surgical interventions while monitoring for gestational thyrotoxicosis during pregnancy.

Nurses must remain cognizant of nutritional recommendations as they develop teaching and discharge plans. Nutritional recommendations for pregnant clients include sufficient iodine intake. Good nutritional sources of iodine include dairy, seafood (watch out for elevated mercury—seafood options), eggs, meat, and poultry (NIDDK, 2017; U.S. Food and Drug Administration, 2023). Iodine is added to table salt and to some prenatal vitamins. Nazeri et al. (2021) found that iodine supplementation can improve iodine levels in pregnant individuals, but the effects on the fetus have not yet been established.



### SAFETY ALERT

#### Mercury Consumption

Pregnant individuals need to be aware of mercury consumption during pregnancy. Mercury is a toxic metal with serious adverse effects for the developing nervous system. Fish containing high levels of mercury include shark, swordfish, and king mackerel; fish with low levels mercury include salmon, trout, and shrimp (U.S. Food and Drug Administration, 2023).



### UNFOLDING CASE STUDY

#### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Sarah delivers a baby girl at 38 weeks' gestation weighing 9 lb 1 oz. Sarah followed the recommendations of her nurse, dietitian, and health care provider, and her blood glucose levels are now at baseline pre-pregnancy levels. Because Sarah is at increased risk for developing type 2 diabetes, her nurse needs to incorporate this information into Sarah's postpartum education.

3. Sarah asks if her diabetes will recur now that she is no longer pregnant. How should the nurse respond?

- a. "You need to be monitored 6 weeks after delivery for the signs of diabetes."
  - b. "Now that you are no longer pregnant, your diabetes has resolved and is no longer an issue."
  - c. "Having gestational diabetes increases your risk for developing type 1 diabetes later."
  - d. "Having gestational diabetes increases your risk for developing type 2 diabetes later."
4. The nurse reviews diet strategies with Sarah to decrease her risk for developing type 2 diabetes. Which of the following statements indicates additional instruction is needed?
- a. "I will limit my intake of concentrated sweets."
  - b. "I will avoid eating nuts."
  - c. "I will try to eat different fruits and vegetables."
  - d. "I will incorporate protein into my meals and snacks."
- 

## Infancy

The endocrine system undergoes extensive development during infancy. The hypothalamus and pituitary gland's primary function encompasses controlling and releasing hormones that regulate growth and metabolism. These two glands are in the brain and mature during infancy to allow for appropriate hormone secretion. Growth hormone encourages growth and development. Growth hormone is at a high level during infancy and contributes to rapid developmental alterations during the first year of life (Murray & Clayton, 2022). The thyroid gland produces the hormones triiodothyronine (T3) and thyroxine (T4), which are required for cellular proliferation and differentiation, energy balance, cardiovascular physiology, and overall growth and development.

During the first few weeks of life, infants use hormones acquired from their mothers via the placenta until their thyroid gland takes over hormone production and secretion. The adrenal glands (located above the kidneys) produce cortisol and aldosterone. Cortisol regulates metabolism, the stress response, and immune function, and aldosterone maintains salt and fluid balance (Kiebzak et al., 2021). Insulin and glucose are hormones regulated by the beta cells in the pancreas. Infants remain sensitive to insulin, which allows for glucose stability. As with the other endocrine glands, the pancreas continues its development during infancy, and hormonal regulation and overall control continue to mature throughout infancy.

Macrosomia refers to a newborn who is significantly larger than average for their gestational age (Akanmode & Mahdy, 2023). This condition is seen more frequently in infants whose mothers are obese, had GD, or had a postdate pregnancy (Akanmode & Mahdy, 2023). Sustained elevations in a pregnant client's blood glucose levels transfer through the placenta to the fetus, resulting in fetal hyperglycemia. This causes hyperplasia of the beta islet cells in the infant's pancreas, leading to overutilization of glucose and storage by the fetus, resulting in increased fetal weight (Akanmode & Mahdy, 2023). Other factors affecting the fetus with fetal hyperglycemia include fetal adiposity and hyperinsulinemia.

### Impact of Nutrition on the Endocrine System During Infancy

Blood glucose problems take the form of neonatal hypoglycemia or hyperglycemia. The definition of **hypoglycemia** is a blood glucose level at or below 40 mg/dL in the first 4 hours of life and a level below 45 mg/dL between the 4th and 24th hours (target level is 90–100 mg/dL; Kurtoglu et al., 2019; Rozance, 2023). Clients experiencing hypoglycemia during these time frames are categorized as having transient neonatal hypoglycemia. Hypoglycemia that persists longer than 60 minutes despite medical interventions is referred to as prolonged hypoglycemia.

Hypoglycemic conditions can develop among infants in the following situations: small for gestational age, sepsis, asphyxia, premature birth, transient hyperinsulinemia, diabetes during pregnancy, intrauterine growth restriction, toxemia, and increased metabolic requirements. The signs and symptoms in a newborn include tremors, irritability, diaphoresis, tachypnea, decreased sucking ability, and high-pitched cry leading to lethargy, hypertonicity, convulsions, and coma.

When treating hypoglycemia, oral feedings are preferred. However, if the infant is unable to take an oral feeding, or if no improvement occurs after 30 minutes, then 2 mL/kg 10% dextrose is given intravenously over 1 min; if the infant has a seizure, 4 mL/kg should be given. Subsequently, glucose is given intravenously at 6–8 mg/kg/min (Kurtoglu et al., 2019). Discontinue intravenous glucose supplementation and resume solely oral feedings after clearance by the pediatrician or neonatologist.

**Hyperglycemia** in a newborn refers to a blood glucose level greater than 125 mg/dL or a plasma glucose level greater than 150 mg/dL (Kurtoglu et al., 2019). Before the development of the pancreas and beta cells, the insulin receptors are not mature, and insulin production and secretion remain low. Neonatal hyperglycemia may be seen in preterm babies following bouts of hypoglycemia resulting from glucose and lipid infusion. Hyperglycemia increases the preterm infant's susceptibility to infection, oxidative stress, bronchopulmonary dysplasia, prolonged hospitalization, retinopathy, and mortality (Kurtoglu et al., 2019). Continuous monitoring remains important during this situation. Treatment includes decreasing the rate of glucose administration and adjusting the rate of insulin administration to keep the plasma glucose level between 150 and 200 mg/dL (Kurtoglu et al., 2019).



### CLINICAL TIP

#### Macrosomia

Infants with macrosomia require lab work and close monitoring after birth for respiratory and metabolic issues. Clinical evaluation of the infant's respiratory effort following delivery is vital because meconium aspiration (when the newborn breathes in a mixture of stool and amniotic fluid during delivery) and transient tachypnea are more frequently seen in infants with macrosomia. Blood work should also be drawn immediately after delivery. These infants are at risk for hypoglycemia, hypocalcemia, hypomagnesemia, increased bilirubin (due to increased hemolysis and inefficient enterohepatic circulation), and polycythemia.

#### Childhood

A child's growth, health, and development depend on a functioning endocrine system. The hormones act as chemical messengers to control physical functions and physiologic development, including growth, metabolism, sexual development, and other physical functions. As children undergo critical and rapid alterations, the main hormonal signals are sent from the hypothalamus and the pituitary gland. These two endocrine organs stimulate the production and release of specific hormones that target the other endocrine glands.

A child's endocrine system goes through many phases as it is stimulated during the growth and development of the thyroid, adrenal glands, pancreas, and gonads (testes in males and ovaries in females). The hormones are necessary for optimal development as the child prepares for **puberty** (a stage of development in which sexual maturation and reproduction capabilities refine and mature). The pituitary gland produces growth hormone, which plays an integral role in the child's growth. **Insulin-like growth factors** (IGF) play a role in mediating growth hormones; both growth hormone and IGF are peptide hormones that effect growth, maintain bone mass, and aid in cellular differentiation (Caputo et al., 2021).

Growth hormone and IGF promote bone and tissue growth, adequate nutrients, and hormone balance, which all play integral roles in overall growth and development across the lifespan (Caputo et al., 2021). Without IGF, the utilization of nutrients at the cellular and tissue levels would be compromised. Growth hormone and IGF maintain a correlational relationship with insulin secretion, leading to the possibility that growth hormone and IGF affect carbohydrate metabolism (Caputo et al., 2021). IGF enhances insulin sensitivity because it prompts glucose uptake.

Dietary guidelines for this age group recommend plant-based fiber because it incorporates amino acids that impact nutrient metabolism and absorption. Protein (lean meat and dairy products) and amino acids are essential for healthy growth and development because they play an anabolic role similar to that of growth hormone and IGF. The recommendation is 5–20% for children ages 2–3 and 10–30% for older children and adolescents (U.S. Department of Agriculture, 2020).

#### Impact of Nutrition on the Endocrine System During Childhood

Children are not immune to endocrine dysfunction. The nurse must recognize that proper balanced nutrition is vital in supporting optimal endocrine function and development in children and across the lifespan. Children require balanced nutrition to support the production and regulation of hormones (Caputo et al., 2021; U.S. Department of Agriculture, 2020). Proteins are the building blocks of neurotransmitters and hormones. Amino acids used to construct proteins stimulate growth hormone and IGF secretion.

A balanced diet includes a wide selection of nutrient-rich foods. When children do not get the proper nutrition they need, they may be diagnosed with failure to thrive, meaning their weight gain is significantly below that of other

children of the same age and sex. A mix of fruits and vegetables, whole grains, lean proteins, and healthy fats encourages growth, development, and proper endocrine function (Caputo et al., 2021). The U.S. Department of Agriculture recommends that children consume 2 or 3 servings of vegetables per day, 2 or 3 servings of fruit, 3 servings of dairy products, 4–6 oz of lean proteins per day, and limited sugary, processed, and fried foods ([Figure 8.4](#)). Fruits and vegetables provide many anti-inflammatory and vital vitamins and nutrients for proper endocrine function. Diets high in protein increase growth hormone and IGF secretion levels, ensuring adequate growth (Caputo et al., 2021). Protein comes from lean meats, poultry, fish, eggs, dairy, legumes, and plant-based protein sources such as tofu.



**FIGURE 8.4** A breakfast that includes fruits, whole grain, and dairy can be fun and encourage children to meet recommended daily nutritional guidelines. (credit: “Breakfast for kids: ‘Berry Bears’” by Ritas Safo/Flickr, Public Domain)

Healthy fats include avocados, seeds, nuts, and plant-based oils. These fats aid in hormone production and remain a supportive element of brain development.

Carbohydrates should be mainly whole grains, such as oats, brown rice, whole wheat bread, and quinoa. Refined sugars and processed foods should be avoided. These recommended carbohydrate options allow for slower energy release and limit blood glucose spikes while providing sustained energy. Children need micronutrients such as calcium, vitamin D, iron, zinc, selenium, and iodine for proper endocrine health. These micronutrients are found in a variety of fruits and vegetables. These recommendations are designed for the general population, but clients diagnosed with a medical condition may need a referral to a registered dietitian. The National Institutes of Health Office of Dietary Supplements provides [recommendations on micronutrient intake by age](#) (<https://openstax.org/r/odnihgovfact>).

### Childhood Obesity and Malnutrition

Obesity in childhood is common, occurring in approximately 17% of youth ages 10–17 (Robert Wood Johnson Foundation, 2023). Although such children look overnourished, the opposite is true (Kobylinska et al., 2022).

**Malnutrition** occurs when the body either does not receive sufficient nutrients or is unable to absorb essential nutrients. The individual’s body composition changes, and functions are impaired (Kobylinska et al., 2022). Obesity and malnutrition share a paradoxical relationship. Although obese children receive an abundance of calories, these calories may lack essential nutrients to promote daily performance, encourage proper growth and development, and encourage overall bodily homeostasis. Moreover, the child with obesity cannot fully absorb the essential nutrients because of systemic inflammation (Kobylinska et al., 2022).

Malnutrition in children with obesity may result from poor dietary choices (nutrient-poor foods), sedentary lifestyles, socioeconomic factors (limited access to healthy and wholesome foods), or lack of nutritional education. These

children are at increased risk for developing chronic diseases such as type 2 diabetes, cardiovascular disease, and metabolic syndrome. Addressing this condition requires the collective efforts of family, caregivers, health care providers, nurses, dietitians, and communities.

### Childhood: Precocious Puberty

Precocious puberty, also known as early development of secondary sexual characteristics, begins before the age of 8 years in females and 9 years in males (Breehl & Caban, 2023). Precocious puberty may be caused by many different endocrine-related factors, including obesity (Soliman et al., 2022). Several correlational studies show high-caloric intake with early puberty onset (Soliman et al., 2022). For example, excessive weight or obesity in childhood has a correlational relationship with the development of precocious puberty (Chen et al., 2017). The mechanism of the link between obesity and precocious puberty is still under investigation.

### Adolescence

Many changes occur within the endocrine system during adolescence. As puberty progresses in adolescence, sexual maturation and reproduction capabilities refine and mature; these capabilities define puberty (Breehl & Caban, 2023). The primary physiological function of puberty is the production of mature adults capable of sexual reproduction. Hormonal changes trigger the onset of puberty, which occurs between the ages of 8 and 13 years in females and 9 and 14 years in males. The physical changes associated with puberty in females include breast development, menarche, and growth of pubic and axillary hair. In males, the changes include genitalia development, voice deepening, increasing height, and growth of pubic hair.

The endocrine glands involved in puberty include the hypothalamus, pituitary gland, adrenal glands, ovaries, and testes. All of the hormones affect nearly every organ system in the body. For example, in the musculoskeletal system, the muscles grow; the circulatory and respiratory systems see rapid growth. The nervous system is influenced by hormonal changes as well. The increase in estrogen and testosterone affects the limbic system through receptor binding, stimulating the sex drive and increasing the emotional roller coaster (Breehl & Caba, 2023). Children might undergo these changes earlier in life (precocious puberty) or experience delayed puberty (after age 13 in females or age 14 in males).

### Impact of Nutrition on the Endocrine System During Adolescence

Nutritional recommendations are crucial for adolescents transitioning from childhood into sexual maturity (Soliman et al., 2022). The rapid changes and increasing energy demand for protein and micronutrients remain necessary for growth and development during this stage of life. Food insecurity, obesity, and body dysmorphia prevent this age group from getting the necessary nutrients. Evidence-based data supporting dietary recommendations for adolescents going through puberty are limited (Soliman et al., 2022). The *Dietary Guidelines for Americans 2020–2025* recommend 3 servings of vegetables, 2–2½ servings of fruits, 7–10 servings of grains, 3 servings of dairy products, and 5–7 oz of lean protein (such as chicken, poultry, and seafood) per day (U.S. Department of Agriculture, 2020). The recommendations also include limiting fried, fatty, and processed foods.



### TRENDING TODAY

#### Type 2 Diabetes on the Rise in Adolescents

*As you work through this Trending Today feature, recall that nurses should rely on evidence-based practice (EBP), which uses scientific evidence rather than anecdotal evidence, to inform their practice and care of clients. Nurses should encourage clients to evaluate nutritional information on social media with the same scrutiny.*

Type 2 diabetes in children and adolescents is on the rise due to an increase in childhood obesity (Teska, 2023). Nurses need to consider nutritional aspects to effectively impact childhood obesity.

On social media, adolescents may view numerous pop-up ads about food and nutrition, which may impact their dietary choices. Research by Chung et al. (2021) addresses the impact of food advertisement via social media on the dietary choices adolescents make.

First, read the report [Adolescent Peer Influence on Eating Behaviors via Social Media: Scoping Review](https://openstax.org/r/adolescent) (<https://openstax.org/r/adolescent>) (Chung et al., 2021).

Next, take some time to review the following social media content and think critically about the information provided and its appeal to adolescent clients:

- [@healthywellnesstips \(Instagram\)](https://openstax.org/r/healthywellnesstipsinsta)
- [Kids Nutrition & Recipes \(Facebook\)](https://openstax.org/r/kidsnutrition)
- [Mayo Clinic Minute: How to help overweight kids get healthier \(YouTube\)](https://openstax.org/r/mayo)

Now answer the following questions:

1. What is the purpose of the social media content you viewed or read?
2. How might this social media content influence the dietary choices of adolescents?
3. If a client came to you with this information, how would you educate them to critically use these sources?
4. How does the social media content you reviewed support or refute the findings in the review by Chung et al.?
5. What alternative sources would you recommend to clients to educate them about this topic?

The nurse should perform a thorough nutritional assessment by asking the adolescent client about their favorite foods, the foods they consume both at home and when they are with their peers, the number of servings of nutrient-dense foods they eat each day, and ways that social media may be influencing their dietary habits. Adolescents who do not consume enough nutrient-rich foods may be at risk for deficiencies of iron, folate, vitamin B<sub>6</sub>, and vitamin B<sub>12</sub>, which might delay their growth and development, as well as puberty.

## Adulthood

The human body in adulthood continues to rely on the homeostasis, metabolic requirements, development, and reproduction function that the endocrine system provides through the secretion of hormones (Campbell & Jialal, 2022). Physiologic changes continue as adolescents transition into young adults and then into adulthood. These changes include peak physical growth; sexual maturation; brain development; and reproductive, metabolism, and hormonal stability. Women stop growing earlier than men do, between 20 and 35 years of age, whereas men continue to grow into adulthood and reach peak physical strength and stamina between 30 and 40 years of age.

Adults also reach sexual maturation. Sexual maturation and reproductive system markers include regular menstrual cycles for females and peak testosterone production for males. Secondary sexual characteristics such as breast development in females and facial hair growth in males reach full development. Growth hormone continues to play a role in adulthood, as male skeletal growth is typically completed during this stage of life. Growth hormone contributes to muscle growth, repair, and maintenance. Thyroid hormones, including T4 and T3, play a role in metabolism, heart function, and energy regulation. Insulin regulates blood glucose levels; during adulthood, nondiabetic adults respond effectively to the insulin their bodies produce, allowing them to fully use the carbohydrates consumed and aid in the metabolism process.

As in all stages of life, the body continuously attempts to achieve homeostasis. This hormonal balance is crucial for overall health, reproductive function, mood regulation, and metabolism. Hormonal changes vary based on individuals' genetics, lifestyle, and overall health. Nutrition integrates within the system to help it reach homeostasis.

Nutrition plays a pivotal role in the health of adults for optimal endocrine function and prevention of endocrine dysfunction (Caputo et al., 2021). The role of healthy nutrients includes overall health and endocrine disorder prevention; energy-based performance; weight management; bone, mental health, and cognitive function; healthy aging; and disease management and healing. A balanced diet includes whole grains, lean protein, fruits, vegetables, healthy fats, and water. Micronutrient foods include antioxidant-rich foods, containing vitamins A, C, D, zinc, iodine, selenium, iron, and magnesium, which decrease inflammation and the inflammatory process, containing vitamins A, C, D, zinc, iodine, selenium, iron, and magnesium. Foods that contain these important micronutrients include leafy green vegetables, citrus fruits, berries, nuts, seeds, lean meats, fatty fish, dairy, and whole grains. The nurse should advise individuals to avoid processed and refined sugary foods and beverages to encourage optimal endocrine function. Heavily processed foods contribute to inflammation, insulin resistance, and hormonal imbalances.

## Later Adulthood

Age-related changes affect every endocrine organ (van den Beld et al., 2018). As the function of the organ system

begins to decline with age, other factors, such as inflammation and caloric intake, play a role in endocrine function. A study by van den Beld et al. (2018) found that regular aging changes were associated with an increase in the concentration of serum thyroid-stimulating hormone (TSH); but alterations in TSH concentration remained dependent on iodine status. T3 blood concentrations fluctuate depending on the individual. The overall decline in thyroid hormone activity resulted from hormone metabolism changes, inflammation, and energy restriction. Further research is needed to develop age-specific hormone reference ranges to guide health care providers in hormone replacement therapy (van den Beld et al., 2018).

The hypothalamic–pituitary–somatotropic axis remains responsible for growth hormone secretion into the blood from the pituitary gland (van den Beld et al., 2018). Average age-related growth hormone secretion decline is called somatopause. Somatopause is associated with adipose tissue increase and leads to the decline of growth hormone and insulin-like growth factor after puberty.

Undernutrition occurs as normal aging brings appetite suppression and limited food intake (Molfino et al., 2021; van den Beld et al., 2018). The endocrine system plays a role in appetite suppression and anorexia. Hormonal changes include increases in cholecystokinin, leptin, and cytokines and a decrease in ghrelin. Appetite suppression in older adults revolves around the increase in levels of cholecystokinin. Nurses and health care providers combat cholecystokinin with an antagonist to stimulate the appetite and increase nutritional consumption. Frail older adults can experience diminished leptin levels, while healthy older adults can have increased concentration levels of circulating leptin (van den Beld et al., 2018). Aging is also associated with glucose intolerance, elevated insulin levels, and vitamin and mineral deficiencies.

For older adults, consuming enough protein to minimize age-associated loss in muscle mass is important. The recommendation for protein intake includes 23–31 oz per week at the minimum or 35% of total calories (Molfino et al., 2021; U.S. Department of Agriculture, 2020). Continuous anorexia in frail older adults negatively impacts their body composition; to combat this problem, early nutritional intervention improves outcomes and quality of life (Molfino et al., 2021). Like all age groups, older adults should strive to choose nutrient-rich foods. The ability to absorb Vitamin B<sub>12</sub> decreases with age and the use of certain medications, so ensuring adequate intake of this vitamin is of particular concern (U.S. Department of Agriculture, 2020).

## 8.2 Nutrition and Chronic Endocrine Illnesses

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 8.2.1 Discuss the impact of nutrition on endocrine illness.
- 8.2.2 Discuss the impact of nutrition on acute exacerbation of chronic endocrine illness.

### Nutritional Requirements for Optimal Endocrine Health

When hormones are out of balance—either an excess or deficiency of a certain hormone—an endocrine disorder is to blame, and such fluctuations can lead to various types of systemic dysfunction (Rodolico et al., 2020). Endocrine disorders are categorized as either primary or secondary. Primary endocrine disorders occur due to an imbalance in the hormone production from the original endocrine gland; for example, primary hyperthyroidism originates in the thyroid gland. In addition, because the endocrine system has a master gland (the pituitary gland) that regulates hormones based on blood levels, disrupted hormone levels can cause secondary endocrine disorders, meaning that the disorder does not come from the original organ but from the pituitary gland. For example, secondary hyperthyroidism results from a TSH-secreting pituitary adenoma.

Nutrition is a significant factor in the development, management, and progression of various endocrine-related disorders. Nutrients may either aggravate or alleviate endocrine symptoms or conditions.

### Diabetes

The pancreas is the endocrine gland responsible for the production and secretion of insulin and glucagon. The pancreas contains islets of Langerhans, containing insulin-producing beta cells and glucagon-secreting alpha cells. These hormones fluctuate based on blood glucose levels, and an imbalance can result in negative effects. The most notable endocrine disorder is diabetes, which is one of the most common endocrine conditions in the United States (Agency for Healthcare Research and Quality, n.d.; Sapra & Bhandari, 2023). The subclassifications for diabetes

clinically define each type of the disorder. The categories include **type 1 diabetes** (insulin-dependent diabetes), **type 2 diabetes** (noninsulin-dependent diabetes), and gestational diabetes ([Table 8.2](#)).

Diabetes Type	Metabolic Process	Medical Treatment	Insulin Type	Medication	Dietary Recommendations
Gestational diabetes	Pregnancy-related changes result in dysfunction of beta cells and resistance to insulin by cells.	<ul style="list-style-type: none"> <li>Medication</li> <li>Insulin</li> </ul>	<ul style="list-style-type: none"> <li>Long-acting and short-acting</li> </ul>	<ul style="list-style-type: none"> <li>Metformin</li> </ul>	<ul style="list-style-type: none"> <li>Fruits and vegetables</li> <li>Lean proteins</li> <li>Low glycemic index foods</li> </ul>
Type 1	Beta cells are destroyed and produce no insulin.	<ul style="list-style-type: none"> <li>Insulin</li> </ul>	<ul style="list-style-type: none"> <li>Long-acting and short-acting</li> </ul>	<ul style="list-style-type: none"> <li>Short-acting insulin: <ul style="list-style-type: none"> <li>Regular human insulin</li> <li>Insulin lispro</li> </ul> </li> <li>Intermediate/Long-acting insulin: <ul style="list-style-type: none"> <li>Insulin NPH</li> <li>Insulin glargine</li> <li>Insulin detemir</li> <li>Insulin degludec</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Fruits and vegetables</li> <li>Lean proteins</li> <li>Low glycemic index foods</li> </ul>
Type 2	<ul style="list-style-type: none"> <li>Beta cells produce insulin but with limited production.</li> <li>Beta cells do not produce enough insulin to meet metabolic demand.</li> <li>Beta cells produce enough insulin, but the cells develop resistance.</li> </ul>	<ul style="list-style-type: none"> <li>Medication</li> </ul>	<ul style="list-style-type: none"> <li>May or may not need medication</li> <li>Dietary changes</li> </ul>	<ul style="list-style-type: none"> <li>Stimulate insulin production</li> <li>Meglitinides</li> <li>Sulfonylureas</li> <li>Dipeptidyl-peptidase 4 inhibitors</li> <li>SGLT2 inhibitors</li> <li>GLP-1 agonists</li> </ul>	<ul style="list-style-type: none"> <li>Fruits and vegetables</li> <li>Lean proteins</li> <li>Low glycemic index foods</li> </ul>

**TABLE 8.2** Types of Diabetes, the Involved Metabolic Processes, and Possible Treatments

Any of the subcategories of diabetes lead to the same clinical objective finding of hyperglycemia, which is defined as a fasting serum glucose level greater than 126 mg/dL, a random glucose level greater than 200 mg/dL, or a hemoglobin A1C (HbA1c) greater than 6.5% (Agency for Healthcare Research and Quality, n.d.; Sapra & Bhandari,

2023). Many health care providers check clients' HbA1c levels when monitoring blood glucose control and dietary modifications. Continuously elevated levels impair the beta-cell function of the pancreas, resulting in further impaired insulin secretion (Sapra & Bhandari, 2023).

Type 1 diabetes results from the destruction of beta cells in the pancreas that eliminate the production and secretion of insulin (Sapra & Bhandari, 2023). This destruction of insulin-producing cells, usually secondary to an autoimmune disease, results in a dramatic decrease of insulin and elevated glucose levels. The absence of insulin puts the client at risk for complications involving vascular and neuropathic issues and death. Type 1 diabetes requires both insulin injections and nutritional management.

Type 2 diabetes has a different etiology than type 1 diabetes and has more of an insidious onset, with layered causal effects (Sapra & Bhandari, 2023). In contrast to type 1 diabetes, type 2 diabetes results from a sensitivity or resistance to the insulin the body creates. The difference is that in type 1 diabetes, the pancreas no longer creates insulin, so insulin injections are necessary for life, whereas insulin is still produced in type 2 diabetes. However, the circulating insulin in type 2 diabetes does not respond as it should (attributed to fatty acids and proinflammatory cytokines causing glucose transportation challenges). Long-term hyperglycemia results in continued damage to the small blood vessels and the potential development of chronic complications such as kidney failure, blindness, neuropathy, and amputation. Some risk factors for the development of type 2 diabetes include obesity and the decline of organ function or receptor cells associated with aging. Other endocrinopathies, such as acromegaly and Cushing's syndrome, are associated with diabetes and glucose intolerance, so the health care provider must assess for these in the client with diabetes.

Nutrition is the building block for disease management and care plans. Optimal diabetes management includes strict monitoring of carbohydrate intake and blood glucose levels (Sapra & Bhandari, 2023). To ensure optimal endocrine health, individuals should eat a balanced and nutrient-rich diet that includes complex carbohydrates, fiber-rich foods, lean proteins, and healthy fats (Gray & Threlkeld, 2019; Pancheva et al., 2021; Sapra & Bhandari, 2023). Portion control and mindful eating guide weight management and overall glycemic control in this client population.



## UNFOLDING CASE STUDY

### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

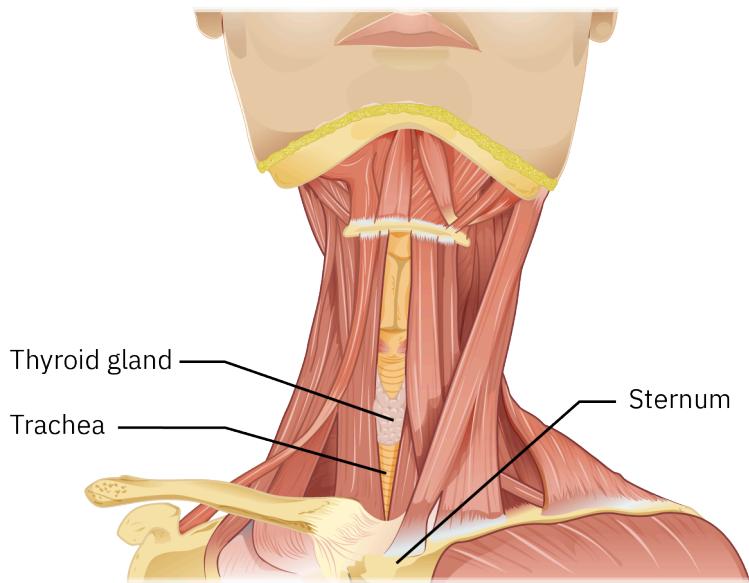
Sarah delivered her baby 4 years ago. She has returned to the clinic for an annual exam. Before the examination, her primary health care provider ordered blood work to check Sarah's metabolic processes and endocrine function. Sarah's HbA1c result is 7.7%. Sarah weighs 167 lb and is 5 feet tall.

5. The nurse recognizes that the test result indicates which condition?
  - a. Hyperthyroidism
  - b. Type 1 diabetes
  - c. Type 2 diabetes
  - d. Hypoparathyroidism
  
6. Which of the following dietary recommendations should the nurse reinforce during this visit?
  - a. Lean proteins, fruits, vegetables, and plenty of starchy potatoes
  - b. Lean proteins, fruits, vegetables, and low glycemic index foods
  - c. High glycemic index foods with limited proteins, fruits, and vegetables
  - d. No dietary recommendations, just medications

### Thyroid Disease

Thyroid disorders refer to abnormal function of the thyroid ([Figure 8.5](#)). The gland plays a vital role in regulating metabolic functions in the body through the production and secretion of thyroid hormones. Thyroid disorders result from insufficient or excessive production or secretion of thyroid hormones or the hormones that stimulate the

thyroid to perform those functions. Treatment options for thyroid disorders depend on the specific condition and the etiology. Some medical interventions include hormone replacement therapy, antithyroid medications, radioactive iodine therapy, or surgical removal of the gland. The nurse should have a basic comprehension of thyroid function and the integral role of dietary factors.



**FIGURE 8.5** The butterfly-shaped thyroid gland is located in the front of the neck. (credit: modification of work from Anatomy and Physiology 2e. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Hyperthyroidism is defined as a low or suppressed level of TSH alongside elevated levels of T3 and T4 (Mathew et al., 2023). If the T3 level is high and the TSH level is low, but the T4 level is normal, the condition is known as T3 toxicosis. When TSH is low but the T3 and T4 levels are normal, the condition is known as subclinical hyperthyroidism. The causes of hyperthyroidism include Graves' disease, toxic multinodular goiter, toxic adenoma, iodine-induced pituitary adenoma, and iatrogenic or drug-related causes. Graves' disease is the most common cause and is associated with autoimmune disease. Graves' disease triggered by autoimmune causes is mostly likely to develop in the younger population; it is more likely associated with iodine deficiency and toxic multinodular goiter when seen in older adults. The condition is more common in women and is associated with micronutrient deficiencies, including iodine and selenium. Iodine and selenium are involved in thyroid hormone development, so inadequate amounts increase an individual's risk for thyroid complications.

Hypothyroidism is categorized as primary or secondary (Patil et al., 2023). Primary hypothyroidism results when the gland produces inadequate amounts of T4. Secondary hypothyroidism, or central hypothyroidism, results from dysfunction at the pituitary or hypothalamus level. Iodine deficiency is the most common cause of primary hypothyroidism in countries with insufficient iodine. Iodine is a vital mineral for the production of thyroid hormones. Adequate intake of iodine allows the thyroid to function effectively and prevent thyroid dysfunction such as hypothyroidism or goiter development.

In the United States, where iodine is in sufficient supply, Hashimoto's thyroiditis, an autoimmune disease, is the leading cause (Patil et al., 2023). Other causes include medications such as lithium and amiodarone, radioactive iodine (treatment for Graves' disease), surgical interventions, radiotherapeutics, pituitary tumors, hypothalamus-compromising tumors, TRH resistance, brain radiation therapy, and cancer drugs. Postpartum thyroiditis, a transient autoimmune condition similar to Hashimoto's thyroiditis, affects approximately 8% of pregnant women the first year after delivery (Rad & Deluxe, 2023). Optimal well-being and thyroid function can be maintained when clients strive toward nutritional balance. A diet that includes iodine incorporates fish, dairy products, and iodized salt (Mathew et al., 2023; National Institutes of Health, 2022a).

### Acromegaly

**Acromegaly** is a disorder caused by too much growth hormone (Adigun et al., 2023; NIDDK, 2020) and results in overgrowth of bones in the face, hands, and feet in response to excessive levels. The primary causes relate to an increase in growth hormone (GH), with the most common cause relating to a somatotroph GH-secreting adenoma of the anterior pituitary gland. Other primary causes are related to familial conditions, such as multiple endocrine neoplasia type 1, familial acromegaly, McCune-Albright syndrome, and the Carney complex (Adigun et al., 2023). Secondary causes are related to lymphoma, pancreatic-islet cell tumors, and excess growth related to specific tumors or cancers. Clients with acromegaly may have a prominent forehead (and crease), brow, prognathism (mandibular enlargement), macroglossia, thick eyelids, a large nose, a large lower lip, and voice deepening (Adigun et al., 2023).

Nutrient and dietary patterns impact the GH and IGF changes that occur with acromegaly. Caputo et al. (2021) concluded in their study that diets low in carbohydrates, such as a ketogenic diet (35 g of carbohydrates per day), were associated with a decrease in IGF while allowing levels of GH to remain stable. For appropriate management of their disease process, individuals with acromegaly should seek the advice of a registered dietitian when changing to a ketogenic diet.

### Dwarfism

**Dwarfism** is the medical term for short stature (Jain & Saber, 2023). There are two types of dwarfism based on the client's physical appearance: proportionate short stature and disproportionate short stature. Proportionate stature refers to the length of the client's limbs and trunk, which are symmetrically small, whereas disproportionate stature describes a difference in length between a client's trunk or extremities. Dwarfism has many causes, including familial inheritance, growth or puberty delay, bone disorders, systemic diseases, and idiopathic, endocrine, and genetic causes.

When dwarfism results from an endocrine disorder, the growth hormones are deficient (Jain & Saber, 2023). The hormones that promote chondrogenesis include GH, IGF, androgens, T3, and T4. Chondrogenesis impacts the growth and development of vertebrae, cartilage, hyaline, fibrous, and elastic cartilage (Jain & Saber, 2023). The GH-IGF-1 axis is the regulatory path for height. IGF is responsible for stimulation of bone elongation and soft tissue and cartilage growth; low levels of IGF correlate with short stature.

Nutritional factors support the health and well-being of individuals with dwarfism. Calcium and vitamin D maintain healthy bone growth. Because individuals with dwarfism have higher incidences of bone and joint issues, nurses should educate these clients about adequate intake of calcium and vitamin D (Caputo et al., 2021; Jain & Saber 2023). Calcium and vitamin D sources include dairy and plant-based milk products, leafy green vegetables, and fortified foods. Individuals can also obtain vitamin D through sun exposure and the intake of fatty fish.

Protein is necessary for growth and tissue repair and should make up 15% of an individual's daily caloric intake (Caputo et al., 2021).

### Addison's Disease

The adrenal glands have two parts, the cortex and the medulla, each producing different hormones (Allen & Sharma, 2023). The adrenal cortex releases cortisol, aldosterone, and androgenic steroids, and the medulla secretes epinephrine and norepinephrine. The hypothalamus releases the corticotropin-releasing hormone, which stimulates the anterior pituitary gland to release adrenocorticotrophic hormone (ACTH) from the adrenal cortex located within the adrenal glands. Aldosterone is a hormone produced by the zona glomerulosa in the adrenal cortex. It plays a role in blood pressure regulation and electrolyte maintenance through the absorption of sodium into the bloodstream and the release of potassium into the urine (Allen & Sharma, 2023). Cortisol is a glucocorticoid hormone produced in the zona fasciculata within the adrenal cortex that regulates fats, proteins, and carbohydrates used in the body while also playing a role in suppressing inflammation, blood pressure regulation, bone formation, and increasing blood glucose. Androgenic steroids are hormones produced in the zona reticularis of the adrenal cortex, and these hormones remain the precursor for estrogens in the ovaries and androgens in the testes. The adrenal medulla remains responsible for the hormone's epinephrine and norepinephrine, which work within the body during stressful situations to stimulate the "fight-or-flight" response or the "rest-and-digest" response.

When the adrenal glands do not secrete enough (clinical definition less than 3 mcg/dL of cortisol levels with elevated ACTH) adrenal hormones, the condition is known as adrenal insufficiency (Allen & Sharma, 2023; Munir et

al., 2023). Primary adrenal insufficiency is called Addison's disease, which occurs as a result of an autoimmune response that destroys the three layers of the adrenal cortex, limiting the production and excretion of hormones. If adrenal insufficiency occurs due to too much glucocorticoid administration, the disease is secondary adrenal insufficiency.

Dietary recommendations are vital in people with primary adrenal insufficiency. The effects of Addison's disease can lead to an imbalance of sodium, so these clients require instruction regarding salt and sodium-rich foods. If a client reaches a state of adrenal crisis, they require hydrocortisone and intravenous saline infusions.

### Cushing's Syndrome

When the adrenal cortex produces an abundance of cortisol (primary hypercortisolism), the condition is known as Cushing syndrome (Allen & Sharma, 2023; Chaudhry & Singh, 2023). Cortisol affects the transcription and translation of enzyme proteins that metabolize fats, glycogen, protein synthesis, and Krebs cycle while elevating blood glucose levels and increasing insulin resistance (Chaudhry & Singh, 2023). Clients with Cushing's syndrome often have comorbidities such as hypertension, peptic ulcer disease, or diabetes.

Low-carbohydrate diets are recommended because they improve related conditions such as hyperglycemia, weight gain, hypertension, and insulin resistance (Dugandzic et al., 2022). Low-carbohydrate diets include 25–50 g of carbohydrates daily or around 5–10% of daily caloric intake. Clients on low-carbohydrate diets should avoid sugars, refined fats, and highly processed foods.

### Alternative Food and Supplement Options

The endocrine system regulates bodily functions by producing and secreting varying hormones. A balanced diet remains the general foundation for supporting endocrine function. Some specific foods and nutritional supplements support the endocrine system and allow optimal function in individuals with endocrine disorders. Although many nutrients and supplements support the endocrine system whether or not an endocrine disorder is present, there is no one-size-fits-all plan. Individuals must tailor their nutritional needs based on factors such as health conditions.

#### Diabetes

The goals of nutrition in diabetes are to manage serum glucose levels, achieve or maintain body weight goals, and delay or prevent complications (Gray & Threlkeld, 2019; Pancheva et al., 2021). Dietary adherence increases the client's quality of life and is the best preventive against potentially developing life-threatening complications. When teaching clients with diabetes, counseling them about nutrient-rich foods is as important as teaching them which foods to avoid. Clients are often taught to adjust insulin requirements to match consumption instead of focusing on fundamental diet instruction (Gray & Threlkeld, 2019; Pancheva et al., 2021). Significant risks for complications associated with diabetes arise from poor dietary choices.

Dietary intake for people with diabetes involves consideration of both macronutrients and micronutrients (Pancheva et al., 2021). Increasing daily water intake helps regulate blood glucose levels, maintains kidney function, prevents dehydration, and helps with weight loss (Sedaghat et al., 2021). Protein recommendations are 1–1.5 g/kg body weight per day or 15–20% of total daily calories consumed (Gray & Threlkeld, 2019). The client's kidney function or the presence of kidney disease needs assessment because most renal diets include protein restrictions.

Fat recommendations include restricting saturated fats to less than 10% of daily intake and eating good fats such as fatty fish that contain omega-3 fatty acids, avocado, nuts, and nut butters (Gray & Threlkeld, 2019; Pancheva et al., 2021). Saturated fats maintain a correlational relationship to cardiovascular disease in individuals with diabetes and are found in fast foods, red meat, and full-fat dairy foods. Saturated fat intake in the United States, including in children, is much higher than recommended (Pancheva et al., 2021). Nurses should teach clients to avoid or limit fried or fast foods, limit intake of saturated fats, use liquid vegetable oils, and consume 1 or more servings of omega-3 fats every day, such as fatty fish, walnuts, soybean oil, ground flax seeds, or flaxseed oil.

Carbohydrate intake has the most substantial influence on glucose control (Gray & Threlkeld, 2019).

Recommendations for carbohydrate consumption sometimes fluctuate as differences of expert opinion do not agree on low carbohydrate versus average carbohydrate intake for diabetes maintenance and weight loss. The definition of low carbohydrate varies among experts and is not recommended for pregnant or lactating women. The current carbohydrate recommendations include 45–50% of the daily intake of carbohydrates (Gray & Threlkeld, 2019; Pancheva et al., 2021). Experts agree that people with diabetes should avoid consuming sucrose (table sugar) and

sugar-sweetened beverages (particularly those that include high-fructose corn syrup) because they provide “empty” calories and can contribute to weight gain (Gray & Threlkeld, 2019). Another recommendation is to consume fructose as a monosaccharide in the form of fruits, some vegetables, and honey. The daily fiber recommendation is 20–35 g/day. Fiber can be found in raw vegetables and minimally refined grain (Gray & Threlkeld, 2019; Pancheva et al., 2021). Total fiber intake includes both dietary fiber and functional fiber. While dietary fiber is considered a carbohydrate, the lignin found in plants is not readily digested by the stomach or absorbed within the gastrointestinal tract. Functional fiber remains responsible for the physiologic benefits of fiber. Diets high in fiber are beneficial for individuals with many chronic disorders, including diabetes.

Vitamins A, E, C, and D are not associated with glycemic control or prevention of complications. However, they do limit oxidative stress and systemic inflammation in association with immune system benefits and inflammatory response. Sodium should be limited to 2300 mg/day to prevent the known correlation between the development of cardiovascular disease and hypertension associated with diabetes (Gray & Threlkeld, 2019).

Probiotics are “good” bacteria associated with fermented foods such as yogurt, kefir, and kimchi. Positive correlational studies show that with probiotic consumption, some individuals saw improvement in glycemic and serum lipid levels (Gray & Threlkeld, 2019).

### **Hyperthyroidism and Hypothyroidism**

The National Institutes of Health [NIH] (2022a) recommends a varying dose of iodine that increases with age as well as during pregnancy. Processed canned foods may be high in sodium but do not contain iodized salt. Some multivitamins include iodine-containing kelp (seaweed). Some plant foods such as soy, cabbage, broccoli, cauliflower, and Brussels sprouts contain iodine. Too much iodine leads to thyroid gland inflammation, so nurses should monitor clients for nausea, vomiting, diarrhea, weak pulse, and coma (NIH, 2022a). Selenium deficiency or inadequate consumption can lead to thyroid dysfunction (NIH, 2022b). Selenium is added to many dietary supplements but is naturally present in Brazil nuts, seafood, organ meats, cereals, grains, and dairy products. Selenium acts as a protective mechanism against autoimmune thyroid dysfunction. Antioxidants and other micronutrients produce anti-inflammatory effects in the thyroid, and a diet high in fruits, vegetables, legumes, nuts, fish, complex carbohydrates, extra virgin olive oil, and plant-based oils is recommended for thyroid health during times of thyroid dysfunction (Bellastella et al., 2022; Osowiecka and Myskowska-Ryciak, 2023). Other micronutrient recommendations include vitamin D, vitamin B complex, vitamin A, vitamin C, magnesium, folic acid, zinc, iron, and selenium.

Nurses should also teach clients to limit saturated fatty acids, refined and processed foods, and sugar because these induce inflammation (Bellastella et al., 2022; Mathew et al., 2023; Osowiecka & Myskowska-Ryciak, 2023). Some foods cause goiter, or an enlarged thyroid gland, and thereby interfere with thyroid function (Can & Rehman, 2023). Cabbage, broccoli, and soy have been potentially linked to goiter development (Bellastella et al., 2022; Mathew et al., 2023; Osowiecka & Myskowska-Ryciak, 2023). If thyroid disease is secondary to another condition, dietary requirements should address both conditions. This emphasizes the importance of a thorough holistic assessment that includes nutrition.

## **8.3 Treatments and Nutrition**

### **LEARNING OUTCOMES**

By the end of this section, you should be able to:

- 8.3.1 Identify drug-food interactions for their impact on treatments used for endocrine disorders.
- 8.3.2 Identify treatments and medications that can cause nutritional deficiencies in clients with endocrine disorders.

### **Health Assessment Considerations**

Not all foods are able to provide necessary nutrients, especially for individuals with endocrine disorders. Nutrition education plays a direct role in optimal health and wellness as well as in the management of disease processes because foods can either enhance or inhibit wellness in the endocrine system. Diet instruction requires careful explanation of scientific concepts in the context of the client’s specific situation. These concepts can seem overwhelming to the client who must balance evidence-based recommendations with real-world conditions. Clients’ food choices are not just by their knowledge of nutrition, but their ability to obtain and prepare nutritious foods that

align with their culture and lifestyle.

## Drug–Food Interactions Associated with Treatments for Endocrine Disorders

Endocrine-related medical interventions and medications are used to manage various endocrine disorders and conditions (Campbell & Jialal, 2022). These treatment options often involve the use of medications that interact with nutrition. Certain medications used in endocrine care affect nutrient absorption, metabolism, and utilization. These medications may also have specific recommendations regarding time frames with the food interaction. Nurses must understand these interactions to educate clients to avoid complications, promote optimal treatment outcomes, and ensure overall well-being.

### Diabetes

Diabetes is an endocrine disorder that involves the amount of insulin the body creates, secretes, and utilizes (Sapra & Bhandari, 2023). The medications used to manage diabetes, such as insulin and oral antidiabetic medications, require careful observation, monitoring, and coordination with meals and carbohydrate intake to ensure proper blood sugar levels (Chen et al., 2020; Gray & Threlkeld, 2019; Pancheva et al., 2021; Rasmussen et al., 2020). When individuals take insulin incorrectly such that the dosage is not appropriate for the given amount of carbohydrates consumed, the individual can enter a state of either hypoglycemia (low serum blood glucose level) or hyperglycemia (high serum blood glucose level; Sapra & Bhandari, 2023). Health care providers may prescribe antidiabetic medications such as metformin to manage type 2 diabetes (Sapra & Bhandari, 2023). These medications need to be taken with meals to limit gastrointestinal adverse effects. Studies indicate that people who take metformin are at risk for vitamin B<sub>12</sub> deficiency (American Diabetes Association [ADA], n.d.). These individuals therefore need regular laboratory testing for B<sub>12</sub> deficiency.

Clients with diabetes need to understand how alcohol consumption affects their blood glucose levels. If an individual with diabetes drinks alcohol on an empty stomach or in excess, the liver cannot release stored glucose, resulting in hypoglycemia. Alcohol also impairs the body's capability to indicate low blood glucose levels; for example, the individual may not experience the usual signs and symptoms of low blood glucose, such as shakiness or sweating. Alternatively, alcoholic drinks that contain sugary mixes potentially increase blood glucose levels. If clients with diabetes choose to drink alcohol, strict glucose monitoring and moderate consumption are recommended because excessive alcohol use is associated with increased liver, nerve, and heart damage. Some antidiabetic medications, such as sulfonylureas or insulin, interact with alcohol and increase the blood glucose–lowering effects of the medication, leading to hypoglycemia.

Some supplements, including chromium and niacin, may interact with diabetes medications and lead to hyperglycemia or hypoglycemia (ADA, n.d.). Chromium deficiency can increase blood glucose levels. In a client with kidney disease, chromium supplementation may further damage the kidneys (ADA, n.d.). Some individuals may take niacin to increase their “good” cholesterol levels; nurses should be aware that niacin can raise fasting glucose levels (ADA, n.d.). Individuals with diabetes should consult their health care provider before adding supplements to their daily dietary intake.

### Thyroid Disorders

Thyroid conditions require individuals to take thyroid medications. Some medications for treating thyroid conditions are associated with potential nutritional interactions (Wiesner et al., 2021). Levothyroxine should be taken at a consistent time in the morning on an empty stomach 1 hour before a meal. Foods that interfere with absorption include soy, calcium supplements, and some fruit juices, including grapefruit, orange, and apple juice (Wiesner et al., 2021). Some clients who are prescribed levothyroxine concurrently take calcium to avoid osteoporosis, so the nurse should advise these clients to avoid taking calcium, as well as iron, supplements within 4 hours of taking levothyroxine because these supplements also reduce absorption of the medication (DailyMed, 2023).

### Parathyroid Disorder

Calcium and loop diuretics balance sodium levels (Ellison, 2019). Loop diuretics inhibit the sodium–potassium–chloride transporter and increase calcium excretion. Furosemide increases calcium excretion and plasma parathyroid hormone (PTH). This hormone is created in the four small parathyroid glands located near the thyroid. It regulates the homeostasis of calcium, vitamin D, and phosphate in the bloodstream, maintaining bone stability (Khan et al., 2022). PTH responds to low calcium levels detected in the blood and stimulates the production

of vitamin D and calcitriol. The increase in calcium excretion from loop diuretics leads to the parathyroid gland decreasing the production of PTH. PTH, as the negative-feedback loop, signals the parathyroid glands to stop releasing PTH. A correlation has been noted between furosemide users and increased risk for hip fractures in the older adult female population (Mohn et al., 2018). Older adults absorb less calcium and are at an increased risk for fractures.

Thiazide diuretics affect the distal tubules, leading to increased calcium reabsorption (Mohn et al., 2018). A correlation study showed that individuals who took hydrochlorothiazide also had a decrease in urinary calcium in hyperparathyroidism, with no change in PTH observed (Mohn et al., 2018). However, more research is recommended in the field of thiazide diuretics and risk factors for fractures in the older population.

## Chapter Summary

- Nutrition plays a fundamental role in human growth and development, beginning in utero and extending throughout the lifespan.
- Pregnancy-related conditions that can impact the pregnant client's nutrition and affect the fetus include hyperemesis gravidarum and gestational diabetes.
- Appropriate nutrition and a properly functioning endocrine system are essential for growth and development through puberty for children and adolescents.
- During adulthood, the endocrine system works to maintain homeostasis but eventually begins to exhibit age-related declines. Adults must adjust their nutritional intake accordingly to decrease the risk for developing diabetes and other endocrine disorders.
- During later adulthood, individuals must maintain adequate nutritional intake to counteract decreased appetite.
- Endocrine disorders develop either from malfunction of the endocrine gland responsible for secreting a particular hormone (primary disorder) or from pituitary gland malfunction (secondary disorder).
- Diabetes is the most common endocrine disorder.

## Key Terms

**acromegaly** a disorder that results in overgrowth of bones in the face, hands, and feet in response to abnormally high levels of growth hormone

**dwarfism** short stature secondary to a genetic or medical condition

**gestational diabetes** a disorder that produces glucose intolerance during pregnancy as the result of dysfunction or delayed response of the beta cells to blood glucose

**glycemic index** a system that ranks carbohydrate-containing foods on a scale from 1 to 100 based on their ability to raise blood sugar levels quickly or significantly

**human chorionic gonadotropin (HCG)** a hormone that stimulates the corpus luteum to produce the progesterone necessary for promoting and maintaining a growing fetus; reduces the pregnant individual's immune function to protect the fetus from immune rejection

**hyperemesis gravidarum** a condition during pregnancy characterized by extreme, persistent nausea and vomiting

**hyperglycemia** a blood glucose greater than 125 mg/dL or plasma blood glucose level greater than 150

Clients with this condition must closely monitor their diet to limit carbohydrates and manage their caloric intake to regulate their blood glucose levels.

- Clients with thyroid disorders must manage their intake of iodine-rich foods, selenium, and other key micronutrients to help regulate their thyroid function.
- Clients with acromegaly may benefit from a ketogenic diet.
- Diet plays a significant role for individuals with endocrine disorders. However, some medications used to treat these conditions can affect nutrient absorption.
- Clients with diabetes must balance food intake with insulin or oral antidiabetic medication administration to decrease the risk for hyperglycemia and hypoglycemia.
- Clients taking levothyroxine for hypothyroidism must take the medication on an empty stomach and avoid certain foods that can inhibit its absorption.
- Clients taking calcium and loop diuretics are at risk for fractures because these medications decrease calcium and parathyroid hormone levels.

mg/dL

**hyperthyroidism** a clinically abnormal, elevated level of thyroid hormone in the blood; characterized by an increased metabolic rate, excessive body heat and sweating, diarrhea, weight loss, tremors, and increased heart rate

**hypoglycemia** a blood glucose level at or less than 40 mg/dL

**hypothyroidism** a clinically abnormal, low level of thyroid hormone in the blood; characterized by low metabolic rate, weight gain, cold extremities, constipation, reduced libido, menstrual irregularities, and reduced mental activity

**insulin-like growth factor (IGF)** a peptide hormone that promotes bone and tissue growth

**malnutrition** occurs when the body either does not receive sufficient nutrients or is unable to absorb essential nutrients, resulting in body composition changes and impaired functions

**puberty** a stage of development in which sexual maturation and reproduction capabilities refine and mature

**relaxin** a hormone secreted by the corpus luteum and then by the placenta to help prepare the body for

childbirth

**thyroid-stimulating hormone (TSH)** a hormone that triggers secretion of thyroid hormones by the thyroid gland

**thyroxine (T4)** tetraiodothyronine (thyroxine) long-acting hormone released by the thyroid gland that can be converted to T3

**triiodothyronine (T3)** hormone released by the thyroid gland to help regulate processes including

metabolism, weight, and energy levels

**type 1 diabetes** insulin-dependent diabetes; develops when insulin producing cells (beta cells) are destroyed in the pancreas, resulting in low to non-existent levels of insulin

**type 2 diabetes** noninsulin-dependent diabetes; results from insulin resistance that develops gradually from obesity and aging

## Review Questions

1. How does protein intake contribute to growth and development during childhood?
  - a. Maintains digestive function
  - b. Influences nutrient absorption
  - c. Plays an anabolic role similar to that of growth hormone
  - d. Mediates levels of growth hormone
  
2. Which of the following foods supplies micronutrients that decrease inflammation?
  - a. Kale
  - b. Sourdough bread
  - c. Beef
  - d. White rice
  
3. Medications given to older adults to stimulate appetite target which hormone?
  - a. Ghrelin
  - b. Thyroid-stimulating hormone
  - c. Insulin
  - d. Cholecystokinin
  
4. Which of the following is a good food choice for a client with Hashimoto's thyroiditis who needs to consume iodine-rich foods?
  - a. Leafy green vegetables
  - b. Fish
  - c. Citrus fruits
  - d. Whole grains
  
5. The nurse is providing dietary education for a client with diabetes. The client asks why their sodium intake should be limited. What is the best response from the nurse?
  - a. "Lowering your sodium intake can decrease your blood glucose level."
  - b. "A low-sodium diet can decrease inflammation in the body."
  - c. "Sodium-controlled diets can lower your elevated risk for developing cardiovascular disease and hypertension."
  - d. "Adding less salt to your food can decrease the food's glycemic index."
  
6. What is the recommended daily intake of saturated fats for individuals with diabetes?
  - a. Less than 5%
  - b. Less than 10%
  - c. Less than 15%
  - d. Less than 20%
  
7. What should the nurse include in dietary instructions for a client with diabetes regarding alcohol consumption?
  - a. Alcohol consumption can either raise or lower blood glucose levels.

- b. Alcohol consumption does not affect blood glucose levels.
  - c. Drinking alcohol is acceptable if low-sugar or sugar-free ingredients are used in mixed drinks.
  - d. Drinking alcohol may worsen signs of hypoglycemia when it occurs.
- 8.** Which of the following practices will help clients with diabetes decrease the risk for hypoglycemia after insulin administration?
- a. Administering less than the prescribed dose of insulin
  - b. Coordinating insulin administration with their meal schedule
  - c. Eating less than the prescribed amount of carbohydrates
  - d. Administering insulin between meals
- 9.** Which of the following instructions should the nurse include when teaching a client about levothyroxine?
- a. "You can take this medication at any time during the day."
  - b. "You can take this medication at the same time you take vitamins and other supplements."
  - c. "Take this medication at the same time every day with meals."
  - d. "Take this medication on an empty stomach."
- 10.** The nurse is documenting a client's medications during an admission assessment. Which of the following medications can decrease parathyroid levels, thereby increasing the risk for bone fractures?
- a. Levothyroxine
  - b. Metformin
  - c. Furosemide
  - d. Insulin

## Suggested Reading

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## CHAPTER 9

# Applying Clinical Judgment to Promote Nutrition for Hematologic Wellness



**FIGURE 9.1** Nutritional deficiencies are known to cause hematologic changes that can impact quality of life. (credit: modification of work "display of vegetables and one orange" by Baileynorwood/Wikimedia Commons, CC0 1.0)

## CHAPTER OUTLINE

- 9.1 Assess and Analyze the Impact of Nutrition on the Hematological System
  - 9.2 Plan Nutritional Strategies to Impact Hematological Wellness
  - 9.3 Implement Nutritional Strategies to Impact Hematological Wellness
  - 9.4 Evaluate Nutritional Strategies to Impact Hematological Wellness
- 

**INTRODUCTION** Metabolic processes with high energy requirements are sensitive to nutrient deficiencies. The production of blood cells, called hematopoiesis, is an energy-intensive metabolic process essential for oxygen and nutrient transport and protects against invasion of pathogens while maintaining hemostasis. The appropriate balance of water and cellular components—such as albumin, electrolytes, macronutrients, and micronutrients—is necessary for blood to optimally function. In the bone marrow, where hematopoiesis occurs, amino acids build the hemoglobin contained in each red blood cell. Red blood cells use only glucose as fuel, which must be in constant supply to support red blood cell metabolism (American Society of Hematology, n.d.).

Consider this case: Grant is a nurse and Ms. Foster is a client. Ms. Foster was sent to the emergency department by her primary care physician after receiving results of her annual laboratory testing that revealed severe anemia (a reduction in circulating red blood cells). Ms. Foster is a 75-year-old widow from a senior living facility who prepares her own meals and is independent in her activities of daily living (ADLs). She has a history of type 2 diabetes and hypertension; she reports that she recently had an episode of fainting and is no longer able to walk to her building's elevator without stopping for rest.

## 9.1 Assess and Analyze the Impact of Nutrition on the Hematological System

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 9.1.1 Recognize cues that indicate the impact of nutrition on the hematological system.
- 9.1.2 Analyze cues to determine the impact of nutrition on the hematological system.

### Assessment of Nutrition and the Function of the Hematological System

Early recognition of hematologic abnormalities and micronutrient deficiency signs can lead to prompt interventions. Nurses play a key role in assessment, delivery of age-appropriate intervention, and education aimed at restoration and prevention of recurrence. Through a comprehensive client assessment, the nurse can apply the nursing process specific to nutritional practices that impact hematologic function. Considering the client's nutritional preferences, the nurse can develop strategies to promote hematologic wellness.

Providing holistic care to clients is a core competency for nurses; however, the quality of nutritional assessments and decision-making can be inconsistent due to variations in clinical experience and settings of practice (Lulloff et al., 2019). Delays in diagnosing excessive or deficient nutritional intake can lead to hematologic abnormalities, which can result in life-threatening complications and long-term disease consequences. Accurate assessment of the client's nutritional status with early intervention gives clients the best chance for recovery.

Nurses who provide continuity and consistency through frequent assessment are well-positioned to recognize subtle changes and to work collaboratively with the health care team to develop a plan of care. Assessment of nutritional impact on the hematological system crosses multiple domains of clients' needs with emphasis on physiological and psychosocial integrity and management of care.

#### Physiological and Psychosocial Assessment

The nurse should begin the assessment with a health history. The client's age and sex are important to consider as bone marrow function and immunity decrease with age, and sex influences specific risk factors for hematologic changes (Márquez et al., 2020). The health history includes past medical and surgical history, with emphasis on blood disorders and any past episodes of bleeding, autoimmune disease, and gastrointestinal disease that may result in malabsorption. Surgical history should include the presence of postoperative complications such as poor wound healing and excessive bleeding or bruising. The nurse should explore family medical history because hereditary anemias and certain metabolic conditions can impact hematopoiesis. Also, because many medications have known hematologic side effects, the nurse should obtain an accurate list of the client's current medications, including over-the-counter products, vitamins, herbs, and nutritional supplements that may provide cues to risk factors when analyzing health data.

The purpose of a nutritional assessment is to identify risk factors and specific nutritional deficiencies, to determine nutritional needs, and to identify the physiological, psychosocial, and socioeconomic factors that may affect hematologic function (Serón-Arbeola, 2022). Dietary history, including the client's eating and drinking habits, could highlight specific nutrient deficiencies; however, obtaining accurate dietary intake is challenging. If time permits, the use of a food diary actively completed by the client is helpful. Behavioral and emotional considerations and social determinants of health also must be explored (Walker-Clarke et al., 2022). Specific themes to discuss include:

- Access to food
- Aversion to specific foods
- Mental health influences of eating, such as anxiety and depression
- Food preparation knowledge and skill
- Time constraints and family meal patterns
- Attitudes and beliefs surrounding food consumption

A physical assessment will include subjective and objective data ([Table 9.1](#)), be system-based, and include vital signs and anthropometric measurements, specifically, height, weight, and body mass index (BMI). Of particular importance is the amount of weight loss (percentage) experienced over a specific period of time. Rapid, unexpected weight loss of 5–10% from baseline is a risk factor for systemic manifestations of nutritional deficiencies. Triceps skinfold thickness (TSF) and midarm circumference (MAC) are used with increased frequency to further define

nutritional status, particularly in clients with concerns of malnutrition. TSF correlates with fat mass and MAC with protein composition (Serón-Arbeola et al., 2022).

Subjective and Objective Findings	Related Nutritional Deficiency
Anemia: <ul style="list-style-type: none"> <li>• Pallor</li> <li>• Fatigue</li> <li>• Changes in energy level</li> <li>• Dyspnea, tachypnea</li> <li>• Tachycardia</li> <li>• Hypotension</li> <li>• Dizziness</li> <li>• Fainting</li> <li>• Difficulty sleeping</li> <li>• Ability to maintain ADLs and recreational activities</li> <li>• Unusual food cravings (<b>pica</b>)</li> <li>• Electrocardiogram (ECG/EKG) abnormalities</li> </ul>	Iron, copper, vitamin B <sub>12</sub> , vitamin C, vitamin E, folate
Thrombocytopenia/Coagulopathy: <ul style="list-style-type: none"> <li>• Gingival bleeding</li> <li>• Easy bruising</li> <li>• Petechiae (<a href="#">Figure 9.2</a>)</li> <li>• Prolonged bleeding</li> <li>• Bloody stool</li> <li>• Prolonged menstrual cycle</li> </ul>	Vitamin K, vitamin C, vitamin E, vitamin B <sub>12</sub>
Neutropenia: <ul style="list-style-type: none"> <li>• Frequent fevers</li> <li>• Frequent infections</li> <li>• Delayed wound healing</li> </ul>	Copper, vitamin D, vitamin B <sub>12</sub> , vitamin C

**TABLE 9.1** Assessment for Potential Nutritional Deficiencies (sources: Le, 2016; Yu, 2019)

 **CLINICAL TIP**

**Ask Open-ended Questions**

Nurses should always ask clients open-ended questions to elicit a more informative history. For example, the nurse could ask “How often do you eat red meat each month?” (instead of “Do you eat red meat?”).



**FIGURE 9.2** Petechiae, a condition characterized by small nonblanching spots as a result of bleeding, may be caused by a vitamin C deficiency. (credit: "This photograph depicts a close view of a patient's skin revealing the presence of numerous perifollicular petechiae, the etiology had yet to be determined"/Centers for Disease Control and Prevention, Public Domain)

#### Management of Care: Diagnostic Assessment

Blood analysis is the primary diagnostic method for evaluating concerns of hematologic changes impacted by nutritional deficiencies; however, nutritional screening, often performed by a registered dietitian, should be completed first in a comprehensive assessment ([Table 9.2](#)).

Some laboratory results can determine the client's nutritional status. Prealbumin levels can be used to evaluate the client's protein status. Transferrin is a protein that transports iron through the blood to different tissues and organs and is often measured when iron deficiency is suspected as a cause of anemia. Complete blood count (CBC), serum iron level, serum vitamin B<sub>12</sub>, and folate levels should also be checked. Blood tests for specific vitamin deficiencies may be necessary for clients who have gastrointestinal malabsorption (Read et al., 2021; Socha et al., 2020).

When blood results fail to confirm a diagnosis in symptomatic clients, a bone marrow aspiration and/or biopsy may be necessary to evaluate the production of hematologic stem cells and the bone marrow microenvironment for evidence of malfunction.

Diagnostic Study	Hematologic or Other Manifestation	Nursing Considerations
Nutritional Screening Tools	<ul style="list-style-type: none"> <li>More than 5% weight loss over past 3 months</li> </ul>	<ul style="list-style-type: none"> <li>Age and population specific</li> <li>Client language</li> <li>Complete within 48 hours of admission</li> </ul>
Nutritional Risk Screening 2002 (NRS2002)	<ul style="list-style-type: none"> <li>All hospitalized clients</li> </ul>	Not applicable
Malnutrition Universal Screening Tool (MUST)	<ul style="list-style-type: none"> <li>Community clients</li> </ul>	Not applicable
Mini Nutritional Assessment (MNA-SF)	<ul style="list-style-type: none"> <li>Older clients</li> </ul>	Not applicable
Nutritional Risk in Critically Ill (NUTRIC)	<ul style="list-style-type: none"> <li>Critically ill clients</li> </ul>	Not applicable

**TABLE 9.2** Diagnostic Studies

Diagnostic Study	Hematologic or Other Manifestation	Nursing Considerations
CBC With Differential Complete Metabolic Profile	<ul style="list-style-type: none"> <li>Bruising, petechiae</li> <li>Gingival bleeding</li> <li>Dyspnea</li> <li>Tachycardia</li> </ul>	<ul style="list-style-type: none"> <li>Total volume of blood obtained in 24 hours; check facility policy</li> <li>Is there a fasting requirement?</li> <li>Appropriate collection tube</li> <li>Handling requirements: specific days processed; temperature of sample once obtained</li> </ul>
Albumin, Prealbumin, Vitamin D (25OHD)	<ul style="list-style-type: none"> <li>Poor wound healing</li> </ul>	
Haptoglobin, Lactate Dehydrogenase (LDH), Reticulocyte, Vitamin E	<ul style="list-style-type: none"> <li>Hemolytic anemia</li> <li>Thrombocytosis</li> </ul>	
Ferritin, Iron, Transferrin	<ul style="list-style-type: none"> <li><b>Microcytic anemia</b> (small red blood cell)</li> </ul>	
Folate, Vitamin B <sub>12</sub>	<ul style="list-style-type: none"> <li><b>Macrocytic anemia</b> (large red blood cell)</li> <li>Neutropenia</li> </ul>	
Vitamin C	<ul style="list-style-type: none"> <li>Excessive bleeding and bruising</li> <li>Brittle, spoon-shaped nails</li> </ul>	
Vitamin K, PT/PTT	<ul style="list-style-type: none"> <li>Prolonged bleeding</li> <li>Coagulopathy</li> </ul>	
Copper	<ul style="list-style-type: none"> <li>Anemia (normocytic)</li> <li>Neutropenia</li> <li>Malabsorption (diarrhea, failure to thrive)</li> </ul>	
Bone Marrow Aspiration/ Biopsy	<ul style="list-style-type: none"> <li>Overlapping hematologic abnormalities</li> </ul>	Does the client need sedation?

**TABLE 9.2** Diagnostic Studies

### Analysis of Nutrition and the Hematologic System

Developing clinical judgment requires the nurse to recognize laboratory abnormalities and associate significance to the client's history and physical assessment (NCSBN, 2022). Making connections between a client's diet history—such as lacking red meat, a critically low hemoglobin, and signs and symptoms of anemia—will result in identification of potential complications and anticipation of medical intervention. See [Table 9.3](#).

Among nutritional blood disorders, iron deficiency anemia is the most common with increased prevalence in young children, pregnant women, and older adults (Burton et al., 2020). Iron deficiency anemia is characterized by a low hemoglobin concentration with small (microcytic), pale (hypochromic) red blood cells. The nurse should consider other nutrient-related hematologic disorders as well:

- Vitamin B<sub>12</sub> deficiency
- Folate deficiency
- Vitamin K deficiency
- Vitamin C deficiency

- Vitamin D deficiency

Deficiency	Conditions and Individuals at Risk	Medical Management	Nursing Considerations
Iron deficiency	<ul style="list-style-type: none"> <li>• Infants</li> <li>• Menstruating females</li> <li>• Older adults over 65 years</li> <li>• Vegans</li> </ul>	<ul style="list-style-type: none"> <li>• Ferrous sulfate 100–200 mg/day for adults dosed on severity of anemia</li> <li>• Orally or intravenously</li> <li>• Dose dependent on age and hemoglobin level</li> </ul>	<ul style="list-style-type: none"> <li>• Take 1 hour before or 2 hours after meals</li> <li>• Take with vitamin C to increase absorption</li> <li>• Avoid antacids, proton pump inhibitors (may decrease iron absorption)</li> <li>• Common side effect: constipation; increase fiber in diet</li> <li>• Food sources: red meat, beans, dark green leafy vegetables, iron-fortified foods</li> <li>• Monitor labs every 3 weeks during first 2 months of therapy</li> </ul>
Vitamin B <sub>12</sub>	<ul style="list-style-type: none"> <li>• Autoimmune gastritis</li> <li>• Celiac disease</li> <li>• Inflammatory bowel</li> <li>• Gastric bypass or ileal resection</li> <li>• Strict vegans</li> <li>• Pancreatic insufficiency</li> <li>• Alcohol use disorder</li> </ul>	<ul style="list-style-type: none"> <li>• Vitamin B<sub>12</sub> intramuscularly or high dose Vitamin B<sub>12</sub> orally daily</li> <li>• Diet modification</li> </ul>	<ul style="list-style-type: none"> <li>• Clients with malabsorption syndrome or gastric resection require parenteral administration</li> <li>• Protect vials from light</li> <li>• Take with meals to increase absorption</li> <li>• Food sources: animal meat, fish, eggs, dairy</li> </ul>

**TABLE 9.3** Management of Common Nutrition-Related Blood Disorders (sources: Burton et al., 2020; Maxfield & Crane, 2022; Nemati et al., 2022; Sizar et al., 2022; Socha et al., 2020)

Deficiency	Conditions and Individuals at Risk	Medical Management	Nursing Considerations
Folate	<ul style="list-style-type: none"> <li>Pregnant clients</li> <li>Clients with alcohol use disorder, malabsorption, hemolytic anemia, eczema</li> </ul>	<ul style="list-style-type: none"> <li>Folic acid, orally once daily</li> <li>Dose dependent on age</li> </ul>	<ul style="list-style-type: none"> <li>Take antacids at least 2 hours after folic acid</li> <li>Take folic acid early in pregnancy for prevention of neural tube defects</li> <li>May turn urine intensely yellow</li> <li>Food sources: leafy green vegetables, fruits, nuts, eggs, meats</li> </ul>
Vitamin K	<ul style="list-style-type: none"> <li>Newborns</li> <li>Liver disease</li> <li>Cystic fibrosis</li> <li>Celiac disease</li> <li>Inflammatory bowel disease</li> </ul>	<ul style="list-style-type: none"> <li>Phytomenadione may be given intramuscularly, subcutaneously, or orally; dose is dependent on condition and age</li> <li>Intravenously in life-threatening bleeding</li> </ul>	<ul style="list-style-type: none"> <li>Lab analysis impacted by drugs: warfarin, antacids, antibiotics, aspirin</li> <li>Food sources: cheese, green vegetables, meat, eggs</li> </ul>
Vitamin C (scurvy)	<ul style="list-style-type: none"> <li>Food insecurity</li> <li>Infants only receiving cow's milk</li> <li>Alcohol use disorder</li> <li>Smoking</li> <li>Eating disorder</li> <li>GI tract disorder</li> <li>Type 1 diabetes</li> <li>Iron overload</li> </ul>	<ul style="list-style-type: none"> <li>Ascorbic acid 100–300 mg/day for children and 500–1000 mg/day for adults</li> <li>Diet modifications</li> </ul>	<ul style="list-style-type: none"> <li>May decrease response to warfarin and antibiotics</li> <li>May interfere with blood and urine glucose test</li> <li>Food sources: citrus fruits, tomatoes, strawberries, cantaloupe, peppers</li> </ul>
Vitamin D	<ul style="list-style-type: none"> <li>Residential/assisted living</li> <li>Dark skin tones</li> <li>Obesity</li> <li>Chronic disease</li> <li>Decreased exposure to sunlight</li> </ul>	<ul style="list-style-type: none"> <li>Vitamin D<sup>3</sup> (cholecalciferol) orally daily or high dose orally weekly</li> </ul>	<ul style="list-style-type: none"> <li>Order lab as 25(OH)</li> <li>Laboratory analysis impacted by barbiturates and corticosteroids</li> <li>Food sources: fatty fish, liver, fortified milk</li> </ul>

**TABLE 9.3** Management of Common Nutrition-Related Blood Disorders (sources: Burton et al., 2020; Maxfield & Crane, 2022; Nemati et al., 2022; Sizar et al., 2022; Socha et al., 2020)

### Nursing Considerations

As the client's relevant information is identified, the nurse will apply the nursing process, determine related nursing diagnoses, and prepare to implement evidence-based care. Potential nursing diagnoses for aiding the client in the restoration of hematologic wellness include (Doenges et al., 2022):

- Imbalanced nutrition, undernutrition

- Fatigue, related to malnutrition
- Failure to thrive, related to nutritional deficiency
- Frail elderly syndrome, related to malnutrition
- Knowledge deficit, related to nutrients needed for hematologic wellness
- Decreased activity tolerance, related to fatigue
- Impaired skin integrity, related to anemia, nutritional deficiency
- Impaired memory, related to anemia
- Infection, delayed wound healing, related to nutritional deficiency
- Impaired gas exchange, related to anemia
- Risk for infection, related to nutritional deficiency
- Risk for bleeding, related to nutritional deficiency
- Risk for falls, related to anemia
- Risk for unstable blood pressure, related to anemia
- Risk for constipation, after iron supplementation
- Risk for ineffective tissue perfusion, related to anemia
- Risk for delayed child development, related to nutritional deficiencies



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Grant continues with his assessment of Ms. Foster. She reports difficulty sleeping for the past several months and poor concentration. Over the past 3 days, she has been short of breath with little exertion and lightheaded. As Grant discusses her diet history and food preferences, Ms. Foster reports that she constantly craves ice; otherwise, her diet consists of bread, chicken, and canned vegetables. While Grant continues to perform his assessment, her primary care physician (PCP) calls to report Ms. Foster's hemoglobin as 6.2 gm/dL from the morning labs and requests additional diagnostic evaluation to determine the etiology of her severe anemia. Grant recognizes that older adults are at risk for nutritional anemias and suspects this for Ms. Foster. He understands the importance of a thorough history and assessment to avoid potentially life-threatening complications of anemia. Grant has completed his assessment of Ms. Foster and has obtained the following blood samples as ordered by her PCP:

- CBC
- Serum iron
- Ferritin
- Folate
- Vitamin B<sub>12</sub>

Her CBC confirms severe microcytic anemia (hemoglobin 6.0 gm/dL with a low mean corpuscle volume). Since Ms. Foster has symptomatic anemia with shortness of breath and lightheadedness, Grant notifies the emergency department physician and requests an additional evaluation. An ECG and chest radiograph are performed; the physician determines that the source of Ms. Foster's symptoms is unlikely related to hemorrhage and is most likely related to a nutritional deficiency. An order to transfuse 1 unit of packed red blood cells over 2–4 hours is received.

Grant recognizes that iron deficiency is the most common cause of nutritional microcytic anemia. He is also aware that the turnaround time for laboratory iron studies is 24–48 hours. He updates Ms. Foster and her daughter with the plan of care and determines the priority nursing diagnosis to be impaired gas exchange, related to anemia; imbalanced nutrition, less than body requirements, related to iron deficiency.

1. Which nutritional screening tool should the nurse anticipate as part of Ms. Foster's evaluation?
  - a. Nutritional Risk Screening 2002 (NRS2002)
  - b. Malnutrition Universal Screening Tool (MUST)
  - c. Mini Nutritional Assessment (MNA-SF)

- d. Nutritional Risk in Critically Ill (NUTRIC)
2. Ms. Foster's priority nursing diagnosis is *impaired gas exchange, related to anemia; imbalanced nutrition, less than body requirements, related to iron deficiency*. What other nursing diagnosis should the nurse consider addressing during this visit?
- Knowledge deficit, related to nutrients needed for hematologic wellness
  - Impaired skin integrity, related to anemia, nutritional deficiency
  - Impaired memory, related to anemia
  - Infection, delayed wound healing, related to nutritional deficiency

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## 9.2 Plan Nutritional Strategies to Impact Hematological Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 9.2.1 Prioritize hypotheses of nutritional habits that optimize hematological wellness.
- 9.2.2 Generate solutions to optimize hematological wellness utilizing nutritional habits.

### Identifying Challenges to Nutritional Goals

Once nutritional deficiencies impacting hematopoiesis have been discovered, the nurse should explore goals aimed at restoration of wellness. Barriers to a client's success can include physiological and psychosocial factors. Assisting the client in determining which nutritional habits can be modified is challenging but essential at this stage of planning. The nurse should consider both the setting (hospital, clinic, client's home) and the audience for discussion. Goals that consider cultural influences are more likely to guide the client toward a nutritional lifestyle with a lasting positive impact (Walker-Clarke et al., 2022).

#### Physiological Factors

Most physical attributes are non-modifiable; however, understanding the impact of physiological factors on nutrition is an important component of client education. Providing anticipatory guidance related to nutrient demands in various stages of life can influence goal setting through the management of expectations. Although clients cannot manipulate their family medical history and genetics, health promotion strategies can be applied using these factors as motivators.

Typically, males have higher energy demands than females, as well as an increased trajectory for height and weight compared. Nutritional needs increase during pregnancy because of physiological and hormonal changes and fetal demand. Folate deficiency is common during pregnancy and can lead to serious hematologic deficits in both the pregnant client and fetus (Grzymisławska et.al., 2020).

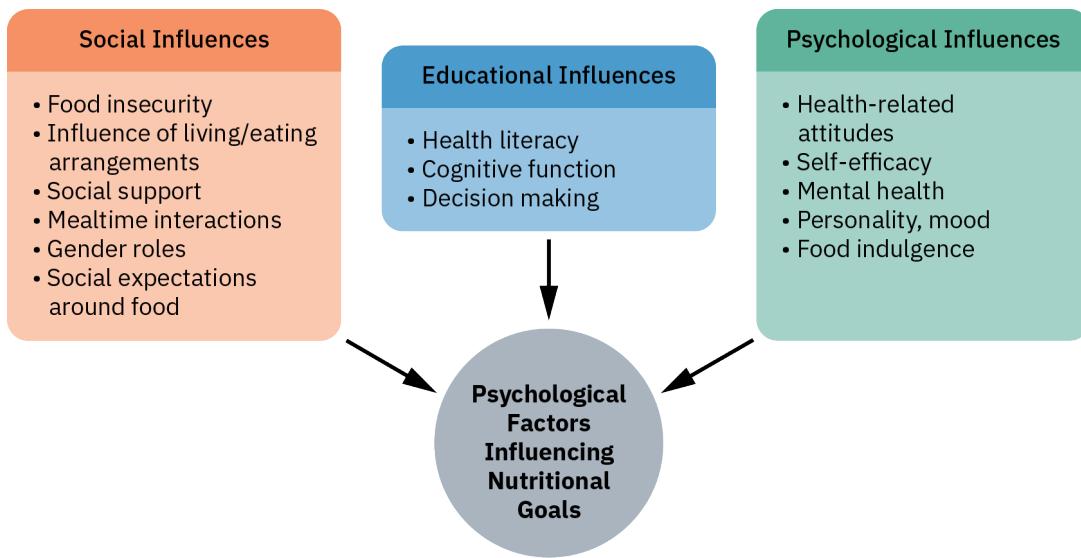
Neonates and infants have increased caloric and protein needs to support the rapid growth and development that occurs during this time, as well as to prevent anemia and bleeding disorders. Breastfed infants are dependent on the health and diet of the person feeding them. Research has discovered that genetic variations in both the parents and child can affect the production and consumption of milk (Golan, 2020). With this knowledge, nurses can intentionally explore breastfeeding habits and provide support and rationale if nutritional supplementation is indicated.

As humans age, growth hormone and erythropoietin deficiencies occur, which contribute to decreased production of red blood cells. Additionally, appetite and food intake decrease due to delayed gastric emptying and changes in taste. Papillae (taste buds) density decreases in older adults that results in taste and smell alterations. Poor dental health, ill-fitting dentures, and dry mouth further contribute to decreased food intake, leading to nutrient deficiencies. Although energy needs decrease with age, protein and micronutrients requirements increase (Kaur et al., 2019).

Disease comorbidities often result in increased caloric, protein, and micronutrient needs. Acute and long-term illnesses such as trauma, burns, cancer, lung disease, and immune dysfunction require even higher protein and micronutrient intake to restore homeostasis during the healing stage.

### Psychosocial Factors

Psychological and social factors impact eating behaviors throughout the lifespan (Walker-Clarke et al., 2022). These are often considered modifiable contributors and are a major target for interventional strategies to restore hematologic wellness ([Figure 9.3](#)). Assisting clients in recognizing the presence of these factors is the first step—requiring empathy, emotional intelligence, and therapeutic communication. For example, although eating more beef or fresh spinach may help combat iron deficiency in the older adult, financial constraints may prevent this intervention; therefore, the nurse is challenged to create a more realistic economical and culturally sensitive option for the client.



**FIGURE 9.3** Psychological and social factors influence nutritional goals. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Planning Nutritional Goals

Understanding clients' needs requires knowledge regarding their food preferences and choices. Accessing nutrient-rich food lists for the client to review can facilitate a meal plan that is both desirable and feasible. Food preferences often cross physical, psychological, social, and environmental domains. Common themes to explore include:

- Taste and food preferences of the client and their household
- Health concerns
- Convenience and time
- Cultural and religious traditions
- Social influences
- Physical environment
- Economics
- Availability and variety

Planning nutritional goals starts with the nurse determining what is reasonable to tackle during the time available and in the current setting, considering both physiological and psychosocial influences. It is important to evaluate the client's immediate external constraints such as finances, knowledge level, and current well-being. For example, has the client recently received medication with drowsiness as a side effect? Will the client be able to focus on the education to actively participate in goal planning?



### UNFOLDING CASE STUDY

#### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Grant is planning a discharge for Ms. Foster as she completes her blood transfusion. He recognizes that Ms. Foster may be experiencing fatigue or drowsiness from the medical interventions and anxiety and/or fear related to the need for a major modification to her diet. Further, he is aware that the emergency department environment can be distracting to learning. With these factors in mind, Grant determines that he will focus the discharge education on iron replacement therapy, follow-up with her PCP, and referral to a dietitian.

He develops the following goal for Ms. Foster's discharge education: Provide oral and written information on iron replacement therapy including dose, route, frequency, side effects, and administration considerations immediately before discharge. Grant will include a list of food sources rich in iron and inform Ms. Foster that taking her iron supplement with 4–6 oz of orange juice can improve iron absorption.

3. Which of the following psychosocial factors should be considered first as the nurse prepares a list of iron-rich foods?
  - a. Cultural and religious preferences
  - b. Home-cooked or prepared meals
  - c. Social influences
  - d. Availability and variety
  
4. Which of Ms. Foster's risk factors for worsening anemia is modifiable?
  - a. Hypertension
  - b. Diabetes
  - c. Decreased taste
  - d. Decreased food intake

### Encouraging Change

To prevent client frustration that can derail nutritional goals, the nurse should anticipate obstacles to the first steps of the plan. After creating a plan to restore hematologic wellness, asking open-ended questions regarding the plan's steps can proactively help identify solutions to barriers (Hooker et al., 2018). Use of motivational interviewing, increasing knowledge, and assessing readiness for change are the first steps. Ultimately, the client needs to believe that the nutritional change will improve their life. For example, in the case of Ms. Foster, Grant learns that Ms. Foster's grandson is getting married in 3 months, and she has been worried about her ability to walk the distance required at the wedding venue. Grant uses this information as an influence of motivation, encouraging her to add iron-rich foods to at least 2 meals daily, eat meals in the dining room with her friends as much as possible, and use a daily pill container or set a reminder to take her daily iron replacement. Convenient foods containing iron, such as canned or frozen spinach, iron-enriched bread and cereals, and canned white beans, are recommended staples to have on hand. He informs Ms. Foster that with these strategies, she should see a significant improvement in her anemia and energy level within 2–3 months, just in time to participate in the wedding festivities.

## 9.3 Implement Nutritional Strategies to Impact Hematological Wellness

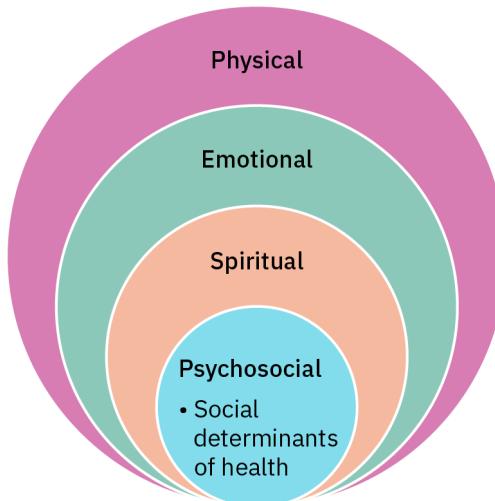
### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 9.3.1 Assess the client for readiness to learn.
- 9.3.2 Teach nutritional strategies to optimize hematological wellness.

### Holistic Nursing Assessment of the Client

Assessing clients for nutritional influences on hematologic wellness must encompass the client and their support circle. The nurse should consider the different realms the client may be impacted by in their nutritional choices ([Figure 9.4](#)). For example, adolescents, who may be adequately knowledgeable about nutrient-rich food sources, may choose less-healthy options at school due to peer influence. The nurse should help clients visualize potentially challenging situations. Visualization of the situation—and how to respond to the situation—can empower clients to improve their attitude and practice of healthy eating and is part of a holistic approach to fostering hematologic wellness (Wiafe et al., 2023).



**FIGURE 9.4** Holistic nutritional assessment domains are important in assessing clients for nutritional influences and must encompass the client and their support circle. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Age-Specific Considerations

For infants, school-aged children, and adolescents, determining where children spend their time and with whom is an important step in developing a holistic approach to nutritional interventions. The modern family is diverse, and often consists of multigenerational members and different households influencing each other's health practices. Gaining the confidence of the family unit's influencer(s) requires a nurse's thoughtful approach and cultural sensitivity (Barnes et al., 2020). For infants, family traditions regarding the addition of solid food and cow's milk to the diet can contradict current evidence-based recommendations and can result in nutritional anemias. Discussing menstruation may be taboo for some female adolescents and thus result in undisclosed menorrhagia and secondary iron-deficient anemia. Older adults are often uncomfortable discussing oral health issues and economic burdens that may have led to late recognition of malnutrition. The nurse is in a unique situation to holistically assess clients and their families utilizing active listening and therapeutic communication strategies.

### Client Teaching

As the teaching session begins, the nurse should ask the client to describe what they already know about the health concern and should be prepared to adjust their educational plan. If the client reports having nutrient-deficient anemia but does not understand what anemia is, the educational plan should start with an overview of the function of red blood cells and how they are produced in the body. Most clients will struggle with adherence to a nutritional plan (meal plan) if they do not understand why the modification is necessary. This is a component of determining the client's health literacy. Other variables of health literacy to consider include:

- Language spoken and read
- Cultural considerations regarding who should be present for the educational session
- The learning style of the client and their significant other as applicable
- External constraints (time, state of health)

### Learning Modalities

Taking advantage of technology and existing reputable resources can be a time saver for both the nurse and the client. Reputable references may be available electronically and/or in writing. Determining access to a computer or internet service is vital if relying on an electronic modality for content. Additionally, consideration of the material in the client's primary language cannot be overlooked. Potential options include:

- One-on-one teaching
- Group or family teaching
- Demonstration—including food preparation and shopping
- Printed materials
- Videos, podcasts, applications for smart phones
- Community resources

A list of client education resources is included at the end of this chapter.



## UNFOLDING CASE STUDY

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### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Grant starts discharge education with Ms. Foster by sharing his intended goal and time frame for completion. Ms. Foster's daughter offers to retrieve the car to expedite discharge. Grant suggests that she stay for the education and participate in identifying potential barriers to the plan. Ms. Foster reports that her anemia should be resolved since she received a blood transfusion. Grant explains to Ms. Foster that the lifespan of transfused red blood cells is approximately 60 days and that she will need to start oral iron replacement therapy as soon as possible to restore her hematologic wellness. He then modifies his educational plan to include an overview of red blood cell production, signs and symptoms of anemia, and the expected time for recovery of symptoms.

5. A holistic approach to client teaching includes consideration of which of the following?
  - a. Spiritual influences
  - b. Family presence
  - c. Medical diagnosis
  - d. Family medical history
  
6. Which of the following age-specific considerations should the nurse consider first before initiating the educational session with Ms. Foster?
  - a. Hearing or vision changes
  - b. Cognitive function
  - c. Preferred spoken language
  - d. Level of alertness

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## 9.4 Evaluate Nutritional Strategies to Impact Hematological Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 9.4.1 Evaluate a nutritional plan for its effect on hematological wellness.
- 9.4.2 Modify a nutritional plan to promote hematological wellness.

### Evaluating Client Readiness to Follow a Nutritional Plan

Assessing a client's readiness to change their nutritional lifestyle requires a collaborative conversation. The nurse should emphasize the direct link between iron-deficient anemia, their current eating habits (craving ice and lack of iron-rich foods) and their recent symptoms. Evidence-based research has shown that clients are more likely to engage in healthy behavior if they believe that their symptoms and complications will negatively affect their lifestyle (Lee & Chung, 2021). Often the only motivator prompting change is the presence of unpleasant symptoms. The next step is for the client to reflect on how they feel about change and what they need to be successful. At this point, the focus should shift to providing additional nutritional knowledge, such as specific dietary needs, and establishing the client's desire to achieve change. The use of a scoring scale can be helpful, asking questions such as

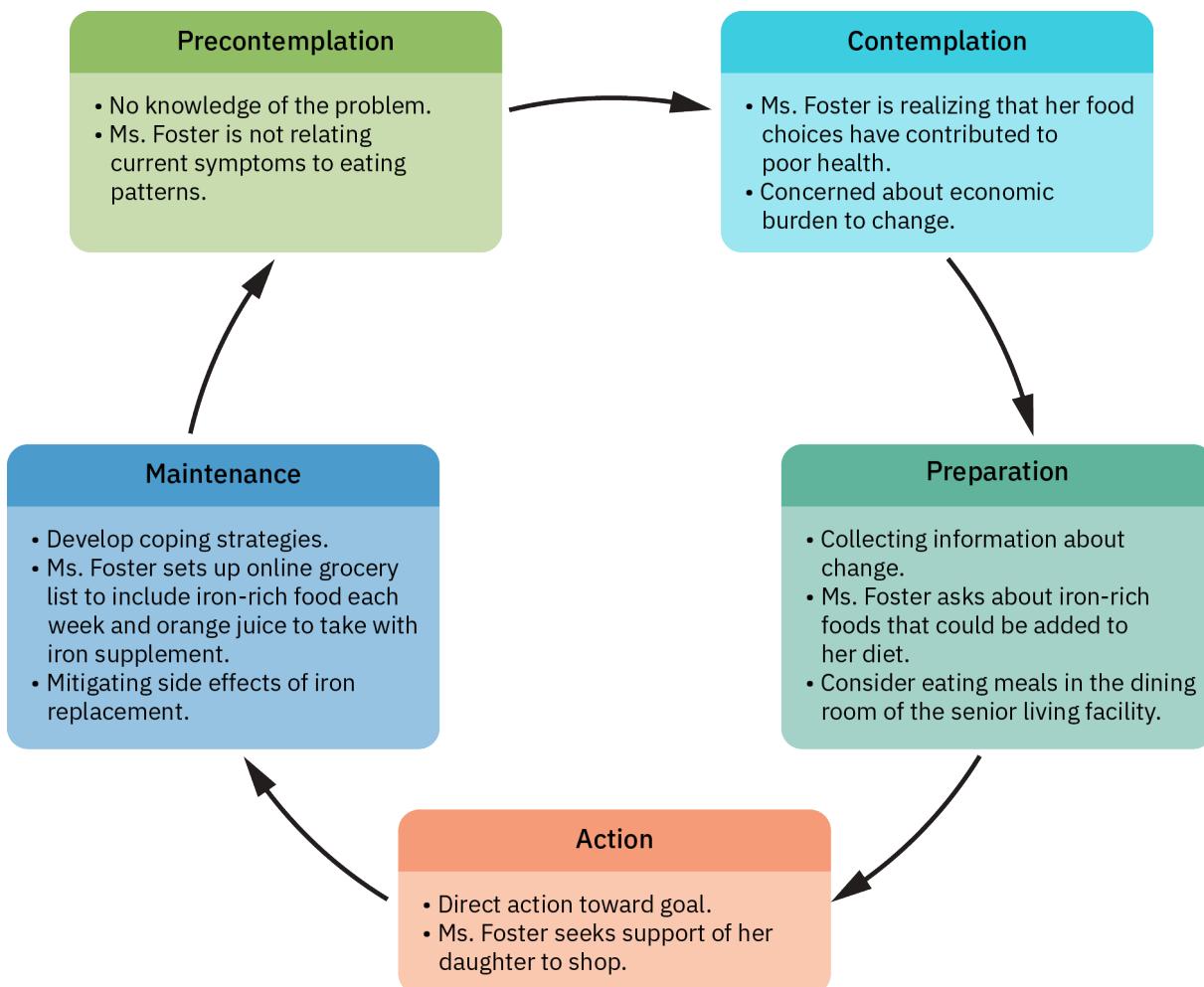
- “How important is it to you to make this change, on a scale of 0 to 10 with 10 being extremely important?”
- “How confident are you that you can make this change, on a scale of 0 to 10 with 10 being extremely confident?”

The nurse must keep in mind that this is not a static process, and the focus must remain on a shared decision-making conversation (National Lipid Association, 2021).

### Making Connections

As previously stated, the client who makes connections between food choices and hematologic wellness is more

likely to intentionally change nutritional habits. According to the **Transtheoretical Model** (TTM), change occurs as a series of steps aligned with the client's degree of motivation (Nakabayashi et al., 2020; Lee & Chung, 2021). This model has been widely used for health education interventions and more recently applied to nutritional interventions, specifically. The model includes five stages: precontemplation, contemplation, preparation, action, and maintenance. [Figure 9.5](#) depicts this model, applied to the scenario in this chapter's unfolding case study.



**FIGURE 9.5** The Transtheoretical Model is applied to the this chapter's unfolding case study to illustrate how the client (Ms. Foster) is changing nutritional habits. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

The nurse's role is to raise a consciousness that empowers the client to recognize there are more positive outcomes than negative to this nutritional modification. The benefit of using the TTM in practice is its applicability in all settings, adaptability to different nutritional needs, flexibility, and cost-effectiveness (Nakabayashi et al., 2020).

An important assumption to the effectiveness of the TTM is the client's nutritional health literacy, as it relates to hematological wellness. Clients with low-to-moderate nutritional literacy are likely to have poor self-management skills and communication with health care providers (Zhong et al., 2020). Client education targeted at enhancing nutritional knowledge is an important point for nursing intervention. In Ms. Foster's case, she has identified a lack of knowledge regarding iron-rich foods; therefore, the nurse should incorporate information about iron-rich foods into the decision-making conversations with Ms. Foster.

### Evaluating the Effectiveness of a Nutritional Plan

According to TTM, maintenance of the behavior change takes 6 months to achieve. In the case of a nutrition-related hematologic disease, the client will need to be evaluated at more frequent intervals due to the serious potential consequences of untreated blood disorders. The nurse should be aware that pharmacologic interventions vary in their onset and duration of action. Correcting long-term nutritional deficiencies is a process. Some medications are dosed according to the extent of the blood abnormality and require intermittent laboratory analysis for dose

modifications. For instance, ferrous sulfate has a dose range that is different for infants and children versus adults and is based on the severity of anemia using hemoglobin and symptoms as determinants. It is recommended to check hemoglobin every 3 weeks during the first month of treatment for potential dose modifications. The nurse should provide anticipatory guidance to the client in terms of frequency of return visits, what will be evaluated at each visit, and what changes or symptoms the client should expect. The client is likely to remain motivated if they can identify signs of improvement, even outside of actual visits with their health care team.

### **Modification of the Nutritional Plan**

The final phase of any change plan is to make modifications based on the evaluation outcome, remembering that change is a dynamic, cyclic process. Use of motivational interviewing with open-ended questions will assist the client in recognizing self-efficacy. Bringing the focus back to hematologic wellness and the potential consequences the client faces if untreated, while praising the successful change, is key. The nurse should re-address the previously established goals and look for opportunities for improvement. In Ms. Foster's case, the nurse would consider the following questions:

- What iron-rich foods have you incorporated into your diet?
- How often do you consume each food? What serving size do you consume?
- How do you rate your level of fatigue and shortness of breath over the past week, compared with before you started iron replacement 3 weeks ago?
- What barriers do you have to obtaining access to iron supplements and food items?



### **UNFOLDING CASE STUDY**

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#### **Part D**

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up from Case Study Parts A, B, and C.

After discussing Ms. Foster's symptoms in relation to her anemia, Grant reviews iron replacement therapy, including the importance of taking iron with a citrus beverage such as orange juice to aid in iron absorption. He informs Ms. Foster that most insurance companies will not cover the cost of iron replacement as it can be purchased over the counter. Grant further offers to search her local pharmacy website to determine the cost and formulations available. He provides a written client education handout on iron deficiency anemia as well as instructions for Ms. Foster to call her PCP for a follow-up appointment in 3 weeks. Grant then discusses several foods that are iron rich ([Table 9.4](#)) and helps Ms. Foster identify 3 food items that she feels she can incorporate into her daily diet. Ms. Foster's daughter repeats the items needed to initiate this plan and offers to take her mother to the store before returning home. Ms. Foster reminds her daughter that she has groceries delivered every other week but will increase to a weekly delivery to ensure fresh or frozen spinach availability daily. At this point, Grant asks Ms. Foster the following: "How confident are you that you can make this change, on a scale of 0 to 10, with 10 being extremely confident?"

Food Item	Serving Size	Iron Content
Tofu	½ cup	3 mg
Kidney beans	½ cup	2 mg
Beef liver	3 oz	5 mg
Canned white beans	1 cup	8 mg
Boiled lentils	½ cup	3 mg
Fortified breakfast cereal	½ cup	18 mg
Potato, baked, flesh and skin	1 medium size	2 mg
Tomatoes, canned, stewed	½ cup	2 mg

**TABLE 9.4** Iron-Rich Foods (source: National Institutes of Health, 2023)

Ms. Foster reports a confidence level of 8, vocalizing her motivation to actively participate in her grandson's wedding in 3 months. Grant feels confident that he and Ms. Foster have developed a solid plan in a collaborative manner. He

provides Ms. Foster with a copy of the plan and educational materials and recommends she ask her PCP for a referral to a registered dietitian to help with meal planning. He adds the nursing care plan to Ms. Foster's electronic medical record to ensure that her PCP's office will have access during the follow-up appointment.

7. What stage of change is Ms. Foster in at the conclusion of the nurse's teaching session?
    - a. Contemplative
    - b. Pre-contemplative
    - c. Preparative
    - d. Action
  
  8. What should the nurse recognize first when modifying a nutritional plan for change?
    - a. Change is a cyclic process.
    - b. Motivational interviewing is the preferred method to determine success of the prior plan.
    - c. Goals of the initial plan for change are important.
    - d. Barriers to success of the initial nutritional change plan exist.
-

## Chapter Summary

- Iron deficiency anemia, characterized by low hemoglobin concentration and microcytic red blood cells, is the most common nutritional blood disorder in young children, pregnant women, and older adults.
- Nutrient-related hematologic disorders include vitamin B<sub>12</sub> deficiency, vitamins C, K, and D deficiency, and folate deficiency.
- Delays in diagnosing excessive or deficient nutritional intake can lead to hematologic abnormalities resulting in life-threatening conditions. Accurate assessment of the client's nutritional status with early intervention gives clients the best chance for recovery.
- Acute and long-term illnesses such as trauma, burns, cancer, lung disease, and immune dysfunction require even higher protein and micronutrient intake to restore homeostasis during the healing stage.
- Aging adults are susceptible to nutrient-deficient blood abnormalities because of decreased production of hormones and red blood cells and a decreased appetite/food intake related to delayed gastric emptying, changes in papillae, and declining oral health.
- Use of the TTM for nutrition educational interventions can provide clients a degree of motivation for successful restoration of hematologic wellness.

## Key Terms

- macrocytic anemia** anemia that is marked by abnormally large red blood cells. Example: Folate and vitamin B<sub>12</sub> deficient anemia
- microcytic anemia** anemia that is marked by abnormally small red blood cells. Example: Iron-deficient anemia
- pica** craving and chewing substances with no nutritional value such as ice, dirt, clay, and paper

**Transtheoretical Model (TTM)** an integrative model of behavior change that assesses an individual's readiness to act on a healthier behavior and that provides strategies, or processes of change, to guide the individual

## Review Questions

1. Which nutritional deficiency listed increases the risk for bleeding?
  - a. Vitamin K
  - b. Iron
  - c. Vitamin B<sub>12</sub>
  - d. Folate
2. The nurse is providing nutritional counseling to a client planning pregnancy. The nurse should emphasize the importance of consuming what micronutrients to avoid macrocytic anemia?
  - a. Vitamin D
  - b. Vitamin E
  - c. Folic acid
  - d. Vitamin C
3. A middle-aged client with a history of alcohol use disorder is admitted to an acute care setting with symptoms of severe anemia. The nurse anticipates what nutrient(s) to be deficient?
  - a. Iron
  - b. Vitamin B<sub>12</sub>
  - c. Calcium
  - d. Copper
4. The nurse notices that a client has excessive bruising and brittle nails. The client reports frequent infections. Which nutritional deficiency would the nurse expect for this client?
  - a. Iron
  - b. Protein
  - c. Vitamin C

- d. Copper
- 5.** A nurse is preparing discharge instructions for a client who has just been diagnosed with iron deficiency anemia and will be starting oral iron replacement therapy. Which of the following is an important nursing consideration to include in the teaching plan?
- Hemoglobin should be checked in 6 months.
  - Always take iron with milk or food to increase absorption.
  - Always take iron with a citrus beverage, 1 hour before or 2 hours after meals, to increase absorption.
  - Increase diet in fatty fish.
- 6.** Which nursing diagnosis is a priority for an older adult client just diagnosed with nutritional anemia?
- Risk for falls
  - Risk for imbalanced nutrition, less than body requirements
  - Frail elderly syndrome, related to malnutrition
  - Risk for bleeding
- 7.** The nurse is preparing discharge instructions for a client with anemia related to vitamin B<sub>12</sub> deficiency. The nurse suggests which of the following food items be increased in the client's diet?
- Animal meat, fish, eggs, and dairy
  - Beans, seeds, and nuts
  - Dark green leafy vegetables
  - Citrus fruits and acidic raw vegetables
- 8.** Which of the following psychosocial influences impacting nutritional goals for hematologic wellness is the best target for an *initial* nursing intervention?
- Health literacy
  - Transportation
  - Social support
  - Cognitive function
- 9.** Assessing a client's readiness to learn about nutrition-related hematologic illness, utilizing a holistic approach, should include all of the following except:
- Providing written materials regarding vitamin C deficiency to the client immediately before discharge
  - Determining the client's preferred language for learning
  - Discussing the client's preferred learning style
  - Delaying discharge education until the client's significant other is present
- 10.** When evaluating the effectiveness of a nutritional plan for iron deficiency anemia, the nurse considers which of the following factors?
- Behavior change typically takes 6 months to achieve, according to the Transtheoretical Model (TTM).
  - Hemoglobin is expected to increase as a response to oral ferrous sulfate within 2 to 3 months of starting.
  - An early sign suggesting improved anemia may include the client's report of sleeping more.
  - Shortness of breath may take several months to improve.

## Suggested Reading

Centers for Disease Control and Prevention. (2021, November 16). *Iron: Infant and Toddler Nutrition*.

<https://www.cdc.gov/nutrition/infantandtoddlernutrition/vitamins-minerals/iron.html>

National Heart, Lung, and Blood Institute. (2022, March 24). *Blood tests*. <https://www.nhlbi.nih.gov/health/blood-tests>

Nguyen, M., & Tadi, P. (2022). Iron supplementation. In *StatPearls [Internet]*. <https://www.ncbi.nlm.nih.gov/books/NBK557376/>

# CHAPTER 10

## Special Nutritional Considerations for Hematologic Health



**FIGURE 10.1** A healthier version of nachos that contains sweet potatoes, which are high in vitamin C, and beans, which are high in iron, can provide nutrients that promote hematologic wellness. (credit: modification of work “Good-For-You-Nachos” by Alabama Extension; ACES | Janet Guynn/Flickr, Public Domain)

### CHAPTER OUTLINE

10.1 The Impact of Nutrition on Hematologic Wellness Across the Lifespan

10.2 Nutrition and Chronic Hematologic Illness

10.3 Treatments and Nutrition

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**INTRODUCTION** Nutritional needs vary from one life stage to the next. Specific stages of life have increased needs, such as during pregnancy and vulnerable times, including acute and chronic illness. Meeting nutritional needs from infancy through older age builds a framework for health and well-being throughout life (Rodríguez-Mañas et al., 2023).

Nutritional deficiencies impacting hematologic health occur at all ages and affect people of all backgrounds and socioeconomic status. Specific comorbidities and lifestyles contribute to a higher chance of experiencing undesired consequences of these deficiencies and require special consideration by the health care team.

Consider this case: Catalina is a 15-year-old Black female adolescent with no prior medical problems. She is in the 10th grade, is in the high school band, and previously made good grades. She reports to her primary care clinic today with concerns of increasing fatigue, headaches, and shortness of breath when playing her trumpet in the school band. Her mother reports that her academic performance has declined over the past 6 weeks. Her diet is reported to be normal for her age, although she does not care for most fruits and vegetables and seldom eats red meat.

## 10.1 The Impact of Nutrition on Hematologic Wellness Across the Lifespan

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 10.1.1 Describe the impact of nutrition on the hematologic system during pregnancy.
- 10.1.2 Describe the impact of nutrition on the hematologic system during infancy.
- 10.1.3 Describe the impact of nutrition on the hematologic system during childhood.
- 10.1.4 Describe the impact of nutrition on the hematologic system during adolescence.
- 10.1.5 Describe the impact of nutrition on the hematologic system during adulthood.
- 10.1.6 Describe the impact of nutrition on the hematologic system during later adulthood.

The most common hematologic consequence throughout the lifespan is anemia, affecting approximately 1.8 billion individuals worldwide (Safiri et al., 2021). Although the specific nutrient responsible for nutritional anemia can vary, the condition is characterized by a deficiency in healthy red blood cells. This can lead to various health conditions and is a major public health issue with significant implications for quality of life, productivity, and mortality.

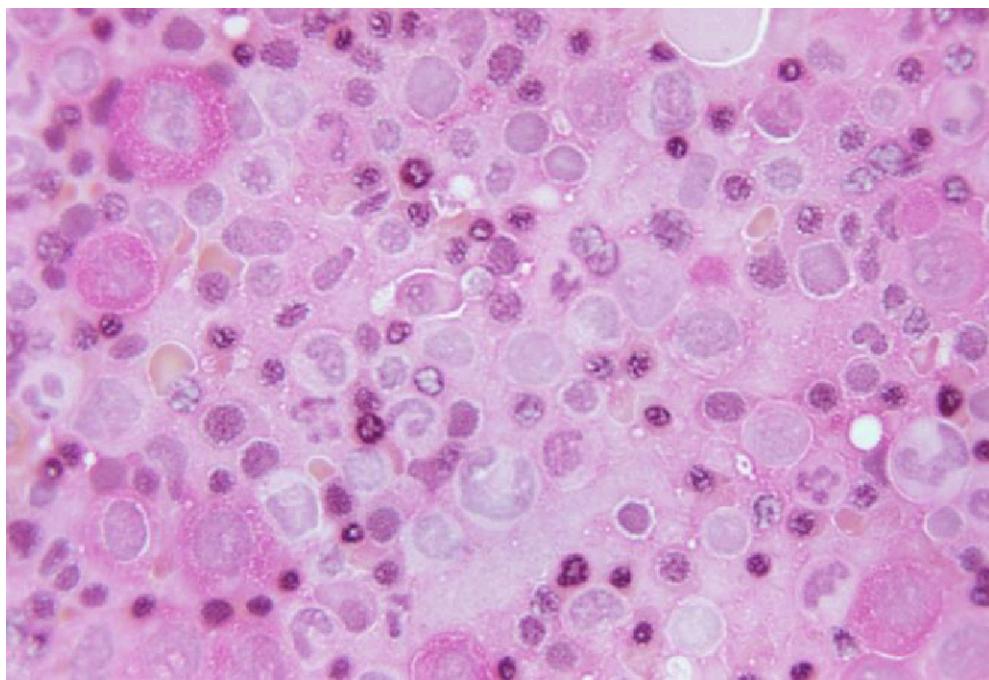
Less common than anemia, nutritional bleeding disorders are a group of conditions that can lead to problems involving prolonged bleeding and thrombosis caused by a lack of nutrients in the diet, such as vitamin K, vitamin C, or iron. Recognizing signs and symptoms related to these deficiencies is critical to avoid life-threatening complications, particularly during health emergencies such as trauma or sepsis. Although seen less frequently, macronutrient and micronutrient deficiencies can also impair immune system function and tissue healing, effects that can be particularly problematic for individuals living with acute or chronic illnesses such as infections or autoimmune diseases.

Controlling anemia requires an interdisciplinary team to prioritize the highest-risk groups, including young children and clients of reproductive age. Despite the nature of the disease, dietary iron deficiency (ID) is the leading cause of anemia in all regions (Safiri et al., 2021). Recent reports indicate an increased trend in anemia and iron deficiency among pregnant clients and young children over the past two decades (National Center for Health Statistics, 2023). According to the World Health Organization (WHO) criteria, anemia and iron deficiency among pregnant individuals and U.S. children have reached the significance of mild and moderate public health problems, respectively (Jefferts et al., 2022). More attention must therefore be paid to nutritional interventions for these high-risk groups.

### Impact on Health During Pregnancy

Red blood cell production increases by 30% during pregnancy to support blood volume expansion and fetal growth (Benson et al., 2022). Iron is preferentially used for **erythropoiesis** (production of red blood cells); therefore, iron deficits can quickly occur, resulting in maternal and fetal anemia.

Anemia affects approximately 36% of pregnant people worldwide and approximately 12% of pregnant people in the United States. The most common causes of anemia in pregnancy are iron deficiency and acute blood loss (Smith et al., 2019; WHO, n.d.-a). [Figure 10.2](#) is an image of human blood from a case of iron deficiency. If iron needs are not met, there is an increased chance of maternal and fetal adverse outcomes. As the severity of anemia worsens, so do the associated risks, which can result in prolonged hospitalization for postpartum clients (Smith et al., 2019; Jefferts et al., 2022). Clients who have multiple births are twice as likely as those who have single births to develop iron deficiency anemia (IDA) due to increased blood volume expansion and utilization of iron stores.



**FIGURE 10.2** Human blood from a case of iron deficiency anemia. The red blood cells are pale and smaller than the larger white blood cells shown in the image. (credit: “This photomicrograph of a Prussian blue stained bone marrow sample, revealed that there was a lack of iron stores. Prussian blue staining for iron particles, which reveals little or no stainable iron in the bone marrow reticulum cells, and normoblasts, is the definitive test for iron deficiency, in the case of iron deficiency anemia (IDA)” by CDC/Dr. Gordon D. McLaren, Public Domain)

The third trimester of pregnancy is the highest risk period of gestation. If the pregnant client has anemia (any type) during pregnancy, they will have a decreased tolerance of blood loss occurring during birth, increasing their risk for hypovolemic shock, heart failure, infection, and the need for blood transfusion (Sharma et al., 2021; Smith et al., 2019). See [Table 10.1](#) for complications and risks associated with anemia in pregnancy.

Race disparities in nutritional anemia exist both globally and within the United States. According to data from the **National Health and Nutrition Examination Survey (NHANES)**, a program conducted by the National Center for Health Statistics to assess the health and nutritional status of adults and children in the United States, non-Hispanic Black pregnant women have the highest prevalence of IDA, particularly during the third trimester of pregnancy (Sharma et al., 2021).

Maternal Risks for Developing Anemia in Pregnancy	Maternal Complications of Anemia	Fetal Complications of Anemia
<ul style="list-style-type: none"> <li>• Maternal age less than 20 years</li> <li>• Maternal age greater than 40 years</li> <li>• Multiparous</li> <li>• Multiple pregnancy</li> <li>• In vitro fertilization</li> <li>• Underweight before pregnancy</li> <li>• Prior cesarean delivery</li> <li>• Hypertension</li> <li>• Chronic disease</li> </ul>	<ul style="list-style-type: none"> <li>• Maternal death</li> <li>• Cesarean delivery</li> <li>• Preeclampsia</li> <li>• Placenta previa with hemorrhage</li> <li>• Placental abruption</li> <li>• Hypovolemic shock</li> </ul>	<ul style="list-style-type: none"> <li>• Preterm birth</li> <li>• Low birth weight</li> <li>• Small for gestational age</li> <li>• Fetal death</li> </ul>

**TABLE 10.1** Complications and Risks Associated with Anemia in Pregnancy

Screening for anemia and ID in pregnant clients to improve maternal and infant health outcomes is a **secondary health promotion** intervention. The American College of Obstetricians and Gynecologists (2021) now recommends screening for anemia in all pregnant clients at the first prenatal visit and, if detected, screening for iron deficiency. However, current guidelines do not recommend prepregnancy iron screening. This decreases the chance of early identification because individuals may not be aware they are pregnant until later in the pregnancy.

Iron deficiency and IDA are found equally often among pregnant individuals; however, ID alone doubles in the third trimester and might go completely undetected if the client is asymptomatic (Cochrane et al., 2022; Nour, 2022). Iron requirements gradually increase during pregnancy from 0.8 mg/day to 7.5 mg/day by the third trimester. The average Western diet includes 1–5 mg of iron daily from food sources; therefore, iron stores will be depleted quickly from a pregnant client if not supplemented (Means, 2020). The Centers for Disease Control and Prevention (CDC) recommends 30 mg/day of elemental iron at the start of pregnancy, and the WHO recommends 60 mg/day. If the pregnant client is diagnosed with anemia during pregnancy, iron should be increased to 60–120 mg/day (National Institutes of Health [NIH], 2023; WHO, n.d.-b).



### CLINICAL TIP

#### Elemental vs. Nonelemental Iron

Elemental iron is a natural substance (heavy metal) directly used by erythrocytes in the body. Nonelemental iron is a chemical compound of iron bound to salt, such as ferrous sulfate. Iron supplements contain an iron salt compound because it is absorbed better than natural iron (Harvard T. H. Chan School of Public Health, 2023). Various iron supplements are available over the counter, which is often confusing for patients and health care professionals. Although health care providers often write prescriptions for iron supplementation, most pharmacies do not carry a “prescription-strength” iron supplement, and clients are directed to over-the-counter products. These product labels will contain two different amounts of iron, elemental and nonelemental; therefore, when providing patient education, nurses must be aware of the amount of elemental iron prescribed and teach clients how to read the labels.

#### Folate and Vitamin B<sub>12</sub> Requirements

Before the United States FDA began mandating folate fortification in 1998, folate (vitamin B<sub>9</sub>) deficiency was a common cause of anemia during pregnancy (Ismail et al., 2023). Folate demands increase during pregnancy to support fetal and maternal tissue development (Ballestín et al., 2021). Both anemia and folic acid deficiency can place the fetus at risk for neurologic compromise, including defects in brain development and in the myelination of nerve fibers (Jefferts et al., 2022). Although not a common cause of anemia in most women, vitamin B<sub>12</sub> deficiency can cause serious maternal-fetal consequences for women with gastrointestinal malabsorption.

Folate and vitamin B<sub>12</sub> deficiencies do not always result in macrocytic anemia during pregnancy; however, a physiologic decline is expected (Achebe & Gafter-Gvili, 2017). Folate deficiency in pregnant clients can result in low birth weight and small-for-gestational age (SGA) newborns. Adequate maternal intake of vitamin B<sub>12</sub> is necessary to support fetal growth and development. Signs and symptoms of vitamin B<sub>12</sub> deficiency include fatigue, pallor, tachycardia, poor exercise tolerance, and suboptimal work performance and should be considered in clients with a history of malabsorption conditions (Achebe & Gafter-Gvili, 2017).

As a **primary health promotion** intervention, the WHO recommends 400 mcg daily of folic acid in pregnant clients until 3 months postpartum. The CDC recommends 400 mcg/day of folic acid for all individuals of childbearing age to prevent neural tube defects in the event of pregnancy. Prenatal vitamins generally contain 1 mg of folate; however, doses of up to 5 mg/day are recommended for those with higher demands, such as during pregnancy in women who have previously had a pregnancy affected by a neural tube defect (Khan, 2023).

### SPECIAL CONSIDERATIONS

#### Vitamin B<sub>12</sub> Deficiency

Vitamin B<sub>12</sub> is readily stored in excess in the liver, so most pregnant clients are not deficient. However, when vitamin B<sub>12</sub> cannot be obtained or absorbed, such as with dietary insufficiency or malabsorption, hepatic stores are depleted, creating a deficiency (Ankar & Kumar, 2022). This includes pregnant clients with a history of a strict vegan diet for the previous 3 years and those who have undergone bariatric surgery. The WHO and the NIH recommend 2.6 mcg of vitamin B<sub>12</sub> daily during pregnancy, increasing to 2.8 mcg postpartum if breastfeeding (NIH, 2022).

The risk of developing vitamin B<sub>12</sub> deficiency is higher for people who do not get vitamin B<sub>12</sub> from their diet, such as those who are vegetarian or vegan and those with health conditions or medication regimens that interfere with absorption of the vitamin:

- Intestinal diseases
- Previous gastric or ileac resection
- History of celiac disease or inflammatory bowel disease
- Autoimmune disorders (Graves' disease, thyroiditis, vitiligo)
- Prolonged use of proton pump inhibitors or H<sub>2</sub> receptor antagonists

Clients with a proven deficiency will need higher doses of replacement therapy as follows:

- Deficiency from diet: 1000 mcg orally once daily
- Deficiency from malabsorption: 1000 mcg parenterally (intramuscular injection) once every 3–4 weeks  
(Ankar & Kumar, 2022)

## Infancy

Infancy, from birth to 12 months, is a period of intense physical and developmental growth. **Hematopoiesis** (formation of blood cellular components) and **hemostasis** (usual reaction to a bleeding injury to stop blood flow) are incomplete at birth, and micronutrient deficiencies can impair the child's long-term potential. Requirements for macronutrients and micronutrients are higher during infancy and childhood than other developmental stages and are influenced by the rapid cell division occurring during growth (Physicians Committee for Responsible Medicine, 2020a). Research indicates that micronutrient deficiencies negatively affect the thymus, which can impact lymphocyte function, increasing the risk of infection and inflammatory disease in children (Pai et al., 2018).

Infants receive **passive immunity** while in utero and through breast milk. This is partially the basis of the American Academy of Pediatrics (AAP) recommendations for breast milk as the “sole source of nutrition for the first 6 months of life, or as long as both mother and baby desire” (Meek et al., 2022). After 6 months, infants should be introduced to supplemental solid foods, including iron-fortified infant cereal. Introducing supplemental foods can be challenging for caregivers, leaving infants and toddlers at additional risk for nutritional deficiencies, especially if food allergies or intolerances are identified. To ensure that infants and young children achieve desirable physical and social milestones, nurses must be well versed in the nutritional considerations affecting this vulnerable population. Educating potential and new parents regarding all health benefits for the breastfed infant is an essential client-centered nursing intervention.

## SPECIAL CONSIDERATIONS

### Infant Benefits of Breastfeeding

According to the AAP Section on Breastfeeding (Meek et al., 2022), exclusive breastfeeding for the first 6 months of an infant's life can decrease risk for:

- Acute and chronic infections, including lower respiratory and ear infections and tooth decay
- Food allergies
- Sudden infant death syndrome (SIDS)
- Otitis media
- Eczema
- Asthma
- Childhood and adult obesity
- Types 1 and 2 diabetes
- Gastrointestinal discomfort, including vomiting, diarrhea, and colic

## Anemia

According to the WHO, infantile and childhood anemia in the United States ranges from 6–18%, with higher rates among low-income families. As with other age groups, ID is the most common cause of anemia, followed by other

nutritional anemias, vitamin B<sub>12</sub>, and folate (NIH, 2022).

Iron deficiency occurs in 12% of infants ages 6–11 months and 8% of toddlers in the United States. Among toddlers, IDA ranges from 0.9–4.4%, depending on the racial and ethnic makeup and socioeconomic status of the household (NIH, 2023). During the first 2 years of life, iron needs are high to build iron stores and support the child's rapid physical and cognitive development rate. Premature infants, infants born to those with iron-deficiency, and infants with low birth weight have been shown to have lifelong learning and memory deficits because of damage to the hippocampus, the brain's memory center. Accordingly, clinical consequences of ID and IDA in children include (Benson et al., 2022; Drakesmith et al., 2021):

- Impaired psychomotor development and cognitive function
- Delayed attention skills
- Social withdrawal
- Decreased leukocyte and lymphocyte function
- Decreased response to childhood vaccines
- Increased neurotoxicity when ID is associated with high lead blood concentrations

Infant iron stores start to diminish at 6 months of age. After this time, breastfed infants are at greater risk for anemia because the iron content of breast milk depends on the lactating person's diet, whereas infant formula is fortified with iron. Full-term infants are at the highest risk between ages 6 months and 9 months if they are not consuming iron-fortified formula or successfully introduced to solid foods rich in iron (NIH, 2023). Additionally, children younger than 2 years are more likely than older children to have IDA associated with a transition to solid foods. Recommendations for preventing and treating ID and IDA are shown in [Table 10.2](#).

Recommending Organization	Infant Considerations	Iron Dosing	Iron-Fortified Foods
Centers for Disease Control and Prevention	Less than 12 months old, not exclusively breastfed	Iron-fortified formula	Label will indicate "with iron"
	Less than 12 months old, preterm or small for gestational age, exclusively breastfed	2–4 mg/kg/day elemental iron until 12 months old	
	Less than 12 months old, full-term, and appropriate for gestational age, exclusively breastfed	Consult health care provider for recommendations.  *If eating iron-fortified foods starting at 6 months old, iron supplement may be discontinued.	<ul style="list-style-type: none"> <li>• Infant rice cereal</li> <li>• Commercially prepared baby food: beef, turkey, pork, lamb, spinach</li> <li>• Mashed chickpeas, white beans, broccoli</li> <li>• Pureed or mashed sweet potatoes; soft, cooked beans; green peas</li> </ul>
American Academy of Pediatrics	4–12 months old, full-term, exclusively breastfed	1 mg/kg/day elemental iron until eating iron-fortified solid foods	

**TABLE 10.2** Recommendations for Iron Supplementation in Infants

Recommending Organization	Infant Considerations	Iron Dosing	Iron-Fortified Foods
	1–12 months old, preterm, exclusively breastfed	2 mg/kg/day elemental iron until 12 months old	
World Health Organization	6–23 months old if diet does not include iron-fortified foods, or if living in a region where anemia prevalence is greater than 40%	2 mg/kg/day elemental iron until 24 months old	

**TABLE 10.2** Recommendations for Iron Supplementation in Infants

Individuals living at high altitudes (greater than 1,500 m) are at increased risk for anemia secondary to increased erythropoiesis. This is a compensatory response to a lower oxygen saturation of the blood, so health care professionals must interpret hemoglobin carefully by using altitude-adjusted algorithms (Mairbäurl et al., 2023). Children living at high altitudes may need a greater intake of iron and micronutrients to avoid growth and development delays (Sharma et al., 2019).

### Bleeding Risks

Vitamin K is an essential fat-soluble vitamin required for adequate blood clotting. Infants have minimal vitamin K stored at birth because only small amounts pass through the placenta. Vitamin K comes from one of two sources: diet or synthesis by **anaerobic** (relating to absence of oxygen) bacteria located in the stomach (Yan et al., 2022). A newborn with a healthy gut will not have bacteria-producing vitamin K until approximately 1 week of life. In addition, breast milk contains low quantities of vitamin K. All infants are therefore at high risk for **vitamin K deficiency bleeding (VKDB)** until they start eating solid foods, which usually occurs at age 4–6 months (Araki & Shirahata, 2020). VKDB is a condition associated with uncontrolled bleeding due to lack of sufficient vitamin K to form blood clots.

To prevent VKDB, the American Academy of Pediatrics (2022) recommends intramuscular (IM) vitamin K prophylaxis as follows:

- Infant birth weight greater than 1500 g: 1 mg vitamin K IM within 6 hours of birth
- Infant birth weight less than 1500 g: 0.3–0.5 mg/kg IM within 6 hours of birth

This risk for VKDB is increased for the following infants:

- Premature infants
- Infants who did not receive vitamin K replacement shortly after birth
- Infants born to mothers with malabsorption or use of antiseizure drugs, antibiotics, warfarin, or antitubercular medications
- Infants with malabsorption, **cholestasis** (slowing or halt of bile flow from the liver), or liver disease

[Table 10.3](#) outlines the three types of VKDB according to the time of presentation. Early and classic VKDB occur in 1 in 60 to 1 in 250 newborns whereas late VKDB occurs in 1 in 14,000 to 1 in 25,000 infants. Newborns who do not receive a vitamin K injection are 81 times more likely to develop late VKDB (Hand et al., 2022).

Type	Timing	Associated Factors
Early	Within 24 hours after birth	<ul style="list-style-type: none"> <li>• Maternal malabsorption or maternal use of specific medications</li> <li>• A spectrum of symptoms from simple bruising to life-threatening cranial hemorrhage</li> </ul>
Classic	Within 1 week after birth	<ul style="list-style-type: none"> <li>• No prophylaxis was received or poorly feeding</li> <li>• Exclusively breastfed</li> </ul>
Late	Between 2 weeks and 6 months after birth	<ul style="list-style-type: none"> <li>• Peaks 2–8 weeks after birth</li> <li>• No prophylaxis was received and infant exclusively breastfed</li> <li>• Infant malabsorption or cholestasis</li> <li>• Most life-threatening: cranial hemorrhage in 30–60%</li> </ul>

**TABLE 10.3** Types of Vitamin K Deficiency Bleeding (sources: Araki & Shirahata, 2020; CDC, 2023b)

## Childhood

A variety of nutritional inadequacies exist among school-aged children (aged 5–12 years), ranging from overeating (caloric excess) to undereating, often due to food insecurity. Children who overeat or undereat are at risk for hematologic consequences from nutritional deficiencies. Iron deficiency is the most common micronutrient deficiency in school-aged children, although this age group has the lowest prevalence overall among all children. Anemia in school-aged children is highest among non-Hispanic Black children, and iron deficiency is explicitly highest among Mexican American children. The etiology of deficiency is mostly diet related, apart from children with malabsorption conditions (Jefferts et al., 2022).

Iron plays an essential role in brain metabolism and neurotransmitter function, and deficiencies can lead to cognitive dysfunction (Pivina et al., 2019). School-aged children are undergoing steady linear growth and a high amount of cognitive processing. Iron deficiency with or without anemia can cause decreased school performance due to poor attention span, poor memory, and visual and auditory deficits, compromising “socioemotional development” (Rodríguez-Mañas et al., 2023). Children participating in extracurricular activities may have low energy, negatively impacting their physical performance. Signs and symptoms related to IDA often have a gradual onset in school-aged children and may not be easily detected. Research has shown a positive link between children with attention-deficit hyperactivity disorder (ADHD) and IDA. Therefore, children over 4 years of age demonstrating poor attention or impulsivity should be evaluated for ID (Mattiello et al., 2020). If it is detected, treatment and dietary changes are recommended to ensure intake of 3–6 mg/kg/day of elemental iron for 2–3 months.

## Vitamin D Deficiency

Fat-soluble vitamin D is essential for calcium absorption, which takes place in the gastrointestinal tract. It is necessary for optimal bone growth; in addition, vitamin D modulates adaptive immunity, and deficiency is associated with an increased risk of infection (Giannini et al., 2022). The fortification of milk with vitamin D significantly decreased the prevalence of rickets, a softening and weakening of bones that can result in bone deformities. However, with fewer children playing outside and an increase in the use of sunscreen, vitamin D deficiency is once again a public health problem, affecting 15% of children aged 1–11 years (Porto & Abu-Alreesh, 2022). Children at increased risk for vitamin D deficiency include those with:

- Decreased dietary intake of vitamin D
- Dark skin tones
- Excess weight
- Decreased sun exposure
- Malabsorption diseases, including celiac disease, cystic fibrosis, pancreatic insufficiency, and short bowel syndrome

The AAP recommends that all infants younger than 12 months old receive 400 units of supplemental vitamin D daily and that children older than 12 months old receive 600 units daily (Porto & Abu-Alreesh, 2022). Children with risks for deficiency or known deficiency will need higher doses.

### Zinc Deficiency

Zinc is a mineral that is essential for growth in children. Deficiencies can impact hematopoiesis, resulting in poor immunity and poor wound healing. Zinc deficiency affects approximately 31% of toddlers 1–3 years old in the United States and up to 80% globally, usually due to poor diet or situations of food insecurity (Vreugdenhil et al., 2021). Zinc is naturally found in meats, poultry, fish, dairy, eggs, and dry legumes, and in the United States, grains and infant cereals are fortified with zinc. Strict vegetarians are at high risk for zinc deficiency because the body does not readily absorb the zinc found in fruits, vegetables, and bread.

### Adolescence

Adolescence is the second time in childhood when rapid growth and development occur. Physically, socially, and psychologically, the energy and micronutrient demands are high. However, parental influence on food choices diminishes during this time, often leading to nutritional deficiencies, most commonly iron.

Adolescence is a time of increased iron needs because of the expansion of blood volume and increase in muscle mass. There are sex differences in ID without anemia in adolescents: 9–20% in females but less than 1% in males. The prevalence of IDA in adolescent females who are not menstruating is 3% (Mattiello et al., 2020). Young females are at particular risk for developing iron deficiency because of menstruation. Approximately 7% of menstruating adolescents have IDA, and those who experience **menorrhagia** (heavy menstrual bleeding) are at increased risk (Eiduson et al., 2021; Mattiello et al., 2020). It is difficult to quantify heavy menstrual bleeding outside of clinical trials; however, excessive menstrual blood loss that affects quality of life requires further evaluation and treatment (Mansour et al., 2021). Counting how often sanitary pads or tampons are changed can aid in estimating the amount of blood loss; for example, changing sanitary pads or tampons every 1–2 hours is consistent with heavy menstrual bleeding (Fulton, 2022). Common signs and symptoms of ID and IDA in adolescents include:

- Decreased psychomotor skills
- Poor concentration
- Decreased academic performance
- Shortness of breath
- Rapid heart rate
- Headaches
- Dizziness and fainting
- Restless leg syndrome
- Irritability
- Mild weakness
- Fatigue and the need to nap more frequently

Oral iron replacement is recommended as the first step for treating ID and IDA in adolescents, at a dosage of 3–6 mg/kg of elemental iron daily for 2–3 months (Miniero et al., 2019). Adolescents will also need counseling regarding dietary modifications and ways to manage potential adverse effects of iron replacement. Long-term dietary changes will be necessary for female adolescents with ID or IDA associated with menstruation. For therapy to be successful, dietary modifications should reflect individual preferences. Vegetarian options may include legumes, beans, tofu, rolled oats, and quinoa.



### UNFOLDING CASE STUDY

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#### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

The nurse prepares to assess Catalina for more details about her past medical history and current health concerns. Catalina reports that prior to the past few months, she had felt great and had managed her grades and social life well. She does not take any medications regularly, including daily vitamins. Her mother confirms that she has no significant past medical issues, which makes her current symptoms more concerning. Catalina never complains and has always prioritized her grades. Catalina and her mother confirm that nothing has changed in their social

circumstances, and Catalina denies symptoms of depression.

The nurse is aware that adolescent females are at risk for anemia and ID once menstruation begins and therefore takes a detailed menstrual bleeding history. Catalina reports that she has had regular menstrual cycles lasting 5–7 days since age 13 years but has noticed an increase in the heaviness of her flow this school year. She further says that her use of sanitary pads has increased, and she must change her pad every 1–2 hours during the day and night. The nurse recognizes this as a sign of heavy menstrual bleeding and notifies the health care provider of her concern that Catalina may be anemic and iron deficient.

1. What is an expected dose of oral iron supplement for Catalina?
  - a. 3 mg/kg/dose twice daily for 3 months
  - b. 6 mg/kg/dose twice daily for 3 months
  - c. 3–6 mg/kg/day for 6 months
  - d. 3 mg/kg/day until anemia is resolved
  
2. Which of the following strategies would be most effective when providing diet instruction to Catalina?
  - a. Ask her to identify her food likes and dislikes.
  - b. List the foods she must eat each week.
  - c. Explain that she needs to make these changes on just a short-term basis until her anemia resolves.
  - d. Explain that the iron supplement has side effects that she will have to tolerate if she is prescribed that medication.

## SPECIAL CONSIDERATIONS

### The Adolescent Athlete

Adolescent athletes face unique challenges related to nutritional needs. They are already at risk for nutritional deficiencies because of rapid growth, unhealthy food choices, and high-risk behaviors. Adolescent athletes have a high nutritional demand due to the daily energy expenditure associated with training and having less time to make healthy food choices. Additionally, many athletes strive for a lean body composition for a competitive edge, setting them up for disordered eating patterns that can have lifelong effects on their overall health (Kontele & Vassilakou, 2021). Adolescent athletes who limit their intake of meat products are at even higher risk for iron imbalance. Because of increased iron needs combined with potentially low iron intake and increased blood loss from menstruation, ID and IDA are common problems among adolescent female athletes and can affect their physical endurance and cognitive performance. In males, ID is often associated with higher physiologic needs from excessive training rather than from diet alone (Desbrow, 2021).

Iron deficiency can manifest as extreme fatigue, increased susceptibility to infection, impaired skeletal muscle function, and poor decision-making (Berg, 2019). Assessment for ID and IDA should be considered for both male and female athletes demonstrating these symptoms. Athletes at the highest risk for iron deficiency include those who are female; are underweight or undernourished; are vegetarian or consume limited amounts of iron-rich foods; have underlying malabsorption conditions; or compete in endurance sports.

### Adulthood

As in other age groups, ID and IDA remain the highest cause of anemia in young and middle adults, although other nutrient deficiencies such as folate and vitamin B<sub>12</sub> contribute (NIH, 2023). In adults ages 19–50, males require more zinc and vitamins C, K, and B complex, and menstruating females of the same age require more iron. Females are twice as likely as males to have nutritional anemia, and moderate to severe anemia is five times more common in nonpregnant females than in males. Race differences are prevalent, with the highest incidence in non-Hispanic Black adults, followed by Hispanic and White individuals (Malek et.al, 2019; Physicians Committee for Responsible Medicine, 2020a; Rodríguez-Mañas et al., 2023).

Modern health care relies on healthy adults to maintain the blood supply. However, 25–35% of frequent blood donors will develop ID, which may not be detected if it is present without anemia (NIH, 2023). This raises concern for the frequent blood donor's health and the quality of blood they donate (Hod et al., 2022).

Folic acid, vitamin B<sub>12</sub>, and vitamin K deficiencies in adults can also be secondary to chronic liver disease and excessive alcohol intake. Middle adults in the United States consume less than the recommended daily requirements for most essential micronutrients, leading to deficiencies that increase the risk for certain chronic conditions. Chronic diseases are now increasingly common among young adults, often because of poor nutrition, lack of physical activity, and smoking (Rodríguez-Mañas et al., 2023). Sixty percent of adults with chronic heart failure have ID, and 17% of those have IDA. The etiology of this is multifactorial and may be related to:

- Poor nutrition
- Malabsorption
- Defective mobilization of iron stores
- **Cardiac cachexia** (unintentional severe weight loss caused by heart failure)
- Use of aspirin or other anticoagulant medications that can lead to microscopic blood loss in the gastrointestinal tract

The economic burden on adults with IDA includes reduced physical productivity and work capacity due to associated symptoms such as fatigue, weakness, and shortness of breath (Jefferds et al., 2022).

### **Later Adulthood**

Aging naturally impacts physical changes, even in the healthiest adults, but healthy aging depends on proper nutrition (Kaur et al., 2019). Although energy needs decrease with age, specific micronutrient needs increase. As they age, adults become susceptible to nutrient-deficient blood abnormalities secondary to a decreased production of hormones and red blood cells, as well as decreased appetite and food intake related to delayed gastric emptying and declining oral health. In addition, older clients may experience nutritional challenges due to age- or disease-related conditions associated with chewing, swallowing, digestion, and absorption of nutrients (Physicians Committee for Responsible Medicine, 2020a). Malnutrition in this phase of life can result in lower physical function, poor quality of life, a greater risk for loss of muscle mass, and a shorter lifespan (Kaur et al., 2019; Rodríguez-Mañas et al., 2023).

Zinc deficiency occurs in approximately 60% of adults older than 70 years, leading to an increased risk for infection. Decreased dietary zinc intake and the physiologic decline in gastrointestinal absorption are the most likely reasons for this deficiency (Kaur et al., 2019).

### **Iron Deficiency**

Older adults have the greatest incidence of nutritional anemia overall, with those aged 80–85 years having the highest. This is the only age group in which males have a greater incidence of anemia than females—as much as two times more. Older adults with anemia have increased hospitalization rates and mortality. Approximately 25–30% of older adults with congestive heart failure have anemia, worsening functional capacity, and are at increased risk of death (Ambrosy et al., 2019). With advancing age, iron stores diminish. This, along with decreased dietary intake of iron-rich foods and increased incidence of gastrointestinal malabsorption and occult blood loss, contributes to ID and IDA in older adults (Burton et al., 2020; Kaur et al., 2019). The prevalence of IDA in older adults is detailed in [Table 10.4](#).

<b>Age</b>	<b>Male</b>	<b>Female</b>
65–75 years	11%	10.2%
76–85 years	15%	7–12%
Older than 85 years	30%	17%

**TABLE 10.4** Prevalence of Iron Deficiency Anemia in Older Adults (Kaur et al., 2019)

Signs and symptoms of IDA in older adults may include:

- Depression
- Fatigue
- Loss of muscle strength
- Decreased cognitive function

Iron-rich foods, such as fortified grains and cereals, and oral replacement are the first step once a deficiency is

confirmed; however, parenteral iron replacement may be required due to the frequency of gastrointestinal malabsorption in this population (Burton et al., 2020).

### Folate and Vitamin B Deficiencies

Vitamin B<sub>12</sub> and folate deficiencies among older adults remain a significant challenge. Approximately 10–30% of older adults are affected by atrophic gastritis, which can interfere with the absorption of vitamin B<sub>12</sub> and folate (NIH, 2022). Additionally, the metabolic processes of each micronutrient are interconnected, so it is difficult to distinguish the source of physical manifestations (Socha et al., 2020). Signs and symptoms include:

- Risk for cardiovascular disease
- Cognitive impairment
- Insomnia
- Impaired mood
- Decreased decision-making ability
- Decreased physical performance, leading to increased risk for falls and fractures

Folate deficiency is more likely to be related to decreased absorption and reduced dietary intake, whereas vitamin B<sub>12</sub> deficiency is more often associated with diseases of malabsorption and polypharmacy. Mild vitamin B<sub>12</sub> deficiency occurs in 20% of adults older than 60, and severe deficiency occurs in 6% of adults older than 70 (NIH, 2022). Nonhematologic symptoms range from vague and nonspecific to severe neurologic and neuropsychiatric disorders (Stauder et al., 2018). Folate deficiency is reported to occur in 5–20% of older adults and is more common in those who smoke, consume excessive amounts of alcohol, are obese, or live alone (Rotstein et al., 2022). Vitamin B<sub>12</sub> deficiency anemia is more likely to be associated with neurologic symptoms not seen in individuals with folate deficiency anemia (Stauder et al., 2018). Anemia associated with both of these deficiencies can be distinguished from IDA based on the size of red blood cells; iron deficiency anemia is microcytic, whereas folate and vitamin B<sub>12</sub> deficiencies are macrocytic. Treatment is focused on nutrient replacement and diet modification.

## 10.2 Nutrition and Chronic Hematologic Illness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 10.2.1 Discuss the impact of nutrition on congenital hematologic disorders.
- 10.2.2 Discuss the impact of nutrition on cancers.

### Congenital Hematologic Disorders

**Sickle cell disease (SCD)**, a genetic **hemoglobinopathy** with chronic anemia, is the most common inherited blood disorder in the United States (McCaskill et al., 2018) and affects the shape of hemoglobin, resulting in blocked blood flow. Individuals with SCD are more prone to micronutrient and macronutrient (carbohydrate, fat, and protein) deficiencies related to hyperreactive hematopoiesis, the physiologic response caused by chronic anemia. Nutrient deficiencies ([Table 10.5](#)) further increase systemic **oxidative stress** (disturbance in the balance between the production of free radicals and antioxidant defenses) and contribute to severe and frequent sickle cell vaso-occlusive crises. These deficiencies can cause the following in people with SCD (Umeakunne & Hibbert, 2019):

- Delayed growth and development
- Decreased quality of life
- Chronic inflammation
- Painful vaso-occlusive crises
- Increased occurrence of stroke, pulmonary hypertension, heart disease, and renal disease

As with SCD, **thalassemia** is a genetic hemoglobinopathy, characterized by less oxygen-carrying protein and fewer red blood cells. There are multiple genetic forms ranging in severity. Thalassemia carries the same nutritional risks as SCD does.

[Table 10.5](#) outlines additional micronutrient deficiencies and recommended interventions.

Micronutrient Deficiency	Recommended Foods/Interventions
Vitamin D*	Milk, yogurt, cheese
Vitamin A	Carrots, sweet potatoes, kale, spinach
Vitamin C	Kiwis, oranges
Vitamin E	Mustard greens, sunflower seeds
Zinc	Nuts, fish, whole grains, dairy products
Folic acid	1 mg daily supplement Leafy green vegetables
Vitamin B <sub>12</sub>	Steamed shrimp, baked snapper, whole grain breads
Omega-3 fatty acids	Meats, beans, nuts, seeds, vegetable oils

\*Vitamin D deficiency is five times more likely to occur in children with SCD than in children without SCD and is associated with increased hospitalizations (McCaskill et al., 2018).

**TABLE 10.5** Common Nutrient Deficiencies in Congenital Hematologic Disorders (source: Sickle-Cell.com, 2023)

#### Genetic Hemochromatosis

Genetic hemochromatosis causes excessive absorption of dietary iron secondary to decreased expression of the peptide hormone hepcidin. It is the most common autosomal recessive disorder in White individuals, affecting one in 300–500 people of northern European descent (Porter & Prashanth, 2023). It is twice as common in males as females and can result in multiple organ dysfunction. Excessive intestinal dietary intake of heme and nonheme iron is primarily managed by dietary modifications (Milman, 2021). These modifications are extensive and require nutritional counseling and reinforcement by health care professionals:

- Consider a vegetarian or semivegetarian diet.
- Consume 21 oz of fruit and vegetables daily; fresh is best.
- Avoid red meat from mammals; instead, choose lean, white poultry.
- Avoid processed meat. Consume no more than 7 oz of meat from poultry per week. Consider additional protein sources such as fish, eggs, and legumes.
- Choose whole grains; avoid iron-enriched grains.
- Beverages should consist of water, green or black tea, coffee, and low-fat milk. Avoid alcoholic beverages.

#### Hemophilia

Hemophilia is an inherited X-linked blood disorder resulting in decreased levels of clotting factor VIII or IX. Occurring in 1 in 5,000 male births, this deficiency results in spontaneous bleeding, often in joints, and severe bleeding following injury or trauma (CDC, 2023a). Nutritional considerations include managing weight and maintaining iron levels to avoid IDA. Obesity is common secondary to a sedentary lifestyle to avoid injury-induced bleeding; however, consequences of decreased physical activity include more stress on the joints and muscle strains that can result in musculoskeletal bleeding (Lim et al., 2020). A recommended diet includes iron-rich foods such as lean red meat, leafy green vegetables, broccoli, dried beans, grains, and raisins. It is important to consume foods containing vitamin C, such as orange juice, to enhance iron absorption.



#### EFFECT OF MISSHAPEN RED BLOOD CELLS ON BLOOD FLOW

[Access multimedia content \(<https://openstax.org/books/nutrition/pages/10-2-nutrition-and-chronic-hematologic-illness>\)](https://openstax.org/books/nutrition/pages/10-2-nutrition-and-chronic-hematologic-illness)

The American Society of Hematology (2009) offers a video that demonstrates how blood flow is affected by misshapen red blood cells.

#### Impact of Cancer on Nutrition and Hematologic Function

Advanced age is a risk factor for nutritional deficiency; the addition of chronic diseases, including malignancy, can quickly lead to malnourishment. These comorbidities can contribute to reduced tolerance of anticancer therapy, impacting survival (Stauder et al., 2020).

The prevalence of anemia in cancer can exceed 90% across all ages and is generally considered to be related to medications, infections, or disorders of hematopoiesis. Common concerns are alterations in activities of daily living affecting quality of life, decreased productivity, and inability to work. Fatigue is reported as the most common troubling symptom of cancer and is directly linked to anemia (Gilreath & Rodgers, 2020). Fatigue and lack of appetite commonly coexist, resulting in an inability to prepare meals, further exacerbating anemia.

Anemia was traditionally believed to be primarily related to the adverse effects of anticancer therapy; however, recent research has shown a direct correlation with chronic, low-grade inflammation. **Functional iron deficiency** (state in which iron is insufficiently incorporated into erythroid precursors even though body iron stores are apparently adequate), malnutrition, and anorexia contribute to cancer-associated anemia (Natalucci et al., 2021). See [Table 10.6](#) for types of IDA in cancer. In contrast, iron overload can occur in clients with symptomatic anemia receiving red blood cell transfusions and can alter the function of effective hematopoiesis, contributing to anemia (Gilreath & Rodgers, 2020). Other micronutrient deficiencies affecting hematologic function in individuals with cancer include folate and vitamin B<sub>12</sub>.

Approximately 50% of adults with colon cancer have anemia due to chronic blood loss from the gastrointestinal tract (Chardalias et al., 2023). The prevalence of anemia in other cancers ranges from 29–46%, mainly related to chronic disease, chemotherapy-induced anemia, nutrient-related anemia, chronic anorexia, and gastrointestinal adverse effects such as nausea, vomiting, and diarrhea (Busti et.al., 2018).

Iron Deficiency	Etiology
Absolute iron deficiency anemia	Associated with bleeding; total body iron stores diminish.
Iron sequestration*	Inflammation results in iron being unavailable for erythropoiesis.
Iron-restricted erythropoiesis*	Erythropoiesis therapy (epoetin) outpaces iron delivery from storage.
*Functional iron deficiency anemia	

**TABLE 10.6** Types of Iron Deficiency Anemia in Cancer

### Nutritional Interventions

Chronic illness has a significant impact on nutrition and, consequently, hematologic wellness. Recommendations have evolved due to more emphasis on a holistic approach to caring for those with hemoglobinopathies and cancer.

The Mediterranean diet has gained popularity in the United States as a way to manage weight, lower cholesterol, and stabilize blood sugar. Close investigation of the constituents of this eating lifestyle reveals significant anti-inflammatory properties that translate well to chronic hematologic illness. Extra-virgin olive oil is has been found to block the proinflammatory cascade (Natalucci et al., 2021).

The following foods and substances rich in antioxidants contribute to anti-inflammatory and microbiota-modulating properties:

- Phytochemical vitamins in red, orange, and yellow fruits and dark green leafy vegetables
- Ginger
- Green tea
- Garlic
- Black pepper
- Turmeric

To avoid severe nutritional deficiencies, a high-calorie, nutrient-rich diet is essential for people living with SCD and thalassemia. Increased oral hydration is vital in SCD to decrease the frequency of painful vaso-occlusive events. Additional recommendations include daily supplements of omega-3 fatty acids, folic acid, high-dose vitamin D, and a multivitamin without iron. For clients with thalassemia specifically, drinking black tea may decrease the gastrointestinal absorption of iron (Goldberg et al., 2018; Physicians Committee for Responsible Medicine, 2020b; Srichairatanakool et al., 2020).

People with SCD and vitamin D deficiency consuming a diet rich in fish, milk, cheese, and eggs were found to have decreased hospital and emergency department visits (McCaskill et al., 2018). High-dose vitamin D replacement (greater than 3000 units per day) has been found to augment immune response and decrease the risk of respiratory

infections in SCD (Umeakunne & Hibbert, 2019). Recent literature strongly correlates that vitamin D and chronic inflammation play an important role in regulating iron homeostasis, which can improve anemia (Natalucci et al., 2021).

Adults living with hemoglobinopathies should avoid drinking alcohol because it potentiates the oxidative damage caused by iron overload (Milman, 2021).

## 10.3 Treatments and Nutrition

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 10.3.1 Identify drug–food interactions for their impact on treatments used for hematologic disorders.
- 10.3.2 Identify treatments and medications that can cause nutritional deficiencies in clients with hematologic disorders.

### Drug–Food Interactions with Treatments for Hematologic Disorders

Some treatments for hematologic disorders will not work as intended if taken with certain foods. Limiting groups of foods during an already vulnerable state of nutritional need can lead to additional micronutrient deficiencies. For example, individuals requiring iron replacement are instructed to avoid cereals, dietary fiber, tea, coffee, eggs, and milk while taking iron supplements because these foods are known to decrease iron absorption (Moustarah, 2022).

Unlike individuals with other hematologic illnesses previously discussed, individuals with SCD and thalassemia are at risk for iron overload rather than iron deficiency. The primary cause of iron overload is red blood cell transfusion therapy. However, iron overload can occur in people with and without transfusion-dependent thalassemia because of intestinal absorption of iron secondary to ineffective erythropoiesis (Srichairatanakool et al., 2020). These individuals are therefore counseled to avoid iron-rich foods. The rate of iron accumulation varies and correlates with the number of red blood cell transfusions received. Each unit of packed red blood cells contains 200–250 mg of elemental iron, equating to 0.3–0.6 mg/kg/day of elemental iron, and most transfusion-dependent older children and adults will receive 2–4 units of blood monthly. The symptoms and associated health risks from iron overload depend on where the iron accumulates. The liver, heart, and endocrine glands are the most common initial sites (Srichairatanakool et al., 2020). Frequent complications of iron overload in people living with hemoglobinopathies include:

- Increased risk for thrombosis
- Pulmonary hypertension
- Hypothyroidism
- Hypogonadism
- Osteoporosis

Nurses should ensure client rights regarding medication administration, which includes understanding any contraindications and drug–food interactions. Equally important is a nutritional evaluation prior to the start of treatment for hematologic disorders and the development of a plan to avoid further nutritional deficiencies that can impact the desired response of treatment.



### UNFOLDING CASE STUDY

#### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Catalina's health care provider confirms that her physical exam is normal other than signs of pallor. A complete blood count (CBC) and ferritin level are ordered to evaluate for ID and anemia. Catalina is also referred to a gynecologist for further evaluation of her heavy menstrual bleeding.

Catalina's laboratory test results reveal a hemoglobin level of 7 g/dL (expected range: 12–15 g/dL) and a ferritin level of 9 ng/mL (expected range: 12–150 ng/mL), confirming IDA. She is started on oral iron replacement and

c counseled on foods to avoid while taking oral iron for better absorption. She is also encouraged to add iron-rich foods to her diet daily and to return in 6 weeks.

At her 6-week follow-up visit, Catalina reports that she is feeling less tired, and her shortness of breath has resolved. Her hemoglobin level at this visit is 10 g/dL. She has also been evaluated by a gynecologist and started on oral birth control pills to decrease her heavy menstrual bleeding. Catalina is instructed to continue oral iron therapy for at least 2 more months and then return for follow-up.

3. The nurse should include which of the following in Catalina's discharge instructions regarding taking oral iron?
    - a. Iron should be taken with milk or tea.
    - b. If stomach discomfort occurs, take the iron with an antacid.
    - c. If a dose is missed, double the dose for the next day.
    - d. Iron should be taken with orange juice to enhance absorption.
  
  4. Which of the following may indicate that Catalina's iron dosage is not adequate or that the iron is not being fully absorbed?
    - a. Constipation
    - b. Increased appetite
    - c. Weakness and dizziness
    - d. Increased menstrual bleeding
- 

### Treatments and Medications That Can Cause Nutritional Deficiencies

Treatments for hematologic malignancies can lead to nutritional deficiencies due to decreased food intake that is secondary to adverse treatment effects such as nausea, vomiting, diarrhea, mouth sores, and loss of appetite. Traditional chemotherapy and novel targeted therapy can affect taste and saliva production, further affecting the individual's interest in food.

Several of the most frequent hematologic malignancies, such as myelodysplasia and **multiple myeloma** (a blood cancer affecting plasma cells found in bone marrow), occur in older adults. The average age at diagnosis for hematologic malignancies in adults is 70 years, and 40% already have reduced food intake. The prevalence of malnutrition in these individuals is approximately 30% and is more common in male clients (Stauder et al., 2020). Associated symptoms include a high systemic inflammatory score, alterations in mood and cognition, and moderate to severe fatigue. Decreased food intake, weight loss, low body mass index, and laboratory evidence of malnourishment have been associated with decreased survival rates in older adults with hematologic malignancies (Stauder et al., 2020). A complete nutritional assessment, timely intervention with micronutrient and macronutrient replacement, and dietary referral are essential.

## Chapter Summary

- Common vitamin and mineral deficiencies that impact hematologic wellness across the lifespan include deficiencies of iron, vitamin B<sub>12</sub>, folate, and vitamins A, C, D, and K.
- Anemia affects approximately 1.8 billion individuals worldwide, most often affecting young children, pregnant individuals, and older adults.
- Non-Hispanic Black pregnant clients have the highest prevalence of IDA, particularly during their third trimester of pregnancy.
- Adolescent athletes have a high nutritional demand due to daily energy expenditure

## Key Terms

- anaerobic** relating to the absence of oxygen
- cardiac cachexia** unintentional severe weight loss caused by heart failure
- cholestasis** the slowing or halt of bile flow from the liver
- erythropoiesis** the production of red blood cells
- functional iron deficiency** a state in which iron is insufficiently incorporated into erythroid precursors even though body iron stores are apparently adequate
- hematopoiesis** the formation of blood cellular components
- hemoglobinopathy** a group of disorders in which the hemoglobin molecule has abnormal production or structure
- hemostasis** the usual reaction to a bleeding injury to stop the blood flow
- menorrhagia** heavy menstrual bleeding lasting more than 7 days
- multiple myeloma** a blood cancer affecting plasma cells that are found in the bone marrow; abnormal plasma cells multiply rapidly, crowd out normal blood-producing cells, and produce an abnormal protein that leaves the bone marrow and damages organs in the body

### National Health and Nutrition Examination Survey

## Review Questions

1. Which of the following nutritional deficiencies can impact hematologic wellness across the lifespan?
  - Vitamin C
  - Vitamin B<sub>12</sub>
  - Magnesium
  - Calcium
2. Anemia affects which population the most often?
  - Pregnant individuals
  - School-aged children

associated with training and less time available to make healthy food choices, putting them at high risk for iron deficiency and anemia.

- Folic acid, vitamin B<sub>12</sub>, and vitamin K deficiencies in adults can occur secondary to chronic liver disease and excessive alcohol intake.
- Individuals with SCD and thalassemia are more prone to micronutrient and macronutrient deficiencies related to hyperreactive hematopoiesis, the physiologic response to chronic anemia.

**(NHANES)** a health-related program conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics designed to assess the health and nutritional status of adults and children in the United States

**oxidative stress** disturbance in the balance between the production of reactive oxygen species (free radicals) and antioxidant defenses

**passive immunity** a type of immunity conferred when a person is given antibodies rather than making them via their own immune system

**primary health promotion** an intervention to prevent disease or injury before it occurs

**secondary health promotion** an intervention that emphasizes early disease detection through screening

**sickle cell disease** an inherited red blood cell disorder affecting the shape of hemoglobin, resulting in blocked blood flow

**thalassemia** an inherited blood disorder characterized by less oxygen-carrying protein (hemoglobin) and fewer red blood cells in the body

**vitamin K deficiency bleeding (VKDB)** uncontrolled bleeding due to lack of sufficient vitamin K to form a blood clot

- c. Male and female adolescents
  - d. Middle-aged females
3. Infants and young children are at high risk for iron-deficient anemia related to which of the following?
- a. Inability to chew meat
  - b. Rapid growth
  - c. Frequent use of a bottle
  - d. Little interest in food
4. Which of the following statements by a parent can indicate that their child is at an increased risk for vitamin D deficiency?
- a. "My child prefers chocolate milk to plain milk."
  - b. "I am careful to put sunscreen on my child every time we go outside."
  - c. "My child has lost some weight since the last visit."
  - d. "My child loves to eat tuna fish sandwiches."
5. You are reviewing the chart of a 15-month-old toddler who was brought to the emergency department for fever for the fourth time this month. The child's father reports that the child was weaned off infant formula 3 months ago and is allergic to eggs and lactose. You suspect this child may have a deficiency of which micronutrient?
- a. Vitamin K
  - b. Zinc
  - c. Folate
  - d. Vitamin B<sub>12</sub>
6. The nurse is teaching a client about sickle cell disease. Which of the following dietary strategies can decrease the risk of disease complications?
- a. Eating several small meals throughout the day
  - b. Limiting carbohydrate intake
  - c. Consuming dairy products and other sources of vitamin D
  - d. Avoiding seafood
7. Folate deficiency is more common in older adults who:
- a. Are underweight
  - b. Follow a vegetarian diet
  - c. Consume alcohol daily
  - d. Eat at restaurants several times a week
8. Which of the following blood disorders is associated with the most nutritional deficiencies?
- a. Thalassemia
  - b. Sickle cell disease
  - c. Aplasia
  - d. Iron overload
9. A client with thalassemia is being discharged after receiving a transfusion of packed red blood cells. Which of the following foods should the client be instructed to limit in their diet?
- a. Nuts
  - b. Dairy products
  - c. Apples
  - d. Iron-fortified breakfast cereals
10. Which of the following diets can be beneficial for people living with chronic illness and nutritional anemia?
- a. High-fat diet

- b. High-protein diet
- c. Mediterranean diet
- d. Low-fat diet

## Suggested Reading

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## CHAPTER 11

# Applying Clinical Judgment to Promote Nutrition for Cardiovascular Wellness



**FIGURE 11.1** Adding spices like garlic or curry powder to foods may improve heart health by reducing cholesterol and improving blood flow.  
(credit: modification of work "Yay, Spices!" by Dennis Sylvester Hurd/Flickr, Public Domain)

### CHAPTER OUTLINE

- 11.1 Assess and Analyze the Impact of Nutrition on the Cardiovascular System
  - 11.2 Plan Nutritional Strategies to Impact Cardiovascular Wellness
  - 11.3 Implement Nutritional Strategies to Impact Cardiovascular Wellness
  - 11.4 Evaluate Nutritional Strategies to Impact Cardiovascular Wellness
- 

**INTRODUCTION** Nutrition plays a key role in the proper development and maintenance of the cardiovascular system. When disease exists in a client's cardiovascular system, the nurse should include nutritional considerations in the client's care plan.

Consider this case: Mr. Jack Thompson, a 65-year-old White male, has no history of cardiovascular disease and skips annual exams with his primary care provider because he's always felt healthy and takes good care of himself. While he does have an extensive family history of heart disease, he watches his diet, exercises regularly, and has not smoked in 20 years. He presents today with a personal problem that he refuses to discuss with anyone other than the provider and nurse when he gets in the room.

## 11.1 Assess and Analyze the Impact of Nutrition on the Cardiovascular System

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 11.1.1 Recognize cues that indicate the impact of nutrition on the cardiovascular system.
- 11.1.2 Analyze cues to determine the impact of nutrition on the cardiovascular system.

### Normal Function of the Cardiovascular System

The **cardiovascular system** includes the heart, blood, blood vessels, lymph, lymphatic vessels, and glands that move blood and lymph through the body. Assessment of this system involves the mechanical and electrical functions of the heart and blood vessels and their effectiveness at circulating blood throughout the body. Assessment should also include an examination of a client's nutritional status.

The cardiovascular system's primary role is to circulate blood throughout the body. The components of this system include the heart, known as the cardiac muscle, and blood vessels. The blood vessels include the **arteries**, which carry oxygenated blood from the heart to other parts of the body; **veins**, which carry deoxygenated blood from the body to the heart; and **capillaries**, tiny blood vessels with thin walls where arteries and veins exchange blood supply.

The heart has two components—the electrical conduction system and the mechanical working component—that work together to effectively pump blood and maintain proper **perfusion**, or movement of blood, oxygen, and nutrients to tissues in the body. The electrical system sends an impulse to the excitable cardiac tissue cells and triggers them to mechanically contract in a specific pattern to push blood throughout the body.

Nutrition can heavily impact the heart's ability to complete the task of pumping blood. Like other muscles in the body, the heart requires electrolytes to produce action-potential impulses in muscles. The electrical charge that sends an impulse to the heart to trigger contraction is highly dependent on the involuntary process of potassium and sodium ion exchange (Balchem, 2021). Likewise, muscles, including the heart, are dependent on calcium and magnesium ion exchange for physical contraction or movement (Balchem, 2021). Low levels of these electrolytes can result in dysrhythmias and ineffective cardiac output and perfusion.

For the mechanical working component of the heart to function properly, the cardiac muscle must be supplied with oxygen and nutrients from the coronary arteries. The cardiac muscle must also be in good physical working condition and able to receive impulses from the heart's electrical conduction system. The mechanical working component is not necessary for the electrical conduction system to function; but, without the mechanical working component, no blood is pumped through the body—and if the electrical conduction system is functioning independently, there will only be **pulseless electrical activity (PEA)**, or electrical conduction throughout the heart without physical movement of the heart muscle.

Another consideration is the vascular portion of the cardiovascular system. While the heart requires electrolytes to create electrical impulses to trigger contractions strong enough to circulate blood throughout the body, it may still be unable to adequately perfuse the body if the vessels are blocked or become hardened, as in arteriosclerosis. The primary cause of this disease is a nutritional intake high in unhealthy fats and cholesterol. When low-density lipid (LDL) cholesterol levels are chronically high, fatty deposits known as plaques form in artery walls and reduce blood flow through that vessel (Icahn School of Medicine at Mount Sinai, 2023). When the heart is forced to push against the increased pressure from the less-elastic and smaller diameter of the diseased vessels, it causes the heart muscle to continually be overworked. The heart muscle can become damaged, and the eventual result can be heart failure.

The other consideration in normal function of the heart is the pressure it exerts against the vessel walls when contracting and relaxing, known as blood pressure. When blood pressure is chronically high, the client has an increased risk of heart failure. Blood pressure is largely regulated in the body by the renin-angiotensin-aldosterone system (RAAS) that utilizes fluid and electrolytes, especially sodium (Martyniak and Tomasik, 2022). This system works to change the sodium concentration in the blood to raise or lower blood pressure as needed by the body (Martyniak and Tomasik, 2022). When the concentration of sodium is chronically high due to excessive intake and is

not able to be excreted by the kidneys, the RAAS system is unable to adequately control blood pressure.

There are two main **circulatory systems** of interconnected blood vessels that flow through the body: the systemic circulatory system and the pulmonary circulatory system. The systemic system provides blood to the body's tissues, organs, and cells, and the pulmonary system transports blood between the heart and lungs allowing for oxygen and carbon dioxide exchange to occur (Sherrell, 2021).

Through the circulation of blood, the cardiovascular system performs several other functions. Blood is considered a "fluid connective tissue" (Visible Body, 2023), and it supports, protects, and gives structure to the blood vessels. Blood provides numerous other functions, including:

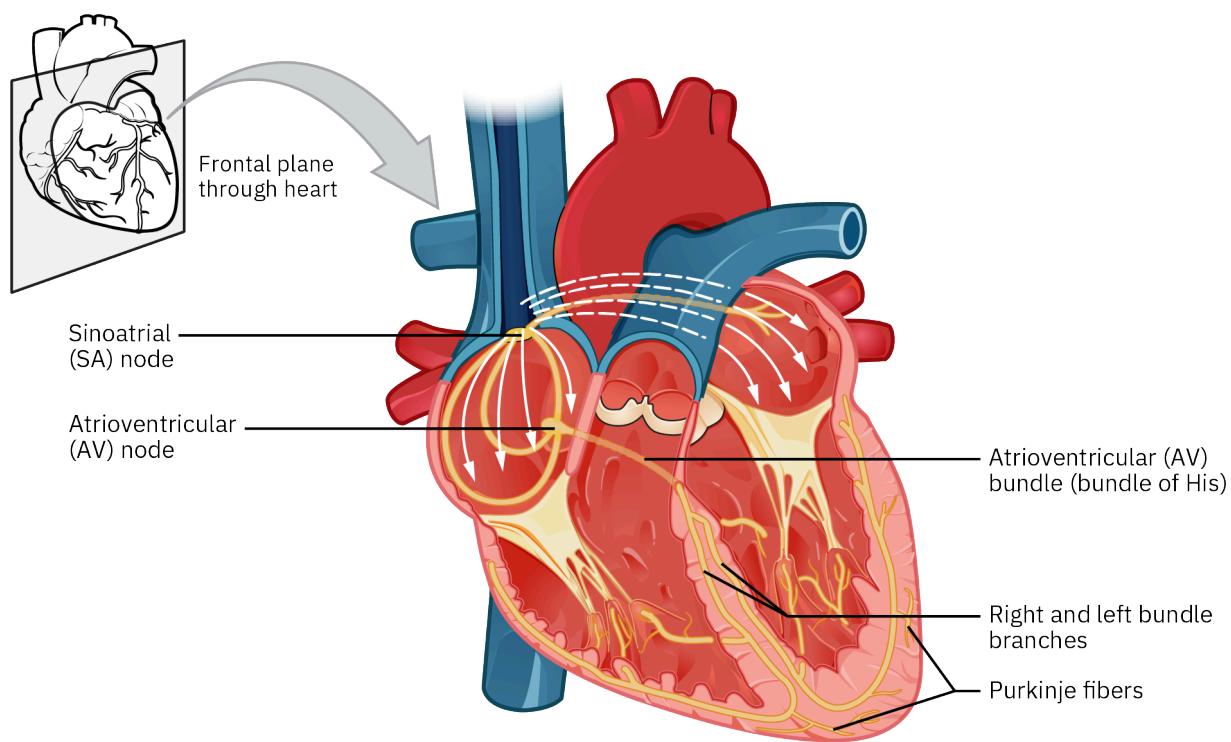
- Clotting for tissue repair
- Protection from infection
- Transportation of body wastes to the kidneys for excretion
- Exchange of oxygen and carbon dioxide between body tissues
- Regulating body temperature
- Transporting nutrients and hormones throughout the body for use and functional regulation (American Society of Hematology, 2023)

## Assessment of Nutrition and the Function of the Cardiovascular System

A thorough assessment of the nutritional status of a client's cardiovascular system involves examining each component. Many diseases are associated with poor nutrition or malnutrition. The most effective method of determining whether nutrition is a contributing factor is to evaluate each component individually. Note that the electrical conduction system and the mechanical working component should be assessed separately.

### Assessing Electrical Conduction System of the Heart

The normal electrical pattern of the heart ([Figure 11.2](#)) starts with the initiation of an impulse at the **sinoatrial node (SA node)**, the pacemaker of the heart. The impulse then travels through the **atria**, the top two heart chambers, causing atrial contraction, down to the **atrioventricular node (AV node)**, an electrical gatekeeper that controls a delay between the atrial and ventricular impulse, allowing blood to fill the ventricle. From the AV node, the impulse travels to the **bundle of His**, a bundle of conducting fibers that branch to each ventricle, then down both bundle branches to the **Purkinje fibers**, or terminal-conducting fibers in the ventricles. This action causes the **ventricles**, or bottom chambers of the heart, to contract (Johns Hopkins Medicine, 2023b).



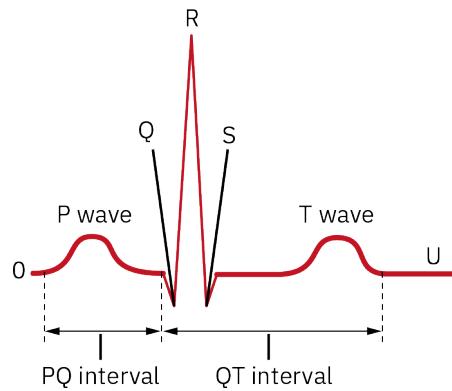
**FIGURE 11.2** The heart muscle and systemic circulation are vital components that work together to deliver oxygen and nutrients to the body's tissues and organs while removing waste products. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

An **Electrocardiogram (ECG/EKG)** or telemetry can be used to evaluate the electrical conduction of the heart. An ECG is a recording of a heart's electrical activity through electrodes placed on the chest to capture signals.

**Telemetry** is the continual measurement of a heart's ECG through a portable device that automatically transmits the reading to a monitor.

A nurse should know several important measurement facts of a telemetry wave ([Figure 11.3](#)):

- Each small square on the telemetry strip represents 0.04 seconds.
- Each portion of the wave indicates a different part of the cardiac polarization (relaxation) and depolarization (contraction) cycle.
- Each wave is expected to have a certain appearance or shape and specific deflection: positive being upward and negative being downward.



**FIGURE 11.3** Nurses are expected to be able to measure and interpret the points of a telemetry wave. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

For the heart to be in optimal health, the electrical conductivity should be a **normal sinus rhythm (NSR)**. An NSR is a rhythm that originates from the sinus node and is characteristic of a healthy heart's cardiac rhythm. With an NSR, the wave tracing should be within normal measurements, and the deflections and appearances or shapes of all

wave components should have a pulse that is calculated between 60 and 100 beats per minute. In addition, the waves should be consistent and resemble each other. [Table 11.1](#) outlines the telemetry wave components, normal measurement, existence in the cardiac cycle, and the expected shape and deflection.

Wave/ Segment	Normal Measurement of Segment	Part of Cardiac Cycle	Wave/Segment Appearance/Shape and Deflection
P		Atrial depolarization	Positive deflection/smooth hill shape
Q		Start of ventricular depolarization	Negative deflection/sharp downstroke if shown (Some normal telemetry readings do not have a true Q wave.)
R		Ventricular depolarization	Positive deflection/sharp mountain peak upward
S		Ventricular depolarization	Negative deflection/sharp downward end of the mountain
T		Ventricular repolarization	Positive deflection/ smooth hill shape
U		Atrial repolarization: not an expected finding on every client	Positive deflection/smooth hill shape (Most normal telemetry readings do not have a U wave.)
QRS complex	0.06–0.12 seconds	Ventricular depolarization	Cluster of QRS waves together
PR interval	0.12–0.20 seconds	Beginning of atrial depolarization to beginning of ventricular depolarization	P wave and segment between P wave and Q wave
QT interval	0.40–0.44 seconds	Beginning of ventricular depolarization through ventricular repolarization	QRS complex, ST segment, and to end of T wave
ST segment	Isoelectric line, not measured separately	Time in-between ventricular depolarization and repolarization	End of ST segment to beginning of T wave—must be on isoelectric line, no deflection

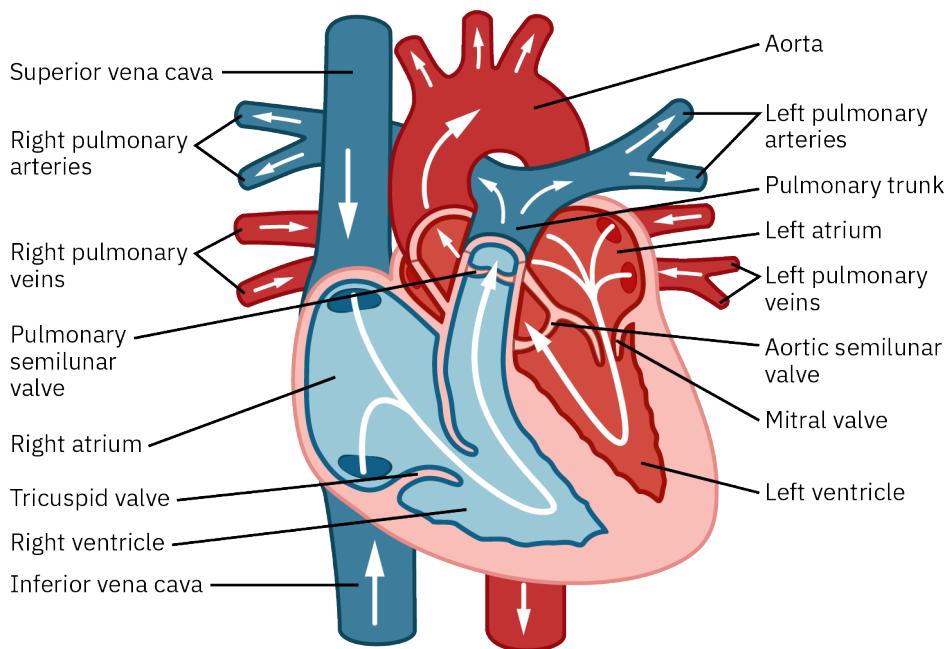
**TABLE 11.1** Normal Telemetry Parameters (source: UNC Eshelman School of Pharmacy, 2023)

There are certain telemetry changes in which nutritional issues and electrolyte abnormalities are often the primary cause. Common examples include:

- Long QT syndrome—when the QT interval is greater than 0.47 seconds in males and 0.48 seconds in females. This can lead to life-threatening dysrhythmias and can be caused by low levels of potassium, magnesium, or calcium.
- Torsades de pointes—a life-threatening dysrhythmia known as a multifocal ventricular tachycardia, caused by low levels of magnesium (Cohagan & Brandis, 2022).
- A peaked or mountain T wave illustrates hyperkalemia (high levels of potassium in the blood) (Bord, 2022).

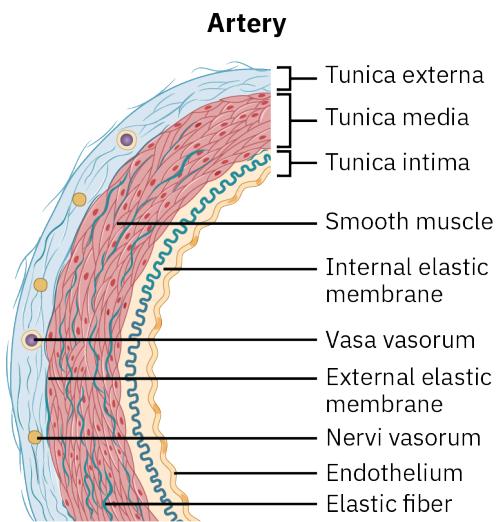
### Assessing the Mechanical Working Component of the Heart and the Blood Vessels

A healthy heart represents the flow of an adequate blood supply, proper stimulation through the electrical system, and effectiveness at physically pumping blood through the body. Normal blood flow through the heart starts when deoxygenated blood is returned to the heart from the body via the superior vena cava. It travels through the right atrium, through the tricuspid valve, and into the right ventricle. The blood is then pumped through the pulmonary valve and into the pulmonary artery to be re-oxygenated in the lungs ([Figure 11.4](#)). Once the blood has gone through the exchanges needed and is oxygenated, it returns to the heart through the pulmonary veins into the left atrium. It will then travel through the mitral valve into the left ventricle, through the aortic valve into the aorta, and out to the body for use (Pediatric Heart Specialists, 2023).



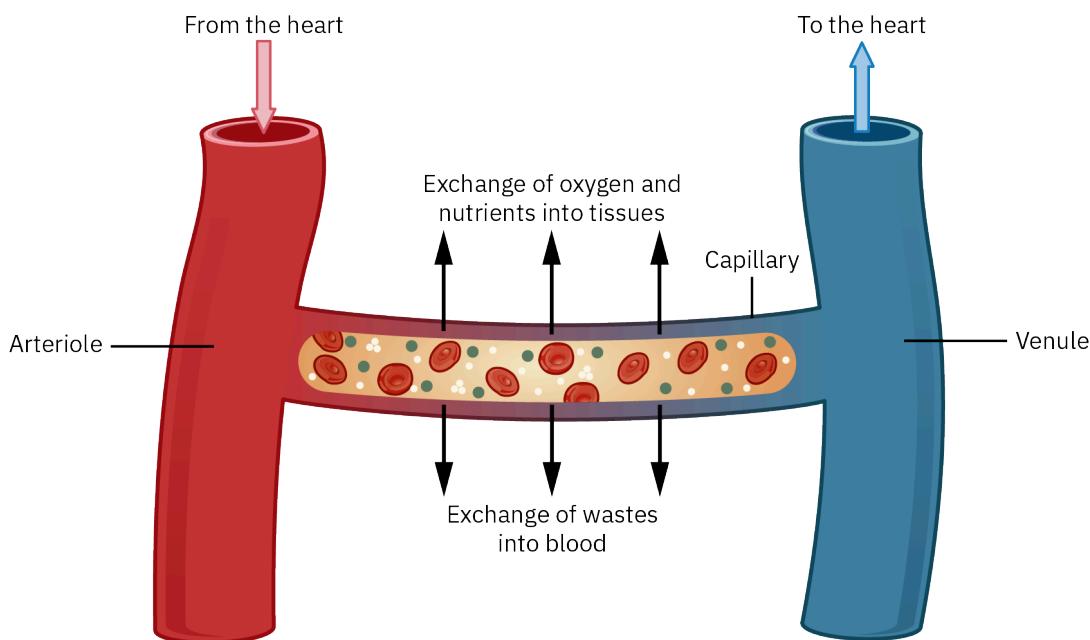
**FIGURE 11.4** Normal blood flow starts when deoxygenated blood is returned to the heart via the superior vena cava. It travels through the right atrium, through the tricuspid valve, into the right ventricle, and is pumped through the pulmonary valve and into the pulmonary artery to be re-oxygenated in the lungs. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

The oxygenated blood is returned to the body through two types of arteries. Elastic arteries are located closer to the heart and are more flexible than muscular arteries. Muscular arteries contain smoother muscle and are farther away from the heart. Both types of arteries must have strong walls, because arteries handle higher pressures from the blood being pumped out of the heart (Cleveland Clinic, 2023b). The main function of arteries is to distribute the oxygenated blood to all body organs and tissues, including the heart itself, through the coronary arteries. Refer to [Figure 11.5](#) for a visual of the artery wall.



**FIGURE 11.5** The walls of elastic and muscular arteries must be both strong and flexible to properly handle high-pressure blood flow. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

As blood travels through the body via the arteries, the arteries get smaller in diameter until they terminate into **arterioles**, the smallest arteries. These arterioles link with capillaries and then connect to **venules**, the smallest veins (Gupta and Shea, 2022). Capillaries are thin-walled vessels that connect arterioles and venules. As shown in [Figure 11.6](#), they are the vehicle for the final exchange of oxygen and nutrients into tissues and wastes into the blood (Gupta & Shea, 2022).



**FIGURE 11.6** Capillaries connect arterioles and venules, and are the vehicle for the final exchange of oxygen and nutrients into tissues and waste into the blood. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

After passing through the capillaries and venules, blood continues into the veins on the way back to the heart. Veins have thinner walls than arteries, because pressures are lower in this portion of the cardiovascular system. Veins also dilate in response to fluid. Some veins, like the large veins in the legs, have valves in them to prevent backflow of blood (Gupta & Shea, 2022). Once blood has traveled through the veins, it ends up in the heart to start the cycle all over again.

#### Assessment

The nurse should complete a client's assessment by recording manual blood pressure and apical pulse (a pulse point on the chest at the apex of the heart). In addition, the nurse should look for other signs and symptoms of adequate perfusion, including:

- Quality and rate of peripheral pulses (carotid auscultation and palpation, brachial, radial, ulnar, femoral, popliteal, and pedal)
- Skin color check for pallor or cyanosis
- Skin temperature for degree of warmth and presence of moisture (Malik & Goyal, 2022)
- Skin turgor (elasticity) to check for edema and venous stasis sores or discoloration
- Capillary refill, which should be less than 2 seconds

Abnormal findings and their relationship to specific nutritional deficiencies are discussed in the next section.



#### UNFOLDING CASE STUDY

##### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Mr. Thompson reports to the provider and nurse that he has had difficulty achieving and maintaining an erection and has noticed worrisome leg swelling. He also states that he was told by a nurse at a health fair a month ago that he should have his blood pressure checked, because it was 139/93 mm Hg. Today his blood pressure is 126/88 mm Hg. The swelling in his legs appears to be dependent edema that is only present when his legs are downward for periods of time and appears to be due to insufficiency of blood return in the lower extremities.

1. Based on these findings, what would the nurse expect the provider to conclude?

- a. The client has an elevated blood pressure, peripheral arterial disease, and erectile dysfunction.
  - b. The client has hypertension, peripheral arterial disease, and erectile dysfunction.
  - c. The client has hypertension, peripheral vascular disease, and erectile dysfunction.
  - d. The client has elevated blood pressure, peripheral vascular disease, and erectile dysfunction.
2. Which of the following tests would the nurse expect the provider to order initially to evaluate heart function?
- a. Electrocardiogram
  - b. Echocardiogram
  - c. Troponin
  - d. Chest X-ray

The provider orders an ECG that is done at bedside and shows no abnormalities. The provider also orders a fasting lipid panel (serum cholesterol levels) to help determine the client's risk for heart disease. Because Mr. Thompson is not fasting, the provider instructs him to return in the morning for a blood draw and to return in one week for follow-up. The provider also explains to Mr. Thompson that erectile dysfunction can be directly related to the decreased blood flow caused by hypertension. The client's hypertension will have to be managed before the erectile dysfunction can be fully evaluated for cause.

(source: Antipolis, S. (2020). How to Treat High Blood Pressure Without Ruining Your Sex Life. *European Society of Cardiology*. Retrieved from <https://www.escardio.org/The-ESC/Press-Office/Press-releases/how-to-treat-high-blood-pressure-without-ruining-your-sex-life>)

## Analysis of Nutrition and the Cardiovascular System

A client's nutritional status and needs can be identified with a physical assessment and lab results. Potassium, cholesterol, and sodium levels can be monitored to best track nutritional needs for cardiovascular health.

### Nutritional Analysis and the Impact on the Cardiovascular System

Nutritional issues can lead to changes in the electrical conduction of the heart. As a result, the client's telemetry rhythm can become abnormal. Rhythm changes include atrial fibrillation, atrial flutter, T-wave abnormalities, ST segment changes related to AMI, U-wave presence or prominence, torsades de pointes, prolonged QT interval, and supraventricular tachycardia. Rhythm changes can relate to one or more deficiencies. See [Table 11.2](#) for a list of telemetry changes, the nutritional relation, and client symptoms.

Telemetry Change	Nutritional Relation(s)	Client Symptom(s)
Atrial fibrillation/atrial flutter	<ul style="list-style-type: none"> <li>• Excessive caffeine or alcohol intake</li> <li>• High cholesterol levels</li> <li>• High blood pressure</li> </ul>	<ul style="list-style-type: none"> <li>• Palpitations</li> <li>• Lightheadedness</li> <li>• Chest pain</li> <li>• Extreme fatigue</li> <li>• Shortness of breath</li> </ul>
Torsade de pointes	<ul style="list-style-type: none"> <li>• Primarily magnesium deficiency</li> <li>• Can be related to calcium deficiency</li> <li>• Can be related to magnesium deficiency</li> <li>• Can be related to potassium deficiency</li> </ul>	<ul style="list-style-type: none"> <li>• Can start with syncope (fainting), palpitations, and dizziness</li> <li>• Cardiac arrest</li> </ul>

**TABLE 11.2** Nutritional Relationship to Rhythm Changes (sources: Akbar et al., 2022; Centers for Disease Control and Prevention, 2022; Cleveland Clinic, 2022a; Cleveland Clinic, 2022c; Cohagan & Brandis, 2022; Kenny & Brown, 2022; Lee, et al., 2022; Mayo Clinic, 2023a–b; Morales-Brown, 2020; Teymour, et. al., 2022)

Telemetry Change	Nutritional Relation(s)	Client Symptom(s)
Supraventricular tachycardia	<ul style="list-style-type: none"> <li>• Excessive caffeine or alcohol intake</li> <li>• Heart disease (high cholesterol, obesity, or blood pressure)</li> </ul>	<ul style="list-style-type: none"> <li>• Palpitations</li> <li>• Pounding sensation in the neck</li> <li>• Weakness</li> <li>• fatigue</li> <li>• Chest pain</li> <li>• Lightheadedness</li> <li>• Shortness of breath</li> <li>• Sweating</li> <li>• Dizziness</li> <li>• Fainting</li> </ul>
T-wave changes	<ul style="list-style-type: none"> <li>• Inverted T waves can relate to cardiac ischemia from heart disease and/or past acute myocardial infarction (AMI) (triggered by high cholesterol and high blood pressure)</li> <li>• Peaked T waves can indicate hyperkalemia</li> </ul>	<ul style="list-style-type: none"> <li>• Symptomology related to cause and type of change</li> </ul>
U-wave presence/prominence	<ul style="list-style-type: none"> <li>• Hypokalemia (low potassium levels) can cause tachycardia and U-wave prominence</li> </ul>	<ul style="list-style-type: none"> <li>• No symptomology unless it interferes with perfusion</li> </ul>
ST segment changes/AMI	<ul style="list-style-type: none"> <li>• AMI can result from high cholesterol, obesity, and old ischemia damage to the heart</li> </ul>	<ul style="list-style-type: none"> <li>• Chest pain</li> <li>• Cardiac arrest</li> <li>• Diaphoresis</li> <li>• Shock</li> <li>• Radiating pain to left jaw and shoulder</li> <li>• Shortness of breath</li> <li>• Weakness</li> <li>• Lightheadedness</li> <li>• Syncope</li> <li>• Pain in one or both arms and/or shoulders</li> </ul>

**TABLE 11.2** Nutritional Relationship to Rhythm Changes (sources: Akbar et al., 2022; Centers for Disease Control and Prevention, 2022; Cleveland Clinic, 2022a; Cleveland Clinic, 2022c; Cohagan & Brandis, 2022; Kenny & Brown, 2022; Lee, et al., 2022; Mayo Clinic, 2023a–b; Morales-Brown, 2020; Teymour, et. al., 2022)

Telemetry Change	Nutritional Relation(s)	Client Symptom(s)
QT interval	<ul style="list-style-type: none"> <li>Shortened QT intervals can indicate hyperkalemia</li> </ul>	<ul style="list-style-type: none"> <li>Can trigger a lethal heart rhythm</li> </ul>
Many other rhythm disturbances	<ul style="list-style-type: none"> <li>Hyperkalemia can cause wide QRS complexes and hidden P waves, prolonged PR interval, decreased P wave amplitude, ventricular fibrillation, asystole, junctional rhythm, bradycardia, ST depression, atrial fibrillation, in addition to other issues listed</li> <li>Hypoalbuminemia can cause low-voltage wave measurements and abnormal QT interval measurements and has been identified as a factor to increase mortality in AMI, atrial fibrillation events, and heart failure</li> </ul>	<ul style="list-style-type: none"> <li>Symptomology related to cause and type of change</li> </ul>

**TABLE 11.2** Nutritional Relationship to Rhythm Changes (sources: Akbar et al., 2022; Centers for Disease Control and Prevention, 2022; Cleveland Clinic, 2022a; Cleveland Clinic, 2022c; Cohagan & Brandis, 2022; Kenny & Brown, 2022; Lee, et al., 2022; Mayo Clinic, 2023a–b; Morales-Brown, 2020; Teymour, et. al., 2022)

Numerous nutritional factors create or impact cardiovascular diseases such as coronary heart disease, cardiomyopathy (a disease of the heart muscle), and hypertension. [Table 11.3](#) outlines a handful of cardiovascular diseases, the impact of nutrition, and the effect on the body.

Disease	Nutrition Impact	Effects on the Body
Coronary artery disease (CAD)	Dietary intake that is high in cholesterol, sodium, trans fats, added sugars, and low potassium and high fluid intake (for CHF and cardiomyopathy and especially with increased sodium specifically)	Can lead to hypertension, cardiomyopathy, and AMI
Peripheral vascular disease (PWD)		Slows return of blood to the heart, leading to pooling of deoxygenated blood in the lower extremities
Peripheral arterial disease (PAD)		Slows flow of blood to the body causing ischemia
Chronic heart failure (CHF)		Causes weakening of the heart muscle
Cardiomyopathy		Causes enlargement and weakening of the heart muscle
Hypertension		Increases workload on the heart leading to cardiomyopathy and CHF

**TABLE 11.3** Cardiovascular Diseases (sources: Albakri, 2019; Centers for Disease Control and Prevention, 2022; Harvard University, 2023; Medline Plus, 2022)

## 11.2 Plan Nutritional Strategies to Impact Cardiovascular Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 11.2.1 Prioritize hypotheses of nutritional habits that optimize cardiovascular wellness.
- 11.2.2 Generate solutions to optimize cardiovascular wellness through nutritional habits.

### Planning Nutritional Goals

Several body metrics can help the nurse evaluate the potential for cardiovascular disease development or to determine level of cardiovascular disease present. These metrics include food intake, body mass index (BMI), waist-to-hip ratio, blood pressure, and cholesterol. The primary goal is to utilize the best nutritional practices to prevent cardiovascular disease. If disease is present, nutrition is used to help control the condition and prevent worsening and exacerbation periods.

### Preventative Care Nutritional Planning

Preventative nutritional planning should focus on a client who does not yet have cardiovascular disease. Prevention is always the highest priority for clients with a known risk of cardiovascular disease but should also be routine education for all clients, as it affects a large portion of the population. Planning for disease prevention includes monitoring weight and BMI, cholesterol levels, waist circumference, and intake of sodium, potassium, magnesium, calcium, fluid, and fiber.

When educating the client on proper nutritional practices to reduce the risks of developing cardiovascular disease, the client must first understand how to properly manage cholesterol levels and the differences in the types of fats they ingest in relation to these levels. Three main types of fat are most often discussed in relation to cardiovascular disease and its prevention—unsaturated fats, saturated fats, and trans fats, which are a form of unsaturated fat. Saturated fats and trans fats are in semi-solid form at room temperature. Like all fats, they are made up of carbon, oxygen, and hydrogen, but they have more hydrogen molecules than other forms of fat (Moll, 2022). Saturated fats and trans fats are more likely to form deposits inside arteries and harden as plaques, making them forms of fat that the client should limit to less than 6% of their daily intake (Moll, 2022). High intake of saturated and trans fats can increase the client's levels of low-density lipid (LDL) cholesterol levels (Moll, 2022). This is typically referred to as “bad” cholesterol in the body, as it is the type most likely to deposit and stick to artery walls. While not all LDL is harmful and plaque forming, it still puts the client at higher risk when they consistently have higher LDL levels. High-density lipid (HDL) cholesterol is referred to as “good” cholesterol because of its low risk of plaque depositing. Unsaturated fats should make up the majority of the daily recommended 20–35% of daily fat intake (Moll, 2022).

Maintaining adequate fiber intake will help to prevent cardiovascular disease. Fiber has been shown to lower LDL cholesterol levels, lower blood pressure, and create satiety (a feeling of fullness) to help in weight loss (Harvard Health Publishing, 2020). When increasing fiber intake, it is important to also increase fluid intake, particularly water intake, to prevent constipation. Adequate fluid intake (particularly water) of at least 6–8 cups per day for women and 8–12 cups per day for men is needed for many body processes, including proper blood vessel function, blood circulation, effective cardiac pumping, and sodium level maintenance, which can help prevent heart disease risk if maintained at 142 milliequivalents per liter (mEq/L) and below (Dmitrieva, Liu, Wu, & Boehm, 2022; National Institutes of Health, 2022).

Another important piece of education for the client is the proper regulation of their daily sodium intake. Too much daily intake can increase the risk of hypertension, which can lead to heart failure. Americans consume an average of 3400 mg/day of sodium, which is well above the recommended limit of 2300 mg/day for those without heart disease (American Heart Association, 2023). This maximum is still not optimal as the AHA recommends that clients without heart disease move toward a limit of 1500 mg/day and those with heart disease to 1000 mg/day. While this is the current recommendation, there is some debate from new findings by the American College of Cardiology (2023) that individuals with heart disease do not benefit from limiting their sodium any more than those without heart disease.

The nurse should have a nutrition education discussion with the client that includes maintaining a proper diet for healthy BMI, waist circumference, calcium, magnesium, and potassium levels. The nurse can discuss both the use of the MyPlate and DASH diets to accomplish this. The nurse should keep in mind, however, that a fine balance must be maintained between potassium, sodium, magnesium, and calcium for proper conduction and mechanic pumping of the heart to take place. Most clients can maintain these three electrolytes through balanced nutrition, but if they are deficient in any of these and are unable to regulate them through nutritional intake alone, supplementation should be considered. The nurse should discuss types of foods the client should include and limit in their diet for cardiovascular health ([Table 11.4](#)).

Nutrient	Foods High in the Nutrient
Calcium	<ul style="list-style-type: none"> <li>Soybeans (edamame)</li> <li>Collard greens</li> <li>Spinach</li> <li>Turnip greens</li> <li>Bok choy</li> <li>Kale</li> <li>Broccoli</li> <li>Breakfast cereal</li> <li>Tofu</li> <li>Plant-based milks</li> </ul>
Potassium	<ul style="list-style-type: none"> <li>Beans</li> <li>Lentils</li> <li>Potatoes</li> <li>Winter squash (acorn, butternut)</li> <li>Spinach</li> <li>Broccoli</li> <li>Artichoke</li> </ul>
Sodium	<ul style="list-style-type: none"> <li>Smoked, cured, salted, or canned meat, fish, or poultry</li> <li>Frozen breaded meats and dinners</li> <li>Canned entrees</li> <li>Salted nuts</li> <li>Beans, canned with salt added</li> </ul>
Magnesium	<ul style="list-style-type: none"> <li>Soy products</li> <li>Legumes and seeds</li> <li>Nuts, peanuts, and peanut butter</li> <li>Whole grain breads and cereals</li> <li>Fruit</li> <li>Vegetables, particularly dark green and leafy</li> <li>Dried beans</li> </ul>

**TABLE 11.4** Nutrient Education Table (sources: American Diabetes Association, 2023; Penn Medicine Lancaster General Health, 2023; University of California San Francisco, 2023; University of Rochester Medical Center, 2023; University of Washington, 2023; U.S. Department of Health and Human Services, 2023)

Nutrient	Foods High in the Nutrient
Fiber	<ul style="list-style-type: none"> <li>Avocado</li> <li>Brussels sprouts</li> <li>Broccoli</li> <li>Split peas</li> <li>Artichokes</li> <li>Lentils</li> <li>Kale</li> <li>Turnip greens</li> </ul>
Saturated fats	<ul style="list-style-type: none"> <li>Processed foods such as potato chips</li> <li>Baked goods with hydrogenated oil or partially hydrogenated oil</li> <li>Margarines</li> <li>Shortening</li> <li>Lard</li> <li>Fatback and salt pork</li> <li>High-fat meats</li> <li>High-fat dairy products</li> <li>Butter</li> <li>Cream sauces</li> <li>Gravy made with meat drippings</li> <li>Poultry skin</li> </ul>

**TABLE 11.4** Nutrient Education Table (sources: American Diabetes Association, 2023; Penn Medicine Lancaster General Health, 2023; University of California San Francisco, 2023; University of Rochester Medical Center, 2023; University of Washington, 2023; U.S. Department of Health and Human Services, 2023)

### Secondary Care Nutritional Planning

Two main diets have been shown to benefit clients with heart disease: the Dietary Approaches to Stop Hypertension (DASH) diet and the Mediterranean diet. The intent of these diets is to control weight and reduce cholesterol levels and hypertension. This approach needs to be balanced with the client's need for protein, because malnourishment and heart failure can lead to **hypoalbuminemia**, a condition in which the body does not produce enough albumin, a protein that keeps fluids in blood vessels.

The nurse should consider BMI, which is calculated as weight in kilograms by height in meters squared ( $\text{kg}/\text{m}^2$ ) and waist size values:

- BMI—A healthy BMI is  $18\text{--}24.9 \text{ kg}/\text{m}^2$ ; an overweight BMI is  $25\text{--}29.9 \text{ kg}/\text{m}^2$ ; and obesity is a BMI of  $30 \text{ kg}/\text{m}^2$  or higher.
- Waist size—A person who has a large waist size has a higher chance of developing cardiovascular disease, even with a normal BMI. Males should aim to keep their waist size below 40 inches (102 cm) and females should aim to keep their waist size below 35 inches (88 cm) (Harvard University, 2023).

### BMI MEASUREMENT

The nurse should know a client's BMI before creating a nutritional plan because a high BMI increases cardiovascular risks. For clients with a high BMI, weight loss should be included in the plan. Harvard Medical School provides a useful [BMI calculator \(<https://openstax.org/r/healthharvaed>\)](https://openstax.org/r/healthharvaed).

Another metric is blood pressure, which measures hypertension or the advancement of hypertension. Hypertension is known as the silent killer, because many people often do not have symptoms. Blood pressure is measured in millimeters of mercury, or mm Hg. A single high hypertension value may not indicate an issue, but two or more consecutive high readings is considered hypertension (Mayo Clinic, 2023c). Blood pressure ranges and their associated condition are listed in [Table 11.5](#).

Blood Pressure	Systolic	Diastolic
Low	< 90 mm Hg	Or < 60 mm Hg
Normal	< 120 mm Hg	And < 80 mm Hg
Elevated	120–129 mm Hg	Or < 80 mm Hg
Hypertensive	> 129 mm Hg	Or > 80 mm Hg

**TABLE 11.5** Blood Pressure Ranges (source: National Institute on Aging, 2022)

Cholesterol levels are also critical. Excessive cholesterol levels can lead to the buildup of plaques along blood vessels, resulting in restricted blood flow and leading to hypertension, peripheral vascular and artery disease, and cardiomyopathies, and can cause embolizing events in the body. [Table 11.6](#) outlines ranges of cholesterol measurements and their meanings (Johns Hopkins Medicine, 2023a).

Cholesterol Measurement	Near Optimal mg/dL	Optimal mg/dL	Normal mg/dL	Borderline High mg/dL	High mg/dL	Very High mg/dL
Total cholesterol			< 200	200–239	> 239	
Low-density lipids (LDL) (“bad” cholesterol)	100–129	< 100		130–159	160–189	> 189
Triglycerides			< 150	150–199	200–499	> 499
High-density lipids (HDL) (“good” cholesterol)		> 60	> 40			

**TABLE 11.6** Cholesterol Levels (source: Johns Hopkins Medicine, 2023a)



## UNFOLDING CASE STUDY

### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Mr. Thompson has returned for his one-week follow-up. His cholesterol values are:

- Total cholesterol: 269 mg/dL
- LDL: 139 mg/dL
- HDL: 130 mg/dL

His blood pressure is 133/87 mm Hg, and his weight has increased by 2 lb. The nurse calculates his BMI to be 21 kg/m<sup>2</sup> and his waist size is 42 inches.

3. Based on these results, what recommendations should the nurse include in Mr. Thompson’s dietary education?
  - a. Increase red meat intake.
  - b. Decrease caffeine intake.
  - c. Increase fiber intake.
  - d. Decrease dairy consumption.

4. The nurse starts to discuss the diet and exercise recommendations with Mr. Thompson, but he insists he is following a heart-healthy diet and that the tests are wrong. What food selection in Mr. Thompson's 24-hour diet recall illustrates inaccuracy in his statement?
- Freshly squeezed orange juice
  - Steamed broccoli
  - Baked fish
  - Grilled beef cheeseburger

The nurse discusses the dietary choices that Mr. Thompson can recall eating in the last few days and discovers that he is not eating a heart-healthy diet. The nurse makes suggestions for other food choices, and the provider refers Mr. Thompson to a dietitian for further education and nutritional management. He is asked to schedule a follow-up appointment in 3 months. At that time, the provider will determine if these changes have been effective enough or if medications will need to be added to his treatment plan.

### Identifying Challenges to Nutritional Goals

Motivation, food security, financial resources, disability, and comprehension are additional factors that impact cardiovascular health. Motivation is a significant factor because behavior changes may be needed, and the client may need help maintaining their health plan. For example, the client may need to learn a new diet that includes food they feel is lacking in taste, start exercising, or quit smoking. The client will have to truly desire to make changes.

The second major factor that can impact nutritional goals is access to the foods required in the nutritional plan (meal plan) created for the client. Healthy foods like fresh fruits and vegetables cost more and do not last as long as processed unhealthy food. This can be difficult for a client who is already financially or geographically challenged. Frozen fruits and vegetables are another potential healthy source that will last longer than fresh varieties, but they are still more expensive. These also require the client to have storage for these that they may not have, depending on their living situation. Canned fruits and vegetables are the least expensive options they could add to their diet, but they are also the least healthy. They may be prepared with large amounts of salt and sugar, and this will outweigh the benefits the client will obtain from eating them. Even low-sodium and low-sugar options are higher in salt and sugar than fresh options are.

A third major factor is the client's ability to understand the nutritional plan. The client must fully understand what foods are on the diet plan, how to properly read food labels, and how to make appropriate substitutions and measurements. If they do not have a firm understanding, they may struggle to follow the plan. It may be necessary to refer the client to a registered dietitian and follow up consistently to ensure the client both understands the education given and is adhering to the recommendations.

Lastly, debilitating health can contribute to the challenge of cardiovascular health. In the later stages of many of diseases, shortness of breath and fatigue can make eating very difficult. It also increases the difficulty level in food preparation, making it easier for a client to revert to eating fast foods in favor of less effort. The registered dietitian can offer some solutions regarding food preparation to reduce fatigue, such as purchasing prechopped fruits and vegetables, making sheet-pan meals, and using slow-cooker recipes. This will not alleviate the fatigue that clients with breathing difficulties will have during the act of eating. The registered dietitian can take this breathing issue into account and help with the selection of more nutrient-dense foods, so that the client will have to eat less to meet their needed requirements.

## 11.3 Implement Nutritional Strategies to Impact Cardiovascular Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 11.3.1 Assess the client for readiness to learn.
- 11.3.2 Teach nutritional strategies to optimize cardiovascular wellness.

### Holistic Nursing Assessment of the Client

An implementation strategy is necessary for success. To solidify plan compliance, the nurse should involve the client in the creation of the plan, ensure that the client has a clear comprehension of the plan, and evaluate the holistic

needs of the client.

Maintaining cardiovascular health when no disease is present is also critical. A first step to maintenance is to review diet plans. The MyPlate, DASH, and Mediterranean diets are well known and can be utilized to maintain cardiovascular health. In addition, reducing alcohol consumption, caffeine intake, red meats, saturated and trans fats, processed food consumptions, refined carbohydrates, sugary foods and drinks, and sodium have all been shown to be protective for cardiovascular health (Harvard University, 2023; Morales-Brown, 2020). Likewise, increasing the intake of fruits and vegetables, whole grains, fish, nuts, and poultry and using monounsaturated or polyunsaturated oils in place of saturated oils will help prevent cardiovascular disease (Harvard University, 2023).

If the client wishes to prescribe to one of the recommended diets, the nurse should educate them on inclusions, exclusions, and reductions ([Table 11.7](#)).

Diet Type	Inclusions or Increases	Exclusions or Reductions
Mediterranean	<ul style="list-style-type: none"> <li>High intake of olive oil, nuts, vegetables, fruits, whole grains, and cereals</li> <li>Moderate intake of fish and poultry in place of red meats</li> </ul>	<ul style="list-style-type: none"> <li>Restrict red meats, processed meats, sweets, dairy products, and added sugars</li> <li>Red wine consumed in moderation with meals</li> </ul>
DASH	<ul style="list-style-type: none"> <li>Increase vegetables, fruits, and whole grains</li> <li>Include fat-free or low-fat dairy products, fish, poultry, beans, nuts, and vegetable oils over other oils</li> <li>Increase food rich in potassium, calcium, magnesium, fiber, and protein</li> </ul>	<ul style="list-style-type: none"> <li>Decrease saturated fat, whole-fat dairy products, and tropical oils such as coconut, palm kernel, and palm oils</li> <li>Decrease sugary beverages and sweets</li> <li>Decrease trans fats</li> <li>Decrease sodium</li> </ul>
MyPlate	<ul style="list-style-type: none"> <li>2 cups fruit daily*</li> <li>2.5 cups vegetables daily*</li> <li>5–10 oz of total grains (preferably half of this being whole grains) daily*</li> <li>5.5 oz lean protein/meat daily*</li> <li>3 cups dairy per day—preferably low-fat options*</li> </ul> <p>* Note: These are averages, as sex and age can change recommended amounts.</p>	<ul style="list-style-type: none"> <li>Decrease added sugars to &lt; 50 g/day</li> <li>Decrease saturated fats to &lt; 22 g/day</li> <li>Decrease sodium to &lt; 2300 mg/day</li> </ul>

**TABLE 11.7** Mediterranean, DASH, and MyPlate Diet Plan Inclusions, Increases, Exclusions, and Reductions (sources: Harvard University, 2023; Hinze & Chien, 2023; National Heart, Lung, and Blood Institute, 2021; U.S. Department of Agriculture, 2020)

Holistic care is critical to heart health and should include a review of other lifestyle habits that can contribute to cardiovascular disease. For example, smoking cessation is extremely important, as nicotine constricts blood vessels and reduces blood flow while increasing blood pressure (Srakocic, 2023).

Physical activity is also paramount when reducing cardiovascular risks. Exercise helps with weight control, BMI, and waistline management, and reduces the risk for diabetes. Regular physical activity can also help manage stress and improve mood (Harvard University, 2023).

Lastly, sleep is a key consideration. Maintaining an adequate sleep schedule contributes to cardiovascular risk reduction. Sleep has been shown to have an impact on factors that relate to cardiovascular health, such as dietary intake, weight, exercise, inflammation, and blood pressure (Harvard University, 2023).

## Client Teaching

Teaching a client with cardiovascular disease can be challenging. Symptoms like chronic fatigue, weakness, chest pain, and shortness of breath can make it difficult to motivate the client to learn. For these reasons, the nurse

should include caretakers and family members whenever possible during education.

Teaching should include DASH, Mediterranean, and MyPlate diets. The nurse should help the client decide which would be most appropriate for their lifestyle. The nurse may need to adjust the diet to accommodate specific cultural and religious preferences and allergies, and to accommodate other comorbidities that require special dietary considerations.

## 11.4 Evaluate Nutritional Strategies to Impact Cardiovascular Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 11.4.1 Evaluate a nutritional plan for its effect on cardiovascular wellness.
- 11.4.2 Modify a nutritional plan to promote cardiovascular wellness.

### Evaluating Client Readiness to Follow a Nutritional Plan

Client readiness is an important metric in their desire to make necessary life and nutritional changes. The nurse needs to work with the client to evaluate their desire to change. Most changes involve significant lifestyle adjustments, and if the client isn't ready, diet changes alone may not be enough. If the client is willing to follow the nutritional plan, the nurse should educate the client on diet modifications. This will help the client understand how much needs to change and ensure they feel that they can follow the plan.

The nurse also needs to evaluate ableness. The nurse should evaluate the challenges and provide recommendations on how to remove those challenges. The nurse must ensure the client is capable of comprehending the information given to them and that they can make decisions on how best to follow the plan. One step to aid in this evaluation is to ask that the client return with a documented meal plan and include appropriate substitutions for daily meals.

### Evaluating the Effectiveness of a Nutritional Plan

Continual monitoring of lab values and blood pressure is the most effective way to evaluate a nutritional plan. The client's LDL levels should trend downward along with total cholesterol levels, if they were not in normal or optimal ranges. Their blood pressure reading should trend downward to a normal level if it was increased. Levels of prealbumin (a protein produced by the liver) should increase to the normal range if they had been low. BMI should trend downward if it was high. Overall, all values should slowly trend toward standard levels if the client adheres to the nutritional plan and the plan is effective.



### UNFOLDING CASE STUDY

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#### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Mr. Thompson has returned for his 3-month follow-up. He claims to be compliant with all the required changes he and the provider and nurse previously discussed, and he said he is feeling great. The nurse documents that his blood pressure is 122/78 mm Hg, his BMI is  $20 \text{ kg/m}^2$  (a slight change), and his waist measurement is 38 inches.

5. Based on these results, what would the nurse conclude about the dietary and exercise changes?
  - a. They appear effective.
  - b. They appear ineffective.
  - c. They are not effective enough.
  - d. This is not enough information to determine.
  
6. When evaluating the client's caloric intake versus their activity level, what would the nurse document based on these findings?
  - a. The client appears to be compliant.
  - b. The client appears to be partially compliant.
  - c. The client is not compliant.

- d. There is not enough information to determine.
-

## Chapter Summary

- The nurse should assess the cardiovascular system, a life-sustaining system in the body containing the heart and blood vessels, by checking both the mechanical (physical) function and the electrical function of the heart, as well as assessing how effectively the vessels allow the movement of blood around the body after it is pumped by the heart.
- If the electrical conduction of the heart is not working properly, the mechanical function will not work at all.
- The biggest dietary considerations in the health of

## Key Terms

- arteries** blood vessels that carry oxygenated blood from the heart to the body
- arterioles** arteries shrink to this smallest form and link with capillaries
- atria** the top two heart chambers
- atrioventricular (AV) node** a second node in the heart that creates a delay in the electrical impulse from the SA node to the bundle of His to allow time for ventricular filling
- bundle of His** a bundle of conducting fibers that branch to each ventricle of the heart
- capillaries** the point at which arteries and veins exchange blood supply
- cardiovascular system** a system within the body that includes the heart, blood vessels, blood, lymph, lymphatic vessels, and glands that moves blood and lymph through the body
- circulatory systems** interconnected blood vessels that flow through the body
- electrocardiogram (ECG/EKG)** a recording of a heart's electrical activity in which electrodes are

- the cardiovascular system include cholesterol, potassium, trans fats, saturated fats, sugars, magnesium, calcium, and sodium.
- Dietary changes need to be implemented with healthy lifestyle changes to see adequate outcomes from nutritional plans.
- When evaluating risk factors for cardiovascular disease, BMI, waist size, and blood pressure are major considerations, along with specific comorbidities such as diabetes.
- Even those without cardiovascular disease should have a heart-healthy diet.

placed on the chest to capture signals

**hypalbuminemia** a condition where the body does not produce enough albumin, a protein that keeps fluids in blood vessels

**normal sinus rhythm (NSR)** the heart's cardiac rhythm that originates from the sinus node

**perfusion** the movement of blood, oxygen, and nutrients to tissues in the body

**pulseless electrical activity (PEA)** electrical conduction throughout the heart without physical movement of the heart muscle

**Purkinje fibers** terminal-conducting fibers in the ventricles

**sinoatrial (SA) node** the pacemaker of the heart

**telemetry** the measurement of a heart's ECG through a portable device that automatically transmits to a monitor

**veins** blood vessels that carry deoxygenated blood from the body to the heart

**ventricles** the bottom chambers of the heart

**venules** the smallest veins that link with capillaries

## Review Questions

- The nurse is educating a client with hypertension about the Dietary Approaches to Stop Hypertension (DASH) diet. Which statement by the client indicates the need for further teaching?
  - "The DASH diet increases my sodium intake."
  - "The DASH diet increases my vegetable intake."
  - "The DASH diet increases my potassium intake."
  - "The DASH diet decreases my sugar intake."
- The nurse is reviewing a client's medical record and notes that the last two blood pressure readings were 130/81 mm Hg and 122/99 mm Hg. Which diagnosis does the nurse anticipate for this client?
  - Normal blood pressure
  - Elevated blood pressure
  - Low blood pressure
  - Hypertensive blood pressure
- The nurse is educating a client on ways to promote heart health. Which food modification would the nurse

- recommend for a heart-healthy diet?
- Red meat at 2 meals a day
  - Prepackaged meat products
  - Pineapple slices
  - Caffeinated unsweetened tea
- 4.** The nurse is evaluating a client at a follow-up appointment who reports following a heart-healthy nutritional plan for 3 months. Which objective data should the nurse utilize to support the client's statement?
- BMI change from 30 to 29 kg/m<sup>2</sup>
  - LDL change from 100 to 110 mg/dL
  - Blood pressure from 142/88 to 144/86 mm Hg
  - Increased shortness of breath
- 5.** The nurse in the outpatient cardiology clinic is assessing a client who had an acute myocardial infarction 6 months ago and has completed an outpatient cardiac rehabilitation program. Which cholesterol level indicates to the nurse that the client has achieved a desired level?
- Total cholesterol 202 mg/dL
  - LDL 130 mg/dL
  - HDL 48 mg/dL
  - Triglycerides 242 mg/dL
- 6.** The nurse is caring for a client with newly diagnosed atrial fibrillation. Which food should the nurse educate the client to avoid?
- Coffee
  - Oranges
  - Milk
  - Fish
- 7.** The nurse is caring for a client with a history of cardiac arrest due to torsades de pointes. Which laboratory value is a priority for the nurse to monitor in this client?
- Total cholesterol
  - Calcium levels
  - Magnesium levels
  - Potassium levels
- 8.** The nurse notes a very high and peaked T-wave abnormality on a client's electrocardiogram (ECG). Which laboratory value should the nurse expect the provider to order?
- Magnesium level
  - Sodium level
  - Calcium level
  - Potassium level
- 9.** The nurse is caring for a client who has hyperlipidemia. Which food choice by the client is appropriate?
- Cake
  - Oatmeal
  - Fried chicken
  - Hot dog
- 10.** The nurse is caring for a client who is prescribed the DASH diet to manage their high cholesterol levels. What food choice in the client's 72-hour diet recall requires further teaching?
- Whole milk
  - Potatoes
  - Oysters

- d. Orange juice

## Suggested Reading

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# CHAPTER 12

## Special Nutritional Considerations for Cardiovascular Health



**FIGURE 12.1** Fish is a good source of omega-3s and other nutrients that contribute to heart health. (credit: modification of work “Sashimi” by Ocdp/Wikimedia Commons, CC0 1.0)

### CHAPTER OUTLINE

12.1 The Impact of Nutrition on Cardiovascular Wellness Across the Lifespan

12.2 Nutrition and Long-Term Cardiovascular Illnesses

12.3 Treatments and Nutrition

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**INTRODUCTION** The cardiovascular system plays a significant role in the care of clients throughout their lifespan. This chapter will look at important nutritional modifications that impact cardiac-related events.

Consider this case: Tara is a 42-year-old multigravida pregnant client who presents to her obstetrician’s office complaining of a severe headache, blurry vision, and edema to her legs. She is gravida 6, para 3 abortion 2 (meaning the client is pregnant for the 6<sup>th</sup> time, 3 pregnancies have resulted in live births, and 2 pregnancies ended without a live birth). The client is 25 weeks pregnant and has a history of hypertension and obesity. She was taking lisinopril for hypertension prior to finding out she was pregnant and then changed to labetalol. In the office, Tara’s blood pressure is 220/115 mm Hg. The provider examines Tara and sends her to labor and delivery for laboratory work and further monitoring.

## 12.1 The Impact of Nutrition on Cardiovascular Wellness Across the Lifespan

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 12.1.1 Describe the impact of nutrition on the cardiovascular system during pregnancy.
- 12.1.2 Describe the impact of nutrition on the cardiovascular system during infancy.
- 12.1.3 Describe the impact of nutrition on the cardiovascular system during childhood.
- 12.1.4 Describe the impact of nutrition on the cardiovascular system during adolescence.
- 12.1.5 Describe the impact of nutrition on the cardiovascular system during adulthood.
- 12.1.6 Describe the impact of nutrition on the cardiovascular system during later adulthood.

### Pregnancy

During pregnancy, multiple changes occur within the cardiovascular system. As cardiac output increases, vascular volume increases, and there is a decrease in systemic vascular resistance and subsequent blood pressure. The vessels also dilate, which leads to lower blood pressure in the second trimester. After 20 weeks of gestation, blood pressure increases but typically remains near pre-pregnancy levels. These changes are designed to provide perfusion—the flow of blood to tissues and organs—to the fetus (Kepley, Bates, & Mohiuddin, 2023). To best support this growth and development of the fetus, the cardiovascular system of the client needs to be properly supported.

The pregnant client should increase caloric intake by 340–450 calories daily during the second and third trimesters. Increasing folic acid, iron, and choline are important as well. Pregnant clients should avoid all alcohol, decrease or eliminate caffeine intake, and avoid uncooked meats and fish. Although for clients with a pre-existing condition such as **hypertension** (high blood pressure) and obesity, other measures will need to be incorporated into the nutritional plan (meal plan) to help prevent complications (Lu et al., 2018; Anderson-Villaluz & Quam, 2022).

The food that the expectant client eats can also affect the fetus's growing organs. Nutritional recommendations include consuming skim or low-fat milk, yogurt, and cheese; healthy, lean proteins including oily fish; fresh fruits and vegetables; and whole grains to help the fetus's heart grow healthy. Pregnant clients are encouraged to avoid food high in fat, cholesterol, and sodium as this does not only affect the client, but the fetus as well (Advent Health, 2021).

Research shows that optimal nutrition during pregnancy is linked with other healthy behaviors such as an increase in physical activity and avoidance of smoking and alcohol.

### Impact on the Client's Health During Pregnancy

The demands of pregnancy on the client significantly changes the physiological functioning of the cardiovascular system (Kepley, Bates, & Mohiuddin, 2023). The increase in metabolic demand promotes optimal **uteroplacental** circulation—the transfer of oxygen and nutrients from client to fetus through umbilical cord and placenta—that is needed by the fetus for growth and development. The increase in the cardiac output affects the client and the fetus by increasing pressure on the vena cava from the weight of the extra fluid within the placenta and the weight of the fetus. Vasodilation begins early in pregnancy, with a decrease in systemic vascular resistance. Maternal heart rate also increases. Other changes that occur to the cardiovascular system due to the developing fetus include rotation of the heart due to the pressure on the diaphragm, increase in heart rate, and mild hypertrophy due to the increase in vascular volume (Gersh, 2022).

Maintaining healthy nutrition for heart health during pregnancy is important because it allows the heart to cope with the stress of pregnancy. Implementing healthy heart behaviors positively impacts pregnancy and can help during delivery and the postpartum period. Healthful measures that can be taken are using added salt sparingly, increasing water intake to at least 64 oz daily, increasing protein in the diet, decreasing the amount of fried foods, exercising, avoiding alcohol and caffeine, and elevating the feet during the day (American Pregnancy Association, 2023).

Many symptoms—such as shortness of breath, increase in heart rate, and swelling—experienced during pregnancy are linked to cardiovascular changes. Decreased venous return to the head can cause the pregnant client to experience **syncope** in which the client loses consciousness for a brief time or **near-syncope** episodes where the client feels like they may pass out or have some lightheadedness or dizziness. The nurse should advise the client to change positions slowly to minimize the associated risks for falls if this happens. The client may experience

**dyspnea** or difficulty breathing with exertion and/or visible pulsations of the jugular veins, as well as edema of the lower extremities. Research also shows that not only the mother's health is affected during pregnancy, but also the developing fetus. The choices the mother makes nutritionally can affect the fetus's risk for heart disease, kidney disease, and metabolic disease in adulthood (Cunningham & LaMarca, 2018). Consistent themes found in the research to best promote cardiovascular health during pregnancy through nutrition focus on decreasing total cholesterol levels, regulating fasting glucose levels, and maintaining normal blood pressure readings.

It is important to teach clients what food choices are best. Suggestions include educating clients on how to drink water or milk and eat fresh fruits and vegetables. When choosing meats, choose meat that is grilled rather than fried and avoid raw fish. Eating a plant-based or vegetarian diet during pregnancy has been associated with higher risks of congenital heart defects in the neonate at birth (Yang et al., 2019). Salads are typically a good source of nutrition but can have many hidden calories in the dressings and various toppings that can be included in the salad. Clients should choose low-fat salad dressing and eat desserts sparingly (Howland, 2018).

### The Client with Pre-existing Cardiovascular Disease

Cardiovascular disease is a leading cause of complications in pregnant females (Cleveland Clinic, 2022a). The pregnant client may be unaware of previous cardiovascular issues until they become pregnant. People with previously undiagnosed cardiac issues may experience new cardiovascular-related health concerns and diagnoses due to the increase in cardiac output and decreased systemic resistance. Heart murmurs, chest pain, and generalized swelling should be evaluated by a health care provider (Gersh, 2022).

Clients with congenital heart disease can experience an exacerbation of related cardiovascular issues from pregnancy-related physiological and hormonal changes (Ifitkhar & Biswas, 2023). There is an increased risk for both maternal and fetal death associated with cardiovascular disease and pregnancy. Clients who have pre-existing cardiovascular diseases need to be counseled about the additional risk factors that they could potentially encounter during pregnancy, and they need to be counseled on ways to help keep their heart and their fetus's heart healthy.

The amount of weight that the client gains during pregnancy can impact cardiovascular health by increasing the need for higher cardiac output. For the client who gains more weight than what is recommended, the baby can be too big and lead to complications during delivery according to the Centers for Disease Control (CDC, 2022b). Studies have shown that only about one-third of pregnant women gain the recommended weight during pregnancy. The recommended weight gain varies according to the pre-pregnancy body mass index (BMI) and if the client is pregnant with one or more fetuses (CDC, 2022). To help prevent cardiovascular disease, the client should try to meet the expected weight gain during pregnancy by increasing calories during the second (340 additional calories) and third trimester (450 additional calories). The nurse should track and monitor pregnancy weight gain and encourage the client to eat a well-balanced diet to help prevent cardiovascular problems during pregnancy (CDC, 2022).



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Upon arrival at the labor and delivery department, Tara is placed on a fetal monitor, blood work and urine are collected, and her vital signs are obtained.

Vital Signs	Laboratory Results
Temperature: 37.4°C	<ul style="list-style-type: none"> <li>Urine shows protein</li> <li>Liver enzymes are slightly elevated</li> </ul>
Blood pressure: 224/200 mm Hg	
Heart rate: 92 beats/min	
Respiratory rate: 22 breaths/min	

TABLE 12.1

Vital Signs	Laboratory Results
Oxygen saturation: 96% on room air	

**TABLE 12.1**

Tara is started on a labetalol drip for blood pressure control. The fetal monitor shows no distress to the fetus, so she is transferred to the intensive care unit for blood pressure monitoring and labetalol infusion.

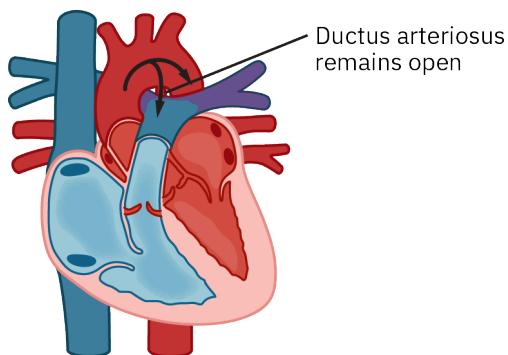
Tara spends 4 days in the intensive care unit to get her blood pressure under control and to monitor her liver enzymes and kidney function. Her liver enzymes and kidney function normalize, and her blood pressure is now down to 120/76 mm Hg. She is converted to oral labetalol and will be ready to discharge home in the next day or two for a follow-up with the obstetrician within 3–4 days.

The nurse is providing nutritional education to Tara since she has a history of hypertension and developed pre-eclampsia. They both understand that nutrition and lifestyle modifications play a significant role in controlling blood pressure and helping prevent Tara’s blood pressure from spiking.

1. Which part of Tara’s assessment or history is concerning due to the possibility of complications during pregnancy?
  - a. Respiratory rate of 22 per min
  - b. Hypertension
  - c. Heart rate of 92 beats per min
  - d. Temperature of 37.4°C
  
2. Tara asks about going out to dinner since she has a busy schedule. Which foods would be the best for her to choose for her diet?
  - a. Fried chicken fingers and fries
  - b. Well-grilled chicken salad with full-fat cheddar cheese and ranch dressing
  - c. Raw sushi and rice
  - d. Well-grilled steak and steamed broccoli

### Impact on the Fetus

The fetus of a client with cardiovascular disease is at an increased risk for morbidity, cardiovascular disorders— inherited and congenital— premature delivery, and a restriction in fetal growth and development (Russell, 2022). Fetal growth and development restriction, related to inadequate placental perfusion, also increases the risk for fetal demise. Additionally, infants born to clients experiencing poorly controlled cardiovascular disease complications during pregnancy were noted to experience small gestational weight measurements and extreme prematurity. An infant who is preterm also has reduced cardiomyocyte proliferation, which affects the total number of cardiac cells they have. The decrease in myocytes affects the heart’s ability to repair itself and can decrease the function of the heart (Bensley et al., 2018). Some cardiac problems that infants can develop from prematurity include, but are not limited to, patent ductus arteriosus ([Figure 12.2](#)) and low blood pressure (Mayo Clinic, 2023c).



**FIGURE 12.2** Patent ductus arteriosus is a common cardiac effect seen in premature fetuses. (credit: modification of work from *Anatomy & Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Superior nutrition during pregnancy is important not only for the client but for the developing fetus. Those who have a limited intake of fruits, vegetables, fish, meats, and dairy can have infants who are stillborn or have a low birth

weight; the fetus could also have developmental delays. Those who lack nutrients such as iodine, folate, calcium, and zinc can have complications during pregnancy that could potentially result in material death (UNICEF, 2023). Research shows that if a pregnant person has gestational diabetes, there are cellular changes that occur within the developing heart of the fetus. It is important to monitor the client's blood glucose and if they do have diabetes, make sure the glucose is under control. Cellular changes that occur during the development of the heart of the fetus have been linked to high glucose levels in the pregnant client (Garg, 2020).



## UNFOLDING CASE STUDY

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### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Tara is at an advanced maternal age. As an already busy mom and working full-time, she regularly has a very hectic schedule. Meals are often whatever she can pick up quickly. Tara has gained more weight in the second trimester than her obstetrician recommends; the doctor is concerned about her elevated blood pressure, cholesterol and glucose levels, heartburn, and lower leg edema.

Upon examination, fundal height is appropriate for gestation and fetal heart tones are normal. Considering Tara's busy schedule and the three children she is already caring for, Tara is concerned about how to feed her family and keep herself healthy.

3. While preparing education for Tara, which information does the nurse need to include in the educational packet to help keep Tara and her fetus healthy?
    - a. Decrease food intake
    - b. Exercise 60 minutes daily
    - c. Increase fruits and vegetables
    - d. Increase salt in the diet
  
  4. Which finding in Tara would be the most concerning for premature birth?
    - a. Busy schedule
    - b. High blood pressure
    - c. Fundal height
    - d. Pregnant with one fetus
- 

### Infancy

For healthy infants born without cardiovascular disorders, research data indicates that breastfeeding for the first 6 months is best because it provides the infant with optimal nutrition. The goal is to breastfeed infants for a full year while introducing solid foods (CDC, 2023e). Infants who are breastfed have a decreased risk for subsequent cardiovascular-related diseases such as obesity and type 1 diabetes. Commercially made formulas are developed to mimic breast milk. Infant formulas must meet the nutritional requirements that are set by the federal government (FDA, 2023). The FDA recommends that formula preparations include calcium, fats, folate, iron, protein and carbohydrates in the appropriate amounts for infants. Additionally, micronutrients of zinc, vitamins A, C, D, E, K, and B vitamins are included in the recommendations (Watson, 2022). To ensure the infant receives the correct amount of these macro and micronutrients, it is important to provide the formula as prepared or reconstitute as directed. Watering down the formula will not provide the infant with the nutrients needed to support growth and development.

Complementary foods can be added to the diet after the infant is 6 months old. Complementary foods include iron-fortified infant cereals, pureed vegetables, and fruits. As more food is introduced to the infant, food choices should include fruits and vegetables, whole grains, and whole milks, such as pumpkin, apples, pears, carrots, peas, and pureed lean meats. Commercially prepared infant foods are available in various stages of infant development. Home-prepared foods should be pureed to a consistency that is easy for the baby to eat with all peelings and seeds removed (Advent Health, 2021) or cut into small pieces to avoid choking.

## SPECIAL CONSIDERATIONS

### Foods and Drinks to Avoid with Infants

Specific food items should be avoided until 12 months of age. Infants under 12 months should avoid honey, due to the potential for botulism, unpasteurized drinks/foods, foods high in salt or sugar, caffeinated drinks, cow's milk, and fish high in mercury (CDC, 2023b). Other foods that should be avoided that could potentially cause harm are nuts, sunflower seeds, cherries with pits, raw carrots, popcorn, hard candy, raw apples and pears, grapes, cheese cubes, and hot dogs or sausage because these have the potential to lodge in the infant's trachea and block the airway. Peanut butter and chewing gum can also make the mouth sticky and get lodged in the airway (Nemours Children's Health, 2023).

Infants with congenital heart disease require additional calories to support growth and development (Royal Brompton and Harefield Hospitals, 2021). Babies with congenital heart disease may experience fatigue and typically require more calories daily than the average infant. Many of these babies cannot eat or drink enough to meet their caloric needs. The pediatrician can recommend supplementing breast milk or prescribe a high calorie formula. Baby foods that are higher in calories are bananas with tapioca, mango with tapioca, prunes and rice, mixed vegetables, and sweet potatoes. Many others can be obtained from the grocery store in the baby food aisle (American Heart Association, 2023; Royal Brompton and Harefield Hospitals, 2021). Formulas that the provider can prescribe include Infatrini and Similac High Energy with 100 calories and 2.6 g of protein per 100 mLs, in comparison to the standard formula, which has 70 calories and 1.5 g of protein per 100 mLs (Royal Brompton and Harefield Hospitals, 2021). Infants who have heart issues also may require nasogastric tube feeds to help keep up with their nutritional needs.

Feeding during infancy is an opportunity to introduce infants to a heart-healthy diet and encourage food likes that will extend throughout their lifecycle. Promoting a rainbow of foods and allowing the infant to explore a variety of textures and consistencies will promote a healthy relationship with food as a fuel source that will encourage and sustain growth and development. Limiting processed, high-fat, high-sugar, and high-sodium foods in infancy will develop a pattern of utilizing nutrient-dense foods for fuel across the lifespan.

### Childhood

The heart healthy eating behaviors of infancy should also be followed in childhood, including calorie consumption that supports the growth and developmental needs of the child. As these needs fluctuate, children should take the lead on how much food they consume; parents and caregivers can allow them to stop eating when they are full rather than promoting a clean plate (American Heart Association, 2018). Foods low in added sugar, saturated fats, cholesterol, and salt should be the focus of a healthy childhood diet. A childhood diet should be rich in a variety of colorful foods; 30–35% of daily caloric intake should be mono- or polyunsaturated fats from olive oil or canola oil. See [Table 12.2](#) for the nutritional needs of an average 3-year-old.

Nutritional Needs	Measurements
Dairy	2 cups
Lean meats and beans	2 oz
Vegetables	1 cup
Fruits	1 cup
Grains	3 oz (with half of that from whole grains)

TABLE 12.2 Daily Nutritional Needs for a 3-Year-Old (source: AHA, 2010)

Developing a meal-time routine as a family—where the child is involved in the meal preparation—helps to build life-long healthy eating habits. Including children in the preparation of food and teaching them to make healthy nutritional choices is something parents can incorporate into their meals each day. Kids can help by washing the fruits and vegetables, setting the table, and helping prepare things that are at their cognitive and coordination levels. Involving children in meal preparation makes them feel they have choices in what they eat, and with the parents' help they are making healthier choices. When eating fast food children can learn to choose healthy options such as

carrot sticks instead of French fries, yogurt instead of hashbrowns or other sides that are fried in grease, and fresh fruit instead of baked goods high in added sugar.

Childhood is the optimal time to develop and reinforce heart-healthy dietary eating behaviors that support growth and development throughout life. Heart-healthy nutritional patterns such as watching portion sizes, eating low-fat dairy, limiting saturated fats, and increasing fruits and vegetables in the diet can help decrease the likelihood of obesity, hyperlipidemia, and hypertension in childhood and later as an adult (Cleveland Clinic, 2022c).



## UNFOLDING CASE STUDY

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### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Tara's 3-year-old son, Carter, attends preschool Monday through Friday from 7 a.m. until 5:30 p.m. Other than several upper respiratory tract viral infections and several rounds of otitis media, Carter is relatively healthy. At his latest well-child visit, the health care provider was concerned with Carter's high weight due to subsequent health issues related to childhood obesity.

When discussing a normal 24-hour diet for Carter, Tara shares that he typically eats breakfast, lunch, and a snack at preschool. They typically pick up food for dinner on the way home from work/preschool. As Tara often works from home on the weekends, she admits that Carter tends to get more screen time than she would like.

5. With Carter's height charted at 36 inches and weight at 54 lb, calculate his BMI and indicate his BMI category. You may use this BMI calculator: <https://www.cdc.gov/healthyweight/bmi/calculator.html>.
    - a. 29.3; severe obesity
    - b. 19.2; healthy weight
    - c. 16.2; underweight
    - d. 32.2; severe obesity
  
  6. While teaching Tara about healthy food choices for Carter, which statement is most appropriate?
    - a. "Make sure Carter eats all of his food at each meal and that his plate is clean."
    - b. "Let Carter help you prepare meals in the kitchen while you are cooking."
    - c. "Since you are busy, Carter can have a cheeseburger and fries daily to help you."
    - d. "Screen time is good for Carter since you work and need to keep him occupied."
- 

### Adolescence

Some important modifiable risk factors for cardiovascular disease in adolescents include poor dietary quality and obesity, which can lead to early-onset **atherosclerosis** (Raeside, 2019). Preventing the occurrence of cardiovascular disease in adolescents reduces the risk for early death from cardiovascular disease in later life. Although the information presented previously focuses on nutrient-dense, heart-healthy foods is equally applicable to adolescents, it is also imperative to integrate teaching strategies in ways meaningful for this age group.

To decrease the risk for long-term cardiovascular disease, preventing or delaying the occurrence of negative, modifiable risk factors is essential (Dahm et al., 2016). Promoting the high consumption of fruits and vegetables, as well as whole grains, lean meats, and fish, while minimizing the intake of processed foods, sodium, and artificial trans fats during adolescence has been shown to decrease the incidence of cardiovascular disease in adulthood. Refer to [Table 12.3](#) for the daily nutritional needs of adolescents.

Foods	Female – 1,800 Calories	Male – 2,200 Calories
Dairy	3 cups	3 cups
Lean meats and beans	5 oz	6 oz
Vegetables	2.5 cups	3 cups

**TABLE 12.3** Daily Nutritional Needs for the Average, Healthy 15-Year-Old (source: AHA, 2018)

Foods	Female – 1,800 Calories	Male – 2,200 Calories
Fruits	1.5 cups	2 cups
Grains	6 oz (with half of that from whole grains)	7 oz (with half of that from whole grains)

**TABLE 12.3** Daily Nutritional Needs for the Average, Healthy 15-Year-Old (source: AHA, 2018)

Although many aspects of social media are not viewed positively, social media can provide information about heart-healthy behavior in a way that positively impacts adolescent behaviors (Mayo Clinic, 2022a). The use of digital media has been noted to be effective in providing adolescents with information when and where they seek it (Mayo Clinic, 2022a). Additionally, utilizing social media assists teens in establishing a feeling of connection with their peers, which can foster healthy behaviors (Anderson et al., 2022). Social media also reduces barriers to information, increasing the accessibility of heart-healthy information available to this age group. Parents and nurses can balance the positive implications with an awareness of the negative implications of social media. Research has indicated one of the best ways to help alleviate negative impacts that social media can play on the teen is for parents and guardians to have open communication with their teens.

Eating disorders, such as purging, binging, or limiting food/not eating certain foods, are more prevalent among female adolescents than males. In the U.S. it is estimated that 10 in 100 young women have an eating disorder (American Academy of Child & Adolescent Psychiatry, 2018). Teens can become withdrawn, and family may recognize weight loss in individuals suffering from eating disorders. Recognizing these symptoms is crucial to the health of the teenager.

In addition to diminished mental health, eating disorders lead to diminished physical health: electrolyte imbalances, such as hypokalemia and hyponatremia; increased liver enzymes; increased bilirubin levels; anemia; and leukopenia. These changes can affect the electrocardiogram by prolonging QT intervals, causing bradycardia, and ventricular tachycardia. The effects of these disorders can decrease the blood pressure and cause a higher risk for heart problems, such as cardiomyopathy, by causing the larger walls of the heart to become thicker and lose their ability to pump blood (Sarder et al., 2015). Clients with anorexia typically have an amino acid deficiency because they do not consume enough protein, which is essential for bodily function. Without enough protein, the body will use the available protein for vital functions and the other nonessential functions will shut down. Nails become brittle, menstruation ceases, muscles begin to thin and waste, and the essential functions that help to regulate the heart become altered. Heart abnormalities are commonly seen in severe anorexia due to cardiac muscle cell death (Comprehensive Psychiatric Resources, 2023).

## Adulthood

Cardiovascular disease is occurring in younger adults more often because other diseases that can cause cardiovascular disease are happening at younger ages. Risk factors for developing heart disease include hypertension, **hyperlipidemia**, smoking, obesity, diabetes, sedentary lifestyle, and poor dietary choices (CDC, 2023c).

Cardiovascular disease (CVD) is a broad category, but includes four subtypes: coronary heart disease, **stroke**, peripheral artery disease, and aortic disease. [Table 12.4](#) includes a complete description of each.

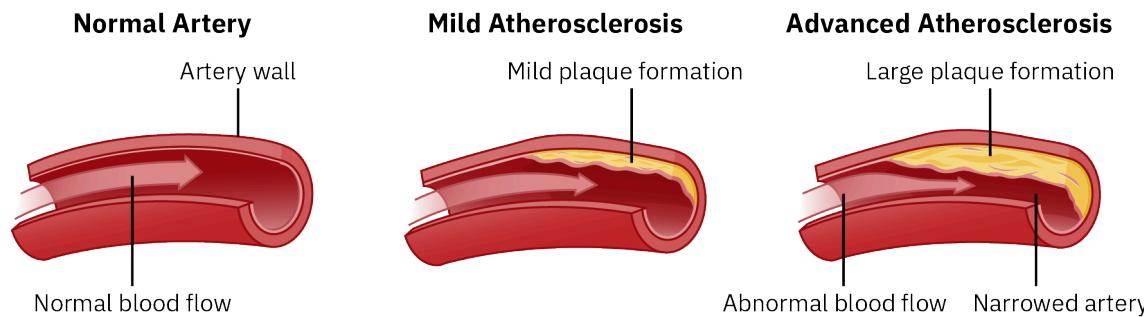
Disease Subtype	Description
Coronary heart disease (CHD)	<b>Plaque</b> builds up on the walls of the arteries that supply blood to the heart, which decreases blood flow to the heart. This causes <b>angina</b> , which is chest pain from the lack of oxygen delivery to the heart.
<b>Transient ischemic attack (TIAs)</b>	The temporary period of symptoms that are like a stroke and is caused by the occlusion of the arteries leading to the brain. TIAs typically only last a few minutes and the client usually recovers without any permanent damage.
<b>Stroke</b>	The vessels leading up to the brain are blocked, stopping blood from flowing to the brain. Brain cells are damaged or possibly die, which can lead to long-term disability.

**TABLE 12.4** Subtypes of Cardiovascular Disease (sources: CDC, 2023f; Mayo Clinic, 2022c)

Disease Subtype	Description
Peripheral artery disease (PAD)	A blockage in the arteries to the extremity, usually the leg. This can produce pain in the legs while walking.
Aortic disease	This is a broad category for any condition that impacts the ability of the aorta to function correctly. The most common type is aortic aneurysm.

**TABLE 12.4** Subtypes of Cardiovascular Disease (sources: CDC, 2023f; Mayo Clinic, 2022c)

When arteries become built up with plaque, it causes a narrowing of the artery (National Heart, Lung, and Blood Institute, 2022), which impacts blood flow away from the area of **stenosis** (narrowing). Nutritional intake, along with lifestyle choices and heredity, can affect a client's risk for developing atherosclerosis. See [Figure 12.3](#) for a graphic depiction of normal versus abnormal blood flow due to atherosclerosis.



**FIGURE 12.3** Atherosclerosis is due to plaque buildup which causes a narrowing of the artery and impacts blood flow distal to the area of stenosis. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Risks for heart disease include high cholesterol and high triglyceride levels, high blood pressure, and a diet high in saturated fats (Mayo Clinic, 2023d). There are two types of blood cholesterol, low-density lipoprotein (LDL) cholesterol and high-density lipoprotein (HDL) cholesterol. Health care providers commonly refer to LDL as bad cholesterol because it contributes to the development of plaque deposits in arteries; HDL is referred to as good cholesterol as it provides some protection against heart disease (CDC, 2023d). [Table 12.5](#) outlines cholesterol levels in the desirable, borderline, and high ranges.

Laboratory Test	Desirable	Borderline Risk	High Risk
Total cholesterol	< 200 mg/dL	200–239 mg/dL	> 240 mg/dL
LDL cholesterol	< 100 mg/dL	100–159 mg/dL	> 160 mg/dL
HDL (varies dependent on sex)	> 60 mg/dL	40–59 mg/dL	< 40 mg/dL
Triglycerides	< 150 mg/dL	150–199 mg/dL	200–499 mg/dL
Blood pressure	< 120/80 mm Hg	120–129/< 80 mm Hg	> 130/80 mm Hg

**TABLE 12.5** Normal Cholesterol Levels (sources: CDC, 2021; National Heart, Lung, and Blood Institute, 2023; National Library of Medicine, 2022)

The use of the heart-healthy diet has been shown to help lower bad cholesterol (LDL) and increase good cholesterol (HDL). Additionally, avoiding or minimizing processed foods and high-sugar foods and drinks has a positive impact on heart health. Foods, such as red meats and high-fat dairy products that are high in saturated fat, should be reduced to help lower LDL levels. Adding whey protein to the diet can help decrease LDL and total cholesterol (Amirani et al., 2020). Increasing intake of omega-3—by increasing foods such as salmon, mackerel, and walnuts—can reduce blood pressure. Clients can increase soluble fiber in the diet by eating oatmeal, kidney beans, and apples, which can help decrease the absorption of cholesterol in the body leading to overall changes in cholesterol levels. Exercise and quitting smoking can also help improve HDL levels (Mayo Clinic, 2023b). Adhering to these dietary patterns can impact individual cholesterol levels to decrease the risk for developing atherosclerosis and further cardiovascular diseases.

Alcohol consumption has been shown to have negative effects on cardiovascular health, leading to hypertension, **heart failure**, and stroke. Drinking excessively—women more than 4 drinks per day and men more than 5 drinks per day—can also lead to cardiomyopathy, which affects the ability of the heart to pump effectively (Johns Hopkins

Medicine, 2023). An alcoholic drink is defined as 0.6 of fluid ethanol per drink (National Institute on Alcohol Abuse and Alcoholism, 2022). In a study that consisted of 371,463 participants, Biddinger et al (2022), showed an increased risk for hypertension and coronary artery disease with alcohol consumption.

In addition to educating clients on controlling cholesterol, triglyceride, and blood pressure levels and avoiding alcohol, nurses should inform clients about appropriate nutritional plans to combat cardiovascular disease. Nutritional plans should be low in processed food, sugary drinks, saturated fats, fatty dairy products, and sodium (Mayo Clinic, 2023e). The Dietary Approaches to Stop Hypertension (DASH) diet is an appropriate recommendation because it includes a diet high in fruits and vegetables, unsaturated fats, whole grains, fish, legumes, and low-fat dairy. Refer to [Table 12.6](#) for the daily nutritional needs of adults.

Food	1,800 Calories	2,200 Calories
Dairy	3 cups	3 cups
Lean meats and beans	5 oz	6 oz
Vegetables	2.5 cups	3 cups
Fruits	1.5 cups	2 cups
Grains	6 oz (with half of that from whole grains)	7 oz (with half of that from whole grains)

**TABLE 12.6** Daily Nutritional Needs for the Average Healthy Adult (source: U.S. Department of Agriculture, n.d.)

## UNFOLDING CASE STUDY

### Part D

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up from Case Study Parts A, B, and C.

Tara is a busy mother who typically does not like to cook. She does have 4 children ranging from ages 12 years to 2 weeks. While her husband's parents help care for the children, it is typically Tara who cares for them daily. Tara's husband is usually away on business 3–4 nights a week leaving Tara to care for the children herself.

At her last annual physical, her blood pressure was 148/84 mm Hg; total cholesterol was 248 mg/dL and triglycerides showed 173 mg/dL. Her health care provider discussed risk factors associated with cardiovascular disease.

Because school provides breakfast, lunch and a snack for Carter, Tara typically drinks several cups of coffee for breakfast, grabs lunch at work and picks up dinner on the way home from picking up her children from her in-law's house. She works at home on the weekends, but believes she has time to make positive changes in their normal eating routine to include heart healthy meals.

7. Which would be the best choice for Tara to include in her dietary menu planning?
  - a. Macaroni and cheese
  - b. Fried chicken
  - c. Pork sausage
  - d. Apples
  
8. What are ways in which Tara could decrease her cholesterol instead of being placed on medication?
  - a. Increase fiber in her diet
  - b. Drink more sodas
  - c. Increase intake of fatty meats
  - d. Eat more processed foods

### Later Adulthood

Later adulthood can be further broken down as youngest-old adults between 65 and 74, middle-old adults between 75 and 84, with oldest-old age 85 and older (Lee et al., 2018). Although preventative care fostering a healthy

cardiovascular system is the optimal desire, research indicates that there is an increase in cardiovascular disease as people age. The incidence of cardiovascular disease increases from approximately 40% in adults ages 40–59 to 75% from ages 60–79, and approximately 86% in those above age 80 (Rodgers et al., 2019). Depending on the activity level of the client, the older adult typically needs about 2000 calories daily. Additionally, healthy older adults need increased dietary fiber, calcium, vitamin D, and potassium; healthy older adults should decrease their consumption of saturated fats, sodium, and added sugars (FDA, 2022a). See [Table 12.7](#) for the recommended nutritional needs for later adulthood.

Nutrient	Recommended Daily Amount
Dietary fiber	28 g
Calcium	1000 mg
Vitamin D	600 IU
Potassium	3400 mg
Saturated fats	< 10% daily caloric intake
Sodium	< 2300 mg
Added sugars	< 10% daily caloric intake

**TABLE 12.7** Daily Nutritional Needs for Later Adulthood (source: U.S. Department of Agriculture, 2020a)

As people age, many age-related changes occur that can affect nutritional needs. Many adults experience heart complications from coronary artery disease, valvular disease, high cholesterol, heart failure, and arrhythmias. These clients are typically placed on multiple medications to treat their condition. However, the nurse can educate clients on nutrition and other lifestyle strategies to help clients manage their symptoms. Nutritional needs for a healthy heart include eating a variety of fruits and vegetables; eating whole grains; choosing healthy proteins such as nuts, fish, and seafood; decreasing intake of highly processed foods; minimizing intake of added sugars; using herbs instead of salt for seasoning or choosing low-sodium foods; and limiting alcohol intake. The nurse should also instruct clients on the importance of smoking cessation (American Heart Association, 2021). Another consideration is how nutrition can interact with medications clients take to treat their heart disease.

## 12.2 Nutrition and Long-Term Cardiovascular Illnesses

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 12.2.1 Discuss the impact of nutrition on cardiovascular illness.

### Cardiovascular Diseases

The American Heart Association defines cardiovascular disease as any disease of the heart and blood vessels, many of which are related to atherosclerosis (2017). Although some cardiovascular problems are congenital, meaning the client was born with it, most cardiovascular diseases develop over the lifespan. Cardiovascular diseases that develop over the lifespan are often linked with atherosclerosis (National Heart, Lung and Blood Institute, 2022).

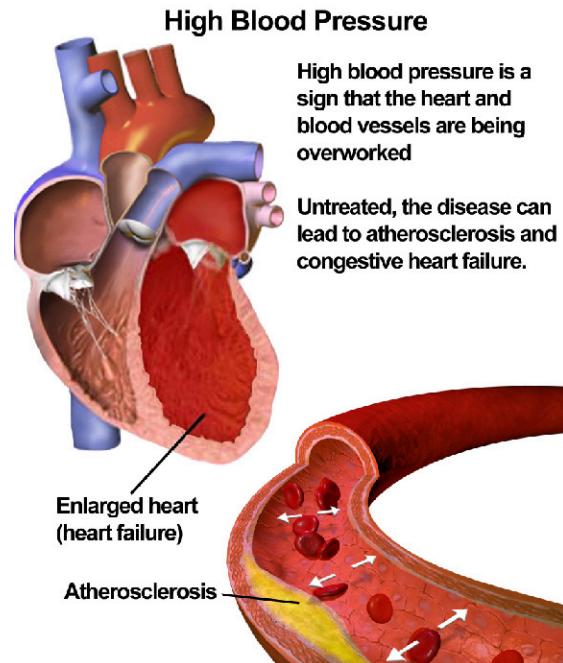
Cardiovascular heart disease indicates a decrease in the amount of blood, and therefore oxygen, available to the heart muscle (American Heart Association, 2017). CVD is often the result of narrowed cardiovascular arteries due to the buildup of cholesterol plaque or atherosclerosis. **Lipids**—LDL, HDL, and **triglycerides**—are components of cell membranes; they assist with energy movement and storage, production of hormones, and vitamin absorption. However, having too much LDL or triglycerides or too little HDL negatively impacts the body (Cleveland Clinic, 2022b). For this reason, a heart-healthy diet seeks to control high cholesterol (hyperlipidemia) (American Heart Association, 2020).

When clients have hyperlipidemia, consider what happens in their vascular system over time. As the buildup of cholesterol begins to form plaques, the vascular system becomes constricted or narrowed. This narrowing causes the heart to pump more forcefully to push blood throughout the cardiovascular system, resulting in hypertension and, potentially heart failure, if the cardiac muscle becomes fatigued. Additionally, when the plaque area leading to the cardiovascular arteries supplying blood and oxygen to the heart muscle continues to narrow until it eventually becomes too stenosed for blood to flow through it, a **myocardial infarction** will occur.

Optimally, individuals will adopt a heart-healthy diet early in life that minimizes hyperlipidemia. This eating style provides the nutrients needed to fuel the body while minimizing foods and food preparation styles that increase cholesterol levels. Heart-healthy diets reduce saturated and trans fat by limiting red meat and whole milk dairy products. Additionally, food is prepared by grilling or baking instead of by frying; healthy oils, such as olive oil, are used, when cooking. Heart-healthy diets focus on fruits, vegetables, poultry, fish—especially fish that contains omega-3 such as salmon (Medical News Today, 2021)—whole grains, and nuts. Sodium intake for clients on a healthy heart diet should be limited to 2300 mg/day (FDA, 2022b; American Heart Association, 2020).

## Hypertension

Hypertension, or high blood pressure is when the pressure needed to push blood throughout the body's circulation is consistently high and reads over 130/80 mm Hg (CDC, 2023a). The formation of plaques can cause constriction or narrowing of the arteries (Figure 12.4). If left untreated, hypertension can increase the risk for cardiovascular diseases. Heart healthy diets are designed to decrease cholesterol levels, decrease blood pressure, and reduce risk for developing congestive heart failure. In addition, hypertensive clients may also follow a low-sodium diet. One of the most effective diets to lower blood pressure is the DASH diet (Mayo Clinic, 2021). In addition to limiting the intake of sodium to 2300 mg/day, the DASH diet also includes foods high in potassium, calcium, and magnesium. The DASH diet encourages limiting saturated fats and sugars (Table 12.8).



**FIGURE 12.4** Atherosclerosis is a primary cause of hypertension. (credit: "Hypertension (High Blood Pressure)" by Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014"/Wikimedia Commons, CC BY 3.0)

Food Types	Serving Size	Recommended Foods
Grains	6–8 servings daily	1 slice of whole grain bread 1 oz of dry cereal ½ cup of cooked rice or pasta
Vegetables	4–5 servings daily	1 cup of raw leafy green vegetables ½ cup raw or cooked vegetables ½ cup vegetable juice
Fruits	4–5 servings daily	1 medium fruit ½ cup fresh frozen or canned fruit ½ cup fruit juice

**TABLE 12.8** DASH Diet Recommended Foods (source: Mayo Clinic, 2021)

Food Types	Serving Size	Recommended Foods
Low-fat/no-fat dairy	2–3 servings daily	1 cup milk or yogurt 1½ oz cheese
Lean meat/poultry/fish	6 servings daily	Each serving = 1 oz Cooked meat, poultry, fish, or egg
Fats/oils	2–3 servings daily	1 tsp butter substitute or vegetable oil 1 tbsp mayonnaise 2 tbsp salad dressing
Nuts, seeds, legumes	4–5 servings weekly	½ cup nuts 2 tbsp nut butter 2 tbsp seeds
Sweets/added sugars	5 or fewer servings weekly	1 tbsp sugar, jelly, or jam 1 cup sweetened lemonade or tea

**TABLE 12.8** DASH Diet Recommended Foods (source: Mayo Clinic, 2021)

### Holistic Assessment of Cultural Considerations

A holistic assessment of the client extends beyond a physical assessment and a nutritional assessment. The nurse should examine which individual characteristics, aspects of medical history, challenges to maintaining health, interest in wellness promotion and family, community, and cultural aspects impact the client's ability to develop and adhere to a nutritional plan designed to optimize cardiovascular function. For the cardiovascular client, the nurse should focus attention on providing education to decrease cholesterol levels and hypertension, while providing a nutrient-dense eating plan that fuels the body.

What are the client's personal characteristics related to food that may impact their ability to adhere to a healthy heart eating plan? For example, the nurse should consider if there are issues related to food enjoyment, food intolerances, and likes and dislikes of certain foods. The nurse can do the following to get a better picture of how to help the client achieve success in developing and adhering to a heart-healthy meal plan:

- Determine if the client likes to engage in the cooking process—plan, prepare, and cook meals—in lieu of eating ready-made processed meals.
- Consider aspects of the client's overall health history, paying specific attention to cardiovascular-related issues.
- Identify if there are long-term cardiovascular issues or if the issue is an acute exacerbation. If the medical issue is long-term, determine what issues in the past have helped or hindered the client to identify and maintain a heart-healthy diet. Incorporate pertinent family members into this assessment.

### SPECIAL CONSIDERATIONS

#### Risks for Heart Disease Vary by Ethnicity

The risk for heart disease varies across different ethnic groups. Black women are more likely to have a heart attack, whereas Black men are more likely to die from having a heart attack. Asian people typically have less coronary artery disease than other ethnic groups, although Asian Indian men and Filipino men and women do have a higher risk in comparison to White people. Hispanic women who are young and have a heart attack are at greater risk for dying than young Hispanic men, young Black adults, and young White adults. (Cleveland Clinic, 2023). In the United States, heart disease is the leading cause of death for people in most ethnic groups (CDC, 2023d).

Planning a heart-healthy menu using the cuisines of diverse cultures can improve adherence as well as provide variety. [Table 12.9](#) outlines different cultures and food choices that would be appropriate for heart health.

Culture	Healthy Food Choices
Mexican	<ul style="list-style-type: none"> <li>• Grilled shrimp, chicken, or fish</li> <li>• Black or pinto beans</li> <li>• Salsa, pico de gallo, cilantro, black olives, jalapeno peppers</li> <li>• Guacamole, fat-free sour cream</li> <li>• Onions, peppers, mushrooms, tomatoes</li> <li>• Whole grain brown rice, corn tortillas</li> </ul>
Asian (Chinese, Thai, Japanese)	<ul style="list-style-type: none"> <li>• Steamed rice</li> <li>• Vegetables such as bok choy, napa cabbage, bean sprouts, daikon, bamboo shoots, and watercress</li> <li>• Mung bean</li> <li>• Rice noodles</li> <li>• Low-sodium soy sauce, chili sauce, oyster sauce, and fish sauce</li> <li>• Curry paste</li> <li>• Curry such as Thai, Japanese, Chinese, or Malaysian curries</li> <li>• Lemongrass</li> <li>• Rice vinegar</li> <li>• Cilantro, mint, ginger, galangal, and green onion</li> <li>• Tofu and bean curd</li> <li>• Edamame</li> </ul>
Indian	<ul style="list-style-type: none"> <li>• Berries such as strawberries, blackberries, and blueberries</li> <li>• Avocado</li> <li>• Fish and fish oil</li> <li>• Whole grains such as whole wheat, barley, oats, millet, brown rice, and high fiber cereal</li> <li>• Legumes such as lentils, mung beans, and kidney beans</li> <li>• Seeds and nuts</li> <li>• Chia seeds</li> <li>• Spinach</li> <li>• Collard and mustard greens</li> <li>• Curry</li> </ul>
Italian	<ul style="list-style-type: none"> <li>• Chicken or turkey (grilled, or baked)</li> <li>• Low-fat ricotta cheese</li> <li>• Farro or whole grain rice</li> <li>• Tomatoes and bell peppers</li> <li>• Whole wheat pastas</li> <li>• Olive oil</li> <li>• Low-sodium marinara sauce</li> <li>• Grilled vegetables such as zucchini, eggplant, and radicchio</li> <li>• Mussels, octopus, squid</li> </ul>
Soul food/traditional southern cooking	<ul style="list-style-type: none"> <li>• Roasted vegetables such as okra and bell pepper</li> <li>• Berries and stone fruits</li> <li>• Baked chicken without skin</li> <li>• Baked sweet potato</li> <li>• Roasted turkey or pork</li> <li>• Brown rice</li> <li>• Cauliflower pasta</li> <li>• Collard, mustard, and turnip greens</li> </ul>

**TABLE 12.9** Culturally Appropriate Food Choices for a Heart Healthy Diet Among Cuisines Popular in the United States (sources: Cleveland Clinic, 2020a; Cleveland Clinic, 2020b; Patiala Heart Institute, 2023; Martin, 2023; WebMD, 2022; National Lipid Association, 2020)

## 12.3 Treatments and Nutrition

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 12.3.1 Identify drug-food interactions for their impact on treatments utilized for cardiovascular disorders.
- 12.3.2 Identify treatments and medications that can cause nutritional deficiencies in clients with cardiovascular disorders.

### Drug-Food Interactions with Treatments for Cardiovascular Disorders

Nurses should be aware of the drug and food interactions that can occur with cardiac medications. This section will discuss some of the most common.

#### Warfarin and Vitamin K

Warfarin keeps blood from coagulating too quickly and is used for treatment of venous thromboembolism and for stroke prevention for certain conditions like atrial fibrillation or mechanical heart valves. Vitamin K works to assist in coagulation. Warfarin and vitamin K work in opposite ways, so the client must be aware that their normal, daily consumption of vitamin K should be consistent. Women typically need about 90 mcg of vitamin K daily; men typically need about 120 mcg. Green, leafy vegetables, Brussels sprouts, broccoli, asparagus, and green tea are all high in vitamin K (Mayo Clinic, 2022b). The clients can eat leafy greens, but they need to eat them in a consistent amount. When a client's consumption of leafy greens fluctuates, it can cause fluctuations in the effects of warfarin.

#### Diuretics and Electrolytes

There are a variety of diuretics used for heart failure and a few for hypertension; the most common are the loop diuretics such as furosemide. Diuretic medications decrease the workload of the heart muscle and rid the body of excess fluid, which can cause fluctuations in electrolyte levels, particularly potassium. The nurse should assess the client for (and instruct the client to note signs of) hypokalemia—potassium levels less than 3.5 mEq/L. Symptoms of hypokalemia include constipation, muscle cramps, heart palpitations, and fatigue (Mayo Clinic, 2023a).

Although the loop diuretics are the most common diuretics that are associated with electrolyte imbalances, the clients who are taking other types of diuretics such as potassium-sparing diuretics need to be aware of the risk for hyperkalemia that can develop from the use of these medications (Knott, 2020). Hyperkalemia, or elevated potassium levels, can cause muscle fatigue, paralysis, arrhythmias, and nausea.

Since diuretics help the body to get rid of excess water, there is a risk that sodium—also an electrolyte—can be reduced too much and cause hyponatremia. The nurse should inform clients of signs and symptoms of hyponatremia: nausea and vomiting, weakness, and changes in level of consciousness; extremely low levels of sodium can cause seizures (Sterns, 2022).

### Treatments and Medications That Can Cause Nutritional Deficiencies

Clients with cardiovascular disease frequently take one or more prescribed medications that can potentially cause nutritional deficiencies. Diuretics, for example, are used by clients with hypertension, heart-failure, and other cardiac-related conditions. Deficiencies of water-soluble vitamins are related to the use of diuretic therapy which causes increased excretion of these nutrients (Lennie et al., 2018). Other cardiovascular medications associated with nutrient deficiencies include statin medications used to treat hyperlipidemia. Studies have shown that levels of serum CoQ10, important for converting food into energy, decrease with the use of atorvastatin and similar medications (Chong et al., 2021).

Traditionally, sodium has been the focus of research examining the role of nutrition in the management of heart failure (Lennie et al., 2018). However, recent research has expanded the search for nutritional factors that influence the management of clients with heart failure and other cardiovascular diseases. Researchers have found that clients with heart failure frequently experience calcium, folate, magnesium, zinc, and vitamins C, D, E, and K deficiencies (Lennie et al., 2018). These deficiencies can be related not only to medication use, but also other factors. Another related factor to nutritional deficiencies among clients with heart failure is the lack of diet variety (Lennie et al., 2018). These clients frequently experience loss of appetite, feel full after eating only a small amount, and have limited energy to prepare and eat food. They are more likely to eat the same foods repeatedly, limiting their potential to consume a variety of needed nutrients (Lennie et al., 2018).



## UNFOLDING CASE STUDY

### Part E

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up from Case Study Parts A, B, C, and D.

Recently, Tara has noticed her legs are swelling and she has experienced some shortness of breath with activity, so she schedules an appointment with her primary care provider.

At Tara's appointment, her provider takes her vital signs and finds her blood pressure is 165/85 mm Hg and her heart rate is 72 beats per minute. She is experiencing crackles in the base of her lungs and 2+ pitting edema to bilateral lower extremities.

The provider is concerned that Tara has developed heart failure and wants the nurse to educate Tara on healthy food choices. The provider places Tara on the diuretic furosemide to decrease Tara's swelling and a potassium supplement. The provider orders laboratory work that includes a comprehensive metabolic panel and B-type natriuretic peptide.

9. The nurse is educating Tara on nutritional considerations related to her condition. Which education statement would be appropriate for the nurse to tell Tara?
  - a. "You need to increase your intake of potassium-rich foods."
  - b. "You need to increase the amount of sodium in your diet."
  - c. "You need to identify a small list of foods that you can easily prepare and eat several times a week."
  - d. "You may need a vitamin supplement if you are unable to eat a variety of foods."
  
10. The nurse is giving Tara an example of a healthy meal for her heart. Which meal would be the most appropriate for the nurse to share with Tara?
  - a. Fried chicken, green beans, and tea
  - b. Grilled fish, steamed vegetables, and water
  - c. Hamburger, chips, and water
  - d. Baked chicken, rice, and white roll

## Chapter Summary

- Proper nutrition is essential for maintaining a healthy heart through the lifespan and is important for overall health.
- Physical activity, at least 150 min weekly, is an important aspect of all stages of life.
- As a person ages, it is important to have routine checkups which include monitoring cholesterol, triglycerides, and blood pressure.
- Childhood dietary habits can impact adult health, so it is important to establish habits like eating whole grains, vegetables and fruits, utilizing low-fat or non-fat dairy foods, and selecting fish and lean meats, as well as avoiding or minimizing processed foods and high-sugar foods and drinks.
- Older adulthood diseases can affect heart health.

## Key Terms

**angina** chest pain caused by inadequate blood supply to the heart

**atherosclerosis** plaque buildup within the vascular system

**dyspnea** difficult or labored breathing

**heart failure** inability of heart to pump blood effectively to keep up with body demands

**hyperlipidemia** excess of lipids or fats in the blood

**hypertension** consistent blood pressure readings above 130/80

**lipids** fatty acids insoluble in water; lipids in the blood are LDL, HDL, and triglycerides

**myocardial infarction** death of heart muscle due to lack of blood flow and oxygen

**near syncope** feeling of loss of consciousness

**plaque** fatty deposits of cholesterol on inner lining of artery

**stenosis** narrowing and hardening in diameter

**stroke** loss of oxygen to cerebral tissue

**syncope** loss of consciousness for a short period of time

**transient ischemic attack (TIA)** temporary loss of oxygen to cerebral tissue without permanent damage

**triglycerides** fatty substance circulating in the cardiovascular system

**uteroplacental** transfer of oxygen and nutrients from client to fetus through umbilical cord and placenta

## Review Questions

1. A client who has a pre-existing heart condition consults her provider to plan for her next pregnancy. Which statement would the provider need to include in the teaching for a client who has a normal BMI?
  - a. "You are able to gain as much weight as you need."
  - b. "You need to increase your caloric intake by 340 calories daily in the second trimester."
  - c. "You need to drink whole milk to help the fetus's bones develop."
  - d. "You need to refrain from exercising."
2. When educating a new client about nutrition for their child to promote heart health, which statement should be included?
  - a. "Use only breast milk for the first 6 months of life."
  - b. "At six months, pureed vegetables can be added to the infant's diet."
  - c. "You can give your infant 100% fruit juice."
  - d. "Healthy eating habits cannot start until later."
3. When teaching a client about healthy snack choices for their child to promote heart health, which snack choice would be the most appropriate?
  - a. Fruit flavored snacks
  - b. Whole milk
  - c. Banana
  - d. Ice cream
4. For a client who is following a heart healthy diet, what is the recommended sodium intake?
  - a. < 1500 mg/day
  - b. < 2300 mg/day
  - c. < 3000 mg/day

- d. < 4000 g/day
5. Which factor can influence teenagers' nutritional intake but may not have as strong an influence in other age groups?
- a. Social media
  - b. Parental guidance
  - c. Income level
  - d. Availability of food
6. A teenager comes to the clinic with her parents for concerns about eating disorders. Which long-term complication is associated with eating disorders?
- a. Aortic stenosis
  - b. Diverticulitis
  - c. Hypokalemia and hyponatremia
  - d. Rheumatoid arthritis
7. A nurse is providing education to a client with a total cholesterol of 240 mg/dL. Which of the following diet strategies needs to be included?
- a. Continue to consume 5–7 alcoholic beverages each week
  - b. Decrease intake of red meat and full-fat dairy products
  - c. Decrease intake of oatmeal, lentils, and other sources of fiber
  - d. Continue the current diet plan—this cholesterol level is within the accepted range
8. Which of the following would be an example of a DASH diet meal?
- a. Sliced ham, canned corn, and a cup of milk
  - b. Fried eggs, bacon, and coffee
  - c. Grilled shrimp with whole grain rice and mixed vegetables
  - d. Oatmeal, sausage, and apple juice
9. A client is taking warfarin for a valve replacement. Which food should the nurse include in the teaching that the client should consistently consume?
- a. Asparagus
  - b. Potatoes
  - c. Water
  - d. Protein
10. The nurse is educating a client on how to eat heart healthy. The client tells the nurse that their typical meal consists of traditional Mexican foods. Which meal chosen would indicate the client understands the instruction?
- a. Beef enchilada with cheese sauce and refried beans
  - b. Nachos covered with grilled chicken, cheese, sour cream, and lettuce
  - c. Quesadilla with fried shrimp, black beans, and pico de gallo
  - d. Grilled chicken, onions, green peppers, and avocado with corn tortillas

## Suggested Reading

National Heart, Lung, and Blood Institute. (2022, March 24). *Choose Heart-Healthy Foods*.  
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## CHAPTER 13

# Applying Clinical Judgment to Promote Nutrition for Pulmonary Wellness



**FIGURE 13.1** Selection, portion, and balance of food choices leverage nutrition as a modifiable risk factor to improve pulmonary health.  
(credit: modification of work "Cheese, wine and bread in Cafe Vavin, 18 Rue Vavin, 75006 Paris" by Joe deSousa/Wikimedia Commons, CC0 1.0)

## CHAPTER OUTLINE

- 13.1 Assess and Analyze the Impact of Nutrition on the Pulmonary System
- 13.2 Plan Nutritional Strategies to Impact Pulmonary Wellness
- 13.3 Implement Nutritional Strategies to Impact Pulmonary Wellness
- 13.4 Evaluate Nutritional Strategies to Impact Pulmonary Wellness

**INTRODUCTION** The pulmonary system is a set of organs that, in conjunction with the cardiovascular system, provide life to the rest of the body through oxygenation. Numerous nutritional factors support, or prevent, full function of the pulmonary system. When the pulmonary system is impaired by acute disease (cold, flu, pneumonia, etc.) or chronic conditions (chronic obstructive pulmonary disease [COPD], asthma, cystic fibrosis, etc.), nutritional support and considerations assist clients in healing. Additionally, obesity and chronic inflammation increase risks for and worsen outcomes in lung disease through altered surfactant function, impaired vascular homeostasis, and increased susceptibility to acute injury (Kokoszynska et al., 2021). Nurses' understanding of nutrition and their ability to apply the nursing process creates nutritional impact for optimal client health.

Consider this case: Katrice is an 11-year-old Black female who is overweight but active in school activities and sports. Her past medical history includes seasonal allergies and diagnosis of asthma 1 year ago. Family history includes three older siblings with seasonal and food allergies, eczema, and asthma. Her parents report “trying to ensure a healthy diet” despite the need to eat prepared meals and fast food frequently because of the family’s busy

schedule. They present today for an asthma follow-up appointment for Katrice.

## 13.1 Assess and Analyze the Impact of Nutrition on the Pulmonary System

### LEARNING OUTCOMES

By the end of this section, you should be able to:

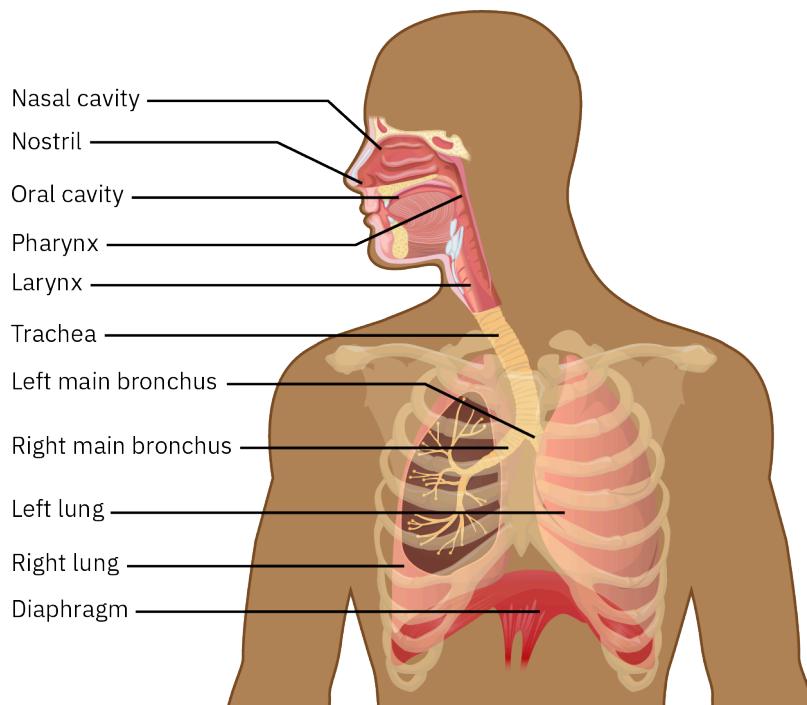
- 13.1.1 Describe the normal function of the pulmonary system.
- 13.1.2 Identify cues of nutritional impact on the pulmonary system.
- 13.1.3 Analyze cues of nutritional impact on the pulmonary system.

Development of the pulmonary system spans from its initiation in the first trimester of pregnancy through to early adulthood (Ariglani et al., 2018). To assess and analyze the impact of nutrition on the pulmonary system, the nurse must understand the system's normal function. The pulmonary or respiratory system comprises the upper and lower **airways** (passageways through which air moves), along with the lungs and alveolar sacs. The primary function of the pulmonary system is to ensure adequate oxygenation throughout the body. This occurs with **gas exchange**, which involves transporting oxygen to the cells and transporting carbon dioxide away from the cells. This process happens through ventilation, diffusion, and perfusion. **Ventilation** is the movement of atmospheric air that is higher in oxygen into the lungs and the removal of carbon dioxide. Ventilation is the number-one function of the respiratory system.

**Respiratory diffusion** occurs when gases move down the concentration gradient across the alveolar sacs and capillaries. **Perfusion** is the process of the arterial blood moving through the tissue to the entire body. Adequate gas exchange is essential for all systems of the body. If the pulmonary system is inadequate, total health and well-being can be affected (Norris, 2019).

### Normal Function of the Pulmonary System

The normal function of the pulmonary system is best understood when divided into the upper and lower respiratory tract. The respiratory system plays a significant role in ensuring all body systems adequately receive gas exchange for tissue perfusion ([Figure 13.2](#)).



**FIGURE 13.2** The major respiratory structures span from the nasal cavity to the diaphragm. (credit: modification of work from *Anatomy and Physiology* 2e. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Upper Respiratory Tract

The upper respiratory system is responsible for inhalation and exhalation and also influences speech and the sense of smell. The upper respiratory tract is comprised of the:

- Nose—responsible for smell, which occurs via receptors from the olfactory nerve located in the upper areas of the nose
- Sinuses—give a fullness to speech and act as shock absorbers if facial trauma occurs
- Pharynx (throat)—a passageway for the respiratory and digestive tracts
- Larynx (voice box)—houses the vocal cords, which are responsible for speech

### Lower Respiratory Tract

The lower respiratory tract is comprised of the airways, lungs, and accessory muscles of respiration. The lower respiratory system is responsible for gas exchange and perfusion.

The lower respiratory tract consists of the trachea, bronchi, bronchioles, alveolar ducts, and alveoli. Gases move to and from the lungs through the airways. The airways only allow for movement of gases, not gas exchange, because the airways are too thick to allow for diffusion. The actual respiratory gas exchange occurs in alveolar sacs that arise from the ducts and contain groups of alveoli. **Surfactant** is a fatty protein that lines the alveoli and reduces surface tension. Without surfactant, **atelectasis**, which is the collapse of the alveolar, will occur and gas exchange cannot happen, because the collapse causes a reduction of the alveolar area.

The lower airways consist of two elastic lungs located in the pleural cavity of the chest. The two lungs are not equal in size or gas exchange. The right lung is larger and consists of three lobes; the left lung has two lobes. Most of the function (55–60%) occurs in the right lung. If the client's right lung is compromised, it will interfere with gas exchange and perfusion to a greater extent than a compromised left lung.

Respirations occur when changes in size of and pressure within the chest cavity take place. The diaphragm and chest muscles contract and relax to cause these changes. When the work of breathing is increased, back and abdominal muscles may be used in addition to chest muscles. When back and abdominal muscles are used, the client is said to be using accessory muscles to breathe.

Humans breath in and out approximately 22,000 times a day (Canadian Lung Association, n.d.). While environmental or contaminant factors impact pulmonary function, a natural degradation of function over time also occurs. The following Special Considerations box describes respiratory changes that occur with aging. Respiratory changes in older adults can be related to normal aging or respiratory disease. Age-related changes in the muscles and the cardiovascular system may also cause abnormal respirations (Schneider et al., 2021).

## SPECIAL CONSIDERATIONS

### Age-Related Changes in the Respiratory System

As individuals age, changes to the musculoskeletal, vascular, and respiratory systems that alter function and may require nursing interventions, as outlined in [Table 13.1](#).

Changes	Nursing Implications
<ul style="list-style-type: none"> <li>• Alveolar surface area decreases.</li> <li>• Diffusion capacity decreases.</li> <li>• Elastic recoil decreases.</li> <li>• Bronchioles calcify and become rigid.</li> <li>• Alveolar ducts dilate.</li> <li>• Ability to cough decreases.</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage vigorous pulmonary hygiene (i.e., client to turn, cough, and deep breathe) and use of incentive spirometry, especially if the client is confined to bed or has had surgery, to reduce the risk for infectious respiratory or mechanical complications.</li> <li>• Encourage upright position to minimize ventilation-perfusion mismatching; slumped and supine positioning allows the abdomen to compress the diaphragm and may limit full lung expansion.</li> </ul>
<ul style="list-style-type: none"> <li>• Residual volume increases.</li> <li>• Vital capacity decreases.</li> <li>• Efficiency of oxygen and carbon dioxide exchange decreases.</li> <li>• Elasticity decreases.</li> </ul>	<ul style="list-style-type: none"> <li>• Include inspection, palpation, percussion, and auscultation in lung assessments to detect normal age-related changes.</li> <li>• Assess client's respirations for abnormal breathing patterns; Cheyne-Stokes respiration may occur in older adults without pathology.</li> <li>• Encourage frequent oral hygiene to aid in the removal of secretions.</li> <li>• Help the client actively maintain health and fitness to keep losses in respiratory functioning to a minimum.</li> </ul>
<ul style="list-style-type: none"> <li>• Muscles atrophy.</li> <li>• Laryngeal muscles lose elasticity.</li> <li>• Vascular resistance in the pulmonary system increases.</li> <li>• Pulmonary capillary blood volume decreases.</li> <li>• Risk for hypoxia increases.</li> </ul>	<ul style="list-style-type: none"> <li>• Have face-to-face conversations with the client when possible because the client's voice may be soft and difficult to understand.</li> <li>• Assess a client's level of consciousness and cognition, because hypoxia from acute respiratory conditions can cause the client to become confused.</li> </ul>
<ul style="list-style-type: none"> <li>• The body's compensatory measures to avoid hypoxia and hypercarbia decrease.</li> <li>• Respiratory muscle strength, especially in the diaphragm and intercostals, decreases.</li> </ul>	<ul style="list-style-type: none"> <li>• Assess subtle manifestations of hypoxia to prevent complications.</li> <li>• Encourage pulmonary hygiene and help clients actively maintain health and fitness to promote maximal respiratory system functioning and prevent respiratory illnesses.</li> </ul>

**TABLE 13.1** Expected Changes in Respiratory Symptoms for Older Clients (sources: Dezube, R., 2023; Schneider et al., 2021; Sun et al., 2021)

Changes	Nursing Implications
<ul style="list-style-type: none"> <li>Effectiveness of the cilia decreases.</li> <li>Alveolar macrophages are altered.</li> <li>Immunoglobulin A decreases.</li> </ul>	<ul style="list-style-type: none"> <li>Encourage pulmonary hygiene and help clients actively maintain health and fitness to promote maximal functioning of the respiratory system and prevent respiratory illnesses.</li> </ul>
<ul style="list-style-type: none"> <li>Anteroposterior diameter increases.</li> <li>Progressive kyphoscoliosis occurs.</li> <li>Chest wall compliance (elasticity) decreases.</li> <li>Mobility of chest wall may decrease.</li> </ul>	<ul style="list-style-type: none"> <li>Discuss the normal changes of aging to help reduce anxiety about symptoms.</li> <li>Discuss the need for increased rest periods during exercise, because exercise tolerance decreases with age.</li> <li>Osteoporosis is possible, leading to chest wall abnormalities.</li> <li>Encourage adequate calcium and vitamin D intake (especially during a client's premenopausal phase) to help prevent or reduce later osteoporosis.</li> </ul>

**TABLE 13.1** Expected Changes in Respiratory Symptoms for Older Clients (sources: Dezube, R., 2023; Schneider et al., 2021; Sun et al., 2021)

## Assessment of Nutrition and the Function of the Pulmonary System

The nurse should complete an accurate assessment of the pulmonary system to identify the type and severity of breathing problems that may interfere with gas exchange and be positively impacted by nutritional support. This assessment should include a nutritional history and habits, fluid assessment, and barriers to nutritional goals. This assessment will provide cues to direct the client's care and enable optimal nutritional intake.

### Client History

Accurate client information is important to identify how food intake may interfere with pulmonary function. The nurse should be aware that age, gender, and race may affect nutritional needs and risks related to the respiratory system. The client history should include allergies (food and environment), dietary habits, special dietary needs and food sensitivities, food access and/or insecurity, smoking (tobacco and vaping), alcohol, illegal drug use (particularly inhaled substances), travel and environmental exposures, and residential conditions. The history should specifically include:

- Allergies**—Include documentation of food, dust, pollen, bee stings, and medications. Document the onset of allergy and the specific allergic response, such as wheezing, difficulty breathing, cough, rhinitis, hives, swollen lips, or anaphylaxis. If the client identifies allergies, inquire as to number of prior reactions, treatments utilized, response to treatment, hospitalizations, and if the client has been prescribed and/or carries epinephrine. Food allergies are a risk factor for asthma along with asthma morbidity (daytime symptoms, increased rescue therapy, hospitalization, ventilator use, unplanned health care utilization) and mortality (Sherenian et al., 2018).
- Dietary habits**—Assess initially with a 24-hour food recall, in which a client reports all their food and fluid intake on the last day ([Figure 13.3](#)). The 24-hour recall is used most often in dietary surveys and has been adapted and validated for use by adolescents and adults, as well as by adults in reporting their child's intake (Arsenault et al., 2020). While not completely accurate for micronutrient evaluation, the 24-hour food recall can be reviewed and discussed to determine if the reported food intake is typical for the client's normal routine. For example, if a client typically skips breakfast, eats mostly processed foods or fast food, drinks sugary beverages, and/or eats high-sodium food such as packaged and processed items, this information will assist the nurse in identifying areas for nutrition education.
- Special dietary needs**—Include specific dietary preferences, religious requirements, or medically indicated restrictions, such as gluten free, diabetic diet, low salt, avoidance of tree nuts or peanuts, kosher, halal, or pork free. Dietary restrictions may put clients at increased risk for nutrient deficiency (vitamin E, magnesium, sodium, potassium, and calcium), resulting in increased presence of respiratory symptoms such as wheezing and airway hyperreactivity (Sherenian et al., 2018).
- Social determinants of health (SDOH)**—Include conditions in the home, school, work, place of worship, and

social environments that affect health, quality of life, and risks for illness (Office of Disease Prevention and Health Promotion [ODPHP], 2020). Economic and social conditions may limit or create uncertain access to adequate food, known as food insecurity. Restrictions may result from insufficient monetary resources, social support (for example, lack of school lunch during school breaks), or shortage of full-service supermarkets. Food insecurity is associated with increased obesity, asthma, COPD, and cancer(ODPHP, 2020).

- **Smoking**—Include status as a current smoker, having ever smoked, the age when the client started, and the number of cigarettes smoked daily. This should be recorded as **pack-years**, calculated as the number of packs smoked per day multiplied by number of years smoked. The nurse should also assess for use of chewing tobacco, hookah smoking, and vaping, including the product the client uses, such as nicotine or tetrahydrocannabinol (THC). For pediatric clients, any exposure to smokers should document relationship, frequency, location (home, car, or other) and duration of smoke exposure. According to the CDC (2022a), smoking is the leading cause of preventable death and is associated with increased risk for asthma, COPD, and immune-system damage or dysfunction. It is the primary cause of lung cancer, with 9 out of 10 lung cancer deaths caused by smoking or secondhand smoke exposure.
- **Alcohol intake**—Include the number of drinks in a single event in a day and the cumulative total per week. The Centers for Disease Control (CDC) (2022b) recommends that women have no more than 1 drink per day and that men have no more than 2 drinks per day; they further define binge drinking as consumption of 4 or more drinks during a single event for women and 5 or more during a single event for men. Alcohol use disorder affects the respiratory system and increases the incidence and associated risks of asthma, COPD, lung infection, aspiration pneumonia, and acute respiratory distress syndrome (ARDS) (Arvers, 2018).
- **Illegal drug use**—Include questions regarding any substance the client inhales, snorts, chews (edibles), or injects. This includes paint, markers, bleach, cleaning supplies, marijuana, cocaine, opioids (heroin and fentanyl), methamphetamines, gamma-hydroxybutyric acid (GHB), hallucinogens (ketamine, LSD, PCP, magic mushrooms), MDMA (ecstasy and Molly), and flunitrazepam (Rohypnol). Impact of drug use on the respiratory system involves respiratory sedation, risk of respiratory arrest, and immune-system suppression, increasing the potential for respiratory infections (Plein & Rittner, 2018).
- **Prescription medications**—Document the medication name, dose, frequency, and compliance; this will include medications taken for breathing problems and all other conditions. The nurse should be aware that clients may need prompting for the inclusion of medical cannabis in their medication list, as the number of states allowing for medical prescribing is increasing. Also assess the use of over-the-counter medications and herbal remedies. Certain medications may affect the respiratory system. For example, angiotensin-converting enzyme (ACE) inhibitors to treat hypertension may cause a dry nighttime cough. Aspirin and other nonsteroidal anti-inflammatory drugs (NSAIDs) induce bronchospasm and should be avoided in clients with a history of sensitivity to these medications.
- **Travel, geographic location, and environmental exposure**—Assess to reveal exposure to diseases and pathogens found in certain areas that increase the risk for infection. Environmental exposures such as forest fires, pollution (often more common in lower socioeconomic or dense urban areas), gasoline fumes, or aerosolized chemicals (i.e., chlorine) increase upper and lower respiratory tract irritation and may worsen chronic respiratory conditions (Lee et al., 2021). Residential conditions influence the health of individuals; for example, substandard housing materials and overcrowding, along with biologic (molds, mites, roaches), chemical (lead, carbon monoxide), and physical (temperature, fine particles) hazards lead to respiratory disease (OASH, 2020). The nurse should document type of housing (single-family home, apartment, mobile home), setting (rural, suburban, urban), number of occupants, number of bedrooms, and any hazards or contributors to disease.

### Food Diary

Use this food diary to record what you have to eat and drink each day.

Meal	Food and Drinks	Amount	Preparation Method
Breakfast			
Morning snack			
Lunch			
Afternoon snack			
Dinner			
Evening Snack			
Notes			

**FIGURE 13.3** A 24-hour food diary provides clues about nutrients and how they may be impacting wellness. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)



### CLINICAL TIP

#### Allergies

The nurse should document any known allergies, especially to medications. The specific type of response the client experienced and what was done to correct it should be documented in a prominent place in the client's medical record.

When conducting an assessment, the nurse should obtain a family history of respiratory disorders. This provides information regarding diseases that have genetic components, such as cystic fibrosis or emphysema. A family medical history of allergies is often present in clients with asthma. The nurse should ask about infectious diseases such as tuberculosis, because families have similar environmental exposures.

A client's complete medical history including current conditions and diagnoses that impact the client's health should be documented. In addition, the primary complaint or reason for the current health intervention (office visit or hospitalization) is necessary; this is often collected using the acronym OLD CARTS, referring to:

- Onset
- Location
- Duration
- Character
- Associated symptoms or aggravating factors
- Relieving factors
- Timing
- Severity or scale

In pulmonary diagnoses, primary concerns may include cough, wheezing, chest tightness, or shortness of breath. Examples include:

- Cough—A potential sign of lung disease. Questions that the nurse might ask include: Is it the same, better, or worse than when it started? Is the cough dry or does it produce sputum? Does anyone else you spend time with have a cough?
- Sputum—A large cue in the respiratory assessment. The nurse should note the color, consistency, and amount. The nurse should also ask about a time of day when coughing is more prevalent (in the morning, during or after meals, etc.). Sputum can indicate infection, pulmonary edema, or cancer.

- Wheezing—A sign of airway restriction. Does it occur with exercise or activity, or also at rest? Do you hear it while breathing in, breathing out, or both?
- Shortness of breath—May indicate different types of lung problems. The nurse should note **dyspnea**, difficulty breathing, or breathlessness. Another factor that should be determined is **orthopnea**, shortness of breath that occurs when lying down and is relieved by sitting up. These findings often occur with chronic lung disease.

To assess further, the nurse should ask if the complaint or problem has ever occurred before, if there are known triggers, and what treatments have been used to make it better (Dezube, 2023).

A client history provides awareness of risks and conditions that may shape nutritional interventions. This could include:

- Childhood illnesses—asthma, pneumonia, communicable diseases, hay fever, allergies, eczema, frequent colds, croup, and cystic fibrosis
- Adult illnesses—pneumonia, sinusitis, tuberculosis, HIV/AIDS, COPD, emphysema, sarcoidosis, obesity, obstructive sleep apnea, diabetes, hypertension, heart disease, influenza, and COVID-19
- Vaccinations—pneumococcal vaccine (PCV 13, PCV 15, and PPSV 23) influenza vaccine, COVID-19 vaccine, and bacille Calmette-Guérin (BCG) vaccine
- Past surgical history—surgeries of the upper or lower respiratory tract
- Injuries, hospitalizations, and tests—injuries to the upper or lower respiratory tract, hospitalizations related to pulmonary conditions, and dates of last chest x-ray, pulmonary function test, tuberculin test, or other diagnostic tests and their results
- Indications of infectious disease (tuberculosis)—recent weight loss, night sweats, sleep disturbances
- Travel, occupation, hobbies, and social history—geographic areas of risk for infection or pollutants, occupational hazards (aerosols or chemicals), tobacco, vaping, or other inhalants (Dezube, 2023)



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

In this visit with Katrice and her parents, the health care team wants to collect a complete client history including Katrice's medical and social history, family history, and current asthma symptoms. Katrice reports utilizing her asthma inhaler before exercise but has rarely needed the inhaler outside of exercise. They deny audible wheezing, nighttime cough, or asthma attacks that have required hospitalization. They are pleased overall with her asthma control. The provider notices on exam that Katrice's body mass index (BMI) has increased since her last visit, taking her from overweight to obese.

1. Which statement indicates Katrice and her parents understand the normal function of the pulmonary system?
  - a. "It's ok if I wheeze every day; as long as I use the inhaler, my lung function will stay the same for my whole life."
  - b. "The pulmonary system goes from my mouth through to the bottom of my lungs; it's how my body gets oxygen."
  - c. "Wheezing is a sign that my airways have expanded too much, and air is moving through them too fast."
  - d. "Secondhand smoke doesn't affect the lung tissue."
2. What additional history information would signal the need for additional intervention by the nurse?
  - a. The family of five living in a four-bedroom single-family home
  - b. Wearing masks and playing inside when visiting family who live near a factory in a high-pollution area
  - c. Wheezing sometimes associated with taking NSAIDS before exercise
  - d. Having grandma smoke outside, away from the house, and covering her clothing with a "smoking jacket"

### Physical Assessment

Physical assessment begins with vital signs. Blood pressure, heart rate, respiratory rate, pulse oximetry, height,

weight, and BMI provide foundational information regarding respiratory effort, cardiovascular workload, oxygenation, and nutritional status (underweight or overweight). The respiratory tract exam should include the nose and sinuses; pharynx, trachea, and larynx; and lungs and thorax. Pulmonary assessment should include:

- Skin for color (cyanosis), pallor, and nail clubbing. These signs may indicate poor oxygenation from respiratory disorders.
- Visual inspection of the nose and sinuses for deformities, swelling, lesions, pain to palpation, and the presence of drainage or bleeding.
- Visual inspection of the mouth and throat. The health care provider should note the size and condition of the tonsils, erythema, postnasal drainage, symmetry of the neck, shape and size of the lymph nodes, and position of the trachea. Specific measures that may be documented are **Mallampati score** (an airway assessment scale to classify the visibility of the oropharyngeal structures) and neck circumference, both of which contribute to evaluation for obstructive sleep apnea. A specialist should examine the larynx if continued hoarseness is noted.
- Inspection, palpation, percussion, and auscultation of the lungs and thorax.



### CLINICAL TIP

#### Assessing Airway Sounds

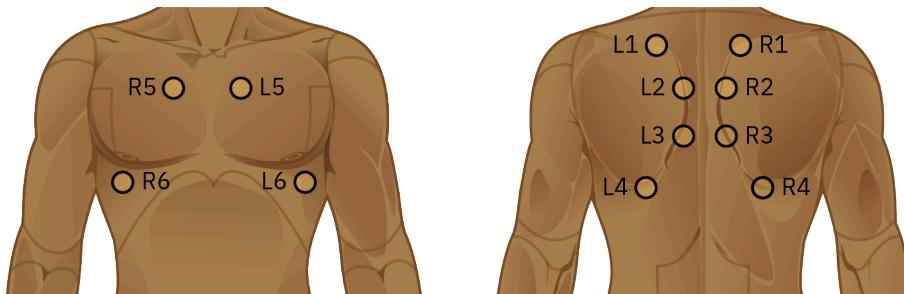
If the client is having difficulty breathing with secretions present in the upper airway, respirations would be loud and gurgling. Secretions may be present due to infection, allergies, or other issues. The nurse should instruct the client to clear their throat before proceeding with the assessment.

With inspection of the thorax, the nurse should visually observe the rate, rhythm, depth of inspiration, and symmetry of the chest. The adult respiratory rate at rest is 12–16 breaths per minute (Dezube, 2023). The nurse should also note the type of breathing, intercostal retractions, and the use of accessory muscles. Also, the nurse should observe the comparison of lateral or transverse diameter to anteroposterior diameter; the normal ratio is 2:1. These cues indicate lung disease such as COPD and advanced aging.

With palpation, the nurse should examine by touch and note for any abnormalities found, such as tenderness or swelling. The nurse might note **crepitus** (air trapped in and under the skin), which is typically felt as crackling. This should be reported to the health care provider. The nurse should also note **fremitus** (a vibration in the chest wall as the client speaks) during palpation.

**Percussion** is systematic tapping over the intercostal spaces, moving through the anterior, lateral, and posterior thorax. With percussion, the presence of abnormal fluid or air in the lungs may be detected, as noted by different sounds. Resonance is expected over lung areas; hyperresonance, dullness, or flat sounds may indicate concerning respiratory findings (Dezube, 2023).

With **auscultation**, the nurse should listen with a stethoscope for normal breath sounds, abnormal sounds, and voice sounds. These sounds provide information about the flow of air through the lungs and trachea, which help to identify fluid, mucus, or obstruction in the respiratory system (Dezube, 2023). [Figure 13.4](#) shows the proper sequence for auscultation. The nurse should begin at the apex of the lung, moving from side to side in a systematic approach ending at the lung bases.



**FIGURE 13.4** Auscultation should be done posterior and anterior. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)



## AUSCULTATING LUNGS

[Access multimedia content \(<https://openstax.org/books/nutrition/pages/13-1-assess-and-analyze-the-impact-of-nutrition-on-the-pulmonary-system>\)](https://openstax.org/books/nutrition/pages/13-1-assess-and-analyze-the-impact-of-nutrition-on-the-pulmonary-system)

The proper way to auscultate lungs, including the correct locations, can be seen in this video. This is of great importance to ensure that respiratory issues will not be missed and will be effectively monitored throughout the course of disease.

### Psychosocial Assessment

A psychosocial assessment is important to determine how the client is coping with respiratory distress, either acute or chronic. The client's emotions and responses may be based on concerns for normalcy, fitting in, bullying, cost of medications and health care, missed time from work or school, access to and cost of proper nutrition, safety, and support systems. In addition, the physical manifestations of disease may cause psychosocial symptom manifestation. A client with a high fever may be disoriented, a client with COPD may be depressed due to lack of cure, or a client with breathing difficulty may have anxiety caused by the sensation of not getting enough air.

The nurse should encourage clients to express their feelings and fears, allowing the health care provider to address their anxiety, depression, stress, or other concerns. The nurse should discuss coping mechanisms to enable the client to better handle the emotions and promote optimum disease and symptom management. The nurse may educate the client on coping mechanisms such as deep breathing, relaxation, and other techniques that decrease anxiety. Referrals to social, financial, educational, occupational, or mental health resources may be appropriate.

### Diagnostic Assessment

The diagnostic assessment should include a laboratory assessment, imaging, and other noninvasive diagnostic tests. The laboratory assessment may include blood studies and arterial blood gases. Arterial blood gases are the best way to determine adequate oxygenation in hospitalized or unstable clients. An initial evaluation of albumin may indicate concern for dehydration or malnutrition. Prealbumin provides a valid evaluation of protein–calorie malnutrition. The example laboratory profile in [Table 13.2](#) shows normal ranges and possible reasons for abnormal ranges.

Test	Normal Ranges (SI Units)	Significance of Changes from Normal
<b>Complete Blood Count</b>		
Red blood cells	• $4.2\text{--}5.9 \times 10^{12}$ cells/L	<ul style="list-style-type: none"> <li>Elevated levels (polycythemia): excessive production of erythropoietin in response to a chronic hypoxic state</li> <li>Decreased levels: possible anemia, hemorrhage, or hemolysis</li> </ul>
Hemoglobin, total	<ul style="list-style-type: none"> <li>Females: 120–160g/dL (12–16 g/dL conventional units)</li> <li>Males: 140–170 g/dL (14–17 g/dL conventional units)</li> </ul>	<ul style="list-style-type: none"> <li>Same as for red blood cells</li> <li>Based on hemoglobin and hematocrit levels, follow-up labs may include serum ferritin, iron, folate, and B<sub>12</sub></li> </ul>
Hematocrit	<ul style="list-style-type: none"> <li>Females: 37–47% (conventional units)</li> <li>Males: 41–51% (conventional units)</li> </ul>	<ul style="list-style-type: none"> <li>Same as for red blood cells</li> <li>Based on hemoglobin and hematocrit levels, follow-up labs may include serum ferritin, iron, folate, and B<sub>12</sub></li> </ul>

**TABLE 13.2** Pulmonary Laboratory Assessment Indications of Nutritional Concerns (sources: Castro et al., 2022; Padilla & Abadie, 2022; Pagana & Pagana, 2018)

Test	Normal Ranges (SI Units)	Significance of Changes from Normal
WBC count (leukocyte count, WBC count)	<ul style="list-style-type: none"> <li>Total: <math>4.5\text{--}11 \times 10^9</math> cells/L</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: possible acute infection or inflammation</li> <li>Decreased levels: an overwhelming infection, an autoimmune disorder, or immunosuppressant therapy</li> </ul>
<b>Differential White Blood Cell (Leukocyte) Count</b>		
Neutrophils	<ul style="list-style-type: none"> <li><math>2.6\text{--}8.5 \times 10^9</math> cells/L</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: possible acute bacterial infection (pneumonia), COPD, or inflammatory conditions (smoking)</li> <li>Decreased levels: possible viral disease (influenza)</li> </ul>
Eosinophils	<ul style="list-style-type: none"> <li><math>0\text{--}0.55 \times 10^9</math> cells/L</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: possible COPD, asthma, or allergies</li> <li>Decreased levels: pyogenic infections</li> </ul>
Basophils	<ul style="list-style-type: none"> <li><math>0\text{--}0.22 \times 10^9</math> cells/L</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: possible inflammation; seen in chronic sinusitis and hypersensitivity reactions</li> <li>Decreased levels: possible in an acute infection</li> </ul>
Lymphocytes	<ul style="list-style-type: none"> <li><math>0.77\text{--}4.5 \times 10^9</math> cells/L</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: possible viral infection, pertussis, and infectious mononucleosis</li> <li>Decreased levels: possible during corticosteroid therapy</li> </ul>
Monocytes	<ul style="list-style-type: none"> <li><math>0.14\text{--}1.3 \times 10^9</math> cells/L</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: See lymphocytes; also may indicate active tuberculosis</li> <li>Decreased levels: See lymphocytes</li> </ul>
Albumin	<ul style="list-style-type: none"> <li><math>35\text{--}54 \text{ g/L}</math> (<math>3.5\text{--}5.4 \text{ g/dL}</math> conventional units)</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: dehydration</li> <li>Decreased levels: chronic disease, malabsorption, malnutrition with low protein, or dilution by IV fluids</li> <li>Follow-up diagnostics: prealbumin, blood urea nitrogen, or zinc (deficiency increases risk for pneumonia [Keller, 2019])</li> </ul>
Prealbumin	<ul style="list-style-type: none"> <li><math>180\text{--}450 \text{ mg/L}</math> (<math>18\text{--}45 \text{ mg/dL}</math> conventional units)</li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: chronic kidney disease, steroid use, or alcohol use disorder</li> <li>Decreased levels: malnutrition, liver disease, infection, or inflammation</li> <li>Follow-up diagnostics: nutritional assessment, hemoglobin, and anemia evaluation (iron, transferrin, folate, and vitamin B<sub>12</sub>)</li> </ul>
<b>Arterial Blood Gases</b>		
PaO <sub>2</sub>	<ul style="list-style-type: none"> <li><math>75\text{--}100 \text{ mm Hg}</math></li> </ul>	<ul style="list-style-type: none"> <li>Older adults: Values may be lower</li> <li>Elevated levels: possible excessive oxygen administration</li> <li>Decreased levels: possible COPD, asthma, chronic bronchitis, cancer of the bronchi and lungs, cystic fibrosis, respiratory distress syndrome, anemias, atelectasis, or any other cause of hypoxia</li> </ul>
PaCO <sub>2</sub>	<ul style="list-style-type: none"> <li><math>35\text{--}45 \text{ mm Hg}</math></li> </ul>	<ul style="list-style-type: none"> <li>Elevated levels: possible COPD, asthma, pneumonia, anesthesia effects, or use of opioids (respiratory acidosis)</li> <li>Decreased levels: hyperventilation/respiratory alkalosis</li> </ul>

**TABLE 13.2** Pulmonary Laboratory Assessment Indications of Nutritional Concerns (sources: Castro et al., 2022; Padilla & Abadie, 2022; Pagana & Pagana, 2018)

Test	Normal Ranges (SI Units)	Significance of Changes from Normal
pH	• 7.35–7.45	<ul style="list-style-type: none"> <li>Elevated levels: metabolic or respiratory alkalosis</li> <li>Decreased levels: metabolic or respiratory acidosis</li> </ul>
HCO <sub>3</sub>	• 22–26 mEq/L	<ul style="list-style-type: none"> <li>Elevated levels: possible respiratory acidosis as compensation for primary metabolic alkalosis</li> <li>Decreased levels: possible respiratory alkalosis as compensation for a primary metabolic acidosis</li> </ul>
SpO <sub>2</sub>	• 95–100%	<ul style="list-style-type: none"> <li>Older adults: Values may be slightly lower</li> <li>Decreased levels: possible impaired ability of hemoglobin to release oxygen to tissues</li> </ul>

**TABLE 13.2** Pulmonary Laboratory Assessment Indications of Nutritional Concerns (sources: Castro et al., 2022; Padilla & Abadie, 2022; Pagana & Pagana, 2018)

The imaging assessment should include a chest x-ray and possibly a computed tomography (CT) scan. Chest x-ray is used to evaluate and assess the lungs. The x-ray may detect pneumonia, atelectasis, pneumothorax, and a tumor. If further evaluation is needed, a CT can be ordered, used in cases where suspicious lesions or clots are thought to be present. The CT will verify these findings.

Pulse oximetry, capnography, and pulmonary function tests are noninvasive tests that provide information about gas exchange in the client (Wood, 2022). Pulse oximetry identifies hemoglobin saturation with oxygen; the range should be 95–100%. A range below 91% in a client with no chronic respiratory problems is an emergency. The capnography measures carbon dioxide, and the pulmonary function test assesses breathing problems and lung function; they are utilized in both diagnosis and management of COPD and asthma.

### Analysis of Nutrition and the Pulmonary System

With a complete pulmonary assessment, the provider must note any abnormal cues and analyze these findings. The abnormal findings typically are related to nutritional requirements and deficits. Depending on the indications from the initial 24-hour food recall, follow-up or repeated assessments would assist in determining any repeated calorie excesses or deficits. A focus on types of food intake, portions, meal patterns, and knowledge of nutrient content provide the initial clues for the physical exam findings that may be present in clients with pulmonary conditions.

A cursory consideration of weight and BMI may not be the best indication of the nutritional status and overall health for a client. In fact, a low BMI is linked to increased mortality for COPD clients due to the physiologic consequences of diaphragmatic weakness, decreased lung function, and systemic inflammation (McDonald et al., 2019).

Malnutrition may result in clients with COPD or other chronic diseases from their increased energy expenditures, causing fatigue, less activity, muscle loss, and poor appetite. Weight loss can worsen with each exacerbation (McDonald et al., 2019). Diminished muscle mass is a sign of exercise intolerance and sedentary lifestyle for clients with chronic pulmonary disease. Malnutrition is a negative factor in the prognosis of COPD.

Obesity is a well-established health factor, recognized by the World Health Organization (2023) as a leading public health issue, with estimates in the 2016 data that 41 million children under age 5 and 240 million children ages 5–19 are overweight or obese. These children typically remain overweight or obese in adulthood. Obesity is a factor for increased asthma risk through its role in inflammation and pulmonary overreaction to environmental triggers (Calcaterra et al., 2021). Obesity alters the mechanics of the pulmonary system, leading to dyspnea, wheezing, and airway hyperresponsiveness (Dixon & Peters, 2018). Excessive weight reduces pulmonary and chest wall compliance, contributing to increased work of breathing in adults and children, but the inflammatory immunomodulatory impact of high-fat, high-sugar, and low-nutrient “Western” diets is the predominant obesity impact in children with asthma (Calcaterra et al., 2021). These physiologic responses are exacerbated by the low activity levels that are a natural consequence of pulmonary symptoms.

[Table 13.3](#) lists key nutritional physical exam findings in clients with chronic pulmonary conditions.

Physical Exam Finding	Effect
Generalized nutrient deficiency	<ul style="list-style-type: none"> <li>• Low BMI</li> <li>• Obesity or central obesity</li> </ul>
Protein energy malnutrition	<ul style="list-style-type: none"> <li>• Poor physical performance in activities</li> <li>• Lack of muscle strength</li> <li>• Dull/dry hair or hair loss</li> <li>• Banding of nails</li> <li>• Bilateral edema</li> </ul>
Anemia	<ul style="list-style-type: none"> <li>• Fatigue</li> <li>• Decreased activity/exercise tolerance</li> <li>• Weakness</li> <li>• Palpitations</li> <li>• Irritability</li> <li>• Headaches</li> <li>• Paresthesia</li> <li>• Sore tongue</li> <li>• Brittle nails or spoon-shaped nails</li> <li>• Pallor</li> <li>• Pica (ice, starch, clay)</li> </ul>
Dehydration	<ul style="list-style-type: none"> <li>• Dry skin and mucous membranes</li> <li>• Poor turgor</li> <li>• Sunken eyes</li> <li>• Decreased urine output</li> <li>• Change in neurologic status</li> </ul>
Poor oxygenation	<ul style="list-style-type: none"> <li>• Muscle retractions</li> <li>• Tripod breathing</li> <li>• Clubbing of nails</li> </ul>
Micronutrient deficiency	<ul style="list-style-type: none"> <li>• Dim-light vision (vitamin A)</li> <li>• Glossitis or inflammation of the tongue (iron, zinc, or riboflavin)</li> <li>• Poor tooth health</li> <li>• Lack of muscle strength; falls or fractures (vitamin D, calcium, magnesium)</li> <li>• Excessive bruising or bleeding (vitamin K)</li> <li>• Dermatitis and diarrhea (niacin)</li> <li>• Muscle cramps (vitamin C or magnesium)</li> </ul>

**TABLE 13.3** Nutritional Physical Exam Findings in Clients with Chronic Pulmonary Conditions (sources: Esquivel, 2018; Gea et al., 2018; Rolo; Silvestri et al., 2022)

## 13.2 Plan Nutritional Strategies to Impact Pulmonary Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 13.2.1 Identify nutritional habits that optimize pulmonary wellness.
- 13.2.2 Generate solutions to optimize pulmonary wellness utilizing nutritional habits.

Poor dietary habits are a modifiable risk factor and treatment target for clients with both acute and chronic illness. A client with a cold, influenza, or pneumonia may need immune support (vitamin C and zinc), while a client with chronic conditions needs a comprehensive approach to nutritional intervention. *Healthy People 2030*, the U.S. Department of Health and Human Services' public health initiative, identifies health behaviors focused specifically on nutrition and food. The healthy-eating objectives include increasing fruit, vegetable, and whole-grain

consumption, decreasing intake of sugary drinks and sodium, reducing food insecurity, increasing intake of vitamins and minerals, increasing number of infants breastfeeding, and reductions in obesity. MyPlate utilizes evidence-based data from the *Dietary Guidelines for Americans 2020–2025* and is a pictorial representation of the types and quantities of food that should be consumed at meals.

[Table 13.4](#) identifies some specific nutrition recommendations to impact pulmonary health. These principles designed to promote general health are particularly useful for clients with chronic pulmonary conditions. Additional strategies may include a focus on protein-rich foods that are easily digested.

Nutrient	Food Source	Consideration
Antioxidants (vitamin C, vitamin E, and beta carotene)	<ul style="list-style-type: none"> <li>Fruits and vegetables</li> </ul>	Reduce inflammation, strengthen the immune system, support lung function, and reduce asthma symptoms
Vitamin D	<ul style="list-style-type: none"> <li>Fortified foods such as cereal, orange juice, and yogurt</li> <li>Naturally occurring in salmon, tuna, mushrooms, egg yolks, and cheese</li> </ul>	Supports lung function and reduces upper respiratory infections
Antioxidants (flavonoids) and selenium	<ul style="list-style-type: none"> <li>Apples, berries, grapes, seafood, meat, and eggs</li> </ul>	Anti-inflammatory benefits and promote normal lung tissue
Whole grains	<ul style="list-style-type: none"> <li>Whole oats, whole-wheat pasta and bread, buckwheat, and bulgur wheat, in addition to being a part of a healthy diet</li> </ul>	May reduce asthma symptoms promote better asthma control
Sulfites (preservative)	<ul style="list-style-type: none"> <li>Dried fruits and vegetables, pickled foods, shrimp, wine/beer</li> </ul>	May be an allergen for some clients and trigger reactions or asthma attacks

**TABLE 13.4** Nutrition Recommendations for Pulmonary Wellness (sources: Andrianasolo et al., 2018; Nutrition for lung health and COPD, 2023; Vezina & Cantin, 2018; Vlieg-Boerstra et al., 2021; Tinsley & Lewisley, 2023)

The following nutritional supports and actions are available to optimize function and health in pulmonary conditions for infancy through adulthood:

- Infants—Breast milk ([Figure 13.5](#)) is best in the first year, supporting optimal nutrition (vitamin A) and development of immune system, and is associated with less allergic disease and as a protective mechanism in later childhood against illness (wheezing, asthma, and viral illness). As an alternative, formula in the first year is acceptable, although not protective against atopic disease or asthma. Cow's milk and soy milk should be avoided in the first year (CDC, 2022c); they are difficult for an infant to digest, and cow's milk can cause iron deficiency and iron deficiency anemia (Calcaterra et al., 2021).
- Children—Combine preferences with a balanced diet plan. Consider finger foods; establish an eating routine (i.e., sitting for meals, focused mealtime, pleasant environment for eating); educate on nutrition content, balanced diet, MyPlate, and reading labels; create games that make nutrition fun; avoid sugary drinks; encourage exercise and active play. Apples, kiwi fruit, spinach, garlic, avocados, broccoli and bananas are easy to eat or add to other dishes; these are excellent fruits and vegetables for children with asthma due to the nutrient content (minerals, vitamin C, vitamin E, and antioxidants) and the anti-inflammatory properties.
- Adolescents—Combine preferences with balanced diet plan. Educate about nutritional needs for growth and on how to choose healthy options when eating out. Convenience foods that are easy to grab on the go and may appeal to adolescents but that also contain antioxidants include oranges, strawberries, carrots, nuts, and sunflower seeds.
- Adults—Educate on the impact of diet on health conditions, meal planning, and use of Mediterranean diet, MyPlate, or nutrient dense meals.



**FIGURE 13.5** Breastfeeding in the first 12 months provides optimal nutrition for infants. (credit: U.S. Department of Agriculture/Flickr, Public Domain)

Pulmonary rehabilitation assists in reducing respiratory symptoms, improving function, and increasing emotional and physical participation in activities that promote quality of life. The rehabilitation team will vary based on the facility but often includes physical therapist, occupational therapist, respiratory therapist, and dietitian along with the client's health care provider. Instruction on nutrition, breathing techniques, and exercise assist in maximizing energy.

For clients with dyspnea, frequent coughing, or fatigue, the following additional instructions and guidance from the American Lung Association (2023) may be useful in supporting the opportunity for improved nutrition:

- Take smaller bites of food and eat slowly.
- Sit upright while eating.
- Take a break between bites and practice deep breathing exercises.
- Eat more food early in the morning if too tired to eat later in the day.
- Avoid foods that cause gas or bloating, which tend to make breathing more difficult.
- Eat 4–6 small meals a day to enable the diaphragm to move freely and let the lungs fill with air and empty out more easily.
- Limit liquids with meals or drink after meals if drinking liquids causes a feeling of fullness, but continue to strive for 6–8 glasses of water daily.
- Consider adding a nutritional supplement at night to avoid feeling full during the day.

### Planning Nutritional Goals

The goal of nutrition therapy for pulmonary wellness is to maintain adequate respiratory function to decrease or prevent malnutrition and obesity. Avoiding malnutrition will help preserve muscle strength and help maintain the integrity of the immune system. Adequate and proper nutrition is the primary goal in pulmonary wellness; this involves achieving a total daily caloric intake that meets the client's metabolic needs with foods from a variety of food groups and an emphasis on including antioxidants. If mucus overproduction and/or retention is problematic, as with COPD, chronic bronchitis, emphysema, cystic fibrosis, and asthma, reducing foods high in histamine (such as processed meat, aged cheese, legumes) is advised. Clients should avoid empty calories (calories lacking nutritional value).



### TRENDING TODAY

#### Pulmonary Wellness Through Holistic Care Strategies

*As you work through this Trending Today feature, recall that nurses should rely on evidence-based practice*

(EBP), which uses scientific evidence rather than anecdotal evidence, to inform their practice and care of clients. Nurses should encourage clients to evaluate nutritional information on social media with the same scrutiny.

Holistic care is a prevailing trend for nutritional venues promoting pulmonary wellness. Focusing on the apothecary found through herbs, @healingartsapotheчary promotes a variety of nutritional components that assist with bronchial drainage, liquefying mucus, and minimizing lung secretions. These herbs, from oregano oil to wild cherry bark tea, can promote lung health year round but may be especially helpful during seasons that exacerbate respiratory issues. Facebook followers can visit LUNGevity Foundation, which promotes the use of specific foods to minimize treatment side effects encountered by individuals diagnosed and living with lung cancer.

Take some time to review the following social media content and think critically about the information provided and its appeal to clients.

- [@healingartsapotheчary](https://openstax.org/r/healingartsapotheчary) (<https://openstax.org/r/healingartsapotheчary>) (TikTok)
- [LUNGevity Foundation](https://openstax.org/r/lungevity) (<https://openstax.org/r/lungevity>) (Facebook)

Now answer the following questions:

1. Which account did you prefer when viewing or reading? Explain.
2. What is the purpose of the content you viewed or read?
3. How would you evaluate these sources for use of EBP, and which sources used EBP?
4. If a client came to you with this information, how would you educate them to critically use these sources?
5. What alternative sources would you recommend to clients to educate them about this topic?

### Carbohydrates, Fiber, Proteins, and Fats

The nurse should advise clients to choose complex carbohydrates, such as whole-grain bread and pasta, fresh fruits, and vegetables, and to limit simple carbohydrates such as table sugar, candy, cake, and soft drinks and sugary beverages. Women should aim for about 25 g/day of fiber; men should aim for 38 g/day (or 14 g for every 1000 calories) (Larson, 2021). Fiber is contained in bread, pasta, nuts, seeds, fruits, and vegetables. For clients prone to gas or bloating, it can make breathing more difficult, so avoiding beans, legumes, and gas-producing vegetables, such as Brussels sprouts, broccoli, cauliflower, and cabbage, may be necessary.

Proteins play a major role in preventing malnutrition and the integrity of the immune system. Protein requirements increase according to illness severity ranging from 0.8–1.2 g/kg of protein per day for mild or moderate illness up to 1.2–1.5 g/kg of protein per day for clients with severe illness (Deer & Volpi, 2018). Good sources of protein include milk, eggs, cheese, meat, fish, poultry, nuts, and peas. Clients who are malnourished should choose protein with a higher fat content, while clients who are overweight or obese should choose low-fat or leaner options. To increase protein intake, add peanut butter, whey, or soy (vegan) protein powder during food preparation, or add a protein drink or shake as a supplement.

The client should choose healthier unsaturated fats from plant sources such as canola and olive oils, which do not contain cholesterol and are liquid at room temperature. To reduce inflammation and support cellular rebuilding, the client should choose omega-3 fatty acids and other healthy fats that are found in nuts, eggs, avocados, and fish. The client should avoid artificial trans fats and saturated fats. Adding healthy fats to protein-based meals is a way to add extra calories to food for undernourished clients who need them. To lose weight, clients will want to limit fat intake.

### Vitamins, Minerals, and Antioxidants

Multivitamins will likely help support overall nutrient balance. Additionally, older clients or those with chronic pulmonary illness requiring corticosteroid use may also benefit from calcium carbonate or calcium citrate and vitamin D supplements for general bone health and the prevention of osteoporosis. All use of supplements should be discussed with the health care provider.

Too much sodium may cause edema and impact blood pressure and fluid volume (American Lung Association, 2023). Processed and prepared foods, such as food that comes in cans, bottles, jars, or frozen packaging, may have high sodium content. Clients should look for packages marked as low sodium. During food preparation, spices and herbs can season foods instead of additional salt. They should also avoid adding salt to food after it is prepared.

Clients with COPD and hypoxemia will benefit from a lycopene-enriched diet. Fruit, vegetables, whole grains, and nuts are rich in antioxidants and encouraged.

### Identifying Challenges to Nutritional Goals

The client will face numerous challenges that make achieving nutritional goals challenging, if not impossible. Challenges based on normal physiologic changes occurring with age, such as decreased taste and smell, may be improved by utilizing spices, herbs, colorful foods, and preferred foods or those with pleasant food memories. Fatigue, particularly in clients with dyspnea or increased work in breathing, will be best addressed through small frequent meals and increased functional status. The involvement of physical therapy, occupational therapy, and opportunities for strength building is essential. Increased energy requirements for clients who are underweight or malnourished will require frequent calorie-dense meals, snacks, and likely nutritional supplementation with whey or soy (vegan) protein drinks. Protein drinks provide high protein amounts in low-volume portions and may provide the nutritional components necessary for muscle synthesis and improved muscle strength (Ahmadi et al., 2020).

The health care provider must develop strategies to improve or overcome these challenges to ensure the client consumes adequate and proper nutrition for pulmonary wellness. The involvement of a registered dietitian for a consult and for maintenance support will emphasize the importance of nutrition. Continued nutritional support and individualized nutritional intervention by a dietitian over the course of 6 months lowers mortality in polymorbid older adults after hospital discharge (Gomes et al., 2018).

Clients with limited function and impaired health due to significant pulmonary disease, obesity, or lack of strength and energy secondary to malnutrition may struggle with isolation, depression, and anxiety. These may produce fear, food avoidance, reliance on highly processed foods due to convenience, or various other barriers to quality nutrition. Optimum management of pulmonary conditions is an excellent initial step in managing the associated mental health conditions. Additional nutritional considerations may be the Mediterranean-style diet and the Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND) diet, which have cognitive and neurotransmitter benefits, reduce stress and anxiety, increase energy, and lower the chance of depression and psychological distress (Grajek et al., 2022).

Financial limitations, access to resources, and religious or cultural barriers may also exist. Clients may need considerations for social support and referrals (government or charitable resources), such as financial assistance or meal-delivery programs. The Congregate Nutrition Program and the Home-Delivered Nutrition Program provide meals to low-income and older adults, while the Supplemental Nutrition Assistance Program (SNAP) is the largest hunger safety net in the U.S., assisting with the purchase of food items. Unfortunately, additional barriers exist in accessing these programs due to lack of awareness, confusion about eligibility, application challenges, lack of transportation to a meal site, and stigma due to the desire for autonomy and independence (Burris et al., 2021). Social services offices at the organizational, city, or county level, along with non-profits (senior centers and community groups), provide some individualized support in addressing these barriers and accessing essential resources.

Religious and cultural barriers may exist related to locating and understanding how to select nutritious items that are kosher or halal. Maximizing nutrition in shorter periods of time may be a challenge that clients face during periods of fasting observed by Muslims during Ramadan, and Catholics, Protestants, Greek Orthodox, or those of Jewish faith during religious holidays or selected periods of spiritual discipline. Involvement of community groups, specialized websites, and members of faith communities, as well as provider and dietitian support, can assist a client to address these barriers.



### UNFOLDING CASE STUDY

#### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Katrice is in today for a routine asthma follow-up. The provider collects and reviews the 24-hour food recall with

Katrice and her parents, praising the few high-quality food choices and providing education about MyPlate as a guide for the types and quantities of food that will better support Katrice's nutrition. Katrice admits to having donuts or other sweet items for breakfast because they are "easy to grab and have in the car." She also has candy daily and fast-food meals at least 4–5 times a week. The provider explains the physiologic changes associated with obesity and increased BMI, which can worsen Katrice's asthma and impact her health during sports and play. Katrice and her parents verbalize understanding. They will implement the new knowledge over the next 2 weeks, and return for follow-up, bringing a food log with them and any questions. The provider also discusses a referral to physical therapy for assessment and post-exercise stretches to support less pain and need for medication. The provider educates about the risks of bronchospasm with NSAID use and recommends acetaminophen instead. Katrice's parents verbalize understanding and are receptive to education.

3. Which of the following statements by the client indicates additional diet instruction is needed?
  - a. "I will try to cut back on the amount of fast food I eat."
  - b. "I am going to get some deli meat so I can make sandwiches to eat at school."
  - c. "I'm going to try to eat sandwiches made with whole grain tortillas."
  - d. "I will try to eat baked chicken instead of fried."
  
4. Which of the following breakfast options is the best choice for the client?
  - a. A whey protein shake
  - b. Two strawberry toaster tarts
  - c. Pancakes and bacon
  - d. Whole grain toast

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### 13.3 Implement Nutritional Strategies to Impact Pulmonary Wellness

#### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 13.3.1 Assess the client for readiness to learn.
- 13.3.2 Teach nutritional strategies to optimize pulmonary wellness.

#### Holistic Nursing Assessment of the Client

Holistic assessment should take into consideration the overall health of the client, including their physical, psychological, social, and spiritual well-being.

##### Social

As described earlier, holistic nursing assessment must look at a client's overall health. Discussed were physical and psychological assessments that need to consider the impact of social engagement in clients related to nutrition and pulmonary wellness. The fatigue and malnutrition caused by the disease process will impact the client's ability to continue to engage in their normal social settings. This causes the client to experience depression and anxiety. The health care provider will need to educate the client on ways to conserve energy and increase their caloric intake so they might continue their normal activities.

##### Spiritual Well-Being

The health care provider must assess the client's spiritual beliefs in a holistic assessment. This is important in understanding the client's nutritional intake, because certain spiritual and cultural practices do not allow the client to eat certain foods. This information will be important if the client is experiencing malnutrition and will enable the health care provider to help the client select foods high in caloric intake and value that do not go against their beliefs.

#### Client Teaching

The nurse should assess teaching needs and the client and family's learning ability. Deficits that may interfere with learning, such as language barriers, literacy, numeracy, hearing, and educational levels, must be determined. Appropriate accommodation provides the best opportunity for success and will allow the client to be educated to the fullest. A balanced diet, energy expenditure, adequate protein, higher intake of iron, and small meals are important topics to add to the client's education so nutritional goals are met. Key summative points for the client

include:

- During respiratory distress or illness exacerbation, small frequent meals support increased functional status.
- Dietary changes or supplementation is an important modifiable risk factor and treatment component for clients with both acute and chronic illness.
- Obesity alters the mechanics of the pulmonary system, leading to dyspnea, wheezing, airway hyperresponsiveness, and increased work of breathing.
- Energy expenditure is typically elevated in clients with COPD due to increased efforts to breathe; adequate protein stimulates the ventilatory drive. Clients benefit from protein-rich meals. Foods that are high in protein include milk, eggs, cheese, meat, fish, poultry, and nuts.
- A balanced diet with high protein, complex carbohydrates, and healthy fats is used with differing volumes and portions to support both clients who are malnourished and those who need to reduce weight.
- A healthy diet will increase the client's likelihood of access to vital nutrients. The need for supplemental drinks, multivitamins, and micronutrient supplements should be discussed with a registered dietitian.
- Control sodium intake by choosing fresh versus packaged food. High sodium levels will cause edema and interfere with breathing, increasing the workload and causing a greater risk of malnutrition.

Implementing the following ideas from the American Lung Association (2023) and the COPD Foundation (2021) can make mealtimes easier and more nutritious by increasing energy and protein without increasing food volume:

- General principles:
  - Consume small, frequent meals.
  - Eat a large meal when well rested, such as the first meal of the day.
  - Encourage the use of high-calorie, high-protein supplements.
  - Swallow as little air as possible when eating.
  - Use easily prepared or nutritious snacks (fruits, carrots, nuts, hard-boiled eggs) to decrease fatigue.
- Clinical and home health care settings:
  - Eat high-calorie foods first.
  - Try more frequent meals and snacks.
  - Add low-sodium margarine or butter, mayonnaise, sauces, gravies, and peanut butter to foods.
  - Limit liquids at mealtimes.
  - Try cold foods, which give less sense of fullness than hot foods.
  - Rest before meals.
- At home:
  - Keep favorite, nutrient-dense foods and snacks on hand.
  - Keep ready-prepared meals available for periods of increased shortness of breath.
  - Eat larger meals when you are not as tired.
  - Avoid foods that cause gas.
  - Add skim milk powder (2 tbsp) or whey protein powder to regular milk (8 oz) to increase protein and calories.
  - Use milk or half-and-half instead of water when making soups, cereals, instant puddings, cocoa, or canned soups.
  - Add low-sodium grated cheese to sauces, vegetables, soups, and casseroles.
  - Choose dessert recipes that contain egg, such as sponge cake, angel food cake, egg custard, bread pudding, and rice pudding.



## UNFOLDING CASE STUDY

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### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Katrice and her mother return after 2 weeks, bringing the food log from the past 2 weeks. They report that they used the MyPlate website and games to help the whole family understand a healthier diet. They have not been as

compliant with the healthy eating principles as they would like due to “already having food at home that still needed to be eaten.” However, Katrice’s mother reports that during their grocery shopping yesterday, they used the MyPlate guidelines to focus on fresh food, complex carbohydrates, high-protein snacks, and limiting nonwater beverages to low-sugar or sugar-free options.

5. Which snack item demonstrates Katrice’s understanding of healthy eating when choosing food for pre-game energy?
  - a. Low-fat string cheese and a handful of almonds
  - b. Canned peaches and crackers
  - c. Peanut butter cookies
  - d. Pudding and a bag of chips
  
6. Which statement explains the correlation of Katrice’s obesity and her pulmonary health?
  - a. Obesity is a nonmodifiable risk factor and shouldn’t be the focus for asthma clients.
  - b. Obesity increases a client’s likelihood of access to vital nutrients.
  - c. Obesity alters the mechanics of the pulmonary system, leading to wheezing and airway hyperresponsiveness.
  - d. Obesity can be reversed by eating the largest meal of the day right before bed.

## 13.4 Evaluate Nutritional Strategies to Impact Pulmonary Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 13.4.1 Evaluate a nutritional plan for its effect on pulmonary wellness.
- 13.4.2 Modify a nutritional plan to promote pulmonary wellness.

### Evaluating the Client’s Compliance with the Meal Plan

Evaluation of nutritional strategies is imperative to verify a meal plan’s effectiveness and help the client achieve pulmonary wellness. An evaluation aims to measure understanding of the intervention and progress made for the specific interventions. Many clients cannot process large volumes of new medical information on the first exposure, and they only remember a minimal amount of what has been taught (Timmers et al., 2020). Clients and families will likely have questions requiring additional education and interval evaluation of each nutrition intervention. Each time the impact of a nutritional intervention is evaluated, education reinforcement should occur. Nursing nutrition interventions and evaluations vary based on organizational protocols and often involve a multidisciplinary approach.

Frequent tools used in the approach to evaluation of nutritional interventions include screening and diagnostic tools and anthropometric measures (skin-fold measurement, arm circumference, height, weight, BMI, and patterns of loss/gain), nutritional plan outcomes (appetite, eating difficulties, self-management strategies, pain with eating, oral/dental status, physical activity, and quality of life), diagnostics (labs and tests), and physical findings (appearance, muscle strength and function, muscle or fat wasting, swallow function, and affect) (van den Berg et al., 2021). When evaluating nutritional strategies and interventions with this approach, nurses can compare current findings with the previously recorded status to evaluate the success of the intervention on the client’s health and outcomes.

### The Ability to Obtain Adequate Nutrition

The health care provider must determine the ability to adhere to a meal plan. Questions to consider:

- Can the client afford the recommended food items?
- Is nutritious food available and accessible to the client?
- Do the foods in the meal plan go against the client’s culture or religious beliefs?

These are all things that must be determined so the client can be adherent and avoid worsening obesity and exacerbated pulmonary illness. If the client’s answers present barriers to adequate nutrition or a source of possible nonadherence, attention must be given to supporting the client with adjusted recommendations, resources, or referrals to enable the client to follow the dietary guidelines and meal plan.

### Case Study Conclusion

As noted in the case study, the client's BMI was increasing, and she had moved from overweight to obese. The client needed instruction to achieve proper nutrition including:

- Understanding the physiologic changes associated with obesity that can worsen asthma and impact health during sports and play
- Using MyPlate as a model for adjusting food intake
- Focusing on a low-fat and high-protein diet with teaching about what foods fall into each food category
- Keeping a food log for review and education
- Removing medication (NSAID) use that would worsen asthma

The health care provider can give these instructions, enabling the client to adhere with the meal plan and optimal respiratory health.

## Chapter Summary

- Nutrition is a key factor in promoting pulmonary wellness and supporting the function of the pulmonary system.
- A systematic approach to assessment, physical exam, diagnostic tests, and nutritional intervention is essential in supporting the nutritional needs of clients with pulmonary disease.
- Dietary choices including high protein, complex carbs, and healthy fats give nutritional support to clients and provide a mechanism for improved function despite chronic respiratory conditions.
- Any nutritional implementation by the client will likely have barriers or challenges. Recognition of the barriers and considering client preferences, religious beliefs, cultural norms, and social determinants of health in the design of interventions provides a holistic approach when planning goals and implementation strategies.
- Education about and implementation of nutritional health require follow-up care and reinforcement to achieve the client's desired benefits.

## Key Terms

- airways** passageways through which gases move to and from the lungs
- atelectasis** the collapse of the alveoli
- auscultation** listening with a stethoscope for normal breath sounds, abnormal sounds, and voice sounds
- crepitus** air trapped in and under the skin, typically felt as crackling
- dyspnea** difficulty breathing, or breathlessness
- fremitus** a vibration in the chest wall as the client speaks
- gas exchange** oxygen being transported to the cells and carbon dioxide being transported away from the cells
- Mallampati score** an airway assessment scale to classify the visibility of the oropharyngeal structures
- orthopnea** shortness of breath that occurs when lying down and is relieved by sitting up

**pack-years** the number of cigarettes or other smoke packs smoked per day multiplied by number of years smoked

**percussion** a systematic tapping over the intercostal spaces, moving through the anterior, lateral, and posterior thorax

**perfusion** the process of the arterial blood moving through tissues throughout the entire body

**respiratory diffusion** occurs when gases move down the concentration gradient across the alveolar sacs and capillaries

**surfactant** a fatty protein that lines the alveoli and reduces surface tension

**ventilation** the movement of atmospheric air that is higher in oxygen into the lungs and removal of carbon dioxide

## Review Questions

1. Which disease-related alteration can potentially place an older client with chronic obstructive pulmonary disease (COPD) at risk for altered nutrition?
  - Altered taste
  - Decreased energy requirements
  - Fatigue
  - Altered smell
2. On initial laboratory tests, an adult client's albumin level is below 3.5 g/dL. Which additional test could potentially be utilized to gather additional information about nutritional risk for malnutrition?
  - Hemoglobin A1C
  - Antinuclear antibodies (ANA)
  - Prealbumin
  - Chest x-ray
3. What is the process for carbon dioxide and oxygen exchange?
  - Ventilation
  - Gas exchange
  - Perfusion
  - Diffusion

4. The nurse is instructing an older client on the importance of adequate calcium and vitamin D intake. Which of the following age-related changes would this intervention affect?
  - a. Decreased lung capacity
  - b. Increased muscle atrophy
  - c. Decreased elasticity
  - d. Increased vascular resistance
5. For the client with chronic obstructive pulmonary disease (COPD), which dietary teaching should be incorporated?
  - a. High-fat food choices
  - b. Simple carbohydrates as primary food choice
  - c. High-protein, calorie-dense food choices
  - d. Low-fiber food choices
6. Which of the following is a primary goal of nutrition therapy for a client with chronic obstructive pulmonary disease (COPD)?
  - a. Maintaining a healthy body weight
  - b. Improving oxygenation status
  - c. Preventing muscle wasting
  - d. Lowering CO<sub>2</sub> levels
7. The nurse is instructing a client with chronic obstructive pulmonary disease (COPD) on strategies to maximize food intake. Which of the following responses by the client indicates additional education is needed?
  - a. "I will treat myself to cake or pudding for dessert."
  - b. "I will eat add cheese to my food whenever possible."
  - c. "I will eat more cold foods rather than hot meals."
  - d. "I will try to eat as much as I can during the evening before I go to bed."
8. A client with chronic obstructive pulmonary disease (COPD) is being assessed by a nurse. With palpitation, the nurse feels crackling. What does the crackling most likely indicate?
  - a. Fremitus
  - b. Orthopnea
  - c. Crepitus
  - d. Tuberculosis
9. Which of the following findings is the best indicator that the client has followed the prescribed nutritional plan to maintain a healthy weight?
  - a. The client can verbalize why obesity is detrimental to pulmonary health.
  - b. The client can describe the MyPlate approach to food selection.
  - c. The client's food log demonstrates adherence to healthy nutritional plan.
  - d. The client has reached their recommended weight range.
10. A client states that they are experiencing a nighttime cough. Which medication could explain this symptom?
  - a. Acetaminophen
  - b. Ibuprofen
  - c. Beta-2 agonist
  - d. Angiotensin-converting enzyme (ACE) inhibitors

## Suggested Reading

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# CHAPTER 14

## Special Nutritional Considerations for Pulmonary Health



**FIGURE 14.1** Red bell peppers contain vitamin E, which can help stop oxidative damage and lung inflammation. (credit: modification of work “Chicken and rice wok, Mazatlán. Date: April 4,2023” by El Nuevo Doge/Wikimedia Commons, CC0 1.0)

### CHAPTER OUTLINE

14.1 The Impact of Nutrition on Pulmonary Wellness Across the Lifespan

14.2 Nutrition and Chronic Pulmonary Illnesses

14.3 Treatments and Nutrition

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**INTRODUCTION** Nurses begin with assessments, including across-the-room (inspection) or head-to-toe (palpation, percussion, and auscultation) assessments, as part of the nursing process. As breathing and oxygen are vital to life, the pulmonary evaluation must take priority as it represents a significant initial part of every holistic client assessment. Any dysfunction in the respiratory system compromises vital gas exchange and poses a potential medical emergency and respiratory failure (National Institute of Health [NIH], 2022e). Respiratory problems lead to life-threatening consequences if not identified and managed promptly.

Consider this case: Kai is a 55-year-old Pacific Islander with a 30-year history of smoking. Kai works as a construction worker on the island of Kauai. He worked his way up to foreman and finds he works long hours, making fast food his main food option in the morning and evenings. During his time on the construction sites, he picked up the habit of smoking, which he has adamantly vowed to stop but has yet to succeed at. Kai is 6 feet tall and weighs 280 lb. When Kai was younger, he ate traditional Hawaiian foods that contained fish, rice, pork, and poultry with a wide variety of fresh fruits and vegetables.

## 14.1 The Impact of Nutrition on Pulmonary Wellness Across the Lifespan

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 14.1.1 Describe the impact of nutrition on the pulmonary system during pregnancy.
- 14.1.2 Describe the impact of nutrition on the pulmonary system during infancy.
- 14.1.3 Describe the impact of nutrition on the pulmonary system during childhood.
- 14.1.4 Describe the impact of nutrition on the pulmonary system during adolescence.
- 14.1.5 Describe the impact of nutrition on the pulmonary system during adulthood.
- 14.1.6 Describe the impact of nutrition on the pulmonary system during later adulthood.

### Pregnancy

Nurses must be skilled in assessing the holistic aspects of client care across the lifespan. One of the critical aspects often overlooked but of incredible value is the nutritional intake of clients. Nurses must comprehend the pulmonary system from pregnancy and infancy to older age, as they assess the dietary aspect and provide education and advocacy for the clients they treat.

As clients progress through the reactions and lifestyle modifications that occur during pregnancy, considering nutrition and how it impacts the pulmonary system is yet another area of importance. Pregnancy elicits various responses from the pregnant client (Dokuhaki et al., 2021). The body undergoes various physiological changes to adapt to the introduction and adjusts to a growing fetus. The pregnant client's nutritional needs transform to accommodate the developing fetus and consider the client's physiological changes (Widysanto & Mathew, 2022). Maternal nutritional needs and deficiencies are vital to fetal lung development and prevention of fetal and childhood complications (Arigliani et al., 2018; Baiz et al., 2019; Fandino et al., 2019; Rocha et al., 2021).

#### Physiological Changes to the Pulmonary System During Pregnancy

Upper-airway changes that occur during pregnancy include nasal congestion, called **rhinitis**, because of hyperemia, edema, plasma leakage into the stroma, glandular hypersecretion, increased phagocytic activity, and increased mucopolysaccharide content. **Hyperemia** occurs as a result of a higher-than-normal blood flow. The exact etiology of rhinitis during pregnancy is unknown but is thought to be related to increased blood volume and hormonal fluctuations. Complications of rhinitis in pregnancy include snoring and sleep-disordered breathing, both related to hypertension and preeclampsia.

The chest wall structurally adapts in pregnancy to anticipate the growing uterus and maternal weight gain as the subcostal angle of the rib cage widens between 68.5° and 103.5° and the circumference of the lower chest wall increases by 5–7 cm in girth while the diaphragm shifts upward. With pregnancy, total body blood volume increases 40% (Sanghavi & Rutherford, 2014; Soma-Pillay et al., 2016). The rise in the relaxin hormone initiates relaxation and loosening of ligament attachments in the lower ribs.

#### Nutritional Needs and Deficiencies Related to Pulmonary System During Pregnancy

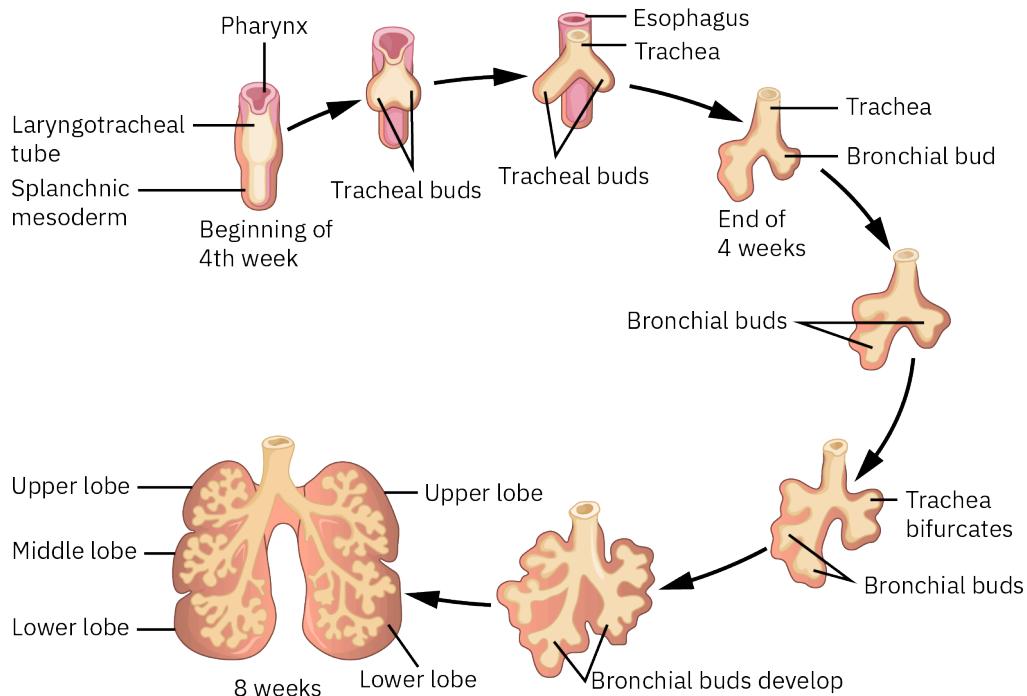
Pregnant clients have additional specialized dietary needs that support the physiological changes of the client and growth of the fetus. A balance in macronutrients such as protein are vital for healthy pregnancies and babies (Herring et al., 2018). Baiz et al. (2019) recommend consuming eggs and raw or cooked vegetables to limit the effects of allergic rhinitis during pregnancy.

Under- or overnutrition of a pregnant client causes imbalances of nutrients such as amino acids and increases blood cortisol levels and oxidative stress (Herring et al., 2018). If malnutrition prevails during pregnancy, the results equate to “impairment of offspring growth and development, maternal insulin resistance, cretinism, IUGR [intrauterine growth restriction], birth defects, cognitive and behavioral defects, postpartum complications, preeclampsia, eclampsia, anemia, preterm birth, maternal hemorrhaging, and additional long-term effects for both mother and offspring” (Herring et al., 2018).

Maternal needs and nutritional deficiencies related to malnutrition negatively impact the pulmonary system during pregnancy. Undernutrition in a pregnant client alters hormones that disrupt the lung maturation of the fetus (Fandino et al., 2019). Macronutrient and micronutrient recommendations are discussed further in the next section.

### Maternal Nutritional Impact on the Fetus

Adequate maternal nutrition prevents intrauterine complications such as intrauterine growth restriction (IUGR) and lung development in the growing fetus (Bendix et al., 2020; Fandino et al., 2019; Voraphani et al., 2022). See [Figure 14.2](#) for the stages of lung development. IUGR results from below-average fetal development and equates to babies that are small for gestational age and have an abnormal growth trajectory; it is linked with placental dysfunction and malnutrition. The term IUGR is often interchanged with small for gestational age (SGA), but the terms vary in that SGA means the fetus is small for gestational age but has an average growth trajectory. The clinical definition of IUGR is a baby weighing less than two standard deviations below the mean or remaining below the tenth percentile at a specified gestational age (Bendix et al., 2020). Infants with IUGR are at risk for complications such as asphyxia, hypothermia, hypoglycemia, and polycythemia. Long-term complications include growth limitations, neurodevelopmental handicaps, and disease processes linked to the cardiovascular, renal, and immunological systems. Even if the growth occurs in incremental units, the fetus may experience IUGR or meet poor outcomes from maternal malnutrition (Arigliani et al., 2018; Fandino et al., 2019; Rocha et al., 2021).



**FIGURE 14.2** Fetal lung development occurs in distinct phases during different weeks of gestation. When development is complete the fetus is prepared for breathing that takes place outside of the womb. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

If a pregnant client has inadequate nutrition, the infant with IUGR is at a higher risk for reduced nutrient availability and oxygen related to placental insufficiency. Undernutrition during pregnancy leads to impaired alveolarization and suppressed surfactant protein expression, diminished pulmonary vascular development, lower alveolar surface area, increased extracellular matrix, and thickened blood-gas barrier, limiting compliance and capacity. Causes of IUGR include severe maternal starvation and suppressed pregnancy weight gain, high altitude, maternal hypoxia, diabetes, and infections such as tuberculosis. Inadequate protein intake during pregnancy leads to embryonic losses, IUGR, and reduced postnatal growth, leading to a deficiency in amino acids critical for cellular metabolism and function (Herring et al., 2018). In contrast, high protein intake during pregnancy may also cause IUGR and embryonic death related to amino acid excess and ammonia toxicity (Herring et al., 2018). Nurses must assess and educate the pregnant client on the importance of moderate protein consumption. The recommended protein intake for the first trimester is 46 g/day and increases to 71 g/day during the second and final trimesters (Murphy et al., 2021).

### Infancy

Infancy is a stage that begins the lifespan. It follows pregnancy and birth and is characterized by rapid growth, development, and adaptations. During infancy, the baby experiences rapid weight and height gains. Generally,

depending on the source, babies are considered infants from birth up to age 1. Cognitive development during infancy includes exploration, attention, memory, inquisitiveness, and communication acquisition. An infant's milestones include holding their head up, rolling over, sitting with support, crawling, standing, and walking. Infants form bonds with their caregivers that are shared through eye contact, touch, responsive care, and body language. Infants rely on their parents or caregivers for full support.

The pulmonary system undergoes significant adaptations to support the transition between the in-utero and outside world. The fundamental pulmonary changes include the lungs' transition from fluid-filled to breathing outside air (Arigliani et al., 2018; Fandino et al., 2019; Rocha et al., 2021). Surfactant production increases late in pregnancy and continues through development and maturation during the first few weeks of life. The lungs can expand and stretch, allowing for growing volume capacity. The airways continue to grow and mature. Infants obtain antibodies through breast milk in colostrum (in the first few days of life) and immunoglobulin A (after the first few days) to help infants fight infection and support their immune systems.

### Nutritional Impact During Infancy

Nutrition is crucial in lung growth, development, and repair in fetuses, preterm infants, infants, and children (Arigliani et al., 2018; Bendix et al., 2020; Fandino et al., 2019; Rocha et al., 2021). One of the primary systems to develop in a fetus is the respiratory system, which begins on day 22 after conception. Although the process begins early with the trachea, lungs, bronchi, and alveoli, complete development does not occur until around age 8 (Rehman & Bacha, 2022). If a child is born with IUGR or SGA, health care providers must assess nutritional aspects to determine if undernutrition or malnutrition contributes to stunted growth. Micronutrients that play a role in lung maturation include vitamins A, D, E, selenium, and omega-3 fatty acids (Arigliani et al., 2018).

### Childhood

Alveolarization continues from infancy through approximately 8 years of age. Even if pulmonary development and function is normal at birth, insulting exposures can cause setbacks. Some scientists have traced poor lung function from infancy through childhood to identify potential events associated with decreasing optimal pulmonary development and capacity. A child born without any difficulty in pulmonary function but exposed to second-hand smoke may experience stunted growth (Schultz et al., 2018). According to Schultz et al. (2018), in the same study, when individuals demonstrated limitations at age 8 in lung function, they maintained these lower levels of function even when retested at age 16. When 8-year-old children have developmental limitations and are exposed to second-hand smoke, their lung function diminishes. Maternal smoking habits throughout pregnancy also play a role in decreased lung development. Schultz et al. (2018) study results further support the view that being born prematurely increases the risk for diminished lung development and function as the child grows. These children do not recover the lost development with age. They also are at an increased risk for developing asthma, wheezing, and declination of lung function during respiratory infection season.

### Nutritional Impact During Childhood

Nutrition plays a significant role in the development and function of the respiratory system throughout childhood. Adequate nutritional intake during childhood maintains a healthy growth pattern, aids lung tissue repair, and supports the immune system to prevent and treat infection (Gozzi-Silva et al., 2021). Intake of adequate amounts of macronutrient protein and micronutrients vitamins A, C, E, omega-3 fatty acids, and zinc is important for lung function. Inadequate consumption of the proper nutrients causes impaired lung function and respiratory problems. Improper nutritional intake affects the immune system, which protects the lungs from infection and inflammation. Malnutrition throughout childhood increases the risk for infection and exacerbates conditions like asthma. Childhood obesity causes detrimental effects on lung capacity by reducing lung capacity, expiratory reserve, and residual volume due to excessive adipose tissue increasing the intraabdominal pressure on the diaphragm, altering full chest expansion (Ferreira et al., 2020).

### Adolescence

Childhood progresses into the adolescence stage through physiological alterations (Han et al., 2019; Schultz et al., 2018). These changes include increased lung volume, respiratory muscle strength, airway resistance, susceptibility to respiratory tract infection (RTI), and decreased respiratory rate, as follows:

- Lung volume increases as the child grows. The lung capacity and volume continue to grow as long as there are

no underlying factors hindering growth (Schultz et al., 2018).

- Increased respiratory muscle strength continues, and muscles increase the ability to exchange air in the lungs.
- Increased airway resistance occurs because of functional and structural changes during adolescence.
- Increased susceptibility to respiratory infections occurs as changes to the immune system and lack of adequate nutritional intake influence.

Overall, the physiological changes that occur during adolescence contribute to or detract from pulmonary capacity and function. Although RTI susceptibility increases and asthma can be challenging during adolescence, the pulmonary systems of most adolescents experience growth.

Nutritional intake during adolescence is crucial as the pulmonary system grows and develops (Gozzi-Silva et al., 2021). Adequate macronutrient and micronutrient intake also aids in the immune system's development. Protein consumption should include 0.85–1.2 g of protein per kilogram of body weight per day (Hudson et al., 2021). Solid recommended sources of protein include lean meats, poultry, fish, eggs, dairy products, beans, tofu, legumes, and nuts.

Micronutrient intake for adolescents should focus on vitamins A, C, and E, omega-3 fatty acids, magnesium, and water (Gozzi-Silva et al., 2021; Scoditti et al., 2019). Vitamins A, C, and E are essential antioxidants that protect the lungs from oxidative stress and inflammation. See [Table 14.1](#) for a list of vitamins and possible food sources. Finally, adolescents must remain hydrated, which is essential for all life functions.

Micronutrient	Food Source
Vitamin A	<ul style="list-style-type: none"> <li>• Carrots</li> <li>• Liver</li> <li>• Spinach</li> <li>• Sweet potatoes</li> </ul>
Vitamin C	<ul style="list-style-type: none"> <li>• Citrus fruits</li> <li>• Kiwi</li> <li>• Strawberries</li> <li>• Tomatoes</li> </ul>
Vitamin E	<ul style="list-style-type: none"> <li>• Leafy green vegetables</li> <li>• Nuts</li> <li>• Seeds</li> <li>• Vegetable oils</li> </ul>
Magnesium	<ul style="list-style-type: none"> <li>• Chia seeds</li> <li>• Leafy green vegetables</li> <li>• Legumes</li> <li>• Nuts</li> <li>• Seeds</li> <li>• Whole grain</li> </ul>
Omega-3 fatty acids	<ul style="list-style-type: none"> <li>• Chia seeds</li> <li>• Flaxseeds</li> <li>• Mackerel</li> <li>• Salmon</li> <li>• Sardines</li> <li>• Walnuts</li> </ul>

**TABLE 14.1** Micronutrient Food Sources (source: Gozzi-Silva et al., 2021)

Diets full of fruits, vegetables, whole grains, lean proteins, and healthy fats all regulate the development of lung tissue and repair, promoting a healthy immune system. In addition to these specified nutrients, adolescents need to consume a balanced and varied diet (Gozzi-Silva et al., 2021) and exercise regularly to support proper pulmonary function.



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Unlike many other American adolescents, Kai grew up eating fresh fruits and vegetables. His family had fruit trees in his yard, so he grew up picking fresh fruits from their source. His mother would obtain the rest of their food items from the local food market, with everything being grown locally. Kai's mother would cook all their meals at home, and he would walk to school and play football to get plenty of exercise. No one in his family smoked, and they rarely ate outside of the home.

1. What lifestyle choices in Kai's adolescence might lead the nurse to believe that Kai comprehends the benefits of good lifestyle choices?
  - a. His family growing their own fruit
  - b. His family's history of eating fresh fruits and vegetables and his daily exercise
  - c. His screen time
  - d. His family not eating outside of the home
  
2. What information from Kai's past can the nurse incorporate into the dietary client's education plan?
  - a. Previous history of adolescent exercise and dietary selection
  - b. Smoking cessation
  - c. History of food sourcing
  - d. History of being a football star

### Adulthood

Adulthood is a developmental stage after adolescence and typically lasts until later adulthood. During this period, individuals reach physical and cognitive maturity and assume adult responsibilities, such as career development, marriage, and parenthood. Fewer physiological changes occur as the state of health stabilizes, and fewer rapid developmental changes occur. The body does gradually change in function and structure during the aging process. Some of these changes occur in the pulmonary system, so it is vital for nurses to advocate for healthy lifestyle modifications and perform regular health screenings to promote optimal pulmonary health throughout adulthood.

The physiological changes during this time include lung size and function, respiratory muscle strength, respiratory diseases, immune function, and lifestyle habits (Han et al., 2019; Schultz et al., 2018; Rogers & Cismowski, 2018). By adulthood, lung growth and development are maximized, and function begins to decline. Respiratory muscle strength improves during adolescence but declines as one ages. In adulthood, respiratory disease risk increases related to unhealthy lifestyle choices such as smoking, occupational exposure (chemical plant workers, construction workers, and health care providers exposed to chemicals such as chemotherapy), and not exercising. The immune system protects the respiratory system as one of its functions from infection and inflammation. When a client reaches adulthood, immune function diminishes gradually, making individuals more susceptible to illnesses throughout aging.



## UNFOLDING CASE STUDY

### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

When Kai moved out of his parent's house at age 20, he found it difficult to get a job, so he started working with a local construction company at age 24. Kai began smoking when he was 25 while working on the construction sites. He stated, "Smoking used to help me decompress." The local construction company required Kai to work long

hours, making healthy food choices and exercise incorporation challenging. Kai found himself relying on fast food options and the hard work on the construction sites as his daily “exercise.” Kai moved through the ranks and is now a foreman, where he supervises the employees under him at the job sites. He sits more frequently than he used to and found himself putting on more weight, jumping from 255 lb to 280 lb.

3. What lifestyle choices occur during adulthood might lead Kai to an increased risk for respiratory disease later in life?
  - a. Construction work, smoking, and eating fast foods
  - b. Smoking, drinking alcohol, and exercising
  - c. Eating fast foods, construction work, and drinking lots of water
  - d. Smoking, construction work, and working long hours
  
4. What lifestyle changes can Kai make early on to decrease his chance of developing a chronic respiratory disease?
  - a. Working out
  - b. Smoking cessation and eating better
  - c. Different job
  - d. Go back to school

### Nutritional Needs Related to Pulmonary System for the Adult

Nutritional support is essential throughout the lifespan in maintaining healthy lung function (Collins et al., 2019; Scoditti et al., 2019; Sharifi-Rad et al., 2019; Vahid & Rahmani, 2021; Voraphai et al., 2022; Yuan et al., 2021). As lung function and capacity decline as a client ages, the importance of healthy lifestyles and nutrient-rich dietary choices cannot be overstated. The dietary choices include antioxidant-rich foods that protect the lungs from free radical damage (discussed in the next section) and oxidative stress. Fruits and vegetables are excellent sources of antioxidant-rich foods, especially berries, citrus fruits, leafy greens, and tomatoes. Omega-3 fatty acids hold anti-inflammatory properties that reduce inflammation in the lungs. Excellent sources of omega-3 fatty acids include salmon, mackerel, sardines, flaxseeds, chia seeds, and walnuts. Lean protein is an essential macronutrient to aid in repairing lung tissue and is found in skinless chicken, fish, beans, and legumes. Avoiding harmful environmental substances, not smoking, avoiding excessive alcohol intake, and getting regular exercise promotes lung function and health.

### Later Adulthood

As people age, their progression parallels their risk for chronic disease. The lungs experience physiological changes as people age, leading to altered lung capacity and increased risk for infection. The lungs also suffer a barrage of continuous assaults over their lifetime. These assaults are chemical, mechanical, biological, immunological, and xenobiotic. These insults lead to oxidative stress in the lung tissue because of antioxidant capacity depletion.

**Free radicals** are unstable molecules that contain unpaired electrons in an atomic orbit that participate in phagocytosis's cellular destruction mechanism through macrophages and granulocytes (Sharifi-Rad et al., 2020). Phagocytosis is the process of phagocytes ingesting and eliminating larger particles. Free radicals are kept at bay by the body's antioxidant system. Adverse effects occur when homeostasis of the free radicals is not maintained. Research studies indicate the free radicals of oxygen play a role in chronic disease and deoxyribonucleic acid (DNA) damage (Sharifi-Rad et al., 2020). Increasing the amounts of free radicals cause cellular damage and **apoptosis** (the death of cells). Antioxidants counteract the free radical destruction process.

### Nutritional Needs Related to Pulmonary System for the Older Adult

The nurse treating older clients must recognize the need for antioxidant supplements. The current American diet is high in processed foods and additives. These food choices increase the risk for oxidative stress in the body, depleting the antioxidant capacity. The pulmonary system's reaction to oxidative stress includes activating the inflammatory response, which further compromises the lungs and cascades further oxidative stress. These oxidative reactions to the stressors are directly linked to chronic diseases such as asthma, chronic obstructive pulmonary disease (COPD), and lung cancer (Rogers & Cismowski, 2018).

## 14.2 Nutrition and Chronic Pulmonary Illnesses

### LEARNING OUTCOMES

By the end of this section, you should be able to:

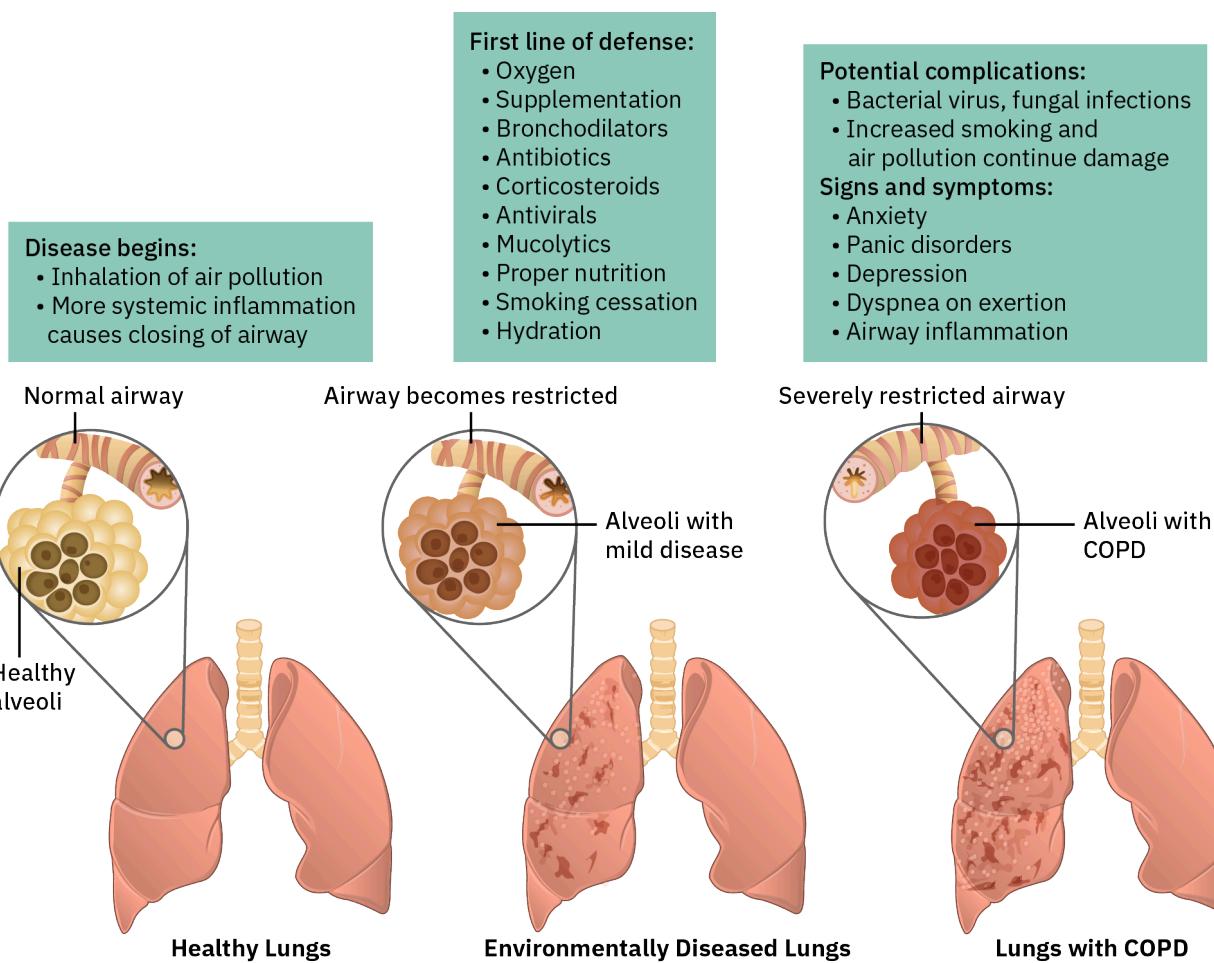
- 14.2.1 Discuss the impact of nutrition on pulmonary illness.
- 14.2.2 Discuss the impact of nutrition on chronic pulmonary illness.

### Nutrition Requirement for Optimal Pulmonary Health

Lung disease is the umbrella term for several diseases and disorders of the pulmonary system that prohibit the lungs from performing optimally (NIH, 2022b). Lung diseases inhibit and alter respiratory function, breathing capabilities, and lung capacity. Lung diseases vary in etiology. Infectious microorganisms cause some, while others maintain an environmental cause. Chronic pulmonary diseases cause long-term breathing problems, drastically impacting a client's quality of life. These conditions include symptoms of cough, wheezing, and shortness of breath. Other common chronic pulmonary diseases include chronic obstructive pulmonary disease, asthma, pulmonary fibrosis, and pneumonia. Pulmonary conditions that are not long term include respiratory tract infections and pulmonary embolism.

#### Chronic Obstructive Pulmonary Disease (COPD)

Chronic or long-term lower pulmonary diseases are classified as **chronic obstructive pulmonary disease (COPD)**. The COPD categories include emphysema and chronic bronchitis (Gozzi-Silva et al., 2021; NIH, 2022b; NIH, 2022d). These obstructive diseases are progressive and limit the volume of air that flows into and out of the airways, decreasing gas exchange and making it difficult to breathe (NIH, 2022d). See [Figure 14.3. Emphysema](#) results in damage between the walls of the air sacs, or alveoli, that exchange gas in the lungs (NIH, 2022d; Pahal et al., 2023). Without injury present, the alveoli easily expand and stretch with inhalation and deflate readily with exhalation (Pahal et al., 2023). Emphysema leads to permanent dilation of the airspaces and decreases alveolar and capillary surface area. For example, consider an overinflated balloon that does not maintain the same elasticity over time. The common cause of emphysema is exposure to cigarette smoking and other noxious gases, such as sulfur dioxide (Pahal et al., 2023). **Chronic bronchitis** is the result of continuous inflammation of the airway linings, causing increasing mucus with clinical manifestations that include a productive cough of at least 2 months occurring within a 2-year time frame (NIH, 2022b; Widysanto & Mathew, 2023). As with emphysema, cigarette smoking, active or passively, or inhaling toxic chemicals and industrial pollutants is the leading causative factor in developing chronic bronchitis.



**FIGURE 14.3** The COPD disease process begins as healthy lungs endure exposure to different noxious environmental exposures.  
(attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Chronic lung conditions such as COPD severely diminish the quality of life, so individuals should strive to consume foods that promote lung function throughout the chronic diseases states to prevent exacerbations (Collins et al., 2019; NIH, 2022b; NIH, 2022d; Pahal et al., 2023; Scoditti et al., 2019; Widysanto & Mathew, 2022). Exercise is limited in clients with COPD, because they often suffer from dyspnea on exertion as a condition symptom. The lack of exercise is attributed to muscle loss and dysfunction, resulting in fatigue. Even the act of eating might trigger dyspnea, leading to anorexia. If a client is faced with the choice between breathing and eating, they will breathe to survive, which why anorexia and malnutrition is a common finding in these clients. As anorexia is present, the risk for significant malnutrition increases while vital vitamin and nutritional depletion continues. The lack of critical nutritional components accelerates respiratory decline as respiratory muscles weaken and cough pressure diminishes. As cough pressure declines, mucosal buildup threatens potential complications such as pneumonia.



### UNFOLDING CASE STUDY

#### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Kai is in the clinic today for difficulty breathing upon walking. His current vital signs are listed on the left side of the following table. Kai states that he has smoked for 30 years and frequently eats fast food because his job demands long hours and he does not have time for grocery shopping. You notice a cough; Kai states he does not know when it began exactly. He has noted a decrease in his weight, and he has a hard time working the long days his job demands because he becomes short of breath. You look at his chart, shown on the right side of the following table, which

includes his vital signs and exam notes from his visit last year.

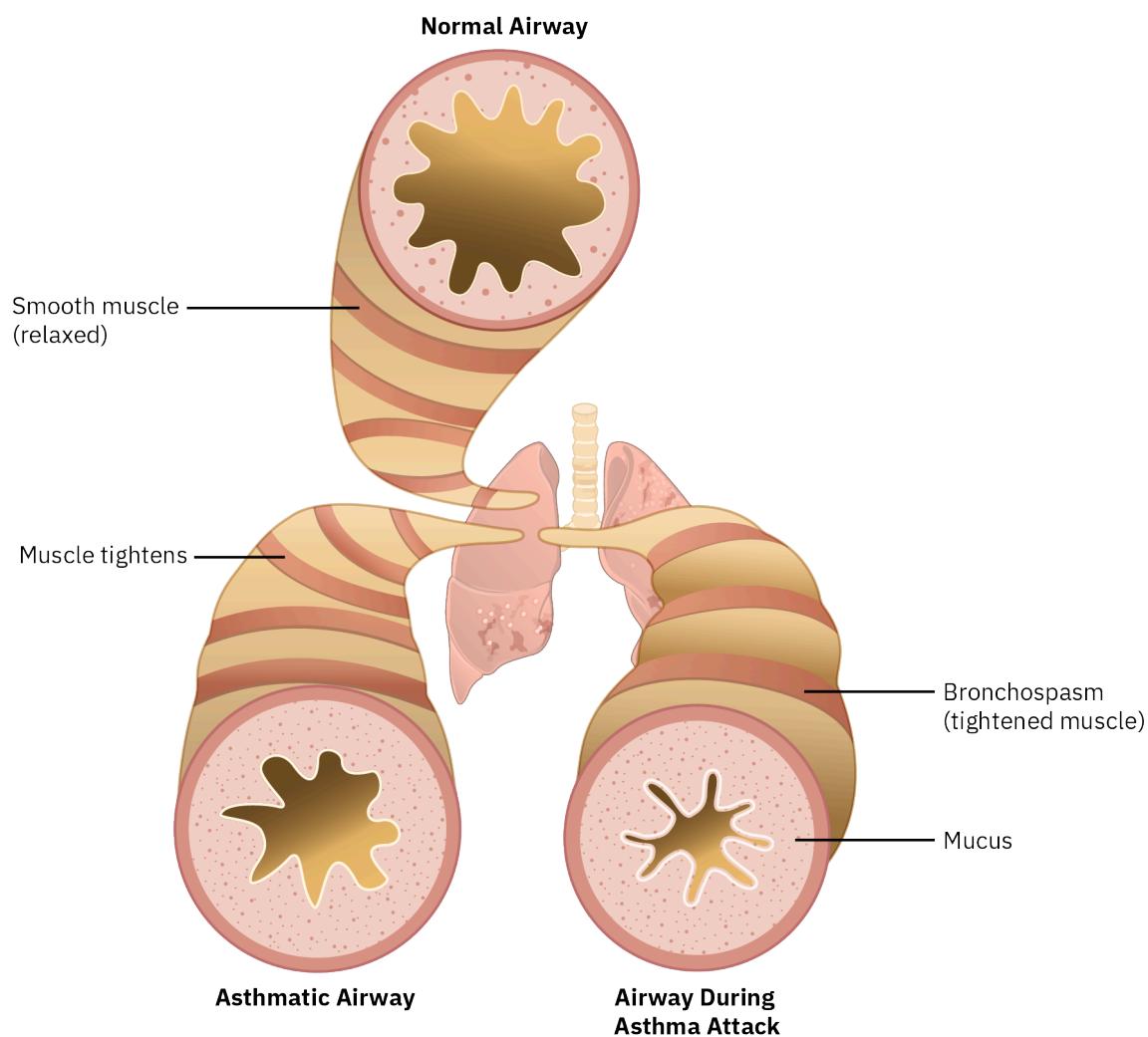
Today's Vital Signs	Last Year's Vital Signs and Exam Notes
Temperature: 97.6°F Blood pressure: 128/89 mm Hg Heart rate: 99 beats/min Respiratory rate: 28 breaths/min Oxygen saturation: 89% on room air (drops to 77% while walking) Height: 6'0" Weight: 268 lb	Temperature: 98.0°F Blood pressure: 126/82 mm Hg Heart rate: 89 beats/min Respiratory rate: 20 breaths/min Oxygen saturation: 92% on room air Height: 6'0" Weight: 280 lb <p>The client presents with mild dry cough for 2 weeks. Client's chest x-ray shows enlarged lung air pockets. The client does not have a history of respiratory conditions but stated he has smoked for 30 years. The client is a construction worker with a fluctuating dietary history. Recommendations for client include smoking cessation.</p>

TABLE 14.2

5. Based on the documented visit history, which of the following issues requires follow-up by the nurse during today's visit?
  - a. Smoking
  - b. Hydration status
  - c. Dietary recommendations
  - d. Workplace safety
  
6. The nurse is constructing a teaching plan for Kai to address potential complications of COPD. Which of the following conditions will the nurse include in the plan?
  - a. Asthma
  - b. Respiratory syncytial virus
  - c. Pulmonary fibrosis
  - d. Pneumonia

### Asthma

**Asthma** is a chronic disease clinically characterized by recurrent inflammation and airway narrowing (Gozzi-Silva et al., 2021; Hashmi et al., 2023; NIH, 2022a). These symptoms of chronic inflammation result from irritation from correlated efforts between the respiratory epithelium and both the initial and the (later) adaptive immune responses. Hyperresponsiveness is the reaction of the airway results from the activation of the granulocytes, such as the eosinophils, lymphocytes, macrophages, and mast cells. The response of the granulocytes triggers the smooth muscle in the airways to contract and secret mucus and also includes microvascular leakages. As the airway swells, gas exchange is prevented, and symptoms such as shortness of breath, dyspnea, cough, and wheezing is present. The disease process is associated with childhood and can carry into adulthood, or it might occur in adulthood. The etiology of asthma relates to allergic and environmental factors such as hay fever, tobacco smoke, particulate matter, pollen, mold, dust mites, food, and eczema. Asthma has no cure, affecting 1 in 13 people in the United States (Centers for Disease Control and Prevention, 2022). [Figure 14.4](#) provides a visual of a normal airway with asthmatic and asthma attack airways.



**FIGURE 14.4** During an asthma attack, chronic inflammation triggers an immune response that causes the smooth muscles in the airways to tighten, preventing gas exchange and restricting the ability to breathe. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Pulmonary Fibrosis

Like scars that develop on the skin, **pulmonary fibrosis** involves scarring of the lung tissue (Krishna et al., 2022). Scar or fibrotic tissue does not function normally in gas exchange. The fibrotic tissue prevents oxygen flow from the alveoli into the bloodstream, leading to low oxygen levels and compromised lung capacity as the scar tissue stiffens. Pulmonary fibrosis etiology might be idiopathic or secondary to another illness, medication, radiation therapy, or environmental exposure (Agarwal & Huda, 2022; Krishna et al., 2022).

Nutritional intake significantly impacts clinical outcomes for individuals with pulmonary fibrosis. Nutrients are in high demand due to the increase in respiratory workload, activation of inflammatory mediators, hypoxemia, and lack of physical exercise (Faverio et al., 2020). As with COPD, malnutrition remains prevalent for those with inadequate nutrition intake. Some preferred treatment medications for pulmonary fibrosis cause diarrhea and other adverse effects such as food malabsorption. Specific dietary counseling by a registered dietitian is recommended for those who experience these effects.

### Respiratory Tract Infections

**Respiratory tract infections (RTIs)** encompass a variety of microorganisms that cause respiratory symptoms in the individuals that contract them (LaRocque & Ryan, 2019; Saleri & Ryan, 2019). RTIs are commonly acquired viral infections. These infections manifest in either the lower tract as pneumonia or in the upper tract as bronchitis, rhinitis, sinusitis, otitis, pharyngitis, epiglottitis, and tracheitis. Systemic manifestations include fever, headache, sore throat, cough, chest pain, dyspnea, and myalgia (LaRocque & Ryan, 2019; Saleri & Ryan, 2019). Transmission occurs through direct droplet contact or inhalation (Saleri & Ryan, 2019). While many upper respiratory tract

infections are short term, some may lead to pneumonia. [Table 14.3](#) outlines several RTIs and their symptoms.

Respiratory Tract Infections Type	Symptoms	Recommendations
<b>Upper respiratory tract</b>		
Common cold	Sneezing, stuffy nose, runny nose, sore throat, watery eyes, fever, cough	
Pharyngitis	Sore throat, dry throat, pain with swallowing, pain with speaking	
Acute rhinitis	Sneezing, stuffy nose, runny nose, itchy nose, throat, eyes, clear drainage from ears	
Acute otitis media	Fever, ear pain, loss of balance, hearing difficulties	
Laryngitis	Hoarseness, raw and sore throat, dry cough	
Tonsillitis	High fever, headache, earache, feeling tired, voice changes	<ul style="list-style-type: none"> <li>• Hot tea with lemon or hot soup for sore throat</li> <li>• Gargle with warm salt water</li> <li>• Cold liquids</li> <li>• Popsicles made with all-natural fruit and fresh fruit juices</li> <li>• Plenty of fluids (water)</li> <li>• Honey</li> <li>• Elderberry</li> <li>• Increasing vegetables</li> <li>• Reducing dairy intake until symptoms improve</li> <li>• Ginger</li> <li>• Chicken-noodle soup</li> </ul>
<b>Lower respiratory tract</b>		
Acute bronchitis	Runny nose, low-grade fever, congestion, wheezing, cough	Same as for upper respiratory tract infections
Pneumonia	Cough, difficulty breathing, rapid heartbeat, fever, loss of appetite	

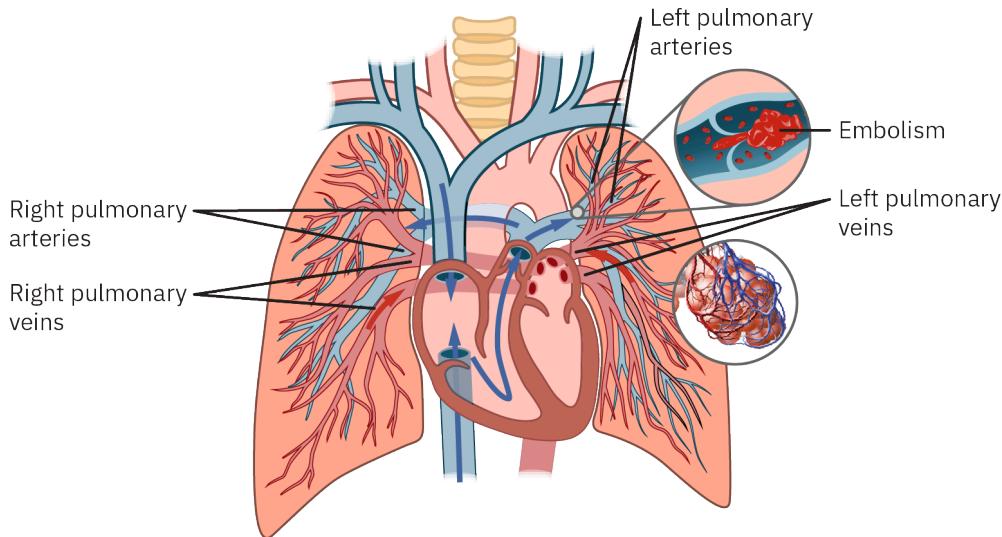
**TABLE 14.3** Respiratory Tract Infections, Their Symptoms, and Dietary Recommendations to Alleviate Symptoms (sources: Green et al., 2020; Lucas et al., 2019; Saleri & Ryan, 2019; Thomas & Bomar, 2022)

### Pneumonia

**Pneumonia** is a condition that leads to inflammation of lung parenchyma caused by infection, chronic pulmonary diseases, ventilator use, or aspiration (NIH, 2022c; Sattar & Sharma, 2022; Sanivarapu & Gibson, 2022). When germs migrate into the lungs, the immune system is activated, causing alveoli and lung parenchyma inflammation. The inflammation causes the lungs to fill with fluid or pus. When an infection is a cause, the types of pneumonia are classified by acquisition type: community (within 48 hours of hospital admission), hospital-acquired (nonintubated person after 48 hours of hospital admission), ventilation (within 48 hours after intubation), or health care-associated (hospitalization within last 3 months) pneumonia. Pneumonia can lead to further chronic complications for some clients, such as lung fibrosis, damaged lung parenchyma, necrotizing pneumonia, cavitation, empyema, abscess, and death (Sattar & Sharma, 2022; Sanivarapu & Gibson, 2022). When left untreated, the mortality rate for pneumonia is 30%.

### Pulmonary Embolism

A **pulmonary embolism** is a cease in blood flow to the pulmonary artery or its branches. A pulmonary embolism [Figure 14.5](#) causes decreased or no blood flow because a blood clot becomes dislodged and migrates to the lungs (Vyas & Goyal, 2022). As lipid plaques accumulate on the arterial walls, the body's inflammation systems activate (Ashrobi et al., 2022). Initial lipid plaques evolve into fibrous plaques that activate the release of inflammatory markers and procoagulating factors. The process is known as atherosclerosis, and the activation of the platelets causes adhesion and aggregation that triggers clot formation. A thrombus is a clot formed in a blood vessel that prevents the natural flow of blood within the vessel through this process (Ashrobi et al., 2022; Vyas & Goyal, 2022). A thrombus that breaks off becomes an embolus. When it travels to the lungs and prevents the natural flow of blood within the lungs, it is known as a pulmonary embolism.



**FIGURE 14.5** A pulmonary embolism stops the flow of blood within the lungs. (attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Alternative Food and Supplement Options

A well-balanced diet is important for overall health and becomes especially important for the client who remains predisposed to pulmonary conditions. Specific dietary recommendations vary depending on the type and severity of the pulmonary disease. Certain foods have potential benefits for pulmonary disorders and should be included in the overall management and treatment of clients with pulmonary conditions.

#### Chronic Obstructive Pulmonary Disease (COPD)

While eating becomes a complex and breathless chore for clients with COPD, the nurse should educate clients on the proper nutritional intake to promote optimal pulmonary health and prevent COPD exacerbations. Clients who comprehend the need for appropriate healthy balance are met with improvements in health. A diet with high anti-inflammatory foods, such as fresh fruit and vegetables, with minimal consumption of processed sugar, salt, and fried fatty foods, is a solid recommendation from leading government entities. Macronutrient portion intake includes 15–20% proteins, 30–35% fats, and 40–45% carbohydrates (Collins et al., 2019; Hancu, 2019; Scoditti et al., 2019). Protein-required measurements equate to 1.2–1.5g protein/kg (Collins et al., 2019; Hancu, 2019).

Micronutrients from oral nutritional supplements that maintain antioxidant and anti-inflammatory qualities include vitamins A, C, and E. These vitamins, within their function, protect and prevent the progression of COPD. Vitamin D has been found to reduce COPD exacerbation rates (Collins et al., 2019). Individuals with COPD should include vitamin C at 75 mg/day for females and 90 mg/day for males—vitamin D at 600 IU for adults and 800 IU for people aged 70 or older (Hancu, 2019).

As nurses perform their assessments, they should use the information they gather in the client's nutritional planning and as client teaching opportunities. While completing the assessment of a client with COPD, the nurse should consider:

- Some clients with COPD may appear overweight because of their free-fat mass index or visceral fat-area measurements (Hancu, 2019).
- Malnutrition is still of concern in these clients (Hancu, 2019).
- Avoid any judgment toward clients who are overweight.

In addition, the nurse should teach the client to:

- Prepare and/or consume nutritionally dense meals.
- Eat small, frequent meals.
- Rest before mealtimes.
- Time meals when energy level is at its highest.

- Aim for a BMI between 20–24, maintain muscle mass, and include pulmonary rehabilitation.
- Choose food options that require minimal energy expenditure in preparation.
- Limit alcohol consumption.

### Asthma

While some food triggers asthma and allergic symptoms, several foods and food groups have been shown to reduce the risk for developing asthma (Alwarith et al., 2020). Recommendations include daily ingestion of one or more servings of fruits and vegetables and whole grains, which may reduce the risk in children, adolescents, and adults. These food groups have also been shown to make asthma symptoms more manageable and are inversely related to wheezing in children because of the antioxidant effects and preventative oxidative damage. Fruit intake decreases asthma symptoms and the sensitization by inhaled allergens. The anti-inflammatory results of flavonoids in raw vegetables (lost during the cooking process) are believed to explain the association between raw vegetable consumption and well-managed asthma (Alwarith et al., 2020). High-fat intake, commonly in Western dietary preferences, is associated with worsening airway inflammation and lung function limitations. Clients with asthma should consider a plant-based diet, vegetarian diet, or strictly vegan foods to reduce asthma risk and decreases the need for as-needed asthma medication use. If the client decides on a plant-based diet, counseling by a registered dietitian should be included to avoid nutritional deficiencies.

According to Alwarith et al. (2020), a positive relationship exists between dairy consumption and concurrent asthma symptomology. Current dietary guidelines recommend 3 servings per day of dairy for clients with asthma, because it supplies calcium and vitamin D. Consultation with an allergist is recommended if dairy intake must be avoided (Comerford et al., 2021). The nurse should teach the clients who wish to avoid dairy products to seek plant-based milks that are fortified with vitamin D. See [Table 14.4](#) for the various supplements and their relationship to lung anatomy and physiology.

Supplement	Relationship with Pulmonary System	Food Sources
Vitamin E	<ul style="list-style-type: none"> <li>• Stops oxidative damage and lung inflammation</li> <li>• Sunflower, safflower, and soybean oil</li> </ul>	<ul style="list-style-type: none"> <li>• Almonds</li> <li>• Peanuts</li> <li>• Pumpkin</li> <li>• Red bell pepper</li> </ul>
Vitamin C	<ul style="list-style-type: none"> <li>• Encourages airway hydration and decreases free radicals</li> <li>• Controls immune-system cytokines</li> <li>• Stops oxidative damage</li> <li>• Makes asthma symptoms more manageable</li> </ul>	<ul style="list-style-type: none"> <li>• Citrus (oranges, lemon, and grapefruit)</li> <li>• Bell pepper</li> <li>• Strawberries</li> <li>• Tomatoes</li> <li>• Cruciferous vegetables (broccoli, Brussels sprouts, cabbage)</li> </ul>
Selenium	<ul style="list-style-type: none"> <li>• Protects against oxidative damage and lung inflammation</li> </ul>	<ul style="list-style-type: none"> <li>• Pork</li> <li>• Beef</li> <li>• Turkey</li> <li>• Fish</li> <li>• Eggs</li> <li>• Beans and nuts (Brazil nuts)</li> </ul>

**TABLE 14.4** Function of Micronutrients Within the Pulmonary System and Food Examples (sources: Allen & Sharma, 2023; Alwarith et al., 2020)

Supplement	Relationship with Pulmonary System	Food Sources
Vitamin D	<ul style="list-style-type: none"> <li>Aids the immune system and response</li> </ul>	<ul style="list-style-type: none"> <li>Cod liver oil</li> <li>Salmon</li> <li>Fortified foods such as (dairy and plant milks, orange juice)</li> <li>Eggs</li> </ul>
Magnesium	<ul style="list-style-type: none"> <li>Relaxes smooth muscle, used in asthma exacerbation; need monitoring to prevent hypermagnesemia</li> </ul>	<ul style="list-style-type: none"> <li>Pumpkin seeds</li> <li>Chia seeds</li> <li>Almonds</li> <li>Boiled spinach</li> <li>Cashews</li> <li>Peanuts</li> <li>Soy milk</li> <li>Rolled oats</li> </ul>

**TABLE 14.4** Function of Micronutrients Within the Pulmonary System and Food Examples (sources: Allen & Sharma, 2023; Alwarith et al., 2020)

### Pulmonary Fibrosis

The adoption and continued consumption of unhealthy dietary selections increase and accelerate the risk for chronic diseases. Diets high in saturated fats increase the risk for pulmonary fibrosis development in both idiopathic and age-related cases (Mercader-Barcelo et al., 2020). In the same analysis, Mercader-Barcelo et al. (2020) state that a diet high in unsaturated fats reduces the severity of pulmonary fibrosis and the development of pulmonary fibrosis. A diet high in saturated fats and high fructose corn syrup (sodas, candy, processed foods) sped up the development of pulmonary fibrosis, while a diet including plant-derived polysaccharides has shown antifibrotic effects. Plant-based polysaccharides include coconut fiber, barley, oats, wheat bran, and chicory root. The amino acids arginine, glycine, and L-norvaline have demonstrated protection against pulmonary fibrosis in animal studies as they reduce the buildup of neutrophils and macrophages in peripheral blood. As with the chronic illnesses COPD and asthma, including foods high in vitamins A, B, C, D, and E is recommended.

### Respiratory Tract Infections and Pneumonia

A healthy, balanced food intake boosts the immune system and helps prevent respiratory tract infections. Meeting optimal pulmonary health nutritional requirements moderates the body's immune response, promoting lung health and respiratory homeostasis (Gozzi-Silva et al., 2021; Scoditti et al., 2019). Nutritional requirements for respiratory tract infections (RTI) and pneumonia are similar. Undernutrition is associated with an increased risk for frailty, difficulty in healing, increased risk for infection and worsening condition, morbidity, and mortality. A decrease in nutritional status predicts life expectancy in clients who begin with an RTI and develop pneumonia; becoming winded from eating leads to further deterioration of the condition. Nurses should seek to promote healthy habits to prevent and treat RTI with attention to vaccinations, adequate hydration, hand hygiene, smoking cessation, exercise, and nutrition.

Vahid and Rahmani (2021) recommend an anti-inflammatory diet to prevent and manage RTI and pneumonia associated with infections and COPD. Their definition of an anti-inflammatory diet includes using turmeric, ginger, garlic, onion, saffron, vitamin C, vitamin D, zinc, and omega-3 fatty acids. They conclude that these supplements, bulbs, and spices decrease symptoms, minimize the duration, and prevent future infections. Consumption of the micronutrients vitamin C, vitamin D, and zinc play a role in strengthening and protecting the immune system. Adequate protein intake also supports the immune system per Vahid and Rahmani (2021). They state that the anti-inflammatory diet not only aids the immune system but also boosts lung function and decreases oxidation.

Turmeric is a spice hailed for its anti-inflammatory properties. Turmeric contains curcumin (Vahid & Rahmani, 2021), which inhibits the expression of cytokines, thus decreasing the inflammatory response. This inhibitor has also been proposed as an antiviral intermediary for RTI (Vahid & Rahmani, 2021).

Ginger also belongs to the curcumin category, demonstrating similar antiviral and anti-inflammatory responses, such as its classmate turmeric. Ginger is thought to act by diminishing lung inflammation. See [Figure 14.6](#).



**FIGURE 14.6** Ginger, which has been shown to have anti-inflammatory effects, can be added to dishes as an ingredient or a spice. (credit: "English: Wild rice, ginger, carrots, peas, and celery - Massachusetts, USA" by Daderot/Wikimedia Commons, Public Domain)

Garlic has antioxidant, anti-inflammatory, and cholesterol-lowering effects. Garlic is high in folic acid, vitamin C, calcium, iron, magnesium, potassium, zinc, vitamin B<sub>2</sub>, vitamin B<sub>1</sub>, and vitamin B<sub>3</sub>. Garlic is thought to have antiviral, antibiotic, and antifungal effects on the body. See [Table 14.5](#).

Source	Role in the Body
Garlic	<ul style="list-style-type: none"> <li>Aids the immune system by preventing biosynthesis of inflammatory markers</li> <li>Related to the deterrence of virus from attaching to its host cells</li> </ul>
Onions	<ul style="list-style-type: none"> <li>Anti-inflammatory properties because of organosulfur compounds with quercetin and allicin</li> <li>Prohibit virus from attaching to its host cells</li> <li>Improves lung function as antioxidant, anti-inflammatory, and antiviral</li> </ul>
Vitamin C	<ul style="list-style-type: none"> <li>Neutralizes free radicals</li> <li>Minimizes anti-inflammatory markers</li> <li>Inactivates and interferes with virus proliferation</li> </ul>
Vitamin D	<ul style="list-style-type: none"> <li>Strengthens the immune system and helps to prevent RTI</li> <li>Anti-inflammatory properties by limiting inflammatory cytokine response</li> </ul>
Zinc	<ul style="list-style-type: none"> <li>Potentiates antioxidant and anti-inflammatory properties</li> <li>Strengthens the immune system by controlling inflammatory cytokines</li> </ul>
Omega-3 fatty acids	<ul style="list-style-type: none"> <li>Play a role in lung tissue remodeling</li> </ul>

**TABLE 14.5** Micronutrients and Their Role in Pulmonary Health (source: Vahid & Rahmani, 2021)

### Pulmonary Embolism

The American diet contains detrimental inflammation-causing triggers. Yuan et al. (2021) observed that a higher intake of French fries increased the risk for thrombosis. The incidence of pulmonary embolism decreased with a diet high in fresh fruits and vegetables. Pneumonia and pulmonary embolism have inflammatory response activation as compensatory mechanisms to combat the triggers of the disease processes.

## 14.3 Treatments and Nutrition

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 14.3.1 Identify drug-food interactions for their impact on treatments utilized for pulmonary disorders.
- 14.3.2 Identify treatments and medications that can cause nutritional deficiencies in clients with pulmonary disorders.

### Drug–Food Interactions with Treatments for Pulmonary Disorders

Medical interventions for pulmonary disorders may be associated with dietary interactions or adverse effects. Some medications used to treat chronic pulmonary disorders require dietary modifications, while other foods and supplements interact with the prescribed medications. When interactions do occur, harmful side effects can result, or interaction may limit the efficacy of the drug used to treat the illness.

Chronic pulmonary diseases such as asthma, COPD, and pulmonary fibrosis affect millions of people worldwide (NIH, 2022a; NIH, 2022b; NIH, 2022d). Treatment to manage these conditions includes a variety of medications in certain combinations. Bronchodilators, corticosteroids, and immunosuppressants help manage condition symptoms; however, these medications have the potential to interact with certain foods that may alter their absorption ability, limit effectiveness, and jeopardize safety. This section will provide an overview of everyday drug-food interactions associated with standard treatment options for pulmonary diseases.

Health care providers must discuss possible food and drug interactions with their clients to ensure that the medications are being used effectively with maximum results and minimize side effects. The nurse and health care provider should guide clients on the best ways to take prescribed medications and advise on potential dietary restrictions.

#### Bronchodilators

Bronchodilators are beta-2 adrenergic receptor agonists used as first-line medications to treat asthma and COPD. Foods such as caffeine enhance the efficacy of bronchodilators as a first-line treatment options (Wee et al., 2020), because caffeine shares the same effects in the body as bronchodilators. Side effects include tremors, nervousness, anxiety, and heart palpitations. On the other hand, meals high in dietary fat can prohibit the absorption of the bronchodilator (Santo et al., 2021). When the absorption is delayed, the effect of a beta-2 adrenergic receptor is diminished. So high-fat diets should be avoided in clients with asthma and COPD who use bronchodilators.

#### Corticosteroids

Corticosteroids are hormone mediators created in the adrenal cortex (Yasir et al., 2022). This medication class decreases airway inflammation in acute and chronic pulmonary conditions. Corticosteroids are used in asthma and exacerbation of COPD. Nurses should advise clients to take corticosteroids with food to prevent stomach irritation. Some foods—grapefruit, for example—may increase corticosteroid volume amounts in the bloodstream and increase the risk for adverse effects (Food and Drug Administration, 2021).

#### Antibiotics

Antibiotics are commonly used to treat lower RTI and while antibiotics, antivirals, and antifungals are common medical interventions for pneumonia. Levofloxacin is commonly used to treat RTI and pneumonia (DailyMed, 2022). Concurrently using levofloxacin with dairy products or calcium-fortified juices decreases the absorption of the medication and thus should be avoided (DailyMed, 2022).

Fruits and vegetables have antioxidant, antifungal, antibiotic, and antiviral qualities, which support the immune system (Vahid & Rahmani, 2021). These effects help the immune system combat the invader during the use of antibiotics.

### Treatments and Medication That Can Cause Nutritional Deficiencies

Certain medications and medical interventions can be lifesaving when discussing pulmonary disorders. However, these life-saving treatment options sometimes unintentionally affect a client's nutritional condition. These treatment modalities might lead to deficiencies in vital nutrients that maintain, prevent, or improve pulmonary function. It is crucial for health care providers to continuously monitor the clients they treat and educate them about

potential nutritional deficiencies and how to treat them. A balanced and nutrient-rich diet may help reduce nutritional deficiencies and support and improve overall respiratory function.

### Corticosteroids

As previously mentioned, corticosteroids are commonly used to decrease inflammation in the airways in conditions such as asthma and COPD (Yasir et al., 2022). Long-term use of corticosteroids causes some nutritional deficiencies. These deficiencies include decreased potassium, calcium, and vitamin D, which in turn increase the risk for decreased bone density, fractures, diminished muscle mass, muscle weakness, and osteoporosis.

### Oxygen Therapy

Sometimes, chronic pulmonary conditions such as COPD warrant long-term oxygen therapy. Long-term oxygen therapy in COPD clients contributed to deficiencies of vital nutrients in clients already suffering from malnutrition (Mekal et al., 2021). As the energy demand shifts during COPD, hypoxia (low oxygenation to tissues) causes decreased oxygenation and decreased normal intestine function (Zheng et al., 2015). As the body works to oxygenate, the decrease in intestine function causes a loss of nutrients (Zheng et al. 2015). Mekal et al. (2021) noted deficiencies in calcium, vitamins A, C, D, and E, and folates in about 95% of their COPD clients. The lack of vital nutrients impacts the pulmonary system's optimal functional capabilities by decreasing muscle strength and respiratory function. Clients with deficiencies need to be closely monitored and taught about nutrient-rich dietary options to select to minimize these insufficiencies in nutrients.

### Mechanical Ventilation

If an acute or chronic respiratory disease exacerbates to the point of life-saving measurement requirements, mechanical ventilation provides a break to the lungs to allow them time to rest (Kalaiselvan et al., 2021). According to Kalaiselvan et al. (2021), clients on mechanical ventilators do not have appropriate dietary intake, anorexia, and malabsorption of vital nutrients. The prolonged use of mechanical ventilation leads to vitamin D and calcium deficiencies. These deficits contribute to respiratory problems secondary to muscle weakness and difficulty weaning from the ventilator.

### Antibiotics

Malabsorption of vital nutrients contributes to pulmonary problems, limited immunity, and increased risk for RTI. Antibiotics are often used in the treatment plan for RTI and bacterial pneumonia (Sanivarapu & Gibson, 2023). Long-term use of antibiotics disrupts gut bacteria and prevents nutrient absorption, leading to deficiencies. According to Ramirez et al. (2020), healthy bacteria in the colon helps break down xenobiotics and other compounds that play a role in amino acid and vitamin synthesis within the colon. When antibiotics are used, they remove the healthy bacteria that helps vitamin synthesis in the colon, causing the deficiencies. Nurses should recommend probiotic-rich sources such as kimchi, sauerkraut, kefir, yogurt, and drinks such as kombucha to counter the loss of good bacteria with antibiotic use. These probiotic-rich interventions help combat the side effects of antibiotics that include nausea, vomiting, and diarrhea. When the nurse develops a discharge plan that includes antibiotic use, probiotic-rich foods and drinks should be included in the plan.

## Chapter Summary

- Nutrition plays a vital role in the growth, development, and maintenance of the pulmonary system throughout the lifespan. Starting in utero, maternal malnutrition can limit alveolarization and pulmonary vascular development in the fetus.
- Lung development continues through childhood and adolescence during which the child's lung volume expands and respiratory muscle strength increases. By adulthood, respiratory growth and development stabilizes and can begin to decline secondary to aging and comorbidities.
- Pulmonary conditions limit nutritional intake and lead to vitamin deficiencies. COPD is one of the most prevalent conditions affected by this. The diminished respiratory capacity among clients with COPD can limit the amount of food they are able to eat, placing them at high risk for nutritional deficiencies.
- Consuming a nutrient-rich diet boosts the immune system and helps prevent respiratory tract infections and pneumonia. An anti-inflammatory diet can also minimize the impact of infections. High-fat diets can exacerbate asthma and pulmonary fibrosis symptoms.

## Key Terms

**apoptosis** cellular death

**asthma** a chronic disease process clinically characterized by recurrent inflammation and airway narrowing, limiting gas exchange in the lungs

**chronic bronchitis** when the airway lining experiences too much inflammation, leading to increased mucus production

**chronic obstructive pulmonary disease (COPD)** chronic pulmonary diseases known as emphysema and chronic bronchitis

**emphysema** damage between the walls in the alveoli that exchange gas in the lungs

**free radicals** compounds that take part in the cellular destruction mechanism of phagocytosis through macrophages and granulocytes

**hyperemia** a condition that occurs as a result of a higher-than-normal blood flow

**pneumonia** a condition that leads to inflammation of

the lung parenchyma caused by infection, chronic pulmonary diseases, ventilator use, or aspiration; pneumonia can lead to chronic damage, such as lung fibrosis

**pulmonary embolism** a thrombus that becomes dislodged and travels to the lungs, preventing the natural flow of blood within the pulmonary artery or its branches

**pulmonary fibrosis** scarring of the lung tissues that causes stiffening, limiting lung function

**respiratory tract infections (RTI)** microorganisms that infect the upper and lower respiratory tract and lead to symptoms such as fever, sore throat, cough, chest pain, dyspnea, and myalgia

**rhinitis** inflammation that causes symptoms such as nasal congestion, runny nose, sneezing, and postnasal drip

## Review Questions

1. Based on physiological changes that occur during pregnancy, which nutrients should the nurse encourage a client to eat to support the pulmonary system and fetal development during pregnancy?
  - a. Carbohydrates
  - b. Vitamin C
  - c. Proteins
  - d. Vitamin B
2. Nutritional factors play a role in the development and function of the pulmonary system during infancy. Which nutrient is essential for the development of the pulmonary system?
  - a. Iron
  - b. Protein
  - c. Vitamin C
  - d. Omega-3 fatty acids
3. The nurse is caring for a pregnant client who has nutritional deficits. How should the nurse describe the potential fetal effects from maternal malnourishment?
  - a. The fetus will experience lower blood glucose levels.

- b. The fetus will develop a slower-than-normal heart rate.
  - c. The fetus may develop cognitive and behavioral delays.
  - d. The fetus may experience hormone imbalances.
4. The nurse is working with a client who was recently diagnosed with asthma and is using a bronchodilator inhaler. Which of the following foods should the nurse instruct the client to minimize or avoid?
- a. Steak
  - b. Coffee
  - c. Grapefruit
  - d. Kale
5. The nurse is providing prenatal diet instruction for a pregnant client. Which nutrients should the nurse encourage the client to consume to promote explain proper fetal lung function and development?
- a. Proteins, vitamins A, D, and E, and omega-3 fatty acids
  - b. Carbohydrates and vitamins A, D, and E
  - c. Proteins and iron
  - d. Fats, vitamins B<sub>12</sub> and B<sub>6</sub>, and calcium
6. The nurse is providing discharge teaching for a client with respiratory alterations. Which of the following statements regarding the effects of nutrition on the immune system and lung health should be included in the plan?
- a. Good nutrition is important, although it does not prevent acute respiratory tract infections.
  - b. Nutrition only affects lung tissue repair, not the immune system.
  - c. Improper nutritional intake alters the immune system but does not impact lung health.
  - d. Nutrition plays a role in supporting the immune system to prevent and treat infection and repair lung tissue.
7. The nurse is instructing the parent of a child recently diagnosed with asthma. Which of the following foods should the nurse instruct the parent to include with the child's meals to decrease the risk for an asthma exacerbation?
- a. Salmon or other fatty fish
  - b. A lean protein such as chicken
  - c. At least one serving of fruits and vegetables
  - d. A serving of red meat
8. The nurse is counseling a client experiencing worsening COPD symptoms on diet strategies to minimize the impacts of the disease. Which dietary component is associated with worsening airway inflammation and lung function limitations?
- a. Saturated fats
  - b. Carbohydrates
  - c. Vitamins
  - d. Unsaturated fats
9. What is the goal of an anti-inflammatory diet for clients with RTI and pneumonia?
- a. To limit the immune system's response
  - b. To increase the immune system's response
  - c. To decrease lung function and reduce coughing
  - d. To minimize the duration of and decrease the risk for infections
10. The nurse is instructing a client on long-term oxygen therapy at home on the role of nutrition in managing the client's condition. Which of the following statements by the client indicates the client understands the instruction?
- a. "I know my GI tract is not getting as much oxygen as it used to, so I need to make sure I get enough

- vitamins and minerals in my body.”
- b. “I need to eat whatever I feel like I can – calories are the most important thing.”
  - c. “I need to eat as much protein as possible.”
  - d. “I need to try to avoid foods high in calcium as these can affect my condition.”

## Suggested Reading

Calcium NIH recommendations: <https://ods.od.nih.gov/factsheets/Calcium-HealthProfessional/>

Magnesium NIH recommendations: <https://ods.od.nih.gov/factsheets/Magnesium-Consumer/>

Selenium NIH recommendations: <https://ods.od.nih.gov/factsheets/Selenium-HealthProfessional/>

Vitamin A NIH recommendations: <https://ods.od.nih.gov/factsheets/VitaminA-Consumer/>

Vitamin C NIH recommendations: <https://ods.od.nih.gov/factsheets/VitaminC-Consumer/>

Vitamin D NIH recommendations: <https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/>

Vitamin E NIH recommendations: <https://ods.od.nih.gov/factsheets/VitaminE-Consumer/>



## CHAPTER 15

# Applying Clinical Judgment to Promote Nutrition for Renal Wellness



**FIGURE 15.1** Complex carbohydrates, such as breads containing whole grains that are rich in fiber, can have positive effects on the renal system, helping to effectively eliminate waste from the body. (credit: modification of work “Loaves of nice bread” by ProjectManhattan/Wikimedia Commons, CC0 1.0.)

## CHAPTER OUTLINE

- 15.1 Assess and Analyze the Impact of Nutrition on the Renal System
  - 15.2 Plan Nutritional Strategies to Impact Renal Wellness
  - 15.3 Implement Nutritional Strategies to Impact Renal Wellness
  - 15.4 Evaluate Nutritional Strategies to Impact Renal Wellness
- 

**INTRODUCTION** The renal system, which comprises the kidneys, ureters, bladder, and urethra, works to eliminate liquid wastes from the body, manage fluid and electrolyte balance, and regulate blood pH, volume, and pressure. Nutrition markedly impacts this system and can affect morbidity and mortality of clients with abnormal or malfunctioning renal systems. This chapter focuses on assessment of the renal system and analysis of abnormal findings and potential illnesses. The chapter will illustrate how to use this knowledge to identify important nutritional needs and deficiencies to best educate clients on ways to improve morbidity and mortality surrounding renal system illnesses.

Consider this case: Jose Vasquez, a 55-year-old client in an outpatient care setting who returns frequently for regular health evaluations. The client’s diagnoses include obesity, hypertension, diabetes mellitus type 2, and chronic kidney disease (CKD) stage 2. The client receives routine education on dietary and lifestyle changes needed to best preserve kidney function and prevent disease advancement.

## 15.1 Assess and Analyze the Impact of Nutrition on the Renal System

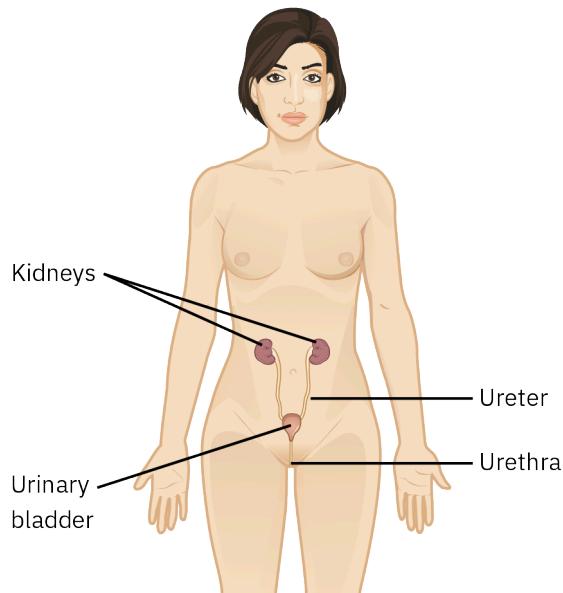
### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 15.1.1 Recognize the normal function of the renal system.
- 15.1.2 Recognize cues of nutritional impact on the renal system.
- 15.1.3 Analyze cues of nutritional impact on the renal system.

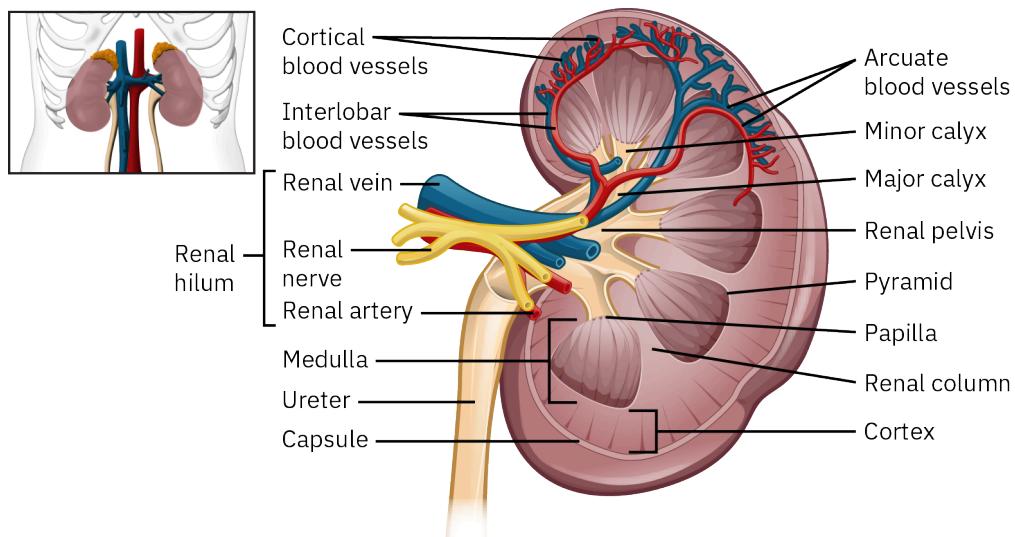
### Normal Function of the Renal System

The renal system contains the kidneys, urinary bladder, ureters, and urethra ([Figure 15.2](#)) The **kidneys** (the primary organs in this system) filter blood and remove serum wastes, excrete wastes from the body, maintain blood pressure (National Institutes of Health, National Cancer Institute, n.d.), maintain acid-base balance, and balance fluids. The kidneys are also responsible for reabsorption of glucose, amino acids, bicarbonate, water, and phosphate, as well as chloride, sodium, magnesium, calcium, and potassium ions (Newman, 2023).



**FIGURE 15.2** The major organs of the renal system are responsible for regulating the composition and volume of bodily fluids, as well as eliminating waste products from the body. (credit: modification of work from *Anatomy and Physiology* 2e. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

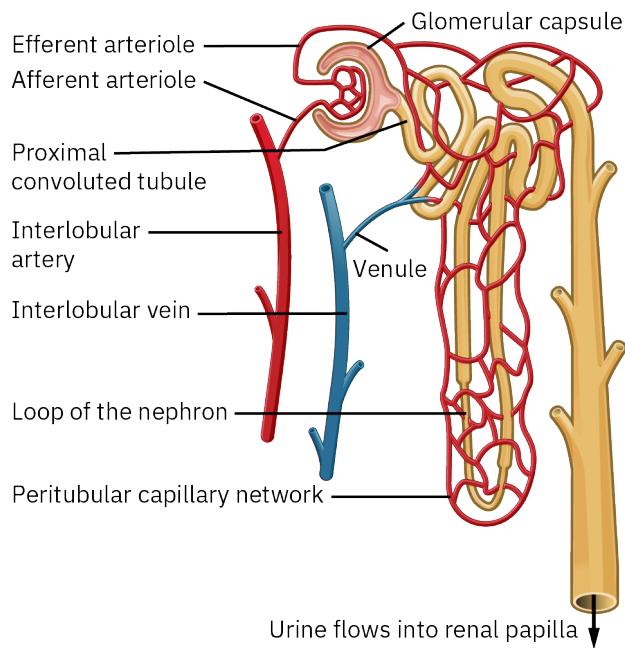
There are two kidneys, each located between the twelfth thoracic and third lumbar vertebrae on either side of the vertebral column. The right kidney is slightly lower than the left because of the liver. A fibrous connective tissue known as the **renal capsule** covers the outermost layer of the kidneys ([Figure 15.3](#)).



**FIGURE 15.3** The kidneys filter waste products and excess fluids from the blood, regulate fluid balance, and produce hormones that help control blood pressure and stimulate production of red blood cells. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Renal Cortex and Medulla

The next layer of the kidney is the **renal cortex**, followed by the **renal medulla**. The renal medulla consists of a series of renal pyramids that contain straight tubular structures and blood vessels. The top point of these pyramid-like structures, known as the **renal papilla**, points toward the innermost layer of the kidney, called the **renal pelvis**, which is found within the renal sinus. The renal sinus (cavity) collects urine that is produced by the functioning layer of the kidney, the **parenchyma** (the renal cortex and medulla together). Inside the parenchyma are the nephrons, the basic functioning units of the kidney ([Figure 15.4](#)).



**FIGURE 15.4** The nephron filters the blood and produces urine. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Nephrons

Each kidney has roughly 1 million nephrons (Cleveland Clinic, 2023b, 2023c). A **nephron** is the functional unit of the kidney and contains two parts: the **glomerulus**, which is a cluster of capillaries and nerve endings that cluster around its second part, the renal tubule. Urine created in the nephrons will pass into collecting ducts and flow to the minor calyces, to the major calyces, into the renal pelvis, and out of the kidney into the ureter.

The kidneys remove three primary wastes: urea, uric acid, and drugs and their metabolites. **Urea** are wastes from protein breakdown, while **uric acid** is waste from the breakdown of nucleic acids (Newman, 2023).

### Hormone Production

The kidneys also play a role in the production of certain hormones that support other body processes. For example, they help balance blood pressure by retaining water and sodium in the body; they also produce **renin** that helps to maintain appropriate blood pressure by managing water reabsorption (Merck Manuals, 2023). The kidneys assist with red blood cell production: they create and release **erythropoietin**, a hormone that signals the bone marrow to produce red blood cells. Another hormone, calcitriol, which is a form of vitamin D that helps the body absorb calcium and regulates the parathyroid hormone, is produced by the kidneys. The kidneys also help to raise glucose levels through employing **gluconeogenesis**—the formation of glucose from precursors—in the renal cortex.

### Renal Artery, Renal Vein, and Ureters

Two other important kidney components are the renal artery and the renal vein. The renal artery controls blood flow to the kidneys for both supply to the organ and for filtering purposes. Blood flows through this artery at a rate of 1.2 L/min (Dalal, Bruss, & Sehdev, 2022). The renal vein carries filtered blood back to the heart, away from the kidneys.

The **ureters** are small tubes that run from the renal pelvis to the urinary bladder, allowing for urine passage (National Institutes of Health, National Cancer Institute, n.d.). The urine is moved by way of peristalsis, or the involuntary constriction and relaxation of musculature that promotes movement. The layers of the ureters include the fibrous coat (outer layer), the muscular coat (middle layer), and the mucosa (inner layer).

### Bladder

The urine that passes down the ureters travels to the **urinary bladder**, a temporary storage area for urine located in the pelvic cavity, posterior to the **symphysis pubis**. The layers of the bladder include the outer superior surface layer, the parietal peritoneum, and the outer fibrous connective tissue. The detrusor muscle is made up of interwoven smooth muscle fibers that control the contraction of the bladder during urination; the submucosa, which supports the mucous membrane and is composed of connective tissue; and the innermost layer, the mucous membrane, which is composed of transitional epithelium that runs continuous with the ureters.

To prevent backflow of urine into the ureters, small flaps of mucosa cover the opening of the ureters into the bladder and act as valves; the internal urethral sphincter, located at the bottom of the bladder, is controlled by the detrusor muscle to control exit of urine through the urethra.

### Urethra

The **urethra** is a thin-walled, hollow tube-like duct that allows urine to pass from the bladder to the outside of the body. The urine enters the urethra through the internal urethral sphincter; to exit the urethra, it passes through the final controlled muscle, the external urethral sphincter, which is composed of striated muscle fibers. The urethra's layers include the fibroelastic connective tissue layer (outer layer), smooth muscle layer (middle layer), and epithelial spongy submucosa (inner layer).

### Adrenal Gland

Although **adrenal glands** are not part of the renal system, they are an extremely important accessory gland. One adrenal gland, or suprarenal gland, sits atop each kidney. These glands release a hormone called **aldosterone**, which helps to balance the blood pH and fluid balance by signaling the excretion of potassium and the reabsorption of sodium by the kidneys; aldosterone is part of the renin-angiotensin-aldosterone system to help manage blood pressure (Merck Manuals, 2023). The other major role adrenal glands play is in the release of **cortisol**. Cortisol has several uses in the body such as helping to maintain blood pressure, increase glucose levels, reduce inflammation, and control metabolism. The relationship to the kidneys comes into play when cortisol signals the kidneys to reabsorb specific electrolytes and excrete others based on the function it is trying to accomplish in the body at a given time.

## Assessment of Nutrition and the Function of the Renal System

Assessment of the renal system starts with collecting subjective data about urinary symptoms the client is experiencing. Assessing for fluid retention, over- or underproduction of urine, and fluid deficit is useful when assessing renal function. Swelling, unexplained weight gain, difficulty breathing, and very clear urine are some

symptoms a client might report that are important to the assessment of the renal system. Additional symptoms might include dysuria (painful or difficult urination) (Urology Care Foundation, 2023), urinary urgency, or urinary frequency. Other information concerning urinary incontinence, passage of urinary stones, color and clarity of urine, retention of urine, and nocturia (nighttime urinary frequency). Objective data collected to validate these subjective findings can include assessment of limb edema, crackles in the lungs, intake and output measurements, and testing of the urine directly.

After collecting subjective data, the nurse should complete a physical examination of the renal system. This can be done through organ evaluation and measurement of function results. The physical assessment of the organs should begin with the abdominal assessment procedure as described in [The Digestive Process](#) with some special considerations to focus on the renal system during this assessment.

The first step is an inspection of the skin, during which the nurse should examine the color and look for masses, bulging areas, or distention. Skin discoloration may indicate anemia, if pale or cyanotic; a bulging area above the symphysis pubis may indicate urinary retention or a full bladder; and distention may indicate fluid build-up. Next, during auscultation of the abdomen, hyperactive bowel sounds can indicate diarrhea, which can result from hyperkalemia (Cleveland Clinic, 2023a), possibly related to renal issues. During palpation of the abdomen, hyperkalemia may manifest as abdominal tenderness; severe skin dryness may mean dehydration; and an overdistended bladder seen through palpation may indicate urinary retention issues. To palpate the right kidney, the nurse should place one hand under the right flank of the client and press downward against the outer edge of the right abdomen to “sandwich” the kidney, which should be smooth and firm (Roscoe, 2022). The left kidney cannot normally be palpated—unless enlarged—due to its location behind the bowel (Roscoe, 2022). Abdominal palpation can also identify urinary retention and a full bladder by identifying fluid in an enlarged bladder. During the final step—percussion of the abdomen—a dullness above the symphysis pubis may indicate bladder distension (Maddukuri, 2022b).

## SAFETY ALERT

### Contraindications for Deep Palpation

Deep palpation is contraindicated in clients with suspected abdominal aortic aneurysm, appendicitis, polycystic kidney disease, kidney transplantation history, or a tender spleen, due to a risk for injury to the client and rupture of organs (Roscoe, 2022).

### Bladder Scanning

Bladder scanning is another way to evaluate the bladder and its ability to effectively empty. This scan can assist in determining whether a client is retaining urine, indicated by bladder distention and abdominal fullness and discomfort. Post void residual (PVR) volume can be measured with a bladder scan machine, which is a portable, hand-held, non-invasive, ultrasound device. A wand is placed at the suprapubic area for examination immediately after the client voids and attempts to fully empty their bladder (Ballstaedt & Woodbury, 2022). Results help to determine if the bladder is being emptied adequately during **micturition**, or urination; determine if urine is being produced in those with renal illness; and assess for any bladder tumors, diverticula, or stones that may be present. For young and middle-aged adults (ages 18–65 years), a PVR of less than 50 mL is considered normal, over 200 mL is considered inadequate; for older adults (over age 65), 50 to 100 mL is considered normal; and for children, more than 20 mL is considered abnormal. A PVR over 500 mL, combined with identified neurologic findings, is highly predictive of cauda equina syndrome, a dysfunction affecting the multiple lumbar and sacral nerve roots of the cauda equina, which can cause a need to strain or an altered flow or altered awareness of the need to urinate.

## SAFETY ALERT

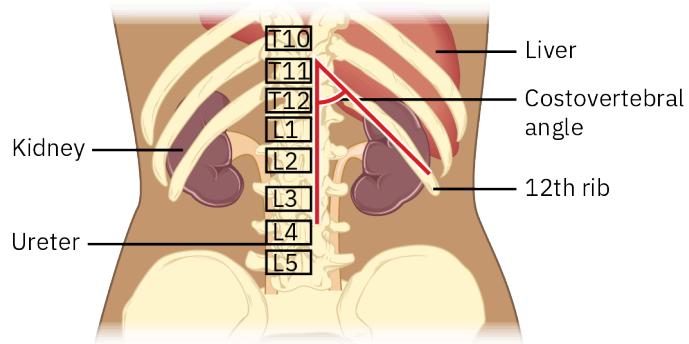
### Bladder Scanning During Pregnancy

Bladder scanning is not suitable on clients who are pregnant, those with uterine prolapse, or those with severe abdominal scarring and abdominal ascites because these conditions may prompt false high results (Ballstaedt & Woodbury, 2022).

### Other Body Assessments

In assessing the renal system, the nurse should examine the chest, skin, **costovertebral angle** (the area on the back flank at the bottom of the 12th rib forming a 90-degree angle to the spine, as shown in (Figure 15.5), rectum, groin and genitals, and neurologic system. In examining these areas, the nurse should:

- Auscultate the chest for heart and lung sounds (Maddukuri, 2022a).
- Examine the skin for color, turgor, and temperature.
- Evaluate neurologic indicators such as level of consciousness, orientation, ability to speak and write clearly, and movements of the hands.
- Review the costovertebral angle for pain (Maddukuri, 2022b).
- Determine if there is any prostate enlargement by completing a rectal examination. (Although the prostate has no relation to the renal system itself as far as function, if it enlarges, it can press against the urethra, preventing urine from exiting the body).
- Examine the groin and genitals for herniation, deviation from normal anatomy, especially of the urethra, possible signs of infection, and any masses.



**FIGURE 15.5** Pain or tenderness at the costovertebral angle, the angle formed by the intersection of the 12th rib and the vertebral column on either side of the spine, should be evaluated for pain or tenderness, as it can indicate problems with the kidneys or urinary tract. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

### Glomerular Filtration Rate, Serum Creatinine, and Blood Urea Nitrogen Tests

In addition to physical assessment, several pertinent tests are used to determine the proper functioning of the renal system and are the true indicators of health. The three major serum tests are the glomerular filtration rate (GFR), serum creatinine, and blood urea nitrogen (BUN) (Centers for Disease Control and Prevention, 2022; National Kidney Foundation, n.d.). The GFR measures how well the kidneys remove excess fluids and waste products from the blood (factoring in age and sex). This test is related to the 24-hour creatinine clearance test, because it can also identify how well the kidneys filter out wastes. The GFR can be used to evaluate the client for acute kidney injury (AKI) as well as to determine the stage of CKD and when the kidneys have failed completely, requiring transplantation or dialysis. Normal GFR for adults (18–69 years) is above 90 mL/min/1.73 m<sup>2</sup>; adults (70 years and older) should be greater than 60 mL/min/1.73 m<sup>2</sup>; children and adolescents (3–17 years) should be greater than 80 mL/min/1.73 m<sup>2</sup>; and newborn to 2 years should be 40–60 mL/min/1.73 m<sup>2</sup> (Mitchell, Strafford, & Tavares, 2022; National Kidney Foundation, 2023a).

Serum creatinine is a measurement of the waste product from muscle energy consumption and muscle damage from the kidneys, whereas BUN is a waste product that comes from ingested proteins excreted by the kidneys. Serum creatinine levels should be 0.74–1.35 mg/dL for men 19 years and older, 0.59–1.04 mg/dL for women 19 years and older, and 0.5–1.0 mg/dL for children ages 2–18 years. Normal BUN levels for all ages are 6–24 mg/dL.

### Urine

Testing urine can indicate how well the renal system maintains fluid balance by measuring hydration status and volume produced. The 24-hour creatinine clearance test measures the amount of creatinine excreted directly into the urine and is conducted through a urine sample collection process completed over 24 hours (Centers for Disease Control and Prevention, 2022; National Kidney Foundation, n.d.). If the creatinine clearance amount is low, then the kidneys are not filtering properly. A full urinalysis can test for pH, sodium, potassium, urea, creatinine, uric acid,

phosphorus, calcium, chloride, ammonia, water, ketones, nitrites, blood, glucose, protein, and leukocytes to evaluate for infection and renal damage (Mitchell, Strafford, & Tavares, 2022). Most often, a urine dipstick test is used, which can test for blood, urine specific gravity, urine pH, glucose, protein, nitrates, and leukocytes (Mitchell, Strafford, & Tavares, 2022). A more specific dipstick urinalysis test, the albumin dipstick test, checks for microalbuminuria that is caused by smaller protein amounts than the standard urine dipstick test can detect. This test can help identify kidney disease in clients who have a negative test for excess protein in the urine in the regular urinalysis testing but who are at high risk for kidney disease (National Kidney Foundation, n.d.). Another specific urine test is the albumin-to-creatinine-ratio that uses the amount of albumin and creatinine levels to form a ratio, which indicates the level of kidney function.

### Image and Biopsy Tests

Imaging tests—such as ultrasound and computed tomography (CT) scans—and biopsies can also be conducted to monitor the function of the kidneys. An ultrasound image of the kidneys can identify obstructions in the urinary tract and evaluate the size and position of the kidneys. A CT scan of the kidneys can help identify obstructions, structural abnormalities (National Kidney Foundation, n.d.), and kidney disease, which would present as abscesses, masses, cystic masses, blockages, or lesions. A kidney biopsy is conducted by taking a sample of the kidney tissue, usually through CT-guided or ultrasound-guided sharp needle aspiration. The tissue sample is then evaluated under the microscope for irregularities like inflammation, protein deposits, or damage, such as scarring or cancerous anomalies (National Kidney Foundation, 2023b).

### Serum Electrolyte Testing

Serum electrolyte testing monitors fluid balance and electrolyte levels, both of which are regulated by the kidneys. Irregular values can indicate issues with function. The major electrolytes—sodium, potassium, calcium, and phosphorus—are monitored; however, bicarbonate, chloride, and magnesium are also important indicators of kidney function. This list describes the importance of monitoring these nutrients:

- Sodium plays a significant role in maintaining fluid and acid-base balance and is primarily regulated by the kidneys. If the kidneys are not functioning properly, sodium values can be impacted (Newman, 2023).
- Potassium, primarily regulated by the kidneys, is an important electrolyte to monitor because minor deviations can cause a client to experience life-threatening problems such as cardiac dysrhythmias, also known as an irregular heartbeat.
- Calcium and phosphorus have an inverse relationship—when one is high, the other is low. Calcium is extremely important to body functions and the musculoskeletal system. If calcium levels get too low, bone structure can break down and be life threatening for a client who has renal disease. Although calcium is not excreted through the kidneys, increased phosphorus levels is a common issue in renal failure. Phosphorus levels must be restricted to prevent low calcium levels.
- Although the kidneys regulate bicarbonate levels, they are not as easily attributed to kidney function—other pathologies in the body and compensatory mechanisms can impact these levels.
- Chloride is excreted and reabsorbed, along with sodium, from the blood. It is, however, found in higher amounts in interstitial compartments and lymph fluid than in the blood, so monitoring sodium is more important than monitoring chloride for fluid balance because most of these storage areas cannot be measured. It is still important to ensure excessive intake in chloride is addressed, as this can lead to an increase in sodium levels, fluid retention, and edema.
- Magnesium plays an important role when renal failure is present because excessive intake can lead to hypermagnesemia and can exacerbate or cause hypocalcemia. Regular functioning kidneys remove excess magnesium, but in the case of failure and an inability to filter, hypocalcemia can become a serious issue leading to **renal bone dysplasia**, a life-threatening condition in which the body breaks down the bones to increase blood calcium levels by releasing the calcium stored in bones.

## SPECIAL CONSIDERATIONS

### COVID-19 and Renal Function

Clients who have a history of COVID-19 infection, particularly severe COVID-19 infection, should be evaluated for renal damage and failure, despite prior history because “30% of clients who are hospitalized with COVID 19

develop AKI" and "more than 50% who are admitted to the intensive care unit with kidney injury require dialysis." This relationship is still being researched, but several hypotheses are currently being considered:

- COVID-19 directly targets renal cells.
- The decrease in oxygen from respiratory failure starves and damages the kidneys.
- COVID-19 causes a cytokine storm that destroys renal cells.
- COVID-19 causes clots that damage the small vessels in the kidneys (Sperati, 2022).

## Analysis of Nutrition and the Renal System

Subjective and objective data should be collected, as previously discussed, to evaluate abnormal findings and the possibility of malfunction in the renal system. The nurse should complete an analysis of the client's nutritional status through the client's lab values and all assessment findings. A baseline of the renal system should then be established and used to develop a nutritional plan.

When assessing the client, the nurse should ask about dysuria (Urology Care Foundation, 2023), urinary urgency, urinary frequency, urinary incontinence, passage of renal stones, color and clarity of urine, retention of urine, and any issues with nocturia. These findings can indicate several pathologies, including **cystitis** (inflammation of the bladder caused by infection from bacteria). Cystitis is commonly referred to as a urinary tract infection (UTI).

Dysuria can also be related to **pyelonephritis**, an infection of the upper urinary tract that involves the parenchyma and kidney pelvis. Pyelonephritis is also a UTI, but it is more serious and is usually accompanied by fever, flank pain, nausea and vomiting, hematuria, and suprapubic tenderness, all of which can be subjective data that is also objectively verifiable.

A report of nocturia, oliguria (low urine output), or anuria (absent urine output) with foamy quality urine can be related to CKD. CKD will very often include many other subjective complaints that will be verifiable by objective data as well. Other assessment data that could indicate CKD include lethargy, fatigue, headache, breathlessness, edema, symptoms relating to anemia, anorexia, nausea, vomiting, weight loss, cramping muscles, **hematuria** (blood in the urine), and **pruritis** (uncomfortable itching). Findings of colicky pain, hematuria, nausea, and vomiting can be an indication of renal lithiasis, or kidney stones. Discharge from the penis or vagina, dysuria, frequency, and purulent drainage from the penis all can be indicative of sexually transmitted infection.

When physical assessment findings indicate potential pathologies in the renal system, testing can assist in diagnosing the issue. GFR will indicate if there is a decrease in the function of the kidneys when the results are less than normal. Serum creatinine should be tested with the BUN results to evaluate kidney function. If the creatinine is high and the BUN is high, kidney functioning is insufficient. [Table 15.1](#) lists laboratory tests typically performed to evaluate possible renal system issues and their relationship to the renal system.

Lab Test	Results	Relationship
White blood cell count	Elevated	UTI
Potassium	Elevated	CKD
Sodium	Decreased	Fluid overload and edema from CKD
Calcium	Decreased or elevated	CKD/hyperparathyroidism related to CKD/renal osteodystrophy
Bicarbonate	Decreased	CKD
Phosphorus	Elevated	CKD
Magnesium	Elevated	CKD or AKI
Chloride	Decreased	Fluid overload and edema from CKD

**TABLE 15.1** Testing for Renal System Abnormalities and the Relationship to the Renal System

## 15.2 Plan Nutritional Strategies to Impact Renal Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 15.2.1 Prioritize the hypotheses of nutritional habits that optimize renal wellness.
- 15.2.2 Generate solutions to optimize renal wellness utilizing nutritional habits.

### Planning Nutrition Goals

The nurse should consider a client's current renal system when planning nutritional goals; therefore, plans will vary accordingly. For the client with healthy kidneys, the goals of nutrition should focus more on dietary needs for comorbidities, including limiting sodium, trans fats, saturated fats, and alcohol; eating appropriate amounts of protein; and maintaining adequate fluid balance.

When creating nutritional plans for clients with compromised kidneys, the nurse should collaborate with a renal dietitian and consider all laboratory test values. The plans for these clients should focus on limiting fluid intake, potassium, phosphorus, sodium, trans fat, saturated fats, magnesium, and proteins, while increasing calcium. Note that at the start of dialysis, slightly different restrictions apply.

### The Healthy Renal System Goals

The nurse should direct clients with a healthy renal system and no comorbidities to consider nutritional goals for renal wellness. A good starting point is to use the MyPlate portioning method with every meal (de Bellefonds, 2021). In addition, it is important to limit sodium intake to no more than 2300 mg/day. Because the majority of sodium intake comes from processed foods and not table salt, encourage clients to avoid pre-processed foods or, at minimum, choose no-sodium or low-sodium options.



### MYPLATE

[MyPlate](https://openstax.org/r/myplateg) (<https://openstax.org/r/myplateg>) pictorially represents healthy portion sizes of different food groups in a nutritionally sound diet. This tool is useful as a good starting point for any healthy client trying to improve their nutritional intake to maintain health.

Clients should also be aware of protein intake because protein byproducts are filtered through the kidneys. Clients should eat enough protein to maintain overall health, but not consume too much because the kidneys will have to work extra hard.

The nurse should encourage the client to choose complex carbohydrates such as whole grains, fruits, vegetables, lentils, and beans over simple carbohydrates such as sweetened beverages, packaged foods, and desserts (de Bellefonds, 2021). Heart health is important to kidney health, so limiting saturated fats and avoiding artificial trans fat is recommended. The client should consider limiting, or even eliminating, their alcohol intake. Alcohol is a waste product that the kidneys need to filter out, making it less efficient to filter out other things during this time; alcohol is also dehydrating, which affects the kidneys' ability to regulate the body's hydration status.

Another factor the nurse should consider is any comorbidities a client has. For example, a client who has a healthy renal system but has hypertension or diabetes is at much higher risk for developing CKD. Dietary goals should include foods that will keep these pathologies under control, as well as include nutrients that support renal health once a client has developed CKD.

### SPECIAL CONSIDERATIONS

#### Fads for Weight Loss—Dangers to Renal System Health

Diets that promote excessive or reduced intake of specific nutrients, such as protein or carbohydrates, can be dangerous because they limit many nutrients and promote disease. For example, diets with excess red meats and saturated fats may cause heart disease; diets high in protein can lead to intraglomerular hypertension that may cause renal hyperfiltration, glomerular injury, and proteinuria, which could lead to CKD (Gang-Jee, et al., 2020). Well-known diets that require extreme nutritional changes include Atkins, Keto, Dukan, Montignac,

Scarsdale, Stillman, and the Zone.

### Goals for Clients with CKD

Clients with CKD need to follow the preceding guidelines, but they also have more restrictions. For clients who have CKD and diabetes and/or hypertension, the following restrictions are also required in addition to their original nutritional plan dictated by their comorbidity, categorized by stage [Table 15.2](#).

Stage	GFR	Function	Water Intake	Nutrient Intake
1	≥ 90 mL/min/ $1.73\text{ m}^2$	<ul style="list-style-type: none"> <li>Working well.</li> <li>Client is unaware of deficiencies.</li> </ul>	<ul style="list-style-type: none"> <li>Increase water intake.</li> </ul>	<ul style="list-style-type: none"> <li>Consume low-fat and low-sodium diet.</li> </ul>
2	60–89 mL/min/ $1.73\text{ m}^2$	<ul style="list-style-type: none"> <li>Still functioning.</li> <li>Client may be asymptomatic or show signs of hypertension.</li> </ul>	<ul style="list-style-type: none"> <li>High water intake.</li> </ul>	<ul style="list-style-type: none"> <li>Continue low-fat and low-sodium diet.</li> <li>Add foods higher in calcium and magnesium.</li> </ul>
3A	45–59 mL/min/ $1.73\text{ m}^2$	<ul style="list-style-type: none"> <li>Decrease in function, with kidneys starting to decline.</li> <li>Client will have hypertension.</li> <li>Client may have anemia, fatigue, anorexia, malnutrition, and bone pain.</li> </ul>	<ul style="list-style-type: none"> <li>Continue high water only if no edema or heart failure present.</li> <li>If client has heart failure or edema, restrict fluids.</li> </ul>	<ul style="list-style-type: none"> <li>Continue with low-fat and low-sodium diet and food options that are high in calcium and magnesium.</li> <li>If heart failure or edema is present, restrict foods with phosphorus, potassium, and protein, limiting proteins that are plant-based or from lean meats.</li> </ul>
3B	30–44 mL/min/ $1.73\text{ m}^2$			

**TABLE 15.2** Nutrient Intake for Clients with CKD, Dependent on Stage of Failure (source: National Kidney Foundation, 2023a)

Stage	GFR	Function	Water Intake	Nutrient Intake
4	15–29 mL/min/ 1.73 m <sup>2</sup>	<ul style="list-style-type: none"> <li>Severe decline in kidney function; may need dialysis.</li> <li>Client will have hypertension, anemia, malnutrition, altered bone metabolism, edema, metabolic acidosis, hypocalcemia, an elevated BUN and creatinine. Client may have uremia and azotemia.</li> </ul>	<ul style="list-style-type: none"> <li>Restrict fluids.</li> </ul>	<ul style="list-style-type: none"> <li>Restrict intake of fat, sodium, potassium, phosphorus, and magnesium.</li> <li>Increase intake of calcium.</li> <li>If not yet on dialysis, restrict protein.</li> <li>If dialysis has been started, increase protein.</li> </ul>
5	< 15 mL/min/ 1.73 m <sup>2</sup>	<ul style="list-style-type: none"> <li>End-stage renal disease (ESRD).</li> <li>Client will have complete kidney failure in which all other symptoms are present and worsened.</li> <li>Client will have azotemia with overt uremia and require dialysis or renal transplantation to survive.</li> </ul>	<ul style="list-style-type: none"> <li>If on dialysis, follow stage 4 recommendations.</li> <li>If recipient of a kidney transplantation, follow regular healthy diet.</li> </ul>	<ul style="list-style-type: none"> <li>If on dialysis, follow stage 4 recommendations.</li> <li>If recipient of a kidney transplantation, follow regular healthy diet.</li> </ul>

**TABLE 15.2** Nutrient Intake for Clients with CKD, Dependent on Stage of Failure (source: National Kidney Foundation, 2023a)

### Identifying Challenges to Nutritional Goals

Many barriers exist for clients with CKD—the more advanced the disease, the higher the likelihood that a client will, either deliberately or accidentally, not follow a nutritional plan. The nutritional plan for clients with CKD restricts fluids, fat, sodium, phosphorus, protein, magnesium, and potassium and increases calcium, which presents many challenges, especially before transplantation. The nurse should counsel the client on the following:

- Restricting fluids can be extremely difficult; the kidneys will excrete more urine if unable to concentrate solutes in smaller urine amounts. The client will then become extremely thirsty because they are losing much more water than they are permitted to drink each day.
- Sodium and phosphorus are not only found in certain fresh items but are also added to many processed foods as preservatives. Processed foods are much cheaper and more readily available to clients with busy lives, so it is more difficult to avoid these types of foods. Fast foods—prepared foods that are readily available—are not only extremely high in both sodium and phosphorus, but also in fat content. The nurse should counsel the client to limit their fast-food intake to only once or twice a week.
- The client with CKD also needs to understand how to combine plant protein sources in the right amounts and types to replace proteins easily found in meat. Although lean meat protein sources are acceptable, options tend to be more expensive.
- The challenge faced when limiting magnesium is that many food sources high in magnesium are high in plant proteins, which can replace meat proteins, making selections more limited. Another difficult balance to achieve with magnesium is that many high calcium foods that need to be increased are also high in magnesium.
- Lastly, potassium is found naturally in a variety of fresh and healthy food choices. Many foods that the client was taught to eat before they had CKD to manage hypertension, diabetes, or any number of other comorbidities, will be ones they now have to avoid due to high potassium content. Potassium is the opposite of most other foods on the list—it is high in fresh food options and low in processed food options.

## 15.3 Implement Nutritional Strategies to Impact Renal Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 15.3.1 Assess the client for readiness to learn.
- 15.3.2 Teach nutritional strategies to optimize renal wellness.

### Holistic Nursing Assessment of the Client

When providing holistic care, the nurse should address potential barriers the client may face in accessing healthy foods. According to the World Health Organization, 30–55% of health outcomes are influenced by social determinant health disparities such as economic stability, food security, social context, and environment, among others (Reinoso et al., 2022; World Health Organization, 2020). Many of the fresh foods recommended on a customized nutritional plan for renal disease are often more expensive and harder to obtain than packaged or processed foods. To set the client up for success in following the plan, the nurse should inquire about any food security issues the client has. The nurse should create a plan that addresses the client's insecurities and further support the client by connecting them to the appropriate resources.



### HELPFUL PROGRAMS

The nurse should refer clients to one of the [multiple government programs](https://openstax.org/r/fnsusda) (<https://openstax.org/r/fnsusda>) available to help with food security issues.

### Client Teaching

Client adherence to the nutritional plan may also be difficult if they are lacking education or fail to engage in a plan. If the client does not understand diet restrictions or the need to follow them, they are not likely to follow the prescribed diet. Client and family or caretaker engagement in the planning of their diet and in the active learning process is considered essential to success—engaged clients are more likely to be proactive in the management of their condition and they are more likely to make the needed behavior changes to improve their quality of life (Kariuki, 2022).

The nurse should use multiple educational strategies to increase client confidence and compliance. Educational strategies may include teach-back evaluation of understanding, programmed medication reminders, access to their medical records, easy communication with their provider, and condition-specific educational resources in multiple formats, including digital formats (Kariuki, 2022). The nurse should educate the client on some of the common difficulties they will face when following the nutritional plan and provide specific strategies to address them. The nurse should provide their client with some tips and tricks to help with some of the previously mentioned difficulties [Table 15.3](#).

Electrolyte/ Restrictions	Substitutions/Hacks
Fluids	<ul style="list-style-type: none"><li>• Use small glasses at meals, or do not fill large glasses completely.</li><li>• Suck on hard, sugar-free candy, such as mints or sour balls, to help lubricate the mouth.</li><li>• Take sips and not gulps to savor liquids.</li><li>• Divide fluid intake into manageable amounts for each part of the day.</li><li>• If going out in the evening, take in less during the day to save intake.</li><li>• Use alcohol-free mouthwash and perform good oral hygiene.</li></ul>
Potassium	<ul style="list-style-type: none"><li>• Avoid high-potassium foods.</li><li>• Use herbs, but not salt substitutes.</li><li>• Take diuretics or potassium binders when directed by the provider.</li></ul>

**TABLE 15.3** Substitutions and Nutritional Hacks to Help with Nutritional Plan Adherence in CKD (sources: DaVita, 2023; National Kidney Foundation, 2022)

Electrolyte/ Restrictions	Substitutions/Hacks
Sodium	<ul style="list-style-type: none"> <li>• Use salt substitutions (not salt substitutes) such as garlic or onion.</li> <li>• Make sauces, gravies, and snacks at home.</li> <li>• Do food prep and freeze meals instead of buying store-bought microwave meals.</li> <li>• Buy and cook fresh meats, not smoked, cured, luncheon, processed, or jerky meats.</li> </ul>
Phosphorus	<ul style="list-style-type: none"> <li>• Use phosphorus binders when prescribed by the provider—take with meals.</li> <li>• Limit foods that are especially high in phosphorus, like dark colas, chocolate, chocolate drinks, cheese, milk, cream soups, ice cream, pudding, regular yogurt, oysters, beef liver, organ meats, sardines, caramels, and processed meats and foods.</li> <li>• Limit any store-bought food that contain phosphorus, phosphate, phosphoric, or pyrophosphate.</li> </ul>
Magnesium	<ul style="list-style-type: none"> <li>• Avoid milk of magnesia to treat for heartburn.</li> <li>• Increase fiber intake, as it helps decrease magnesium absorption.</li> <li>• Eat Greek yogurt as a healthy alternative to help lower magnesium levels, increase calcium, and not raise phosphorus.</li> <li>• Exercise to the point of sweating to lower magnesium.</li> </ul>
Fat	<ul style="list-style-type: none"> <li>• Avoid trans fats and saturated fat.</li> <li>• Avoid processed foods.</li> <li>• Make food at home.</li> <li>• Remove skin and fat from meat.</li> <li>• Bake foods instead of frying.</li> <li>• Use olive oil or avocado oil for cooking.</li> <li>• Avoid sugary desserts.</li> <li>• Read nutrition labels carefully to choose the least amount of trans fat and saturated fat.</li> </ul>
Protein	<ul style="list-style-type: none"> <li>• Limit protein before dialysis—but eat enough to maintain health.</li> <li>• Use plant sources high in protein first, such as quinoa, edamame, lentils, fava beans, chickpeas, pinto beans, lima beans, mung beans, green peas, tofu, pumpkin seeds, soybeans, chia seeds, almond milk, and mycoprotein.</li> <li>• Use animal sources of protein sparingly, and choose lean sources such as skim milk, egg whites, skinless chicken, and fish.</li> </ul>
Calcium	<ul style="list-style-type: none"> <li>• Increase calcium; raising calcium will help lower phosphorus levels as well.</li> <li>• Eat foods high in calcium and enriched with calcium; plant sources of calcium are a better option than dairy sources, as dairy also contains higher levels of phosphorus.</li> </ul>

**TABLE 15.3** Substitutions and Nutritional Hacks to Help with Nutritional Plan Adherence in CKD (sources: DaVita, 2023; National Kidney Foundation, 2022)

## TRENDING TODAY

### Advanced Nutritional Counseling for Nurses

To optimize renal health, it is imperative that clients with preexisting kidney disorders seek advanced nutritional counseling. Nurses can meet this need and positively impact client outcomes by obtaining certifications in nutrition science. As nursing roles expand, nurses continue to look for opportunities to positively impact client care. Several strategies can enhance the nurse's delivery of care, mastery of knowledge, and future job opportunities.

In this Trending Today, explore opportunities that build upon a nursing license as a base to add skillsets to your practice and certifications to your resumé. Evaluate one of the following to determine benefits and challenges of these professional development areas:

- National Academy of Sports Medicine Certified Nutrition Coach at <https://www.nasm.org/> (<https://openstax.org/r/nasmo>)
- Cornell Nutrition and Healthy Living Certificate at <https://online.cornell.edu> (<https://openstax.org/r/onlinecornelledu>)
- National Board of Nutrition Support Certification at <https://www.nutritioncare.org> (<https://openstax.org/r/nutritioncareorg>)

Now answer the following questions:

1. Which evidence-based practice certification did you view, and why?
2. How would obtaining this certification impact the care you provide?
3. How would obtaining this certification impact your practice potential?
4. As a nurse, how would you use a nutrition certification to help your client achieve their optimal level of health?



## UNFOLDING CASE STUDY

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### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Mr. Vasquez is in the clinic for a routine visit following his education session with the renal dietitian 2 weeks prior. The nurse reviews his food recall report for the last 3 days (72 hours) to evaluate the need for further education. The client's diagnoses include obesity, hypertension, diabetes mellitus type 2, and CKD stage 2, so his nutritional education would have included all these issues.

1. Which dietary selection made by Mr. Vasquez suggests the need for further teaching by the nurse?
  - a. Lunch meats
  - b. Turkey off the bone
  - c. Apples
  - d. Hard-boiled eggs
2. Mr. Vasquez has an upcoming celebration and asks the nurse for a suggestion for a dessert that he could eat. What suggestion is appropriate for the nurse to make?
  - a. Cupcakes
  - b. Fruit salad
  - c. Ice cream
  - d. Chocolate milk

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## 15.4 Evaluate Nutritional Strategies to Impact Renal Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 15.4.1 Evaluate a nutritional plan for its effects on renal wellness.
- 15.4.2 Modify a nutritional plan to promote renal wellness.

### Evaluating the Effectiveness of a Nutritional Plan for Renal Wellness

Evaluation of the effectiveness of a nutritional plan involves evaluation of both client adherence to the plan and the effectiveness of the plan to reach the intended outcomes. Mr. Vasquez's nutritional plan is considered in the following Unfolding Case Study feature. If the plan is ineffective in any way, the nurse should determine the cause—adherence or general ineffectiveness—so that they can make appropriate changes.



## UNFOLDING CASE STUDY

### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

At the last visit, Jose Vasquez was educated on nutritional changes that will help preserve kidney function and manage comorbidities. At a recent physical examination, the following are noted:

Vital Signs		Physical Examination
Temperature:	97.9°F (36.6°C)	
Blood pressure:	118/76 mm Hg	
Heart rate:	98 beats/min	
Respiratory rate:	14 breaths/min	
Oxygen saturation:	97% on room air	
Weight:	Client has lost 3 lb (5.44 kg) since his last visit 3 months ago	
Finger stick glucose level:	100 mg/dL	<ul style="list-style-type: none"> <li>• No edema is present.</li> <li>• Lungs are clear to auscultation in all fields.</li> </ul>

TABLE 15.4

Mr. Vasquez reports following the nutritional guidelines strictly, and his food diary reflects this to be the case. Lastly, the nurse receives the following lab results from the sample drawn 2 days ago as a preparation for this visit:

Lab Test	Normal Range	Mr. Vasquez's Lab Results
GFR	90–120 mL/min/1.73 m <sup>2</sup>	52 mL/min/1.73 m <sup>2</sup>
Potassium	3.5–5.0 mEq/L	6.2 mEq/L
Sodium	135–145 mEq/L	122 mEq/L
Phosphorus	2.5–4.5 mg/dL	5.3 mg/dL

TABLE 15.5

3. Based on these assessment findings, what would the nurse document about the success of the nutritional plan for Mr. Vasquez?
  - a. Plan is effective.
  - b. Plan is ineffective due to client nonadherence.
  - c. Plan is ineffective despite client adherence.
  - d. Unable to judge plan effectiveness with assessment presented.
  
4. Which dietary change would Mr. Vasquez need to make if he progressed to stage 3 CKD?
  - a. Increase calcium.
  - b. Restrict fluids.
  - c. Restrict magnesium.
  - d. Increase fats.

### Modifying a Nutritional Plan to Promote Renal Wellness

Unfortunately, renal disease may still progress even when the client follows an appropriate nutritional plan; the client's nutritional plan may need to be modified.



## UNFOLDING CASE STUDY

### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

It is determined that, despite Mr. Vasquez following the nutritional plan, his condition has worsened. Although this disease process will progress regardless, it is still prudent to address the plan because the client's disease is now in an advanced stage; the plan requires modifications to prevent further injury.

5. Now that the client has advanced from stage 2 to 3 CKD, what assessment findings indicate a need to change the current nutritional plan?
  - a. GFR of 51 mL/min/1.73 m<sup>2</sup>
  - b. Symptoms of heart failure
  - c. No dependent edema
  - d. Glucose levels that are low
  
6. Which selection is appropriate for the client to include in their diet?
  - a. Quinoa
  - b. Skin-on baked chicken
  - c. Sirloin steak, well-done
  - d. Fried fish

## Chapter Summary

- The renal system comprises the kidneys, urinary bladder, ureters, and urethra, with the kidneys being the primary organs.
- The kidneys filter blood and remove serum wastes, balance fluids, maintain blood pressure, maintain acid-base balance, and excrete wastes. The kidneys also reabsorb certain products including glucose, amino acids, bicarbonate, water, phosphate, chloride, sodium, magnesium, and potassium ions.
- Heart health is important to kidney health, so making sure to limit saturated fats and avoid artificial trans fat is important for both cardiac and renal health.
- Depending on the stage of renal disease, the client will have to control their intake of fluids, fats,
- sodium, calcium, magnesium, phosphorus, potassium, and protein.
- Clients should engage in the planning of their diet and in an active learning process concerning their health. Engagement is considered an essential pillar for successful health management because barriers to following the nutritional plan are more likely to be identified. Engaged clients are more likely to be proactive and are more likely to make the needed behavioral changes to improve their quality of life.
- The nurse should follow the four components of the client education process—assessment, planning, implementation, and evaluation—holistically when providing client education.

## Key Terms

**adrenal gland** the small glands sitting on top of the kidneys that release adrenaline, noradrenaline, cortisol, and aldosterone

**aldosterone** a hormone that triggers the reabsorption of sodium by the kidneys

**cortisol** a hormone released by the adrenal glands to help maintain blood pressure

**costovertebral angle** the area on the back flank at the bottom of the 12th rib forming a 90-degree angle to the spine

**cystitis** inflammation of the urinary bladder

**erythropoietin** a hormone released by the kidneys that signals the bone marrow to produce red blood cells

**glomerulus** a cluster of capillaries around the end of a kidney tubule that filters waste products from the blood

**gluconeogenesis** the generation of glucose from non-carbohydrate carbon substrates

**hematuria** blood in the urine

**kidneys** a pair of bean-shaped organs that filter out blood wastes and excrete urine

**micturition** the act or urinating

**nephron** the functional unit of the kidney that contains the glomerulus and its tubule

**parenchyma** the renal cortex and medulla together

**pruritis** uncomfortable itching

**pyelonephritis** inflammation of the kidney

**renal bone dysplasia** a life-threatening condition in

which the body breaks down the bones to increase blood calcium levels by releasing the calcium stored in bones

**renal capsule** the outermost layer of the kidney composed of fibrous connective tissue

**renal cortex** the outer layer of the kidney contained inside the capsule

**renal medulla** the inner part of the kidney that contains working filtering units

**renal papilla** the apex of a renal pyramid

**renal pelvis** the top part of the ureter where the kidney tubules drain

**renin** an enzyme secreted by the kidneys that stimulates the production of angiotensin

**symphysis pubis** the joint consisting of a fibrocartilaginous disc sandwiched between the surfaces of the pubic bones

**urea** the wastes from the breakdown of proteins

**ureters** two hollow tube-like ducts that allow passage of urine from the kidneys to the urinary bladder

**urethra** the hollow tube-like duct that allows urine passage from the bladder to the outside of the body

**uric acid** the wastes from the breakdown of nucleic acids

**urinary bladder** a hollow organ posterior to the symphysis pubis that acts as a storage reservoir for urine before excretion

## Review Questions

- The nurse provides dietary instruction to a client with kidney disease. The nurse informs the client which nutrient is not directly absorbed by the kidney?

- a. Calcium
  - b. Sodium
  - c. Magnesium
  - d. Potassium
- 2.** Which laboratory value would indicate to the nurse that an adult male client has a potential renal problem?
- a. Serum creatinine: 1.5 mg/dL
  - b. Blood urea nitrogen: 7 mg/dL
  - c. Glomerular filtration rate: 93 mL/min/1.73 m<sup>2</sup>
  - d. Potassium: 4.1 mg/dL
- 3.** When should the nurse perform a bladder scan to determine a client's PVR?
- a. Before the client voids
  - b. Immediately after the client voids
  - c. One hour after the client voids
  - d. When the client has the urge to void
- 4.** Which snack choice made by a client indicates to the nurse that the client understands the need to increase complex carbohydrates in the diet?
- a. Snack cakes
  - b. Crackers
  - c. Muffins
  - d. Fruits
- 5.** Which nutritional instruction would the nurse give to a client with CKD who is not on dialysis?
- a. Decrease calcium intake.
  - b. Use plant sources of protein before animal sources.
  - c. Increase intake of trans fat.
  - d. Reduce dietary fiber.
- 6.** When developing a nutritional plan of care, which factor should the nurse consider for improving client adherence to plan?
- a. Level of engagement
  - b. Age
  - c. Gender
  - d. Comorbidities
- 7.** Which assessment finding in a client on dialysis is of concern to the nurse?
- a. Client is not restricting protein intake.
  - b. Client chooses foods that are low in potassium.
  - c. Client drinks large amounts of fluids.
  - d. Client has increased intake of calcium.
- 8.** What instruction should the nurse give to a client on a fluid restriction secondary to kidney disease who reports increased thirst?
- a. Suck on hard, sweet candies.
  - b. Use large glasses for drinking.
  - c. Fill drinking glasses completely.
  - d. Sip fluids slowly.
- 9.** Which food item on a 72-hour nutritional recall does the nurse identify as appropriate for a client who needs to restrict phosphorous intake?
- a. Vanilla ice cream

- b. Potato chips
  - c. Hot dogs
  - d. Chocolate milk
- 10.** Which food selection on a 72-hour recall indicates to the nurse that a client who must restrict potassium and sodium intake requires more instruction?
- a. Salt substitute
  - b. Cauliflower
  - c. Grapes
  - d. Apple

## Suggested Reading

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## CHAPTER 16

# Special Nutritional Considerations for Renal Health



**FIGURE 16.1** Renal health is impacted by nutrition and lifestyle choices. (credit: modification of work “dried-fruits” by www.Pixel.Ia Free Stock Photos/Flickr, CC0 1.0)

## CHAPTER OUTLINE

16.1 The Impact of Nutrition on Renal Wellness Across the Lifespan

16.2 Nutrition and Chronic Renal Illness

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**INTRODUCTION** The renal system impacts many other systems in the body. Throughout the lifespan, nutrition and other lifestyle decisions can impact the growth, development, and functioning of this system. The nutritional needs of this system change not only with age but also with the current health status of the kidneys. It is the nurse’s role to ensure that clients understand their nutritional needs based on their specific parameters such as age, renal health, and comorbidity status.

Consider this case: Kayla Davis’ journey begins with the problems her mother encountered during pregnancy. We will examine the various decisions for care in light of her disease and nutritional needs.

## 16.1 The Impact of Nutrition on Renal Wellness Across the Lifespan

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 16.1.1 Describe the impact of nutrition on the renal and urologic systems during pregnancy.
- 16.1.2 Describe the impact of nutrition on the renal and urologic systems during infancy.
- 16.1.3 Describe the impact of nutrition on the renal and urologic systems during childhood.
- 16.1.4 Describe the impact of nutrition on the renal and urologic systems during adolescence.
- 16.1.5 Describe the impact of nutrition on the renal and urologic systems during adulthood.
- 16.1.6 Describe the impact of nutrition on the renal and urologic systems during later adulthood.

### Pregnancy

Nutrition plays a role in the development and function of every system in the body, including the renal system. This role starts with the in utero development of a person and continues throughout their life. Nutrition combined with lifestyle decisions can interact with normal and pathologic processes in the renal system, sometimes resulting in system failure.

Poor nutrition during pregnancy can lead to fetal abnormalities that can cause kidney disease in the future (National Kidney Foundation, 2022). Additionally, individuals with renal disease experience more problems during pregnancy and must manage their nutritional intake differently. This section will cover these nutritional considerations and their impact on the renal system during pregnancy.

#### The Healthy Pregnant Client

Pregnancy is accompanied by expected urinary and renal changes. Increased blood volume and cardiac output result in increased glomerular filtration rate (GFR) and renal blood flow, which in turn causes increased excretion and reduced blood levels of bicarbonate, urea, creatinine, and urate (Willacy, 2022). In increased GFR, the renal tubules are unable to meet the increased fluid demands, resulting in mild glycosuria and proteinuria; fluid retention increases, reducing plasma osmolality. The smooth muscle of the renal pelvis, ureters, and bladder relaxes and dilates, causing the kidneys to increase in length; the ureters to lengthen, curve, and increase in residual urine volume; and the bladder to increase its capacity. The uterus may also put pressure on the bladder and ureters as it increases in size.

Good nutrition during pregnancy can prevent problems and support overall renal health for the pregnant client and fetus. To achieve these aims, the client should:

- Increase caloric intake by 340 calories per day starting with the second trimester and 452 calories per day starting with the third trimester (for a singleton pregnancy).
- Take a prenatal vitamin that includes iron or take a separate iron supplement in addition to a prenatal vitamin to prevent iron-deficiency anemia.
- Avoid caffeine or limit it to less than 200 mg/day (Gleason, et al, 2022).
- Increase fluid intake, especially water.

(source: American College of Obstetricians and Gynecologists, 2023; Holcombe, 2022)

Because of the normal physiologic changes expected, specific renal issues that most commonly arise during pregnancy include urinary tract infections (UTIs), pyelonephritis, and **nephrolithiasis** (kidney stones). Changes make urine less acidic, and it contains more hormones and sugars, increasing risk for bacterial growth (Sissons, 2019). Signs and symptoms of UTI include dysuria, frequency of urination, hematuria (American College of Obstetricians and Gynecologists, 2023b), abdominal cramps, and **dyspareunia** (pain during sexual intercourse).

If a UTI spreads from the lower urinary tract into the kidneys and develops into a more serious infection, pyelonephritis, signs and symptoms may then also include fever of 38.0°C (100.4°F) or higher; flank pain; costovertebral angle tenderness (American College of Obstetricians and Gynecologists, 2023b); chills; nausea; vomiting; and back, side, or groin pain. Significant fetal and maternal morbidity and mortality have been associated directly with pyelonephritis (Wing & Johnston, 2017). For instance, it has been linked to preterm delivery, in which case all of the newborn's systems will be underdeveloped; disseminated intravascular coagulation (DIC), which can lead to hemorrhage and death of both mother and fetus; and maternal sepsis and respiratory distress, which can

lead to renal failure and maternal and fetal death (Wing & Johnston, 2017).

Prevention of UTIs, and subsequently pyelonephritis, is based on urinary hygiene and nutritional recommendations. The nurse should instruct the client to drink 64–96 oz of water daily (American College of Obstetricians and Gynecologists, 2020). Drinking 8–10 oz of unsweetened cranberry juice or taking cranberry supplements daily may also help decrease the risk of UTI. Pregnant clients should also keep caffeine intake to 200 mg or less daily (Holcombe, 2022) and eat an overall healthy diet that includes proper nutritional and caloric intake (Sissons, 2019).

Nephrolithiasis usually occurs in the second or third trimester, when there is greater pressure on the renal organs from the growing uterus, and within the first year of giving birth (Furst, 2021; Urology Care Foundation, 2023). The pressure and narrowing of the passages for urine flow can concentrate urine and thus increase the risk for stone formation. Another factor that increases the risk for kidney stones is an elevated vitamin D level, which increases calcium levels in the urine (Orlando Health, 2023). Signs and symptoms the pregnant client may experience include nausea; vomiting; urgency and frequency of urination; hematuria (blood in the urine); and pain in the back, flank, or upper abdomen. The nurse should provide the following nutritional recommendations for nephrolithiasis during pregnancy:

- Get adequate daily amounts of vitamin B<sub>6</sub> and magnesium (Weinberg, 2023).
- Avoid excessive vitamin C (Peerapen & Thongboonkerd, 2023).
- Limit sodium intake to less than 2.3 g/day (UT Southwestern Medical Center, 2023).
- Drink ten 10 oz glasses of water or other fluids daily (Urology Care Foundation, 2023).
- For calcium oxalate stones, maintain calcium intake at 1000–2000 mg/day and limit intake of oxalate-rich foods (Peerapen & Thongboonkerd, 2023; UT Southwestern Medical Center, 2023).
- For uric acid stones, limit animal proteins and eat more plant proteins (Peerapen & Thongboonkerd, 2023).

A recent study has shown that healthy individuals who developed hypertension during pregnancy had twice the risk of developing kidney disease within the first several years after the birth of their baby. Risks were even higher in those who had hypertension before pregnancy and had worsening of their condition during the pregnancy (Malek et al., 2022; Williamson, 2022). Nutritional recommendations for hypertension include limiting sodium intake to less than 2 g/day, getting 4700 mg of potassium daily, limiting meats and saturated fats, eating 4–5 servings each of fruits and vegetables, and following all other recommendations included in the Dietary Approaches to Stop Hypertension (DASH) diet.

## SPECIAL CONSIDERATIONS

### Disparity Implications—Pregnancy and Hypertension

Research evidence reveals a racial disparity exists showing that Black women were much more highly affected than White women: Black women who had hypertension before and during pregnancy were three times more likely to develop kidney disease (Malek et al., 2022).

### The Pregnant Client with Preexisting Renal Disease

Pregnant clients with preexisting renal conditions will be more severely impacted by mild anemia, due to dilution of the blood from fluid retention; an increased GFR, putting more work on the glomeruli; decreased serum sodium, potassium, urea, creatinine, calcium, and albumin; mild glycosuria and proteinuria; reduced plasma osmolality; increased urine retention in the system, which increases infection risks; decreased urine acidity; and increased pressure in the system due to the growing uterus. Preexisting maternal renal conditions that can be affected by pregnancy include polycystic kidney disease (PKD); post–renal transplant status; and **chronic kidney disease (CKD)**, a progressive disease of the kidneys that eventually ends in kidney failure.

Individuals with CKD are at much greater risk for experiencing adverse pregnancy outcomes, which can include preeclampsia; acceleration in the loss of kidney function, thereby speeding the process of CKD to end-stage renal disease (ESRD) or complete renal failure; fetal intrauterine growth restriction (IUGR); preterm delivery; the infant being of low birthweight or/and small for gestational age (SGA); the need for the infant to receive care in the neonatal intensive care unit (NICU); and maternal or fetal demise (Siliqato et al., 2020; Wiles et al., 2019, 2020).

Kidney function declines as much in the 9 months of pregnancy as it does for a client living 1.7–4.9 years with

kidney disease. Therefore, pregnancy could lead the client with CKD to complete kidney failure and need for a transplant or **dialysis**, purification of blood through means other than the kidneys, which can be extremely dangerous for the mother and fetus (Wiles et al., 2020).

Clients with CKD who have problems with chronic anemia, hypertension, proteinuria, or fluid and electrolyte imbalance before pregnancy will have continuation, and likely worsening, of these problems during pregnancy. Nutritional modifications for these clients involve a delicate balance between the needs of the growing fetus and the requirements of CKD. It has been found, however, that plant-based diets that are moderately restricted in protein decrease risks for preterm delivery and SGA status resulting from IUGR (Attini et al., 2022).

### The Fetus

Certain nutritional components have been found to be critical for renal development in utero, and the pregnant person's nutrition before and during pregnancy, as well as during early lactation, has been shown to have a substantial impact on this system. Clients with severe iron deficiency anemia during pregnancy have been shown to have elevated risks for preterm birth, placental abruption, and fetal malformation, which can include malformations of the fetal renal system (Shi et al., 2022). Pregnant clients with various disease processes may need specific dietary restrictions, but low-protein, low-carbohydrate, low-calorie, and low-sodium diets, as well as diets deficient in the micronutrients folic acid, iron, zinc, and vitamin A, have all been shown to have potential long-term adverse effects on the development of the renal system in the fetus (Nusken et al., 2020). High-fat, high-sodium, and high-fructose diets have also been shown to be detrimental to renal system development. Depending on the exact timing of the deficiency or the amount of exposure during development, adverse effects could include an altered number of nephrons, blood pressure dysregulation, mitochondrial dysfunction, altered sodium handling, endothelial dysfunction, inflammation, and oxidative stress of the kidney.

Studies have shown that increases in fetal growth and infant birth weight may be achieved by enhancing maternal nutrition during pregnancy (Columbia University Irving Medical Center, n.d.). Inadequate maternal nutrition during pregnancy is also a significant modifiable determinant for the development of chronic diseases in the child (Lee et al., 2021). Nutritional intake that is not sufficiently supplied with key nutrients such as iodine, iron, folate, calcium, and zinc can cause severe health problems in the mother (UNICEF, n.d.) that will directly affect fetal development and the individual's lifelong health. The nurse should instruct a pregnant client to take in 30 mg of iron, 220 mg of iodine, 600 mcg of folate, 1000 mg of calcium, and 0.6 mg of zinc daily.

### Infancy

Infants must receive proper nutrition for growth and development because all organs are impacted by malnutrition. Well-balanced nutrition should provide enough calories for energy expenditure. Healthy, full-term infants require around 100 kcal/kg/day (Patel & Rouster, 2022), whereas preterm infants require around 130 kcal/kg/day (Medical Home Portal, n.d.).

Other nutritional recommendations to consider in an infant's diet concern micronutrients, including iron, zinc, copper, chromium, manganese, and selenium (Patel & Rouster, 2022). Infants 7–12 months old should get 11 mg of iron (Gavin, 2021), 3 mg of zinc (Stanford Medicine Children's Health, n.d.), 220 mcg of copper (National Institutes of Health, 2022a), 5.5 mcg of chromium (Duda, 2022), 0.6 mg of manganese (National Institutes of Health, 2021), and 20 mcg of selenium daily (Lubeck, 2023). Infants can quickly become dehydrated, so proper fluid intake is extremely important.

The preceding recommendations are for infants born without renal system defects. Those born with renal issues may need nutritional alterations and fluid restrictions based on their level of kidney function. These restricted diets may be in the form of a specially balanced formula that includes 2–4 mEq of sodium per 100 mL of formula and a restriction of 1–3 mmol/kg/day of potassium (Nelms, 2018). Depending on the specific needs, restrictions may also be in place for calcium, phosphorus, protein, calories, and fluids.

**Oligohydramnios**, a very low to almost absent amount of amniotic fluid, is a severe condition that must be managed before birth and can be related to impaired or absent kidney function in the fetus (Keilman & Shanks, 2022). Starting at 16 weeks' gestation, around 90% of the amniotic fluid is made up of urine produced by the fetal kidneys. Immediate treatment for oligohydramnios is imperative because the fetus's lungs need this fluid to develop properly.



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Jennifer Davis had a difficult pregnancy. Prior to conceiving, she lived with type 2 diabetes, hypertension, chronic moderate anemia, and stage 2 CKD. During the pregnancy, despite being very adherent, her kidney disease advanced. She closely followed her nutritional restrictions for low sodium, low sugar, low carbohydrate, low fat, and low protein, and as she progressed closer to kidney failure, she had to restrict fluids as well. Even though she followed these dietary modifications, after delivery she was diagnosed with ESRD and was scheduled to have a catheter placed to start hemodialysis (mechanical waste filtration).

Because of her health issues, she experienced preeclampsia that developed into eclampsia (seizures), requiring an emergency cesarean birth of her infant at 32 weeks' gestation. Her infant demonstrated effects from Jennifer's health issues as well. Due to Jennifer's chronic anemia, nutritional restrictions, and preterm delivery, the infant was of very low birth weight and small for gestational age (SGA) due to intrauterine growth restrictions. She required 8 weeks of care in the NICU after birth.

Kayla Davis is now 1 week old. She weighs 1 kg (2.2 lb) and is 33 cm (13 in.) long.

1. The nurse caring for Kayla is reviewing her nutritional plan, which is based on the highest normal calorie range daily for a preterm infant. How many calories daily should Kayla receive to meet her nutritional needs?
  - a. 130 calories
  - b. 270 calories
  - c. 2,700 calories
  - d. 4,000 calories
  
2. The nurse is discussing Kayla's need for energy sources in her nutritional intake. Which macronutrient is the body's primary energy source from nutrition?
  - a. Water
  - b. Proteins
  - c. Fats
  - d. Carbohydrate

### Childhood

The U.S. Department of Agriculture (USDA) updated nutritional requirements in 2020, including recommendations for infants and toddlers for the first time. It is recommended that children have no added sugar in their diet until age 2 years (USDA, 2020). They should eat a large selection of fruits, vegetables, and grains, preferably with at least half of the grains being whole grains, and their proteins should come from lean meat sources or plant-based proteins (McCarthy, 2021), with low-fat dairy products added after age 2 years. They should not receive the same portion sizes as adults.

In children with altered kidney function, it may be difficult to ensure that they get enough calories and protein to grow within the confines of their restrictive nutritional needs. To protect renal health in children who do not have altered kidney function, sodium should be limited to less than 2 g/day because amounts greater than this can lead to fluid retention and hypertension. Sugar intake should be limited to less than 25 g/day (American Heart Association, n.d.) because it can lead to obesity, hypertension, and kidney hyperfiltration. Children should be encouraged to eat fruits and vegetables because, in addition to their other benefits, the fiber will help prevent constipation (Deshpande, n.d.) and keep cholesterol in check. Fruits also contain citrate, which helps prevent stone formation (Deshpande, n.d.). Adequate water intake of 34–61 oz/day (1–1.8 L) can prevent urinary infections, constipation, dehydration, and kidney stones and assist in weight control (Deshpande, n.d.).

Common conditions that can develop even if children are not born with renal problems are UTIs, **enuresis** (bladder

incontinence after the age of 3 years), and nephrolithiasis. Nutritional recommendations can help maintain optimal renal health.

Nephrolithiasis has become more common than it once was in children and adolescents (American Academy of Pediatrics, 2021) due to diets higher in processed foods, low vegetable intake, and lower physical activity levels. Risk factors for developing kidney stones in children and adolescents include family history of nephrolithiasis; a diet high in salt, meat, and processed foods; a diet low in fruits and vegetables; dehydration with low urine output; inherited conditions such as **cystinuria** (a rare condition in which kidney stones form from an amino acid called **cysteine**) and **hyperoxaluria** (excessive oxalate in the urine); some medications, including furosemide and topiramate; blocked urine flow; bowel diseases; kidney infection; prolonged sedentary periods, especially bed rest; weight loss surgery (American Academy of Pediatrics, 2021); and urinary tract infections (UTIs).

Enuresis may be diurnal (occurring in the daytime), nocturnal (occurring in the nighttime), primary (occurring in someone who has never had total bladder control), or secondary (occurring in someone who previously could control their bladder) (Johns Hopkins Medicine, n.d.). Enuresis has many psychological and physical causes. Renal causes include bladder pressure from constipation, overactive bladder (OAB), small bladder, structural problems in the urinary tract, inability to feel when the bladder is full (such as during sleep), UTI, and failure to urinate enough. Many of these causes would need to be addressed with the child's primary care provider. However, teaching the child different hygiene habits can be helpful, and OAB can be helped by following special nutritional considerations, discussed later in this chapter.

Children urinate more often than adults because they tend to drink more fluids in relation to their size, have smaller bladders, and have less control over their urinary muscles, which results in feeling the need to "go" more often. UTIs can be very common in this age group; therefore, young children need to be educated on proper urinary hygiene (American Academy of Pediatrics, 2015). Females are more susceptible to UTIs than males because they have shorter urethras, so bacteria can more readily enter the urinary tract (American Academy of Pediatrics, 2015). General signs and symptoms of a UTI include vomiting, high temperature, lethargy, irritability, poor feeding, poor weight gain, and jaundice (NHS Inform, 2023). More specific signs and symptoms include pain or burning with urination; frequency or urgency of urination; deliberate holding of urine; change in toileting habits (such as enuresis); pain in the side, back, or abdomen; bloody or cloudy urine; and foul-smelling urine.

Some nutritional measures can help prevent UTIs. Children should drink plenty of water to avoid constipation and to maintain the kidneys' function in eliminating waste products. Cranberry or blueberry juice can help create a more acidic urinary environment that will discourage bacterial growth (American Academy of Pediatrics, 2015). Colas and caffeinated beverages should be discouraged because these irritate the bladder and cause diuresis.

Certain foods are beneficial in preventing UTIs as well. Yogurts with live and active cultures and other fermented products are recommended because they contain bacteria that help balance the body's systems and can thereby decrease the risk for UTIs (Norton Children's, 2020; Urology Specialists, 2015). Foods high in vitamin C, including oranges, lemons, strawberries, grapefruits, tomatoes, broccoli, and spinach, are beneficial to maintain a balanced urine acidity level ([Figure 16.2](#)). Foods containing proanthocyanidins, including cranberries, raspberries, and blueberries, are a good addition because these substances help prevent *Escherichia coli* infection, the number one bacterial cause of common UTIs (Norton Children's, 2020; Urology Specialists, 2015). High-fiber foods such as whole grains, apples, bananas, and legumes are important to prevent constipation, which can block urine excretion from the body and in turn cause urine stasis, which encourages bacterial growth (Norton Children's, 2020). Sugar intake should be limited because it provides a fuel source and breeding ground for bacteria to thrive (Urology Specialists, 2015).



**FIGURE 16.2** Blackberries, blueberries, and strawberries are nutrient-rich fruits that help promote urologic wellness. (credit: modification of work “strawberries, blueberries, and blackberries” by Jonathan Cutrer/Flickr, Public Domain)



## UNFOLDING CASE STUDY

### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Kayla was diagnosed with hydronephrosis (swollen kidney due to urine accumulation) related to uteropelvic junction obstruction (blockage). This resolved on its own after 2 weeks of life. She was transferred from the NICU to the regular pediatric floor for care at 8 weeks of age and was discharged home the following week. Her prematurity and intrauterine growth restriction have resulted in ongoing effects on her development. She was diagnosed with type 1 diabetes because her pancreas is nonfunctioning, and one of her kidneys is nonfunctioning. The kidney is small and undeveloped. The other kidney is functioning despite the hydronephrosis.

Unfortunately, by age 6, Kayla has developed CKD and is in stage 3 when diagnosed.

3. Which nutritional restrictions will pose the most problems for her growth and development at this stage?
  - a. Protein and calories
  - b. Fluid and potassium
  - c. Phosphorus and calcium
  - d. Magnesium and sodium
  
4. Because this client already has serious issues with their kidneys, the nurse educates the client’s parents on nutritional measures to prevent further kidney issues that can exacerbate their other conditions. Which option would necessitate the need for further education?
  - a. Broccoli
  - b. Whole grain bread
  - c. Cranberries
  - d. Ramen noodles

### Adolescence

During adolescence, puberty, hormonal changes, and growth spurts occur. The body goes through many changes that require healthy and supportive nutrition to ensure proper growth and maturity. Food should include high levels of calcium, vitamin D, and iron for bone and muscle development (Castle, 2022). Iron for males and females aged 9–13 should be around 8 mg/day. Males aged 14–18 should receive 11 mg/day, whereas females in this age group should receive 15 mg/day. The calcium recommendation for adolescents is 1300 mg/day, and the vitamin D

recommendation is 600 International Units daily. Caloric intake should range from 1800–3200 calories daily for males and from 1600–2400 calories daily for females, depending on activity level (USDA, 2020).

Adolescents should follow the same nutritional guidelines as other age groups for urinary health. UTIs and nephrolithiasis are the more common kidney-related issues in this age group. The same nutritional restrictions and recommendations discussed elsewhere in this chapter for these conditions apply for adolescents as well.

UTIs have different causes in this group, necessitating additional educational points to discuss with the adolescent. All of the earlier hygiene recommendations are still important, but an additional cause of UTIs in adolescents (as well as in adults) is sexually transmitted infections (STIs). Chlamydia, gonorrhea, and trichomoniasis all can infect the urethra and advance into the urinary system. Females also have increased risk for developing cross infections from bacterial vaginosis (BV) and yeast infections.

Nutritional recommendations to help avoid BV and yeast infections include staying hydrated with plenty of water and avoiding sugary, caffeinated, and carbonated beverages to help maintain a healthy pH balance. Probiotic and prebiotic foods also help maintain the pH balance in the vagina and prevent yeast or bacterial overgrowth. Foods that contain probiotics include yogurt with live cultures, sauerkraut, kimchi, pickles, miso, tempeh, and kombucha (Sass, 2022). Prebiotics can be found in chicory root, leeks, garlic, asparagus, and onions.

Foods with a low glycemic index may also help prevent BV by helping maintain the pH balance; such foods include whole grains, including oatmeal and barley; quinoa; yogurt; milk; nuts; legumes; beans; grapefruit; oranges; and carrots (Sass, 2022). High-fiber foods support healthy bacterial growth and help prevent BV. Vitamin D has been found to be important in overall vaginal health and pH balance. Foods that contain vitamin D include trout, cooked salmon, sardines, eggs, cheddar cheese, and fortified milk (Sass, 2022). Another important addition to the diet is apples, at least one daily, as these have been shown to improve vaginal lubrication (Sass, 2022; Tommaso et al., 2014). Foods to restrict include white bread, high-sugar foods, white rice, honey, processed grains, and highly processed foods (Sass, 2022).



## UNFOLDING CASE STUDY

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### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up from Case Study Parts A and B.

Kayla and her mother have been managing her condition well, and her stage 3 CKD has remained stable. She is now 13 years old and has come into the clinic for a regular check-up. The nurse is planning to provide Kayla with education on continued management of her CKD.

5. What would the nurse include when teaching a client Kayla's age how to best promote renal health and slow the progression of CKD?
    - a. Recommendation to increase fiber intake
    - b. STI prevention
    - c. Recommendation to increase fluids
    - d. Recommendation to decrease exercise
  
  6. How many calories would be in the acceptable daily allowance range for Kayla?
    - a. 2,000 calories daily
    - b. 1,500 calories daily
    - c. 2,600 calories daily
    - d. 3,000 calories daily
- 

### Adulthood

Adults will not require as much from their nutritional intake for growth, although certain hormonal changes still occur in adulthood. Individuals in this age group face more health risks that can impact the kidneys and their functioning, including hypertension, diabetes types 1 and 2, CKD, PKD, benign prostatic hyperplasia (BPH),

nephrolithiasis, cardiovascular disease, and hyperlipidemia. Foods should be nutrient dense; low in sugars, sodium, and saturated fats; high in fiber and calcium; and include vitamin D (USDA, 2020, p. 101). Nutritional recommendations specific for renal health mentioned previously in the chapter apply to this age group as well. Nephrolithiasis, UTIs, BPH, and CKD are more common in this age group due to the comorbidities that often develop.



## UNFOLDING CASE STUDY

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### Part D

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up from Case Study Parts A, B, and C.

At age 18, Kayla becomes pregnant. Her GFR is  $49 \text{ mL/min}/1.73 \text{ m}^2$ , and she has hypertension, type 1 diabetes, and chronic anemia. Despite the known risks to her and the fetus, she wants to go through with the pregnancy. She is currently not restricting fluids, but she is restricting protein, potassium, phosphorus, sodium, sugar, and carbohydrates. She is following all heart-healthy recommendations.

7. The nurse is educating Kayla about the potential problems in a pregnancy involving her unique health conditions. What would the nurse include in this education?
  - a. Postterm delivery
  - b. Spina bifida
  - c. Multifetal pregnancy
  - d. Fetal intrauterine growth restriction
  
8. When Kayla is being monitored during her pregnancy, which lab value would be concerning and require immediate treatment?
  - a. GFR  $56 \text{ mL/min}/1.73 \text{ m}^2$
  - b. GFR  $15 \text{ mL/min}/1.73 \text{ m}^2$
  - c. GFR  $87 \text{ mL/min}/1.73 \text{ m}^2$
  - d. GFR  $92 \text{ mL/min}/1.73 \text{ m}^2$

Kayla decides to continue with the pregnancy despite the risks. During her second trimester, the fetus is markedly small due to intrauterine growth restriction, and Kayla has advanced to stage 4 CKD and is approaching the need for dialysis. Because of Kayla's rapid decline and the struggle to keep her potassium levels normal, her health care provider orders a catheter to be placed for the impending need for dialysis and plans to deliver the baby as early as safely possible. Unfortunately, 2 days before she is scheduled to have the catheter placed, Kayla goes into cardiac arrest due to a dysrhythmia from hyperkalemia. She is unable to be revived, and her fetus is too premature to survive.

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### Later Adulthood

For adults aged 60 years and older, the risk for chronic disease is highest. Such conditions include cardiovascular disease, type 2 diabetes, obesity, hypertension, hyperlipidemia, CKD, congestive heart failure, cancers, and BPH. Renal function also naturally declines in this age group, with defined GFR being less than  $60 \text{ mL/min}/1.73 \text{ m}^2$  (National Kidney Foundation, 2023). Therefore, preserving kidney function is very important, and medication dosages may need to be adjusted to ensure safety.

Nutritional intake should include nutrient-dense foods and be rich in whole grains, fruits, vegetables, and dairy, as well as protein to prevent muscle loss. Older individuals should also increase their intake of vitamin B<sub>12</sub> because the ability to absorb this vitamin declines as people age (USDA, 2020, p. 128). Foods high in B<sub>12</sub> include beef liver, clams, cooked salmon, tuna, eggs, fortified breakfast cereal, spinach, and kidney beans (National Institutes of Health, 2022b). Adults in this age group must also be sure to drink enough fluids, especially water, because the sensation of thirst declines with age, increasing the risk for dehydration and UTIs (U.S. Department of Agriculture, 2020, p. 129).

## 16.2 Nutrition and Chronic Renal Illness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 16.2.1 Discuss the impact of nutrition on chronic renal disorders.
- 16.2.2 Discuss the impact of nutrition on acute exacerbation of chronic renal disorders.

### Urologic Illnesses

Many different urologic and renal illnesses are impacted by nutrition. Some of the more common urologic illnesses—illnesses that affect parts of the renal system other than the kidneys—that can be impacted by nutrition include overactive bladder, interstitial cystitis, benign prostatic hyperplasia, and bladder cancer. Each of these has different causes and different nutritional impact based on the pathophysiology of the disease.

#### Overactive Bladder

Overactive bladder (OAB), affecting more than 33 million Americans, causes urinary incontinence and urinary urgency resulting from involuntary contraction of the detrusor muscle of the bladder (Mobley et al., 2020). Anticholinergic medications and beta-3 adrenoceptor agonists are prescribed to treat this condition (Mobley et al., 2020). Some individuals also take 2–4 g of sodium bicarbonate twice daily to alkalinize the urine and make it less irritating to the bladder (Mobley et al., 2020).

Nutritional considerations for urologic illness center around reducing symptoms and avoiding medication interactions. Anticholinergic drugs should not be taken with alcohol because this combination can increase the risk for respiratory depression, unconsciousness, and death (Cafasso, 2023). Alcohol also acts as a diuretic, so clients should avoid it to prevent increased urinary frequency (Stoppler, 2020). They should also avoid carbonated beverages because they contain substances that can irritate a sensitive bladder and increase symptoms. Another important nutritional modification is to eliminate caffeine. Coffee, tea, other caffeinated beverages such as energy drinks, and brown chocolate all contain an acid that acts as a bladder irritant and aggravates OAB symptoms (Mobley et al., 2020; Stoppler, 2020).

Citrus fruits, including oranges, grapefruits, lemons, limes, and clementines, are also acidic; they can alter the urine pH and contribute to urgency and incontinence, so clients should avoid or reduce consumption of them (Mobley et al., 2020; Stoppler, 2020). Pineapple, tomatoes, wasabi, chili, spicy salsa, and other spicy condiments are all acidic foods, as are cranberries; although cranberries are beneficial for avoiding UTIs, they contain irritants that exacerbate OAB (Mobley et al., 2020; Stoppler, 2020). Sugar, artificial sweeteners, honey, grapes, bananas, apples, peaches, plums, strawberries, raw onions, dairy products (especially sour cream and aged cheeses), prunes, ketchup, vinegar, soy sauce, and mayonnaise can all contribute to an increase in OAB symptoms (Mobley et al., 2020; Stoppler, 2020). Nocturia can be decreased if individuals restrict their fluids during the day, especially after 6 p.m. (Mobley et al., 2020).

Nurses can encourage clients to try food substitutions. Dill, rosemary, thyme, and garlic are great substitutes for the more irritating spices (Stoppler, 2020). White chocolate is recommended instead of regular chocolate because it contains no caffeine, but clients should be cautioned not to eat too much because it contains sugar. Peas and carrots, along with other high-fiber foods, are encouraged to keep bowel movements regular and prevent symptoms resulting from increased pressure on the pelvic floor from constipation (Stoppler, 2020). In addition to estrogen supplementation for women with OAB symptoms related to estrogen deficiency, these clients can benefit from consuming vegetables that contain phytoestrogens, such as yams and carrots (Mobley et al., 2020). These clients should also increase their intake of potassium, protein, and, especially, vitamin D, which works to reduce urinary urgency at the site of the detrusor muscle (Mobley et al., 2020).

Another significant change clients can make is a lifestyle change, not a nutritional one: Clients who use tobacco should stop, as its use is linked with OAB symptoms (Mobley et al., 2020).

#### Interstitial Cystitis

Interstitial cystitis, also known as chronic pelvic pain syndrome, causes pelvic pain and a persistent desire to urinate, as well as nocturia, urinary frequency, and voiding of only small amounts at a time (Mobley et al., 2020). These symptoms mimic those of UTI, but urine cultures will consistently show no infection. Pentosan polysulfate

sodium, sodium bicarbonate with calcium glycerophosphate, and dimethyl sulfoxide have all been used to treat this condition, and dietary modifications to reduce bladder irritants can effectively supplement pharmacotherapy. Nurses should give the same nutritional recommendations to clients with interstitial cystitis as for those with OAB.

### **Benign Prostatic Hyperplasia**

Benign prostatic hyperplasia (BPH) is an enlargement of the prostate gland, affecting men (19 million in the United States) as they age and as their testosterone levels decrease. Lower urinary tract symptoms (LUTS) include urinary frequency and urgency, a weak urine stream, the feeling of being unable to empty the bladder, postmicturition dribbling, and nocturia (Mobley et al., 2020). Nutrition has not been shown to directly affect testosterone levels, but evidence indicates that the Mediterranean diet can be helpful in decreasing LUTS (Mobley et al., 2020). The Mediterranean diet promotes daily consumption of plant-based foods to replace some meats and starches, and the replacement of unhealthy fats, such as butter and margarine, with healthier fats (Modglin, 2022). This diet is rich in olive oil, small amounts of fish and other seafood, and plant-based options.

### **Bladder Cancer**

Bladder cancer is the seventh most common form of cancer diagnosed, with the highest incidence occurring in White men (Mobley et al., 2020). Tobacco use is the greatest risk factor for the disease. Eating a diet high in isothiocyanates, which are found in cruciferous vegetables such as cabbage and kale, and drinking tea have both been linked to a decreased risk for developing bladder cancer.

## **Renal Illnesses**

Renal illnesses are those that impact the kidney or any portion of the kidney. Many diseases can affect the kidney, and although they may have different causes and initial signs and symptoms, they will also produce very similar signs and symptoms because the diseases all impact the same organ. Common renal illnesses that can be affected by nutrition include nephrolithiasis, CKD, and renal cancer.

### **Nephrolithiasis**

Nephrolithiasis, commonly referred to as kidney stones, can occur as a single incident or as a chronic condition. Kidney stones can cause a wide range of issues, from extreme pain to kidney failure due to hydronephrosis if they block urine flow and are not treated in a timely manner. Nurses should instruct clients to drink at least 88 oz (2.5 L) of fluids daily to help prevent stone formation (Mobley et al., 2022). Fruit juices are also recommended because they contain citrate, which inhibits calcium oxalate and calcium phosphate stone formation (Dai & Pearle, 2022).

The type of nutritional modification required depends on the type of stone and its composition ([Table 16.1](#)).

<b>Stone Type</b>	<b>Composition</b>	<b>Food Modifications</b>
Calcium stones (oxalate or phosphate; 75% of stones)	Calcium oxalate or calcium phosphate	<ul style="list-style-type: none"> <li>Avoid foods high in calcium: cheese, yogurt, edamame, calcium-fortified foods, canned sardines/salmon/tuna, tofu, almonds, leafy green vegetables.</li> <li>Avoid foods high in oxalate: rhubarb, beets, potatoes.</li> <li>Increase consumption of green and black tea.</li> <li>Avoid high-fructose foods.</li> <li>Phosphate stones: Limit sodium intake and nondairy animal protein.</li> </ul>
Uric stones (up to 10% of stones)	Uric acid	<ul style="list-style-type: none"> <li>Avoid foods high in purines: red meat, shellfish, trout, scallops, alcohol, foods containing large amounts of high fructose corn syrup.</li> <li>Limit nondairy animal protein.</li> <li>Ensure that gout is treated effectively.</li> </ul>

**TABLE 16.1** Renal Stone Composition and Nutritional Recommendations (sources: Dai & Patel, 2022; Ferraro et al., 2020; Karki & Leslie, 2023; Leslie et al., 2023; Levchenko et al., 2022; Mobley et al., 2020)

Stone Type	Composition	Food Modifications
Struvite stones (5%–15% of stones)	Mixture of magnesium, ammonium, phosphate, and calcium carbonate	<ul style="list-style-type: none"> <li>Restrict sodium: microwave meals, canned soups, canned meats, pizza, nuts, pickles, sandwich meats.</li> <li>Limit intake of oxalate-rich foods.</li> </ul>
Cysteine stones (1–2% of all stones but 6–8% of all pediatric stones)	Cysteine	<ul style="list-style-type: none"> <li>Increase consumption of fruits and vegetables.</li> <li>Increase water intake to 4 L/day.</li> <li>Decrease sodium intake.</li> <li>Limit nondairy animal protein.</li> </ul>

**TABLE 16.1** Renal Stone Composition and Nutritional Recommendations (sources: Dai & Patel, 2022; Ferraro et al., 2020; Karki & Leslie, 2023; Leslie et al., 2023; Levchenko et al., 2022; Mobley et al., 2020)

### Chronic Kidney Disease

Chronic kidney disease (CKD) affects more than 31 million Americans, but many remain undiagnosed because the early stages are relatively asymptomatic (Mobley et al., 2020). Many things can cause CKD, but the most common causes are diabetes types 1 and 2 and hypertension, conditions that need to be managed correctly to slow disease progression. Nutrition plays a very important role in the health of clients with CKD, even if they advance to end-stage renal disease (ESRD) and require dialysis treatment or a renal transplant to sustain life.

The stage of CKD is determined by GFR levels, which indicate how well the kidneys are filtering wastes from the blood. (See [Table 15.2](#) in [Applying Clinical Judgment to Promote Nutrition for Renal Wellness](#).) Creatinine and blood urea nitrogen (BUN) levels are also monitored closely and change more as the kidneys progress toward failure.

Nutritional restrictions are vital for clients with CKD. Referral to a certified renal dietitian can ensure that clients are properly educated and that their nutritional needs are individualized to improve their quality and length of life.

Foods high in calcium include cheese, yogurt, edamame, canned sardines, canned salmon, tofu, almonds, leafy green vegetables, and calcium-fortified foods. Foods high in magnesium include dark chocolate, avocados, nuts, legumes, tofu, seeds, whole grains, fatty fish, bananas, and leafy green vegetables.

Phosphorus should be restricted to less than 800–1000 mg/day, protein to 0.6–0.8 g/kg/day, and potassium to less than 2000 mg/day (Mobley et al., 2020). Protein should come from lean sources as much as possible, which are those that come from low-fat, high-protein foods such as eggs and skinless chicken.

For clients receiving dialysis treatments, strict fluid restriction is extremely important because gaining too much weight due to fluid retention in between treatments can cause serious side effects. The average fluid restriction for a client on dialysis is 32 oz daily (Fresenius Kidney Care, n.d.). Nurses should instruct clients that fluids are not just beverages and substances that are liquid at room temperature; this category also includes gelatin, ice cream, ice, ice chips, and soup.

### ! SAFETY ALERT

#### Salt Substitutes

Nurses should be sure clients are aware that when a low-sodium diet is required and sodium substitution is recommended, it is dangerous for them to use salt substitutes. These substitutes are made with potassium chloride, which can raise potassium to life-threatening levels. Instead, clients should check food labels for added sodium and flavor their food with herbs and other salt-free substitutes.

### Renal Cancer

Renal cancer, or kidney cancer, occurs sporadically, but associations with aging, obesity, hypertension, smoking, acquired cystic kidney disease, and exposure to asbestos, cadmium, or petroleum have been observed (Mas Que Ideas Foundation, 2022). Most of the time, renal cancer is asymptomatic and found incidentally on an abdominal scan performed for other medical purposes; however, on occasion, a client may experience hematuria, an abdominal lump, or a symptom related to paraneoplastic syndrome, such as anemia, hypertension, weight loss, anorexia, or muscle wasting. Renal cancer will not necessarily cause immediate or automatic kidney failure.

Proper nutrition and nutritional modifications can help lower the risk for renal cancer, prevent adverse effects of cancer treatments and medications, support the highest level of renal function possible, and maintain a client's life expectancy after cancer remission.

Preventing renal cancer is the first priority. Eating grilled and pan-fried foods as well as red meats increases the risk, so nurses should instruct clients to restrict or avoid these (Richards, 2022). Increased intake of vegetables, with special emphasis on cruciferous vegetables, and foods containing vitamin C, such as citrus fruits, strawberries, bell peppers, tomatoes, and white potatoes, shows promise for decreasing the risk for developing renal cancer (Liao et al., 2022). High-fiber foods; foods rich in antioxidants such as vitamin E and selenium; and foods containing phytochemicals, such as whole grains, may also reduce the risk (Thompson, 2023). See [Figure 16.3](#).



**FIGURE 16.3** A diet rich in cruciferous vegetables (purple cabbage), phytochemicals (quinoa), antioxidants (carrots), and vitamin C (bell peppers and peas) may lower the risk for developing renal cancer. (credit: "Asian Quinoa salad food" by Watts/Flickr, Public Domain)

Nutritional changes can address adverse effects of cancer treatment. Many side effects of chemotherapy—such as nausea and vomiting, anorexia, diarrhea, constipation, flatus, bloating, weight loss, sore throat, gastrointestinal problems, dysphagia, heartburn, dry mouth, mouth sores, and changes in taste and smell—make it difficult for the individual to take in enough calories. Therefore, a nutrient-dense diet with sufficient calories, vitamins, and minerals to ensure proper nutrition is important (Richards, 2022; Thompson, 2023). It should include whole foods, such as fruits, vegetables, and whole grains, and limit foods high in salt and phosphorus (Richards, 2022). Fluid volume status should be monitored because decreased kidney function may necessitate fluid restriction (Richards, 2022). Nurses can suggest that clients with painful mouth sores avoid acidic or spicy foods, alcohol, and foods that are too hot or too cold, and instead eat foods that are soft and easy to chew (Thompson, 2023).

Because of the eating issues that chemotherapy can cause, clients may better tolerate smaller, more frequent meals and maybe even different food consistencies, such as soft, lightly mashed, or pureed foods (Richards, 2022). Brief periods of fasting may even be beneficial during chemotherapy treatment because fasting can generate environments in the body that make survival of cancer cells less likely and help normal cells resist the negative effects of chemotherapy. These periods should be very short, and the client should eat calorie-rich, nutrient-dense foods after fasting.

Another significant effect of chemotherapy is the risk for developing infection. Some nutritional precautions to lower this risk include avoiding unpasteurized juice and dairy products as well as raw fish and raw meat (Richards, 2022). Food preparation and storage are also important in infection prevention, so the nurse should educate the client on appropriate methods.

In maintenance, a plant-based diet may improve survival after renal cancer (Richards, 2022). Because chronic

inflammation has been shown to play a major role in cancer, and fruits and vegetables have strong anti-inflammatory properties, fruits and fiber-rich vegetables may have protective effects against renal cancer and its reoccurrence (Thompson, 2023). Since whole grains are high in fiber and contain antioxidants such as selenium and vitamin E as well as phytochemicals, they are also important nutritionally and may help prevent the occurrence and reoccurrence of renal cancer.

### Holistic Assessment of Cultural Considerations

Most long-term kidney disease management is focused on CKD. Care of CKD starts with nutritional restrictions and treatment of any comorbidities to prevent disease progression, as the main goal is to prevent the need for dialysis (Satellite Healthcare, 2022). Some religious beliefs involve more restrictions in nutritional allowances and prevent the acceptance of dialysis or transplants, making it even more important for these clients to slow progression as much as possible for as long as possible.

Nurses must be well versed in the nutritional and other care needs of these clients so they can properly educate them to holistically care for their disease as well as live within the confines of their religious and cultural beliefs. Treatment adherence, quality of life, and the self-care ability of clients with CKD and ESRD increase, and risks for complications decrease, when nurses are actively involved in clients' comprehensive care.

### Promotion of Food Security

Food security must be addressed in all age groups to ensure renal health. The National Kidney Foundation has many partnerships with other organizations that are working on initiatives to address food insecurity, especially for individuals with special nutritional needs due to renal issues.

Economic status and the accessibility of grocery stores can affect people's ability to obtain food. At least 33.2% of low-income individuals live more than a mile from the nearest grocery store (Economic Research Service, 2022). Older adults and individuals with mobility issues may have to rely on others to bring them food and therefore have even more limited food options. Having insufficient ways to obtain food from grocery stores because of transportation issues may lead some people to buy more fast food regardless of their health needs, as fast-food restaurants are often more numerous and easily accessed than grocery stores.

Americans have access to a variety of government resources that can help them with food security issues. The Older Americans Act authorizes meal services and related services for those aged 60 and older, as well as their spouses, regardless of age. These services are provided in settings such as senior centers, churches, schools, and community centers, and meals can be delivered to individuals' homes if they have limited mobility (USDA, 2020, pp. 129–130). The Supplemental Nutrition Assistance Program (SNAP), commonly called food stamps, is a federally funded program that helps Americans with limited incomes obtain healthy foods and beverages during times of constrained resources (USDA, 2020, pp. 68, 90, 105, 120, 129). These same groups of people can take advantage of the Commodity Supplemental Food Program, which directly provides packaged food to older Americans with limited income via federally funded resources and distribution help from nonprofit organizations (USDA, 2020, p. 130). The Child and Adult Care Food Program is a federally funded program that provides reimbursement for food served to children and older adults cared for in after-school programs and day care centers, including adult day care (USDA, 2020, pp. 68, 90, 130). The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides specific healthy foods for women who are pregnant, breastfeeding, or postpartum and for children aged newborn to 5 years (USDA, 2020, pp. 68, 90, 120). The National School Lunch Program and the School Breakfast Program provide low-income children with breakfast and lunch on school days, accounting for two-thirds of their daily caloric needs for those days (USDA, 2020, p. 90).

## Chapter Summary

- Nutrition plays a large role in the developmental process of every organ in the body, including the renal system.
- The importance of nutrition for the renal system starts in utero and continues throughout the individual's entire lifespan.
- Normal nutritional needs are altered when renal or urologic alterations exist.
- Nutrition plays an extremely important role in

promoting quality and length of life in clients with chronic renal illnesses.

- Many illnesses can be controlled or prevented with proper nutritional modifications.
- The most significant nutritional considerations for the most serious diseases involving the renal system concern fluids, calories, protein, potassium, sodium, calcium, and phosphorus.

## Key Terms

**chronic kidney disease** a progressive disease of the

kidneys that eventually ends in kidney failure

**cysteine** an amino acid that contains sulfur

**cystinuria** a rare genetic condition in which

nephrolithiasis are made from cystine

**dialysis** purification of blood through means other

than the kidneys

**dyspareunia** painful sexual intercourse

**enuresis** bladder incontinence after the age of 3 years

**hyperoxaluria** elevated amounts of oxalate in the urine

**nephrolithiasis** kidney stones

**oligohydramnios** very low to almost absent amniotic fluid, which may be related to impaired or absent kidney function in the fetus

## Review Questions

1. The nurse is caring for a client in the first trimester of pregnancy. Which assessment finding requires follow-up by the nurse?
  - a. Decreased GFR
  - b. Increased fluid retention
  - c. Mild glycosuria
  - d. Proteinuria
2. Which instruction would the nurse give to a client about nutrition during pregnancy?
  - a. Eat 340 calories more each day in the first trimester.
  - b. Start prenatal vitamins in the second trimester.
  - c. Avoid or limit caffeine intake.
  - d. Reduce fluid intake.
3. The nurse provides nutrition counseling to the parents of a child with CKD. Which nutritional restriction is most likely to affect growth and development?
  - a. Potassium
  - b. Sodium
  - c. Fluids
  - d. Protein
4. The nurse is educating a 14-year-old female adolescent with CKD and her parents about nutrition. Which recommended daily intake for iron should the nurse teach the adolescent and her parents?
  - a. 7 mg/day
  - b. 9 mg/day
  - c. 12 mg/day
  - d. 15 mg/day
5. The nurse is teaching a client about nutritional interventions for an overactive bladder. Which instruction should the nurse give the client?
  - a. Avoid cola drinks.

- b. Use artificial sweeteners instead of sugar.
  - c. Reduce fiber intake.
  - d. Avoid foods high in potassium.
- 6.** The nurse is providing discharge instructions to a client following the removal of a calcium kidney stone. Which instruction will the nurse give this client to prevent future stone formation?
- a. Avoid foods high in purine.
  - b. Avoid foods high in oxalate.
  - c. Restrict nondairy animal protein.
  - d. Increase sodium intake.
- 7.** The nurse is completing a follow-up assessment of a client with a history of kidney stones. Which of the following dietary habits reported by the client indicates the need for additional instruction related to their kidney stone history?
- a. Drinks at least 2 L of fluid daily
  - b. Eats a variety of fruits and vegetables
  - c. Consumes a high-protein diet
  - d. Drinks less than 6 oz of fruit juice each day
- 8.** The nurse is working at a community health fair, providing information about risk reduction for renal cancer. Which nutritional instruction will the nurse teach to reduce the risk for renal cancer?
- a. Increase intake of cruciferous vegetables.
  - b. Increase intake of red meat.
  - c. Eat more pan-fried foods.
  - d. Cook meats on the grill.
- 9.** The nurse is developing a teaching plan for a client who has just entered stage 4 CKD. Which instruction will the nurse give the client?
- a. There are no restrictions on fluid intake.
  - b. Reduce calcium intake.
  - c. Restrict potassium intake.
  - d. Increase magnesium intake.
- 10.** Which instruction should the nurse give a client with benign prostatic hypertrophy to reduce lower urinary tract symptoms?
- a. Increase intake of fresh fruits.
  - b. Use butter rather than olive oil.
  - c. Reduce intake of whole grains.
  - d. Drink whole milk.

## Suggested Reading

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## CHAPTER 17

# Applying Clinical Judgment to Promote Nutrition for Gastrointestinal Wellness



**FIGURE 17.1** Food ingestion, breakdown, absorption, and metabolism are critical to fuel the body for proper function. (credit: modification of work “[Close-up, a glass of cocktail with green fruit and fresh mint \(https://openstax.org/r/wuestenigela\)](https://openstax.org/r/wuestenigela)” by Marco Verch/Flickr, CC BY 2.0)

## CHAPTER OUTLINE

- 17.1 Assess and Analyze the Impact of Nutrition on the Gastrointestinal System
  - 17.2 Plan Nutritional Strategies to Impact Gastrointestinal Wellness
  - 17.3 Implement Nutritional Strategies to Impact Gastrointestinal Wellness
  - 17.4 Evaluate Nutritional Strategies to Impact Gastrointestinal Wellness
- 

**INTRODUCTION** To stay nourished, humans must ingest food, digest it into smaller usable substances, absorb what is digested into the body cells, and metabolize what is absorbed into usable energy. This chapter covers the expected overall normal findings, the meaning of abnormal findings, and the importance of nutrition in gut health. For detail regarding these processes and the ways to assess the gastrointestinal system properly for appropriate functioning, see [The Digestive Process](#).

Consider this case: We will be following Zekia Azan, a 56-year-old Jamaican American woman with a history of Crohn’s disease. She has an average of five or six watery stools daily despite therapy for her disease. She comes to the outpatient clinic to be assessed after an exacerbation of her disease with increased diarrhea.

## 17.1 Assess and Analyze the Impact of Nutrition on the Gastrointestinal System

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 17.1.1 Recognize the normal function of the gastrointestinal system.
- 17.1.2 Recognize cues of nutritional impact on the gastrointestinal system.
- 17.1.3 Analyze cues of nutritional impact on the gastrointestinal system.

### Normal Function of the Gastrointestinal System

The gastrointestinal system comprises the organs in the upper gastrointestinal tract—the mouth, esophagus, stomach, and duodenum—and the organs in lower gastrointestinal tract—the small intestine, large intestine (or colon), rectum, and anus. The gastrointestinal system is aided by the teeth, tongue, salivary glands, and the pancreas, liver, and gallbladder, which are also known as ancillary digestive organs. The sensory system, the nervous system, the mucous membranes, and glands (digestive and adrenal) also have roles to play.

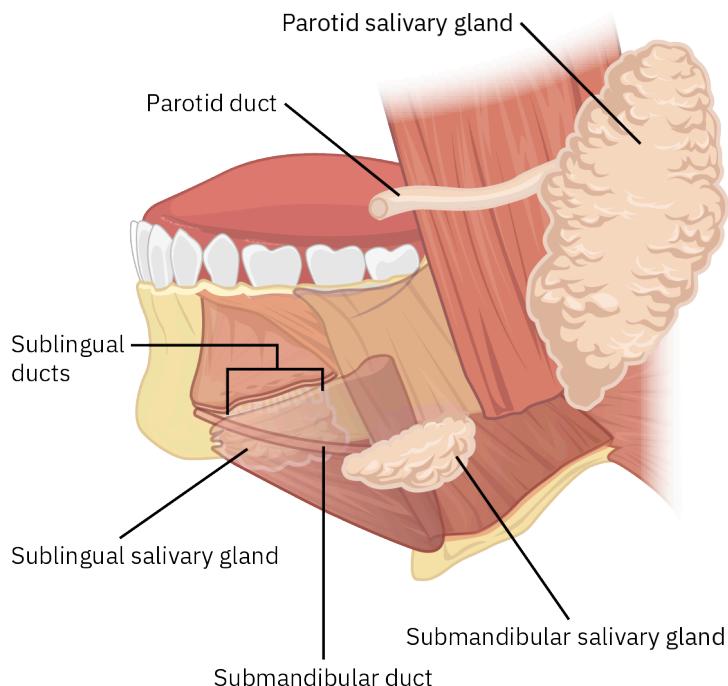
There are four main functions of the gastrointestinal system: ingestion, digestion, absorption, and metabolism.

**Ingestion** is the swallowing and absorbing of substances into the body. This process starts with the sensory organs before food even enters the oral cavity: The smell or sight of appealing food can trigger the salivary glands to release saliva. That process, combined with hunger, can increase the desire to ingest the food. Once the food is inside the mouth, its taste, sensed through the papillae on the tongue, can either encourage or inhibit its further ingestion. Foods that register an unappetizing taste encourage expulsion from the oral cavity.

**Digestion** occurs when the body breaks down what is ingested into absorbable substances. This, too, starts in the oral cavity. The tongue and teeth start the digestion of food using mostly mechanical and some chemical processes known collectively as **mastication**. Mastication employs the use of the tongue for mechanical compression, abrasion, and distortion; secretion of mucins and lingual lipase, which assist in breaking down lipids; and manipulation to assist with movement during chewing and swallowing (Ogobuiro et al., 2023). The teeth are used strictly for mechanical processes during mastication as they cut, tear, grind, and chew food to break it down physically into smaller pieces.

Chemical digestion and lubrication in the oral cavity to aid in food movement are accomplished by the tongue and salivary glands. There are three pairs of salivary glands in the mouth: the parotid glands, which release salivary amylase to break down complex carbohydrates; sublingual glands, which release a mucus secretion that acts as a buffer and a lubricant; and the submandibular glands, which release a mixture of salivary amylase, buffers, and glycoproteins called mucins ([Figure 17.2](#)) (Ogobuiro et al., 2023).

The food is broken down and lubricated enough during mastication to be swallowed and moved to the next phase of digestion. The swallowing reflex is aided by the tongue, allowing food to travel down the esophagus via peristalsis and empty into the stomach through the lower esophageal sphincter.

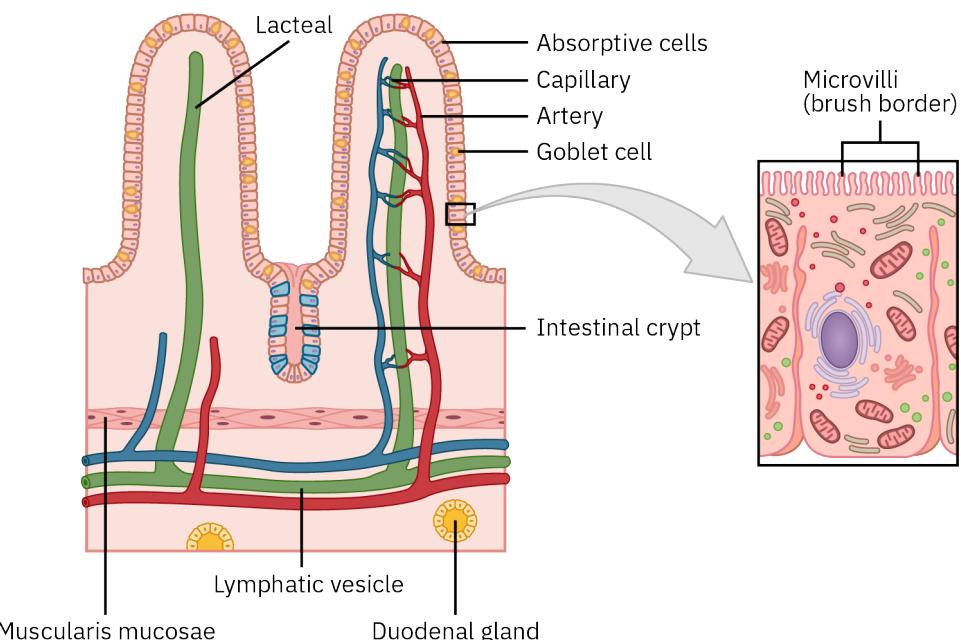


**FIGURE 17.2** The salivary glands aid in chemical breakdown of food in the oral cavity. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Some digestion, both mechanical and chemical, occurs in the stomach, which also temporarily stores food. Food exits the stomach as **chyme**, a blend of gastric juices and digested food particles. The stomach also synthesizes proteins that are needed for vitamin absorption and microbial defenses, propagates the peristaltic reflex, and releases intrinsic factor from the parietal cells, which enables the small intestine to absorb vitamin B<sub>12</sub> (Hsu et al., 2023). When chyme exits the stomach, simple carbohydrates have been digested. Larger molecules such as complex carbohydrates, fats, and proteins have not yet been broken down.

The duodenum breaks down larger molecules. In the duodenum, at the sphincter of Oddi, there is a release of digestive secretions by the ancillary organs (Ogobuiro et al., 2023), specifically from the gallbladder and the pancreas. The pancreas releases active alpha-amylase, colipase, and lipase, and the gallbladder releases bile, produced in the liver, to break down fats, proteins, and complex carbohydrates.

**Absorption** refers to the taking in of the broken-down substances into the cells. Very few substances are absorbed by the stomach. The small intestine handles 90% of food absorption as food travels through its three segments, the duodenum, jejunum, and ileum (Ogobuiro et al., 2023). The innermost layer of the mucosa of the small intestine is composed of absorptive cells known as enterocytes, goblet cells, and enteroendocrine cells (Fish & Burns, 2022). Enterocytes are effective at absorption because each one has around 3,000 microvilli that expand their available surface area ([Figure 17.3](#)).



**FIGURE 17.3** In the small intestine, goblet cells have microvilli to better absorb nutrients. (credit: modification of work from *Anatomy and Physiology 2e*. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

The duodenum is the site for iron absorption and some vitamin B<sub>9</sub> (folate) absorption, but the major site for vitamin B<sub>9</sub> absorption is the jejunum (Fish & Burns, 2022). Minerals and vitamins A, D, E, and K are absorbed through the small intestine. The small intestine absorbs 90% of the water from digested food (Fish & Burns, 2022). The last segment of the small intestine, the ileum, is responsible for the absorption of bile salts and vitamin B<sub>12</sub> (cobalamin); (Fish and Burns, 2022). Each broken-down substance is now in a new, more usable form for use by the body's metabolic processes ([Table 17.1](#)).

Macronutrient	Before Digestion	After Digestion
Carbohydrate: polysaccharides (starchy foods)	Amylose	Monosaccharides
Carbohydrate: disaccharides	Lactose, sucrose, maltose, trehalose	Glucose, fructose, galactose
Protein	Large-chain amino acids joined by peptide bonds	Separate amino acids and peptides (oligopeptides, dipeptides, tripeptides)
Fat	Triglycerides	Monoglycerides, fatty acids

**TABLE 17.1** Nutrients Before and After Digestion for the Body's Metabolic Use (source: Fish & Burns, 2022)

The last part of the absorption process takes place in the large intestine. It has three main functions in digestion: absorption of the remaining water and electrolytes, absorption and production of vitamins, and formation and movement of feces to the rectum for elimination. The first portion of the large intestine, the ascending colon, removes any remaining water and key nutrients from the indigestible material passing through it while solidifying this waste to form stool.

During this part of digestion, water osmosis causes absorption of the remaining water, sodium is absorbed via sodium channels, potassium absorption is regulated by its concentration in the lumen, and chloride and bicarbonate ions are exchanged. In addition, the large intestine houses trillions of bacteria, which produce many vitamins, including vitamin K, B vitamins, and biotin, through fermentation (Azzouz & Sharma, 2023).

**Metabolism** refers to the chemical processes by which the body converts absorbed substances to energy. Catabolic reactions release large amounts of protons, which are transported to mitochondria in the cells to produce adenosine triphosphate (ATP), the body's chemical carrier of energy (Sanchez Lopez de Nava & Raja, 2022). An imbalance between energy spent and energy used, or between anabolism and catabolism, can result in obesity or cachexia (Sanchez Lopez de Nava & Raja, 2022). Obesity is clinically defined as an excessive or abnormal accumulation of fat in the body that can increase an individual's health risks. Cachexia refers to muscle loss with or without fat mass loss.

For these processes to take place effectively and provide balanced nutrition and appropriate energy, the individual must first ingest the proper mix of the required nutrients and water.

### Assessment of the Normal Gastrointestinal System

Assessment of the gastrointestinal organs and normal expected findings are explained in detail in [The Digestive Process](#). This section will cover expected physical assessment findings in clients who demonstrate normal nutritional status. Overall normal physical assessment findings in addition to normal gastrointestinal organ-specific findings can help confirm a fully functioning gastrointestinal system ([Table 17.2](#)).

Organ Assessed	Expected Findings
Lips	<ul style="list-style-type: none"> <li>Symmetric, soft, moist, smooth textured, uniform in color and with expected color for race (pink for fairer-skinned and darker for darker-skinned individuals), symmetrically contoured, symmetrically pursed when individual is asked to purse the lips</li> </ul>
Buccal mucosa and inner lips	<ul style="list-style-type: none"> <li>Uniform pink or freckled brown in darker-skinned individuals, moist (may be slightly drier in older clients because of decreased salivation), glistening, smooth, elastic texture</li> </ul>
Gums	<ul style="list-style-type: none"> <li>Moist and firm without retraction from the teeth; older clients may show some hyperpigmentation and receding of the gumline</li> </ul>
Tongue	<ul style="list-style-type: none"> <li>Central resting position in the mouth but able to move freely; no tenderness, swelling, or lesions; smooth with lateral margins and raised papillae (taste buds); base should be smooth and prominent with veins and no ulcerations</li> </ul>
Oropharynx	<ul style="list-style-type: none"> <li>Smooth and pink at the posterior wall; uvula midline at the back of the soft palate and freely movable; tonsils (if present) smooth, colored appropriately for race, of normal size (usually larger in children than in adults) or not visible, without discharge; gag reflex present</li> </ul>
Teeth	<ul style="list-style-type: none"> <li>Smooth and white with shiny enamel; older adults may have teeth staining, chipping, erosions, or abrasions due to the aging process and wearing of teeth; older children and adults may have dental appliances; any dentures or bridges should be smooth and intact</li> </ul> <p>Expected number of teeth: adults, 32; children by the age of 3 years, 20; children and young adults aged 6–20 years can have a varying number as they lose primary teeth and gain permanent teeth; newborns should not have teeth</p>
Soft palate and hard palate	<ul style="list-style-type: none"> <li>Light pink or colored appropriately for race; the soft palate should be smooth and the hard palate more irregularly textured; newborns may have Epstein pearls, Bohn nodules, or gingival cysts</li> </ul>

**TABLE 17.2** Expected Normal Findings During Physical Assessment of the Gastrointestinal System (sources: Diaz de Ortiz & Mendez, 2022; Gantan & Wiedrich, 2022; Mealie et al., 2022)

Organ Assessed	Expected Findings
Abdomen: inspection	<ul style="list-style-type: none"> <li>• Skin: intact, uniform in color and consistent with race, no ecchymosis or jaundice, silver-white striae (stretch marks) may be present (may be purple-pink in pregnant client), surgical scars may be present</li> <li>• Flat, rounded but not distended or scaphoid (sunken); no protrusions or evidence of spleen or liver enlargement; no visible vascular patterns (except in pregnancy); respirations should cause symmetric movements of the abdomen; in very lean client, aortic pulsations may be visible at the epigastric area, and peristalsis may also be visible; umbilical stump should be present in newborns</li> </ul>
Abdomen: auscultation	<ul style="list-style-type: none"> <li>• Bowel sounds present in all quadrants, low pitched and gurgling and occurring at a rate of 2–5 per minute, lasting from less than 1 second to several seconds each; no bruits or friction rub; no succussion splash</li> </ul>
Abdomen: percussion	<ul style="list-style-type: none"> <li>• Dull, flat, or decreased sounds over organs; more tympanic (louder and higher pitched) over areas of air or gas</li> </ul>
Abdomen: palpation	<ul style="list-style-type: none"> <li>• No pain, crepitus, tenderness, bulging, masses, inflammation, or muscle guarding; deep palpation should reveal normal-sized organs without masses, nodules, or tenderness</li> </ul>
Anus	<ul style="list-style-type: none"> <li>• Skin intact, hairless, and slightly moister, coarser, and more pigmented than surrounding skin; patent anal canal</li> </ul>
Rectum	<ul style="list-style-type: none"> <li>• No masses or fissures; prostate in male client should be firm, smooth, not enlarged</li> </ul>

**TABLE 17.2** Expected Normal Findings During Physical Assessment of the Gastrointestinal System (sources: Diaz de Ortiz & Mendez, 2022; Gantan & Wiedrich, 2022; Mealie et al., 2022)

In addition to assessing individual organs, the nurse should conduct a general physical assessment, being alert for specific findings that indicate adequate nutrition ([Table 17.3](#)). Such findings also help demonstrate that the gastrointestinal system is functioning correctly.

Feature Assessed	Expected Findings
General appearance	Alert, conscious, and ambulatory within the confines of client's ability; no general emaciation
Height, weight, and body mass index	Body mass index of 18.5–24.9 kg/m <sup>2</sup> ; 30 and over is considered obesity, with Class 3 obesity being 40 or greater
Vital signs	Vital signs that fall within expected ranges can indicate good nutritional status, but many pathologies can affect vital signs without regard to nutrition. Blood pressure and pulse can indicate hydration status; low blood pressure (less than 90/60 mm Hg) and tachycardia (heart rate greater than 100 beats per minute) can indicate hypovolemia
Eyes	No pallor of the palpebral conjunctiva, <b>icterus</b> (yellowing) of the sclera, <b>Bitot's spots</b> (oval or triangular patches on the conjunctiva of built-up keratin), <b>xerosis</b> (dryness) of the cornea, or <b>xanthelasmias</b> (yellow plaques on or near the eyelids)
Skin	No <b>xeroderma</b> (dry skin), petechiae, purpura, ecchymosis, jaundice, carotenoderma (yellow-orange skin discoloration), poorly healing wounds, pigmentation or rashes in sun-exposed areas (such as around the neck or on the extremities, where pigmentation might look like gloves or stockings), <b>xanthomas</b> (localized lipid deposits), or loss of subcutaneous adipose tissue

**TABLE 17.3** Expected Normal Findings During General Physical Assessment (sources: Castera & Borhade, 2022; Cleveland Clinic, n.d.-b; Feroze & Kaufman, 2023; Johnson, 2021; Kesari & Noel, 2023; Rosenthal, 2020; Schneider & Gibbs, 2022; UPMC, n.d.)

Feature Assessed	Expected Findings
Hair	No dryness, brittleness, or unexpected discoloration; not easy to pluck; no patches of baldness or extreme thinness
Nails	No dryness, brittleness, discoloration, clubbing, or <b>koilonychia</b> (soft nails that are concave in the center and appear to be “scooped out”)
Extremities	No edema, weakness, paresthesia, sensation loss, bowing, ulcerations, poorly healing wounds, neuropathies, or muscle atrophy or wasting
Odor	No unusual odors; fruity acetone, musty, and sweet, burnt sugary odors can indicate specific nutritional issues due to pathologies
Function	Ability to perform functions at the client's baseline for their age; deficits from baseline or, in infants and children, delays in development, growth, or weight can indicate poor nutritional status

**TABLE 17.3** Expected Normal Findings During General Physical Assessment (sources: Castera & Borhade, 2022; Cleveland Clinic, n.d.-b; Feroze & Kaufman, 2023; Johnson, 2021; Kesari & Noel, 2023; Rosenthal, 2020; Schneider & Gibbs, 2022; UPMC, n.d.)

### Nutritional Deficiencies Related to Abnormal Assessment Findings in the Gastrointestinal System

Abnormal findings in an assessment of the gastrointestinal system and other systems can indicate the presence of disease or nutritional deficit. To best plan nutritional strategies for the client, the nurse should know what each abnormal finding, in conjunction with laboratory results and dietary recall, could indicate. Some abnormal findings and nutritional deficiencies and toxicities related to them are shown in [Table 17.4](#).

Organ Assessed	Abnormal Findings	Nutritional Deficiency or Toxicity
Lips	Fissures, crusts, or scales on the lips or in the corners of the lips, cracked lips, angular cheilitis	Deficiency of vitamin B <sub>1</sub> (thiamine), vitamin B <sub>12</sub> (cobalamin), and/or iron
Tongue	Inflammation of the tongue	Deficiency of vitamin B <sub>2</sub> (riboflavin) and/or B <sub>3</sub> (niacin)
	Loss of taste	Deficiency of zinc
	Halitosis	Deficiency of vitamin B <sub>12</sub> (cobalamin)
	Red, painful tongue that has a burning sensation	Deficiency of iron
Gums/mouth	Ulcerative gingivitis	Deficiency of vitamin B <sub>2</sub> (riboflavin) and/or B <sub>3</sub> (niacin)
	Hemorrhagic gingivitis, painful mouth ulcers	Deficiency of vitamin B <sub>12</sub> (cobalamin)
	Bleeding gingivitis	Deficiency of vitamin C
	Stomatitis (mouth inflammation)	Deficiency of vitamin B complex
	Salivary gland dysfunction, dysphagia	Deficiency of iron
	Recurrent aphthous stomatitis (canker sores)	Deficiency of zinc
Salivary glands	Dry salivary glands	Dehydration or iron deficiency
Teeth	Pits, grooves, or missing areas in enamel of the teeth, giving teeth a translucent appearance	Deficiency of vitamin A
	Periodontal disease	Deficiency of vitamin B <sub>6</sub> (pyridoxine) and/or B <sub>12</sub> (cobalamin)
	Abnormal bone patterns and shapes	Deficiency of vitamin D
	Dental caries (cavities)	Deficiency of vitamin D and/or fluoride

**TABLE 17.4** Relationship of Abnormal Assessment Findings and Nutritional Deficiencies or Toxicities (sources: American Dental Association, 2023; Cleveland Clinic, n.d.-a; Gold & Schoenhaus, 2023; Hakes, 2021; Johnson, 2022; Kesari & Noel, 2023; Mount Sinai Icahn School of Medicine, n.d.; Plewa & Chatterjee, 2022; Sawar et al., 2021; Stewart, n.d.)

Organ Assessed	Abnormal Findings	Nutritional Deficiency or Toxicity
Oropharynx	Recurrent tonsillitis	Deficiency of vitamin D
	Pharyngitis	Deficiency of vitamin B <sub>2</sub> (riboflavin)
	Inflammation of the hard and soft palates	Deficiency of iron, vitamin B <sub>2</sub> (riboflavin), B <sub>6</sub> (pyridoxine), B <sub>9</sub> (folate), and/or B <sub>12</sub> (cobalamin), D, and zinc
Abdomen	Constipation (hypoactive bowel sounds, decreased frequency of bowel movements, hard stools, straining with bowel movements, increased flatus, mild abdominal distention, mild abdominal tenderness)	Deficiency of potassium, magnesium, vitamin B <sub>9</sub> (folate), fiber, and/or fluid volume
	Diarrhea (hyperactive bowel sounds, increased frequency of bowel movements, loose or watery stools, increased flatus, abdominal tenderness, symptoms of fluid volume deficit from losses)	Deficiency of vitamin B <sub>3</sub> (niacin) or excessive intake of potassium
	Abdominal muscle pain and cramping	Deficiency of magnesium, potassium, sodium, vitamin B <sub>1</sub> (thiamine), vitamin D, and/or calcium
Anus	Hemorrhoids and fissures (caused by chronic constipation and straining to pass stools)	Deficiency of fiber and/or fluid volume
General appetite/weight	Loss of appetite	Deficiency of zinc
	Weight loss	Deficient caloric intake, protein deficiency, or impaired absorption
Skin	Skin discoloration	Excessive intake of protein, carotene-containing foods, or supplements (vitamin A), causing diffuse hyperpigmentation, or excessive intake of both protein and zinc, causing carotenoderma
	Ecchymosis	Deficiency of vitamin C, vitamin K, or zinc
Muscle	Muscle pain, cramps	Deficiency of magnesium, potassium, sodium, vitamin B <sub>1</sub> (thiamine), vitamin D, and/or calcium
Eyes	Pallor	Deficiency of iron, protein, or vitamin B <sub>6</sub> (pyridoxine), B <sub>9</sub> (folate), B <sub>12</sub> (cobalamin), or C
	Bitot's spots, xerosis	Deficiency of vitamin A
	Xanthelasmias	Excessive caloric intake, obesity, or hypercholesterolemia
Hair	Dry hair	Deficiency of vitamin A or E
	Brittle hair	Deficiency of vitamin B <sub>7</sub> (biotin)
	Discolored, easily pluckable hair; hair loss	Deficiency of protein or iron; overall severe malnutrition
Nails	Dry and brittle nails	Deficiency of vitamin B <sub>7</sub> (biotin), zinc, or protein
	Nail discoloration	Overall poor nutritional status

**TABLE 17.4** Relationship of Abnormal Assessment Findings and Nutritional Deficiencies or Toxicities (sources: American Dental Association, 2023; Cleveland Clinic, n.d.-a; Gold & Schoenhaus, 2023; Hakes, 2021; Johnson, 2022; Kesari & Noel, 2023; Mount Sinai Icahn School of Medicine, n.d.; Plewa & Chatterjee, 2022; Sawar et al., 2021; Stewart, n.d.)

Organ Assessed	Abnormal Findings	Nutritional Deficiency or Toxicity
	Koilonychia	Deficiency of iron, causing anemia
Extremities	Edema	Deficiency of vitamin B <sub>1</sub> (thiamine) or protein; excessive sodium
	Paresthesia, muscle weakness	Deficiency of vitamin B <sub>1</sub> (thiamine), B <sub>6</sub> (pyridoxine), B <sub>12</sub> (cobalamin), or E
	Loss of sensation	Deficiency of vitamin B <sub>12</sub> (cobalamin) or E
	Muscle atrophy and wasting	Severe malnutrition
	Bowing of the legs (caused by rickets)	Deficiency of vitamin D

**TABLE 17.4** Relationship of Abnormal Assessment Findings and Nutritional Deficiencies or Toxicities (sources: American Dental Association, 2023; Cleveland Clinic, n.d.-a; Gold & Schoenhaus, 2023; Hakes, 2021; Johnson, 2022; Kesari & Noel, 2023; Mount Sinai Icahn School of Medicine, n.d.; Plewa & Chatterjee, 2022; Sawar et al., 2021; Stewart, n.d.)



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Mrs. Azan tells the nurse that she has been having muscle weakness and cramping, abdominal pain, mouth and tongue swelling, and sores in her mouth. When the nurse assesses Mrs. Azan, the nurse finds that she has angular cheilitis, multiple canker sores in her buccal areas, a red and swollen tongue, and general pallor.

1. Based on both the objective and subjective assessment findings, what would the nurse rule out as a potential deficiency being experienced by this client?
  - a. Potassium
  - b. Magnesium
  - c. Vitamin B<sub>12</sub>
  - d. Vitamin A
  
2. Based on Mrs. Azan's presentation, which additional laboratory test should the nurse expect the health care provider to order?
  - a. Iron
  - b. Vitamin D
  - c. Calcium
  - d. Vitamin E

## 17.2 Plan Nutritional Strategies to Impact Gastrointestinal Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 17.2.1 Prioritize nutritional habits that optimize gastrointestinal wellness.
- 17.2.2 Generate solutions to optimize gastrointestinal wellness using nutritional habits.

### Plan Nutritional Goals Based on Testing Results

Nutritional plans (meal plans) should be made with the client based on their specific signs and symptoms. This plan may also include nutrient intake adjustments based on absorption requirements. Nutritional plans should include any nutritional intake restrictions or additions for overall gastrointestinal health based on the client's specific needs. In addition to the nutrients needed to avoid the deficiencies outlined in [Table 17.4](#), the plan should include foods known to be beneficial for the overall wellness of the gut's normal microbial growth and should be based on the client's food preferences and dietary restrictions.

A common vitamin deficiency that displays with abnormal assessment findings is vitamin B. Vitamin B deficiencies that can be found, in order of most importance to the body for normal function, include:

- B<sub>12</sub> (cobalamin)
- B<sub>1</sub> (thiamine)
- B<sub>2</sub> (riboflavin)
- B<sub>6</sub> (pyridoxine)
- B<sub>3</sub> (niacin)
- B<sub>9</sub> (folate)
- B<sub>7</sub> (biotin)

Several macro- and micronutrients can appear as abnormal assessment findings when deficient or toxic. They are listed as follows in order of importance for normal gastrointestinal function:

- Iron
- Zinc (deficiency and toxicity)
- Vitamin D
- Protein (deficiency and toxicity)
- Vitamin C
- Vitamin A (retinol)
- Vitamin E
- Magnesium
- Potassium (deficiency and toxicity)
- Sodium (deficiency and toxicity)
- Fiber, calcium, fluids (water)
- Phosphorus
- Folate
- Vitamin K
- Fluoride
- Calories (underconsumption and overconsumption)
- Saturated fats (specifically for overconsumption only)

The client may require enzyme replacement for digestion in the absence of a functioning liver, gallbladder, or pancreas.

When the nurse is evaluating the client's diet to ensure healthy gut microbiota, dietary additions that might be considered include fiber, additional water, yogurt with active bacterial cultures, whole grains, fruits and vegetables, foods high in antioxidants, and probiotic and prebiotic foods (Afzaal et al., 2022; Gunnars, 2023; Lee et al., 2022; Weersma et al., 2020). Substances that should be restricted include saturated fats and trans fats, sodium, and alcohol (Afzaal et al., 2022).



### CLINICAL TIP

#### Changes to a Client's Nutritional Intake

Before the dietitian or nurse makes any recommendations to add or restrict anything from the client's nutritional intake, laboratory tests should be done to confirm what the physical assessment indicates. Once that testing is completed, the nutritional plan can be established.

Nurses must also understand the synergistic relationships between certain nutrients so they can plan interventions to optimize nutritional progress. For example, if a client is iron deficient, an acidic environment will increase iron absorption, which can be achieved by adding vitamin C to the diet (Academy of Nutrition and Dietetics, 2020a). An inability to absorb iron could be directly related to a problem in the gastrointestinal system because most of the body's iron absorption occurs in the duodenum and proximal jejunum, so adding vitamin C to the client's diet would be crucial to correct their deficiency (Ems et al., 2023). There are also inhibitory effects to be aware of; calcium, phytates, and polyphenols, for example, can reduce iron availability.

The inability to absorb nutrients is concerning when the client has gastrointestinal disease. Their nutritional plan will include supplementation and higher nutritional intake levels than for a healthy client. A client with a gastrointestinal disorder may eventually require injectable forms of vitamins to stay healthy if they cannot absorb them adequately through oral ingestion. To best prepare a nutritional plan with the client, the nurse must consider the client's food preferences and cultural practices.

### Identify Challenges to Nutritional Goals

A client may face several challenges when trying to achieve their nutritional goals for gastrointestinal health. The first is malabsorption. Even when the client adheres to the nutritional plan of care, their body may be unable to absorb the nutrients provided in their oral intake. Many gastrointestinal diseases can cause these issues (refer to [Special Nutritional Considerations for Gastrointestinal Health](#) for greater detail on gastrointestinal diseases). To address such deficiencies, the dietitian, nurse, and health care provider must work closely with the client to monitor laboratory results and add supplementation in oral, enteral (feeding tube), and parenteral forms as needed to reach nutritional goals.

Another challenge that may be encountered is the presence of food allergies or comorbidities. Many foods contain allergens, such as eggs, milk, red meat, nuts, wheat/barley/rye (gluten), shellfish, and citrus fruits. Comorbidities present a concern because if the client already has multiple nutritional restrictions due to other illnesses, such as diabetes, hypertension, or chronic kidney disease, fewer food options may be available to them. In addition, the client may be less motivated or able to follow a nutritional plan the more restrictive it becomes.

The final challenge to consider is the side effects of the gastrointestinal disease processes a client may be experiencing. When a client has a gastrointestinal disease, they may be dealing with nausea, vomiting, anorexia, and/or diarrhea. These issues may cause the client to be unable to consume food or to absorb enough nutrients from what they do consume. For a client with these issues to be successful with their nutritional goals, the health care provider, dietitian, and nurse will need to address these issues, and the nutritional plan will need to include foods that do not aggravate the client's conditions.

## 17.3 Implement Nutritional Strategies to Impact Gastrointestinal Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 17.3.1 Assess the client for readiness to learn.
- 17.3.2 Teach nutritional strategies to optimize gastrointestinal wellness.

### Holistic Nursing Assessment of the Client

The exact foods included in a nutritional plan should be personalized to each client. Caring for the client holistically requires the nutritional plan to evolve based on the client's dietary requirements. A holistic nutritional plan should include food items that are appropriate based on the client's religious, cultural, and personal beliefs. For example, some religions forbid a single type of meat or all meat. In this case, the nutritional plan should include reasonable meat and nonmeat options, such as quinoa or pumpkin seeds, as appropriate to ensure proper protein intake.

### Client Teaching

Client teaching for gastrointestinal health should focus not only on general health but also on the specific nutrients known to improve the health of the gastrointestinal system, as discussed in this chapter. Teaching should begin by determining nutritional goals and setting a plan with the client. A registered dietitian should be consulted to ensure that the nutritional plan is appropriate for all the client's needs, including any restrictions. The nurse should ensure that the client understands the education and the plan developed with the dietitian and should routinely follow up to make sure the client is following this plan. The client must be an active part of this process so that the registered dietitian and nurse can determine if there is a lack of understanding. Active participation also gives the client a chance to verbalize any specific food dislikes or barriers they may have in obtaining certain types of foods.

The nurse should ask the client to use the information they were taught to create a 3-day meal plan that includes breakfast, lunch, dinner, snacks, and beverages. The client and the nurse can then sit down together and discuss good choices and not-so-good choices the client may have made for each meal. This practice allows active learning

for the client and is one way to evaluate the client's understanding of the nutritional plan.

## 17.4 Evaluate Nutritional Strategies to Impact Gastrointestinal Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 17.4.1 Evaluate a nutritional plan for its effect on gastrointestinal wellness.
- 17.4.2 Modify a nutritional plan to promote gastrointestinal wellness.

### Evaluation of the Client's Adherence to the Meal Plan

After a nutritional plan has been in place for at least 3 months, its effectiveness should be evaluated. The client's ability to follow the plan must first be established before the plan is modified. If a client is not able to follow the plan as prescribed, then changes need to be made based on the client's unique reasons for nonadherence.



### UNFOLDING CASE STUDY

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#### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Mrs. Azan returns to the clinic several months later after meeting with the registered dietitian to make dietary modifications. She has been taking her prescribed supplements. Although her previous signs and symptoms have resolved, she is now presenting with unplanned weight loss; pallor; dry, brittle nails; hair loss; edema in the legs; and muscle weakness.

3. What does the nurse recognize as a potential deficiency with these new presenting symptoms?
    - Vitamin C
    - Magnesium
    - Iron
    - Protein
  4. Mrs. Azan states that she has decided to follow a vegetarian diet. Which of the following food choices can the nurse recommend for this diet because it is a high-protein source?
    - Carrots
    - Quinoa
    - Corn
    - Whole grain bread
- 

### Evaluation of the Effectiveness of a Nutritional Plan

After it is established that the client is adhering to their nutritional plan, evaluating the effectiveness of the plan requires checking laboratory results and watching trends as well as performing physical reassessments. If the plan is not effective, adjustments should be made based on the cause of ineffectiveness.



### UNFOLDING CASE STUDY

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#### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Mrs. Azan has returned for her follow-up appointment. It has been 3 months since her last visit. Blood levels were redrawn a week ago, and the results show that vitamin B<sub>12</sub>, magnesium, and potassium have stabilized to a low normal range, but iron is still very low. The laboratory tests ordered also show that Mrs. Azan's calcium and vitamin D levels are low now despite being normal previously. The 72-hour recall the client reports is consistent with the

nutritional goals and education given, and she says she has been following the plan closely. Her food choices are diverse enough to ensure that the calcium and vitamin D levels should not have decreased.

5. Given the results, what should the nurse conclude about the effectiveness of the nutritional plan?
    - a. It is effective, but the client is nonadherent.
    - b. It is effective, but the client is not documenting her food intake correctly.
    - c. It is ineffective because the client cannot comprehend the instructions well enough.
    - d. It is ineffective because the client's Crohn's disease is preventing absorption.
  6. Based on the findings, how should the nurse expect the nutritional plan to be modified?
    - a. There will be no changes because the client has a chronic condition that cannot be cured.
    - b. The amount of food to be consumed will be increased.
    - c. Supplementation, either enteral (feeding tube) or parenteral, will be initiated.
    - d. There will be no changes; instead, the client will be reeducated about the current plan to improve its effectiveness.
-

## Chapter Summary

- The gastrointestinal system has four main functions: ingestion, digestion, absorption, and metabolism.
- The small intestine handles 90% of nutrient and water absorption.
- The duodenum is the site for iron absorption and some vitamin B<sub>9</sub> (folate) absorption, but the major site for vitamin B<sub>9</sub> absorption is the jejunum.
- Minerals and vitamins A, D, E, and K are absorbed by the small intestine.
- The last segment of the small intestine, the ileum, is responsible for the absorption of bile salts and vitamin B<sub>12</sub> (cobalamin).
- The large intestine has three main functions in digestion overall: absorption of the remaining water and electrolytes, absorption and production of vitamins, and formation and movement of feces to the rectum for elimination.
- The first portion of the large intestine, the ascending colon, removes any remaining water and key nutrients from the indigestible material that passes through it, while solidifying this waste to form stool.
- The nutritional plan for clients with gastrointestinal diseases will include supplementation and higher nutritional intake levels than for a healthy client.
- Challenges to nutritional goals include malabsorption, food allergies, comorbidities, and side effects of the gastrointestinal disease processes.

## Key Terms

- absorption** the taking in of broken-down substances into the cells
- Bitot's spots** oval or triangular patches on the conjunctiva of built-up keratin
- chyme** gastric juices and digested food particles
- digestion** the process by which the body breaks down what is ingested into absorbable substances
- icterus** another word for jaundice, a yellowish pigmentation of the skin
- ingestion** the taking in of substances into the body through swallowing or transdermal absorption

**koilonychia** soft nails with a concave indentation, making them appear “scooped out”

**mastication** digestion of food using mostly mechanical and some chemical processes

**metabolism** the chemical processes in the body that convert absorbed substances to energy

**xanthelasma** yellow plaques on or near the eyelids

**xanthomas** localized lipid deposits

**xeroderma** dry skin

**xerosis** extreme dryness of skin or tissue; in corneal xerosis, the cornea may appear hazy

## Review Questions

- The nurse is assessing a client who has poor dentition. Which function of the gastrointestinal system will be affected most by this?
  - Ingestion
  - Digestion
  - Absorption
  - Metabolism
- The nurse is assessing a client for gastrointestinal wellness. Which action should the nurse complete to assess the gastrointestinal system?
  - Auscultate the lungs.
  - Inspect the nares.
  - Palpate the abdomen.
  - Percuss the thorax.
- The nurse is assessing a client for gastrointestinal wellness. Which finding could indicate a vitamin deficiency?
  - Cyanotic lips
  - Angular cheilitis
  - Abdominal tenderness
  - Diaphoretic skin

4. The nurse prioritizes the nutritional content of clients' meal options when planning their care. Which protein option is best for clients of the Buddhist faith who are vegetarians?
  - a. Broccoli
  - b. Fish
  - c. Tofu
  - d. Whole wheat bread
5. The nurse is caring for a client with a protein and iron deficiency who is allergic to beef. Which is the best alternative for the nurse to suggest?
  - a. Edamame
  - b. Milk
  - c. Cheese
  - d. Okra
6. The nurse is providing dietary instruction to a client who needs to eat foods that support the gut's normal microbial growth. Which of the following statements indicates that the client understands the education?
  - a. "I will drink at least a liter of water every day."
  - b. "I will eat yogurt every morning with my breakfast."
  - c. "I will make sure I eat protein at every meal."
  - d. "I will drink an extra glass of milk every day."
7. The nurse is working with a client with an iron deficiency. Which of the following foods would increase iron absorption?
  - a. Whole milk
  - b. Whole grain toast
  - c. Scrambled eggs
  - d. Fresh orange
8. The nurse is preparing a client's nutritional plan for increasing their iron intake. Which vitamin should the nurse include?
  - a. Vitamin A
  - b. Vitamin C
  - c. Vitamin E
  - d. Vitamin D
9. The nurse is reviewing a client's laboratory results and notices there has been little progress in raising the client's vitamin K level. Which assessment finding can the nurse directly relate to this continued deficiency?
  - a. Pharyngitis
  - b. Ecchymosis
  - c. Skin dryness
  - d. Weight loss
10. The nurse is caring for a vegan client who is having difficulty eating enough protein. Which food item is appropriate for the nurse to recommend to this client?
  - a. Quinoa
  - b. Fish
  - c. Eggs
  - d. Carrots

## Suggested Reading

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## CHAPTER 18

# Special Nutritional Considerations for Gastrointestinal Health



**FIGURE 18.1** Nutritional intake starts with the gastrointestinal system, and the types of foods consumed have a direct impact on overall health. (credit: modification of work “mushrooms with lentils-3” by jules/flickr, CC BY 2.0)

## CHAPTER OUTLINE

18.1 The Impact of Nutrition on Gastrointestinal Wellness Across the Lifespan

18.2 Nutrition and Chronic Gastrointestinal Illnesses

18.3 Treatments and Nutrition

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**INTRODUCTION** The gastrointestinal system is vital to the overall health of the body. The ability of this system to function optimally depends not only on the absence of illness but on the proper development of this system throughout the lifespan. This chapter will examine the nutritional requirements needed at each stage of life to assist this system in developing to its optimal capacity. It will also review illnesses that impact this system.

Consider this case: The client—unborn at the start of this chapter's case study—is Bao Nhung. The client's mother, Hien Nhung, is a 23-year-old first-generation Vietnamese American who works as a medical–surgical nurse on the night shift at the local hospital. The client's mother works long nights, and the pregnancy was unplanned. Hien has not received any prenatal care during the pregnancy.

## 18.1 The Impact of Nutrition on Gastrointestinal Wellness Across the Lifespan

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 18.1.1 Describe the impact of nutrition on the gastrointestinal system during pregnancy.
- 18.1.2 Describe the impact of nutrition on the gastrointestinal system during infancy.
- 18.1.3 Describe the impact of nutrition on the gastrointestinal system during childhood.
- 18.1.4 Describe the impact of nutrition on the gastrointestinal system during adolescence.
- 18.1.5 Describe the impact of nutrition on the gastrointestinal system during adulthood.
- 18.1.6 Describe the impact of nutrition on the gastrointestinal system during later adulthood.

### Pregnancy

Pregnancy adds nutritional needs to the pregnant client that were not required before conception, and the client's gastrointestinal health can impact the pregnancy even if they were healthy at the start. When a pregnant client has a gastrointestinal system illness, the stress of the pregnancy only adds to their nutritional needs. It is important that the expectant client maintain optimal nutrition during the pregnancy to ensure proper gastrointestinal development of the fetus as well.

#### The Healthy Pregnant Client

The healthy pregnant client without gastrointestinal illness should maintain a healthy diet and increase their caloric intake by 340 calories from their non-pregnant caloric intake amount daily starting the second trimester of a singleton fetal pregnancy (American College of Obstetricians and Gynecologists, 2023). During the third trimester, the caloric intake should increase by 450 calories from their non-pregnant caloric intake amount daily (Office of Disease Prevention and Health Promotion, 2023). Other recommendations for pregnancy include increasing water intake, decreasing caffeine intake, and adding a prenatal multivitamin with folic acid and iron (American College of Obstetricians and Gynecologists, 2022). It is also recommended that the pregnant client consume food and drinks that are low in added sugars, saturated fats, and sodium (Office of Disease Prevention and Health Promotion, 2023). Pregnant clients can follow the recommendations found using My Pregnancy Plate to ensure that they are eating well for their pregnancy (Oregon Health and Science University, 2023).

Specific recommendations can also be included to maintain the pregnant individual's gastrointestinal health and support fetal development. The **microbiome**, or collection of microorganisms that reside primarily in the gastrointestinal tract, needs to be maintained during pregnancy to maintain overall gastrointestinal health. The gut microbiome promotes immune function and intestinal homeostasis by reducing production of inflammatory mediators (Tabani & Olendzki, 2019), which encourages normal mucosal functioning. Normal mucosal function is needed to ensure optimal intestinal absorption of nutrients.

Additions to the diet that can be recommended by those caring for the client include prebiotic and probiotic foods. **Probiotic** foods are nondigestible substances that stimulate the growth of "good" gut bacteria and include fermented foods that contain live bacteria and yeast, such as yogurt, miso, kefir, kimchi, and honey (Tabani & Olendzki, 2019). **Prebiotic** foods are foods that contain live microorganisms intended to maintain good gut bacteria and include garlic, onions, asparagus, leeks, and bran. See [Figure 18.2](#).



**FIGURE 18.2** Prebiotic foods like this grilled asparagus, which is also high in fiber, can promote gastrointestinal health during pregnancy. (credit: “Ett par sparrisar och några bitar paprika på en klotgrill” By VisbyStar/Wikimedia Commons, Public Domain)

Another important addition for the gastrointestinal system during pregnancy is 25–35 g of fiber daily. Fiber, with adequate water intake, helps to prevent constipation and hemorrhoid development, remove excess cholesterol in the diet, and maintain the gut microbiome (Tabani & Olendzki, 2019). The pregnant client can obtain fiber from barley, flaxseed, oats, lentils, and beans.

The microbiome can also be protected by limiting foods that contain lactose, wheat, corn, and refined sugars that feed harmful bacteria in the gut (Tabani & Olendzki, 2019). These foods promote systemic inflammation and upset the balance of the microbiome.

The fetus will develop their own microbiome based on the maternal microbiome during pregnancy, interaction with the environment after birth, and the diet and lifestyle they develop after birth. Maternal **dysbiosis**, or an imbalance in the microbiome that is associated with unhealthy conditions, can contribute to infant dysbiosis (Garcia-Montero et al., 2023; Martinez et al., 2021). Reducing gluten-containing foods while pregnant can help increase the number of Akkermansia muciniphila, Saccharibacteria (formerly known as TM7 bacteria), and Proteobacteria in the fetus, reducing low-grade inflammation in the infant and the risk for developing diabetes (Tabani & Olendzki, 2019).

Infants exposed to unhealthy maternal microbiomes, especially in conjunction with unhealthy childhood diets, are at increased risk for having lean (lower than optimal bacterial amounts), defective intestinal microbiota, which leads to dysbiosis in the gut (Tabani & Olendzki, 2019). This can lead to dysfunction in genes that are active in both glucose and lipid metabolism (Tabani & Olendzki, 2019). Infants exposed to an unhealthy maternal microbiome are also more likely to have issues with immune system development, develop long-term health issues, and even be predisposed to developing immune-modulated diseases and **Crohn’s disease**, a chronic inflammatory disease that affects the intestines (UMass Chan Medical School, n.d.), particularly the colon and ileum, and can cause ulcerations and fistulas.

The method of delivery can also affect the infant, regardless of the health of the mother’s microbiome. When delivered vaginally, the newborn develops a microbiome higher in Lactobacillus and Prevotella, which is similar to the vaginal flora (Tabani & Olendzki, 2019). Newborns born via cesarean section will have higher levels of Staphylococcus, Corynebacterium, and Propionibacterium, more similar to the mother’s skin flora, which increases risk for developing dairy allergies (Zhang, et al., 2021).

Promotion of a healthy maternal gut microbiome may also prevent preeclampsia as it has been shown to play a role in preeclampsia and decrease the risk for premature birth (Jin et al., 2022). This is important for the overall health of the infant’s gastrointestinal system because prematurity can result in immature development of this system.

The lactating client should continue to maintain their gut health to help prevent issues with their infant. Prebiotics in foods such as kefir consumed by lactating women have been shown to reduce infant risks for developing colic, allergies, and other gastrointestinal problems (Garcia-Montero et al., 2023).

### The Pregnant Client With Preexisting Gastrointestinal illness

Diseases that can heavily affect the nutritional status of the pregnant client and fetus include Crohn's disease; **ulcerative colitis (UC)**, an inflammatory disease that causes ulcerations in the superficial lining of the large intestine; cholelithiasis; gastroesophageal reflux disease (GERD); pancreatic insufficiency; and diabetes types 1 and 2 (Balestrieri et al., 2020; Lifespan Health System, n.d.). When the pregnant client already has a gastrointestinal illness, eating properly for the health of the pregnancy becomes more difficult because intestinal absorption may not be optimal.

Gastrointestinal issues that arise in an uncomplicated pregnancy can pose additional problems for these clients. Conditions such as nausea, vomiting, constipation, heartburn, diarrhea, hemorrhoids, and **hyperemesis gravidarum** (persistent and severe vomiting caused by pregnancy that can lead to weight loss and dehydration) can worsen these clients' ability to absorb and metabolize nutrients.

Managing gastrointestinal issues that commonly occur during pregnancy can help alleviate some of the additional burden placed on these clients. Interventions commonly used during a healthy pregnancy include a healthy diet, increased fluids, and exercise, with medications usually reserved as a last resort. However, the usual treatments will not always address the underlying chronic issues in clients with preexisting conditions, who may need to be initially treated with more advanced treatments, including medication.

These clients face will likely be advised to stop the suppressive medications they take to keep their chronic condition under control. Clients with GERD may have to be switched to less effective medications such as calcium carbonate to manage symptoms during pregnancy. Cholelithiasis can be manageable during pregnancy provided it does not cause infection or cholecystitis. Even if the gallbladder loses the ability to release enough of the needed digestive enzymes due to this condition, clients can be treated with supplemental enzymes.

The gastrointestinal issues that pose the greatest threat to the health of the pregnancy are Crohn's disease and UC. The medications used to treat these may be stopped due to fetal risks. Clients with these diseases are at higher risk for iron (Mahadevan et al., 2019), vitamin D, and vitamin B<sub>12</sub> (Mahadevan et al., 2019) deficiency during pregnancy due to **malabsorption**, a digestive disorder that causes the body not to absorb nutrients from food effectively, which occurs because of the inflammation process these illnesses cause. These clients will also be higher risk for folate deficiency during exacerbation periods due to the need for a low-residue diet during this time, as well as the potential for ileal involvement or the need to take medications that interfere with folic acid absorption (Mahadevan et al., 2019). Due to these issues, supplementation is imperative, and serum levels should be monitored for iron, vitamin D, and vitamin B<sub>12</sub> (Balestrieri, 2020). Although iron supplementation is necessary, it can also increase the risks for constipation and abdominal pain (Mahadevan et al., 2019). These clients should be educated about increasing water intake and using acceptable laxatives during pregnancy.

During pregnancy, these clients should be followed closely by a gastroenterologist. There are significant risks to the fetus because these diseases can impact fetal development. These clients have a greater risk for miscarriage, preeclampsia, poor maternal weight gain, placenta abruption, premature delivery, cesarean delivery, birth of a small-for-gestational-age newborn, and other delivery complications (Mahadevan et al., 2019).

Diet recommendations for clients with Crohn's disease or UC are the same during pregnancy. These clients should be educated about additional needs of the pregnancy in conjunction with the requirements for their diagnosis for maintaining gut microbiome health. These clients need to avoid trigger foods. Although such foods may be different for each individual, common triggers include (Crohn's and Colitis Foundation, n.d.):

- Foods high in insoluble fiber (raw kale, apple skins, sunflower seeds)
- High-fiber foods (cabbage, asparagus, cauliflower)
- High-lactose foods (cow's milk, ice cream, custard)
- Sugar alcohols and artificial sweeteners (sorbitol, saccharin, aspartame)
- Sugary foods and foods with added sugars (cookies, pastries, syrup)
- High-fat foods (butter, cheesy foods, fried foods)

- Spicy foods (sriracha, chili powder)
- Alcohol
- Caffeine (soda, tea, coffee)
- Sugar-sweetened beverages (soda, juices, drinks with syrup)

These clients should also avoid foods that can increase, or play a role in, intestinal inflammation (Crohn's and Colitis Foundation, n.d.):

- Red meat (beef, lamb, pork, bison)
- Processed meat (lunch/deli meat, bacon, hot dogs)
- Coconut oil, dairy fats, palm oil
- Processed foods containing the following additives may also play a role: carboxymethylcellulose, polysorbate-80, carrageenan, maltodextrin, titanium dioxide, sulfates, guar gum

Some foods can be increased in the diet to decrease inflammation (Crohn's and Colitis Foundation, n.d.):

- Fruits (bananas, raspberries, applesauce, blended fruit)
- Vegetables (squashes, green beans, fork-tender cooked carrots)
- Foods rich in omega-3 fatty acids (fatty fish [salmon, tuna, mackerel], walnut butter, chia seeds, flaxseed oil, flaxseed meal)
- Cooked and cooled or reheated starches (potatoes, sweet potatoes, rice, oatmeal) to form retrograde starch (Bedosky, 2022)
- Leafy green vegetables

### The Fetus

A pregnant client with preexisting gastrointestinal disease should closely follow the prescribed dietary recommendations. Adherence will decrease the chances of fetal underdevelopment or premature delivery, which can have lifelong effects for the child.

The fetus's gastrointestinal system begins development at 3 weeks' gestation and continues to mature through the third trimester up to 32 weeks (Bhatia, Shatanof, and Bordoni, 2023). The pregnant client's nutritional intake is the sole source of fetal nutrition, so they should eat foods that are necessary for proper fetal development. Folic acid, iron, calcium, vitamin D, DHEA, and iodine all play vital roles in this development (Getz, 2022). The nurse can educate the pregnant client about specific foods to ensure that their fetus will get these needed nutrients ([Table 18.1](#)).

Nutrient	Foods
Folic acid	<ul style="list-style-type: none"> <li>Dark green leafy vegetables</li> <li>Beans</li> <li>Peanuts</li> <li>Sunflower seeds</li> <li>Fresh fruits, fruit juices</li> <li>Whole grains</li> <li>Liver</li> <li>Eggs</li> <li>Fortified foods</li> </ul>
Iron	<ul style="list-style-type: none"> <li>Red meats</li> <li>Fish and shellfish</li> <li>Eggs</li> <li>Nuts</li> <li>Dried fruit</li> <li>Whole-grain pasta and bread</li> <li>Iron-fortified bread and breakfast cereals</li> <li>Legumes</li> <li>Dark green leafy vegetables</li> <li>Oats</li> <li>Tofu</li> </ul>
Calcium	<ul style="list-style-type: none"> <li>Seeds</li> <li>Cheese</li> <li>Yogurt</li> <li>Sardines and canned salmon</li> <li>Beans and lentils</li> <li>Almonds</li> <li>Whey protein</li> </ul>
Vitamin D	<ul style="list-style-type: none"> <li>Cod liver oil</li> <li>Salmon</li> <li>Swordfish</li> <li>Tuna fish</li> <li>Orange juice fortified with vitamin D</li> <li>Dairy and plant milks fortified with vitamin D</li> <li>Sardines</li> <li>Beef liver</li> </ul>
DHEA	<ul style="list-style-type: none"> <li>Wild yams are the only food that contains anything similar to DHEA.</li> <li>DHEA is made naturally in the adrenal glands.</li> </ul>

**TABLE 18.1** Foods for Proper Development of the Fetal Gastrointestinal System (source: Getz, 2022)

## Infancy

In infancy, nutrition needed for the health of the gastrointestinal tract depends on whether the infant has any congenital abnormalities or early diagnosed illnesses related to the gastrointestinal system. Healthy eating patterns that start with the introduction of solid foods constitute the best start a parent can give their child to ensure the future of their gastrointestinal health because early eating patterns are often carried throughout an individual's life. This is true for all infants regardless of the presence or absence of gastrointestinal issues.

### The Healthy Infant

It is extremely important to optimize nutrition during infancy for proper growth and development of the gastrointestinal system because this period in life involves very rapid growth. Infants who were born prematurely or

had a low birth weight and have continued undernutrition, even in the absence of gastrointestinal illness or abnormality, require additional nutrition to ensure proper growth and development because they are at much higher risk for developing postnatal growth failure, failure to thrive, childhood obesity, and diabetes. They also have a higher mortality risk in the future. These increased risks may be a result of having a low birth weight and rapidly gaining weight as a compensatory measure (Patel & Rouster, 2023). For example, a healthy term infant requires 100 kcal/kg/day, but a preterm or low birth weight infant requires 110–135 kcal/kg/day to establish a healthy growth and development pattern (Patel & Rouster, 2023). (Note: The use of “kcal” matches the wording in the source material and, for the purpose of this chapter, is the same as “cal.”)

The nutrition infants receive comes primarily from breast milk or formula. Protein provided in their diet is needed for proper growth and system development and should be 15% of their daily intake (Patel & Rouster, 2023). Breast milk is a more nutritious option because the protein is more bioavailable than the cow’s milk or soy protein in infant formula, allowing for greater absorption.

### SAFETY ALERT

#### Infant Formula

Infant formula in concentrated forms (both powder and liquid forms) should be mixed as instructed, using the appropriate measurements of formula concentrate and water. Adding additional water to formula concentrate can be dangerous because the resulting diluted formula can lead to suboptimal caloric intake and electrolyte and mineral imbalances. Suboptimal caloric intake can slow growth and development, and imbalances in electrolytes and minerals can cause serious health problems, including seizures, and can also lead to death. (source: Abrams, 2022).

Carbohydrates should be 40–55% of an infant’s daily intake. Carbohydrates are used for energy and must be provided in correct amounts because the body will use protein for energy when not enough carbohydrates are available (Patel & Rouster, 2023). Another portion of daily intake comes from fats (lipids), which also provide energy to the body. Low birth weight and premature infants may require higher amounts of carbohydrates and lipids because they lack sufficient body fat stores. One reason breast milk has been shown to be a healthier option for infants is because it contains higher levels of medium and short-chain triglycerides, which are easier to absorb (Patel & Rouster, 2023) than long chain fatty acids found in formula. When infants are born too early to have developed a proper sucking reflex, it may be necessary for the breastfeeding parent to pump breast milk for feeding via nasogastric or orogastric tube.

Micronutrients are also needed to ensure the health of the gastrointestinal system. These trace elements, absorbed in the gastrointestinal tract, require age-, weight-, and disease-specific adjustments to ensure proper nutrition (Patel & Rouster, 2023). Of these micronutrients, preterm and low birth weight infants require higher levels of iron, zinc, and copper than healthy full-term infants do.

#### The Infant with Gastrointestinal Abnormalities

Infants with gastrointestinal system illness or abnormality require individualized nutritional considerations to ensure that they grow and develop properly. This is especially true when the gastrointestinal issue causes malabsorption. These infants require similar amounts of macronutrients but may become deficient in micronutrients more easily due to malabsorption.

Breast milk has a higher content of more easily absorbed, more bioavailable forms of proteins and fats, making it the optimal choice for infants, especially those with gastrointestinal issues. If the absorption issues do not allow nutritional needs to be met, the infant may require parenteral nutrition for healthy development until the issue can be controlled. Parenteral nutrition does put the infant at higher risk for toxicity from micronutrients. This makes it imperative that the infant be transitioned to enteral feedings as soon as possible and monitored closely for toxicity.

Iron is not needed in higher concentrations in infant with GI abnormalities unless they are preterm or are specifically not absorbing the appropriate amounts, as absorption occurs in the duodenum and proximal jejunum (Patel & Rouster, 2023). Infants with **short bowel syndrome**, a group of problems related to ineffective absorption of nutrients, or with congenital abnormality of zinc absorption are at highest risk for zinc deficiency. They may

require higher amounts of zinc in their diet (Patel & Rouster, 2023).

Although large amounts of selenium are not recommended, it is important that premature infants and infants with gastrointestinal issues receive optimal amounts. Selenium is an antioxidant that reduces a wide range of inflammatory issues such as **necrotizing enterocolitis** (Patel & Rouster, 2023), an intestinal tract disease in which the intestinal lining becomes inflamed and dies and then is sloughed off.

Breastfeeding is the optimal source of nutrients for infants, but it is even more important for infants with gastrointestinal issues the first year of life. Breastfeeding reduces risks for diarrhea, food allergies, inflammatory bowel disease, obesity, and diabetes (Patel & Rouster, 2023).

## SAFETY ALERT

### Contraindication for Breastfeeding

Breastfeeding is contraindicated in infants with **galactosemia**, a genetic disorder in which the galactose-1-phosphate uridylyltransferase (GALT) enzyme is missing or does not function properly (Patel & Rouster, 2023). This enzyme, produced in the liver, is needed to break down galactose, a sugar by-product of lactose, into glucose. It is found in breast milk, cow's milk, and other dairy foods. These infants must be on a lactose-free diet. All infants born in the United States are tested for galactosemia through mandatory blood testing soon after birth.



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Hein Nhung has had a difficult pregnancy. She has experienced hyperemesis gravidarum and worsening of her gastroesophageal reflux disease. Because of her inability to gain the recommended amount of weight and to consume nutrient-rich foods during the pregnancy, Hein's gut microbiome has severely changed. These difficulties contributed to her baby, Bao Nhung, being delivered at 37 weeks' gestation, with a low birth weight for age.

1. Which nutritional option would be best for the nurse to recommend to promote Bao's gastrointestinal health?
  - a. Breastfeeding
  - b. Parenteral nutrition
  - c. High-calorie formula
  - d. Additional water to prevent constipation
  
2. During testing, Bao is found to have a deficiency in galactose-1-phosphate uridylyltransferase. Which change should the nurse expect in Bao's diet?
  - a. None until later in life
  - b. An increase in the number of breastfeedings daily
  - c. A switch to a low-protein formula
  - d. A switch to a lactose-free formula

### Childhood

Solid foods should be introduced into the diet at 6 months of age. After 1 year of age, most of the infant's diet should be solid foods. It is important to initiate healthy eating patterns because many of the habits started during this time will continue throughout the lifespan. Proper nutritional practices will encourage healthy growth and development, resulting in a healthy gastrointestinal system.

Young children tend to be extremely active and are growing, so they need high-energy foods, mostly from carbohydrates (Thomas, 2023). Children aged 5–10 years old require 1500–2000 kcal/day (Thomas, 2023). Their

daily diet should contain appropriately sized portions of 5 or 6 servings of vegetables (in a mix of colors and including both leafy and nonleafy vegetables) and fruits (of different varieties), 4–6 servings of whole grains, 1 or 2 servings of protein (lean meat, fish, nuts, seeds, tofu), and 2–4 servings of dairy products (Thomas, 2023). They should receive whole milk until age 2 and then 2% or lower-fat milk daily, with plenty of water and very limited added sugars and snacks (Ben-Joseph, 2023; [Table 18.2](#)).

Food Group	Daily Servings	Portion Size (Ages 1–3)	Portion Size (Ages 4–6)	Portion Size (Ages 7–10)
Meats/proteins	2	<ul style="list-style-type: none"> <li>• 1 oz meat</li> <li>• <math>\frac{1}{2}</math> egg</li> <li>• <math>\frac{1}{4}</math> cup beans</li> </ul>	<ul style="list-style-type: none"> <li>• 1 oz meat</li> <li>• 1 egg</li> <li>• <math>\frac{1}{3}</math> cup beans</li> </ul>	<ul style="list-style-type: none"> <li>• 2–3 oz meat</li> <li>• 1–2 eggs</li> <li>• <math>\frac{1}{2}</math> cup beans</li> </ul>
Dairy	2–3	<ul style="list-style-type: none"> <li>• <math>\frac{1}{2}</math> oz cheese</li> <li>• <math>\frac{1}{2}</math> cup milk</li> <li>• <math>\frac{1}{3}</math> cup yogurt</li> </ul>	<ul style="list-style-type: none"> <li>• 1 oz cheese</li> <li>• <math>\frac{1}{2}</math> cup milk</li> <li>• <math>\frac{1}{2}</math> cup yogurt</li> </ul>	<ul style="list-style-type: none"> <li>• 1 oz cheese</li> <li>• 1 cup milk</li> <li>• <math>\frac{3}{4}</math>–1 cup yogurt</li> </ul>
Fruits	2–3	<ul style="list-style-type: none"> <li>• <math>\frac{1}{4}</math> cup cooked, frozen, or canned</li> <li>• <math>\frac{1}{2}</math> piece fresh</li> <li>• <math>\frac{1}{4}</math> cup 100% fruit juice</li> </ul>	<ul style="list-style-type: none"> <li>• <math>\frac{1}{4}</math> cup cooked, frozen, or canned</li> <li>• <math>\frac{1}{2}</math> piece fresh</li> <li>• <math>\frac{1}{3}</math> cup 100% fruit juice</li> </ul>	<ul style="list-style-type: none"> <li>• <math>\frac{1}{3}</math> cup cooked, frozen, or canned</li> <li>• 1 piece fresh</li> <li>• <math>\frac{1}{2}</math> cup 100% fruit juice</li> </ul>
Vegetables	2–3	<ul style="list-style-type: none"> <li>• <math>\frac{1}{4}</math> cup cooked vegetables</li> </ul>	<ul style="list-style-type: none"> <li>• <math>\frac{1}{4}</math> cup cooked vegetables</li> <li>• <math>\frac{1}{2}</math> cup salad</li> </ul>	<ul style="list-style-type: none"> <li>• <math>\frac{1}{2}</math> cup cooked vegetables</li> <li>• 1 cup salad</li> </ul>
Grains	6–11	<ul style="list-style-type: none"> <li>• <math>\frac{1}{2}</math> slice bread</li> <li>• <math>\frac{1}{4}</math> cup cooked cereal, rice, or pasta</li> <li>• <math>\frac{1}{3}</math> cup dry cereal</li> </ul>	<ul style="list-style-type: none"> <li>• <math>\frac{1}{2}</math> slice bread</li> <li>• <math>\frac{1}{3}</math> cup cooked cereal, rice, or pasta</li> <li>• <math>\frac{1}{2}</math> cup dry cereal</li> </ul>	<ul style="list-style-type: none"> <li>• 1 slice bread</li> <li>• <math>\frac{1}{2}</math> cup cooked cereal, rice, or pasta</li> <li>• <math>\frac{3}{4}</math>–1 cup dry cereal</li> </ul>

**TABLE 18.2** Examples of Recommended Portion Sizes for Children by Age Group. (sources: American Academy of Pediatrics, 2015; García-Montero, et al., 2023)

An adequate amount of fiber is needed in the diet for gastrointestinal health (Thomas, 2023). Prebiotic and probiotic foods should be introduced when solid foods are introduced. Some child-friendly foods containing probiotics are yogurt with live cultures, pickles, kombucha, and cheese; child-friendly foods containing prebiotics include kiwi, bananas, and apples (Garcia-Montero, et al., 2023). Processed and artificially sweetened foods should be avoided (Stanford Medicine Children’s Health, n.d.). Another important consideration for gut health is to avoid unnecessary antibiotics because they can damage and kill helpful bacteria in the gut.

## Adolescence

Many expected body changes as well as a growth spurt occur during adolescence. These changes require an increase in caloric intake to about 2200 kcal/day for females and 2500–3000 kcal/day for males, depending on activity level such as participation in rigorous sporting activities (Nesta, 2019).

This age group has much more autonomy over their food choices and often eat fast foods because they do not like to sit and eat but prefer fast convenience. Fast foods can contribute to constipation and need to be balanced with nutrient-dense foods, high-fiber foods, prebiotics, probiotics, and high-calcium foods to support a healthy growth and development pattern (Stanford Medicine Children’s Health, n.d.). A good addition to encourage gut health and increase calcium are leafy green vegetables (Johns Hopkins Medicine, n.d.).



## UNFOLDING CASE STUDY

### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Bao has adjusted well to the special diet at birth and transitioned well in late infancy and childhood to an altered diet. At the age of 13, he begins having diarrhea, blood in the stool, fatigue, and abdominal pain and eventually is diagnosed with Crohn's disease. Bao is here today for a wellness visit with Hein.

3. Hein asks how Bao has gotten Crohn's disease because it does not run in their family. Given Bao's history, what put him at increased risk for developing Crohn's disease?
  - a. Inability to consume lactose
  - b. Hein's pregnancy complications
  - c. Bao had no increased risk
  - d. Bao's lack of adherence to the prescribed diet
  
4. The nurse is educating Hein and Bao about managing inflammatory periods. Which food should be avoided during inflammatory periods?
  - a. Beans
  - b. Yogurt
  - c. White rice
  - d. Chicken

### Adulthood

During adulthood, calorie requirements decrease. Current recommendations are 1800–2400 kcal/day for women and 2400–3000 kcal/day for men, depending on activity level (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). Gastrointestinal health requires more of a maintenance approach during adulthood because this system is fully developed at this point in life. Prebiotics and probiotics are still recommended to maintain gut microbiome health.

Clients should be educated to limit or avoid alcohol and to reduce fats and sodium in the diet for gut health (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). Additions for nutritional health include foods rich in iron and calcium (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). People who smoke should be encouraged to stop because one of the negative effects of smoking is decreased blood flow to the intestines, which can have a negative impact on gut health.

### Later Adulthood

As in early life stages, prebiotic and probiotic foods should be continued in later adulthood, along with a low-sugar diet. During this stage in the lifespan, men should consume 2000–2600 kcal/day, and women should consume about 1600–2200 kcal/day because energy expenditure is less than in younger adulthood (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). It is still important for clients in this age group to continue a high-calcium diet for bone health.

For gut health, clients should eat a diet high in fiber and water and low in sodium (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). During this stage in life, constipation may be common. High fiber will help prevent it, and water is required for the fiber to work effectively. Eating adequate protein is important in combination with physical exercise because muscle mass can decrease in older adults (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). Blood flow is increased with muscle mass and is important for gut health and intestinal health.

## 18.2 Nutrition and Chronic Gastrointestinal Illnesses

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 18.2.1 Discuss the impact of nutrition on chronic gastrointestinal disorders.
- 18.2.2 Discuss the impact of nutrition on acute exacerbation of chronic gastrointestinal disorders.

### Nutritional Requirements for Optimal Health With Gastrointestinal Illness

When gastrointestinal illness is present, prebiotics and probiotics are still recommended; however, there are additional recommendations to aid in gut health. High-fiber diets and high water intake are beneficial during nonexacerbation periods in gastrointestinal disease. However,



#### SAFETY ALERT

##### Contraindications for High Fiber Intake

When a client is experiencing inflammation of the gastrointestinal tract due to illness such as ulcerative colitis, Crohn's disease, **diverticulitis** (inflammation of diverticula, which are bulging pouches that can form along the intestines), or any other acute condition, high fiber intake is contraindicated because it can irritate the intestinal lining and increase inflammation.

There are basic recommendations for gut health for individuals with gastrointestinal disease. Foods high in saturated fats and trans fats should be avoided because they increase inflammation. Healthy fats, such as omega-3 fatty acids and monounsaturated fats, may help decrease inflammation and should be used in place of less healthy fat (Nebraska Medicine, 2022). An anti-inflammatory diet is helpful overall in gastrointestinal illness. Antioxidants found in foods such as avocados, broccoli, spinach, carrots, potatoes, and artichokes may help decrease inflammation. Phytonutrients found in fruits and vegetables may help to protect against inflammation (Nebraska Medicine, 2022). The Mediterranean diet follows the principles of anti-inflammatory nutrition.

### Alternative Food and Supplement Options

Supplementation for gut health is often needed when gastrointestinal disease is exacerbated and in the inflammatory phase because malabsorptive issues occur most often during this time. Supplementation adds higher levels of needed nutrients to increase the chances of adequate absorption. In some severe cases, parenteral supplementation may be required.

Food alternatives and simple replacements can be beneficial for promoting gut health, whether illness is present or not ([Table 18.3](#)).

Food	Replacement for Improved Gut Health
Milk	Kefir
Sugary drinks	Kombucha
Milk, cheese curd, mayonnaise	Greek yogurt
Red meats	Fruits and vegetables, fish, chicken
Sugary cereals	Oats
White bread	Sourdough bread
Nonsprouting lentils	Sprouting lentils

**TABLE 18.3** Food Replacements to Improve Gut Health (sources: Crohn's and Colitis Foundation, n.d.; Johns Hopkins Medicine, n.d.; Nebraska Medicine, 2022)

## 18.3 Treatments and Nutrition

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 18.3.1 Identify drug–food interactions for their impact on treatments used for gastrointestinal disorders.
- 18.3.2 Identify treatments and medications that can cause nutritional deficiencies in clients with gastrointestinal disorders.

### Drug–Food Interactions Related to Treatments for Gastrointestinal Disorders

Medications used to treat Crohn’s disease and UC are in the anti-inflammatory and immunosuppressant classes. The most frequently used medications for Crohn’s disease treatment are azathioprine and mercaptopurine. A client with UC is most often prescribed balsalazide, mesalamine, olsalazine, or sulfasalazine. For diverticulitis, antibiotics are needed; the most commonly used are ciprofloxacin plus metronidazole, trimethoprim-sulfamethoxazole plus metronidazole, amoxicillin-clavulanate, and moxifloxacin.

Drug–food interactions are a concern when prescribing these drugs, so clients must be educated about specific interactions to avoid adverse effects ([Table 18.4](#)).

Food	Food Interaction
Azathioprine	<ul style="list-style-type: none"> <li>• Avoid raw or half-cooked foods (can cause foodborne illness).</li> </ul>
Mercaptopurine	<ul style="list-style-type: none"> <li>• Take 1 hour before or 2 hours after ingestion of milk or dairy products (reduces absorption when taken with food).</li> </ul>
Balsalazide	<ul style="list-style-type: none"> <li>• Swallow right away if taken with food as an open capsule (mixing with food can cause staining of the tooth enamel).</li> <li>• Review medication insert for information on mixing medication with applesauce.</li> </ul>
Mesalamine	<ul style="list-style-type: none"> <li>• Take this medication on an empty stomach—at least 1 hour before meals or 2 hours after meals when taking specifically the Asacol HD version of this medication.</li> </ul>
Olsalazine	<ul style="list-style-type: none"> <li>• Drink plenty of water with this medication to protect the kidneys.</li> <li>• Avoid smoking (decreases medication effectiveness).</li> </ul>
Sulfasalazine	<ul style="list-style-type: none"> <li>• Avoid alcohol and spicy foods (increases risk for indigestion).</li> </ul>
Metronidazole	<ul style="list-style-type: none"> <li>• Avoid alcohol during and 24 hours before and after treatments (can cause serious adverse effects).</li> </ul>
Sulfamethoxazole-Trimethoprim	<ul style="list-style-type: none"> <li>• Avoid alcohol (can cause serious adverse effects).</li> </ul>
Amoxicillin-Clavulanate	<ul style="list-style-type: none"> <li>• No interactions.</li> </ul>
Moxifloxacin and Ciprofloxacin	<ul style="list-style-type: none"> <li>• Avoid dairy products (can make less effective).</li> <li>• Avoid vitamins containing iron, magnesium, calcium, or zinc within 4 hours before and after taking this medicine (can make the drug and the vitamins less effective).</li> </ul>

**TABLE 18.4** Foods to Avoid When Taking Certain Drugs (sources: Cancer Research UK, 2022; Mayo Clinic, n.d.; Mayo Clinic, 2023; NHS, 2021; Offices of Disease Prevention and Health Promotion, 2023; PeaceHealth, 2023)

### Treatments and Medications That Can Cause Nutritional Deficiencies

Avoiding certain foods is not the only concern that needs to be addressed regarding treatments. Many of the medications already described can also cause nutritional deficiencies. The client must know which foods they can increase in their diet to prevent deficiency ([Table 18.5](#)).

Drug	Nutrient Deficiency	Foods to Replace Nutrients
Azathioprine	<ul style="list-style-type: none"> <li>Niacin (vitamin B<sub>3</sub>)</li> </ul>	<ul style="list-style-type: none"> <li>Red meat, poultry, fish, brown rice, nuts, seeds, legumes, bananas</li> </ul>
Mercaptopurine	<ul style="list-style-type: none"> <li>Hypoglycemia in children younger than 6 years old when administered in a liquid form</li> </ul>	<ul style="list-style-type: none"> <li>Complex carbohydrates, along with monitoring of glucose levels</li> </ul>
Balsalazide Olsalazine Sulfasalazine Mesalamine	<ul style="list-style-type: none"> <li>Folic acid can reduce adverse effects of the medication</li> </ul>	<ul style="list-style-type: none"> <li>Dark green leafy vegetables, beans, peanuts, sunflower seeds, whole grains, liver</li> </ul>
Ciprofloxacin Moxifloxacin	<ul style="list-style-type: none"> <li><i>Bifidobacterium bifidum</i></li> <li><i>Lactobacillus acidophilus</i></li> <li>Biotin</li> <li>Folic acid</li> <li>Inositol</li> <li>Vitamin B<sub>1</sub> (thiamin)</li> <li>Vitamin B<sub>2</sub> (riboflavin)</li> <li>Vitamin B<sub>3</sub> (niacin)</li> <li>Vitamin B<sub>6</sub> (pyridoxine)</li> <li>Vitamin B<sub>12</sub> (cobalamin)</li> <li>Vitamin K</li> </ul>	<ul style="list-style-type: none"> <li>Kefir, sourdough bread, sauerkraut, kimchi, other fermented vegetables</li> <li>Milk enriched with acidophilus, yogurt containing live <i>L. acidophilus</i> cultures, miso, tempeh</li> <li>Legumes, egg yolks, organ meats, nuts, seeds, mushrooms, avocados, sweet potatoes</li> <li>Dark green leafy vegetables, beans, peanuts, sunflower seeds, whole grains, liver</li> <li>Whole-grain bread and bran, prunes, cantaloupe, citrus fruits, beans, peas, almonds, peanut butter, liver</li> <li>Fortified breakfast cereals, pork, fish, beans, lentils, green peas, enriched cereals, breads, noodles, rice, sunflower seeds, yogurt</li> <li>Dairy milk, yogurt, cheese, eggs, lean beef and pork, organ meats (beef liver), chicken breast, salmon</li> <li>Red meat, poultry, fish, brown rice, nuts, seeds, legumes, bananas</li> <li>Fish, beef liver and other organ meats, potatoes and other starchy vegetables</li> <li>Fish, meat, poultry, eggs, dairy products</li> <li>Kale, collard greens, broccoli, spinach, cabbage, lettuce</li> </ul>

**TABLE 18.5** Nutritional Deficiencies Caused by Pharmacologic Therapies and Foods to Replace Those Nutrients (sources: Kaiser Permanente, 2015; Mayo Clinic, 2023; Naeini et al., 2021; Peace Health, 2015; Prescott et al., 2018; Ratajczak, et al., 2021)

Drug	Nutrient Deficiency	Foods to Replace Nutrients
Metronidazole	<ul style="list-style-type: none"> <li>• Calcium</li> <li>• Carbohydrates</li> <li>• Beta-carotene</li> <li>• Fats</li> <li>• Folic acid</li> <li>• Iron</li> <li>• Magnesium</li> <li>• Potassium</li> <li>• Sodium</li> <li>• Vitamin A</li> <li>• Vitamin B<sub>12</sub> (cobalamin)</li> <li>• Vitamin D</li> <li>• Vitamin K</li> </ul>	<ul style="list-style-type: none"> <li>• Dairy products, soybeans, dark green leafy vegetables, calcium-fortified foods, canned salmon, figs</li> <li>• Grains, fruit, dairy products, legumes</li> <li>• Yellow, orange, and green fruits and vegetables</li> <li>• Fish, avocados, seeds, nuts, olive oil, eggs</li> <li>• Dark green leafy vegetables, beans, peanuts, sunflower seeds, whole grains, liver</li> <li>• Nuts, dried fruits, iron-fortified breads and cereals, legumes, oats, tofu</li> <li>• Smoked, cured, salted, or canned meat, fish, or poultry; frozen breaded meats; frozen processed foods such as burritos and pizza; canned entrees (like canned pasta in tomato sauce); salted nuts</li> <li>• Leafy green vegetables, orange and yellow vegetables, tomatoes, red bell peppers, cantaloupes, mangos, beef liver, fish oils, milk, eggs</li> <li>• Fish, meat, poultry, eggs, dairy products</li> <li>• Cod liver oil, salmon, swordfish, tuna, sardines, beef liver, vitamin D-fortified orange juice and dairy and plant milks</li> <li>• Kale, collard greens, broccoli, spinach, cabbage, lettuce</li> </ul>
Sulfamethoxazole-Trimethoprim	<ul style="list-style-type: none"> <li>• Vitamin K</li> <li>• Calcium</li> <li>• Magnesium</li> <li>• Vitamin B<sub>12</sub> (cobalamin)</li> </ul>	<ul style="list-style-type: none"> <li>• Kale, collard greens, broccoli, spinach, cabbage, lettuce</li> <li>• Dairy products, soybeans, dark green leafy vegetables, canned salmon, figs</li> <li>• Pumpkin seeds, chia seeds, almonds, boiled spinach, cashews, peanuts, soy milk</li> <li>• Fish, meat, poultry, eggs, dairy products</li> </ul>
Amoxicillin-Clavulanate	<ul style="list-style-type: none"> <li>• Vitamin K</li> <li>• Vitamin B<sub>12</sub> (cobalamin)</li> <li>• Folic acid</li> <li>• Potassium</li> <li>• Vitamin B<sub>2</sub> (riboflavin)</li> </ul>	<ul style="list-style-type: none"> <li>• Kale, collard greens, broccoli, spinach, cabbage, lettuce</li> <li>• Fish, meat, poultry, eggs, dairy products</li> <li>• Dark green leafy vegetables, beans, peanuts, sunflower seeds, whole grains, liver</li> <li>• Dried fruits, beans, lentils, potatoes, winter squash (acorn, butternut), spinach, broccoli, beet greens, avocados</li> <li>• Fish, meat, poultry, eggs, dairy products</li> <li>• Milk, yogurt, cheese, eggs, lean beef and pork, organ meats (beef liver), chicken breast, salmon</li> <li>• Kale, collard greens, broccoli, spinach, cabbage, lettuce</li> </ul>

**TABLE 18.5** Nutritional Deficiencies Caused by Pharmacologic Therapies and Foods to Replace Those Nutrients (sources: Kaiser Permanente, 2015; Mayo Clinic, 2023; Naeini et al., 2021; Peace Health, 2015; Prescott et al., 2018; Ratajczak, et al., 2021)

## Chapter Summary

- Gastrointestinal system health starts before birth with the microbiome of the pregnant client.
- Prebiotic and probiotic foods are essential for everyone because they support the gut microbiome.
- Supporting the gut microbiome is one of the most important ways to promote gastrointestinal health.
- Events and changes that occur at each stage can

affect the gastrointestinal system and the ability to absorb nutrients properly.

- Individuals with chronic gastrointestinal illness have increased malabsorption risks and requirements.
- Medications for gastrointestinal illnesses can cause nutrient deficiencies and interact with different foods.

## Key Terms

**Crohn's disease** a chronic inflammatory disease that can cause ulcerations and fistulas in the intestines, particularly the colon and ileum

**diverticulitis** inflammation of diverticula, which are bulging pouches that can form along the intestines

**dysbiosis** imbalance of gut microbiota associated with an unhealthy outcome

**galactosemia** a genetic disorder in which the galactose-1-phosphate uridylyltransferase (GALT) enzyme is missing or does not function properly

**hyperemesis gravidarum** persistent and severe vomiting caused by pregnancy; can lead to weight loss and dehydration

**malabsorption** a digestive disorder that causes the body not to absorb nutrients from food effectively

**microbiome** a collection of microorganisms that reside in the body, primarily in the gastrointestinal tract

**necrotizing enterocolitis** a gastrointestinal tract disease in which the intestinal lining becomes inflamed, dies, and is sloughed off

**prebiotic** nondigestible substances that stimulate growth of “good” gut bacteria

**probiotic** foods that contain live microorganisms intended to maintain “good” gut bacteria

**short bowel syndrome** a group of problems related to ineffective absorption of nutrients

**ulcerative colitis (UC)** an inflammatory disease that affects the superficial lining of the large intestine, causing ulcerations

## Review Questions

1. A nurse is educating a pregnant client about factors that affect the fetal microbiome. Which choice, when asked what factors affect their fetus’s microbiome, indicate the need further teaching?
  - The father’s microbiome
  - The mother’s microbiome
  - The child’s diet
  - Interaction with the environment
2. What is the caloric intake a nurse should expect the provider to order for a premature infant?
  - 2000 kcal/day
  - 120 kcal/kg/day
  - 100 kcal/kg/day
  - 1500 kcal/day
3. The nurse is educating a group of pregnant clients about genetic diseases. Which disease should the nurse explain will need lifelong management due to the individual’s inability to convert lactose into glucose?
  - Diverticulitis
  - Ulcerative colitis
  - Crohn’s disease
  - Galactosemia
4. The nurse is teaching a client about the nutritional needs of their adolescent child. Which information should be included in the education?
  - Young males need fewer calories than young females do.
  - Adolescent females require 3000 kcal/day.

- c. Fast foods need to be supplanted with healthier options.
  - d. Adolescents need less iron intake daily than other age groups.
5. The nurse is teaching an adult client how to maintain good gut bacteria. Which foods would be appropriate for the client to include in their diet to maintain good gut bacteria?
- a. Blueberries, strawberries, and kiwi
  - b. Salmon and tuna
  - c. Broccoli and cauliflower
  - d. Yogurt, kimchi, and honey
6. An older adult reports a problem with constipation. Which dietary recommendation is appropriate for this client?
- a. Decrease water intake.
  - b. Increase sodium intake.
  - c. Decrease calcium intake.
  - d. Increase fiber intake.
7. The nurse is providing teaching to a client with ulcerative colitis. Which nutritional component should be adjusted when the client is in remission?
- a. Water intake
  - b. Fiber intake
  - c. Iron intake
  - d. Potassium intake
8. The nurse is teaching a client about food substitutions to help improve gut health. Which substitution is appropriate for milk?
- a. Ice cream
  - b. Greek yogurt
  - c. Kefir
  - d. Kombucha
9. The nurse is working with a client who has diverticulitis and has been prescribed ciprofloxacin. Which food should this client avoid while taking this medication?
- a. Red meat
  - b. Milk
  - c. Tomatoes
  - d. Oatmeal
10. The nurse is providing discharge education to a client who has been prescribed amoxicillin. Which food should the nurse instruct the client to incorporate into their diet to help prevent medication-related nutrient depletion?
- a. Beans
  - b. Whole grains
  - c. Sunflower seeds
  - d. Kale

## Suggested Reading

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## CHAPTER 19

# Applying Clinical Judgment to Promote Nutrition for Musculoskeletal and Integumentary Wellness



**FIGURE 19.1** Proper nutrition promotes a healthy integumentary and musculoskeletal system. (credit: modification of work “Balsamic Roasted Turkey Salad Ingredients” by Alabama Extension; ACES | Janet Guynn/Flickr, Public Domain)

### CHAPTER OUTLINE

- 19.1 Assess and Analyze the Impact of Nutrition on the Musculoskeletal and Integumentary Systems
- 19.2 Plan Nutritional Strategies to Impact Musculoskeletal and Integumentary Wellness
- 19.3 Implement Nutritional Strategies to Impact Musculoskeletal and Integumentary Wellness
- 19.4 Evaluate Nutritional Strategies to Impact Musculoskeletal and Integumentary Wellness

**INTRODUCTION** These two systems, musculoskeletal and integumentary, are considered together because they are dependent upon one another to keep the body in homeostasis. The musculoskeletal system comprises bones, muscles, ligaments, and tendons and is a part of the body's internal environment that supports the muscles, protects the organs, and aids in movement. The integumentary system encompasses the skin, hair, nails, sweat glands, sebaceous glands, and nerves on the skin. The integumentary system serves as a barrier to protect the musculoskeletal system and other systems from the external environment. Subcutaneous fat absorbs impact from the external environment and protects the musculoskeletal system from trauma. The skin serves as a barrier against germs that would attempt to invade the body and cause harm (Academic Master, Biology, 2018).

A good example of the relationship between the two systems is seen with pressure wounds. As the outer layer of the skin suffers irritation and damage, there is potential risk for the progression of the wounds through the subcutaneous fat, tendons, and even the bones. When this happens, bone inflammation from

infection—osteomyelitis—occurs. With this relationship in mind, it is imperative that the skin integrity of the client always be maintained. Adequate intake of proper nutrients is essential for the musculoskeletal system for bone growth and bone health. The quality and amount of nutritional intake affects muscle mass, strength, and the ability for muscles to repair themselves after injury. The integumentary system is also dependent on essential dietary nutrients to maintain integrity and proper functioning. Many disease processes affect both the musculoskeletal and the integumentary systems.

Consider this case: Mrs. Anne Wilson, a 70-year-old Black woman is referred by the primary care provider to a rheumatologist for complaints of pain and swelling in both knees. Anne states that the ibuprofen that was earlier prescribed is no longer treating the pain. The nurse at the rheumatologist's office notices that Anne appears anxious with a facial grimace and states that she is having 8/10 pain in both knees. The client states that she only got a few hours of sleep last night due to the pain. Anne reports that she exercises daily by walking, but she admits that her nutritional intake could improve.

## 19.1 Assess and Analyze the Impact of Nutrition on the Musculoskeletal and Integumentary Systems

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 19.1.1 Recognize the normal function of the musculoskeletal and integumentary systems.
- 19.1.2 Recognize cues of nutritional impact on the musculoskeletal and integumentary systems.
- 19.1.3 Analyze cues of nutritional impact on the musculoskeletal and integumentary systems.

### Normal Function of the Neurological System

The impact of nutrition on the musculoskeletal and **integumentary systems** cannot be explained without first reviewing the normal function of the neurological system. The neurological system and the **musculoskeletal system** relate to one another in that the brain and nerves tell the voluntary muscles what to do. In response to the messages sent to the brain through the nerve pathways, muscle fibers become tense and cause the muscles to contract.

The brain is the most complex organ in the body. The brain is divided into lobes each having a specific function in the neurological system. The frontal lobes are responsible for imagination, memory, and reasoning. Damage to a frontal lobe is often manifested in memory loss and poor judgment and often follows a cerebrovascular accident (CVA). When this lobe is not functioning properly, secondary issues related to the musculoskeletal and integumentary systems emerge. For example, after injury to the frontal lobe, a client may not recognize the importance of mobility and skin care. Therefore, damage to this area of the brain may have detrimental secondary consequences on the musculoskeletal and integumentary systems (National Institute of Neurological Disorders and Stroke, 2023; National Library of Medicine, 2022).

Important structures in the inner brain that play a part in musculoskeletal and integumentary function, like the **basal ganglia**, initiate and coordinate movements. Diseases of the cells leading into the basal ganglia, such as Parkinson's disease, result in disturbance of movement as seen with tremors. The other important structures in the inner brain include the hypothalamus, thalamus, and hippocampus, which do not directly affect the musculoskeletal or integumentary systems (National Institute of Neurological Disorders and Stroke, 2023; National Library of Medicine, 2022).

### Assessment of Nutrition and the Function of the Musculoskeletal and Integumentary Systems

Nutrition plays a key role in the development of a healthy musculoskeletal and integumentary system. Nurses are taught to holistically view the client during the initial and ongoing assessment to reveal and relay any problems with the client that may help the health care provider in diagnosing and treating the client. Delays in diagnosing and treating the client with nutritional deficiencies can lead to muscle wasting, bone fractures, skin ulcerations, and so much more. Many of the complications of inadequate nutrition are irreversible and even life threatening as related to the musculoskeletal and integumentary systems. After surgery and at other times of stress on the body, the importance of an accurate nutritional assessment cannot be underestimated.

The benefits of eating properly for the musculoskeletal and integumentary systems include healthy skin, muscles, bones, and teeth, as well as maintaining a healthy weight which, in turn, affects the cardiovascular system, the endocrine system, and so on. Maintaining a proper body weight through good nutrition leads to healthier joints, muscles, tendons, and bones because there is less stress on the musculoskeletal system. Musculoskeletal and joint problems such as osteoarthritis are often worse for people who are overweight (Centers for Disease Control and Prevention, 2022). Maintaining a healthy weight lowers the risk of heart disease, hypertension, stroke, and type 2 diabetes, breathing problems and sleep apnea, anxiety, and other conditions in other body systems.

With all the problems associated with inadequate nutritional intake on the musculoskeletal and integumentary systems, the nurse has a priority of completing a full intake history of the client and proper follow-up assessment. From there, the nurse can develop a plan of care for the client. This ensures that the client is assisted in maintaining physiological and psychological integrity throughout the course of their treatment.

The health history should focus on past surgical history, including possible complications of previous surgeries and a family medical history as many of the musculoskeletal and integumentary disorders have heredity tendencies. Some of the most important medical history to obtain in these system categories include history of rheumatoid arthritis or other **autoimmune disorders** (when the body's immune system attacks and destroys healthy body tissue). Osteoarthritis, osteoporosis, osteopenia, scleroderma, systemic lupus erythematosus (SLE), and eczema are just some of the genetically inherited diseases of the musculoskeletal and integumentary systems (Orthopedic Oncology, 2023).

### Normal Function of the Musculoskeletal and Integumentary Systems

Bones, muscles, tendons, ligaments, joints, and connective tissue hold the body together. The main function of the musculoskeletal system is to support the body. This system also allows for movement of the body as well as providing protection for internal organs. The bones that comprise the skeletal system store calcium and phosphorus—minerals important to body function—blood components, and certain fats. The skeletal muscles attached to bones are empowered by nerves with electrical current from the central nervous system. These nerves located throughout the muscles allow for the contraction of the muscles. Only two types of muscles, the skeletal muscles and the smooth muscles, are considered a part of the musculoskeletal system. The skeletal muscles provide for the movement of the body and the smooth muscles are found in intestinal and vessel walls. Ligaments and tendons help with body movement by connecting bones together to form joints (LibreTexts Medicine, 2019).

Aging influences the musculoskeletal system. As a person ages, height decreases because calcium, phosphorus, and other minerals are lost. Fluid decreases between the disks in the vertebrae of the spine, which can cause pain and deformity. Joints tend to lose cartilage contributing to stiff joints and joint pain. This contributes to osteoarthritis and worsens its symptoms associated. Working to maintain a healthy musculoskeletal system is important throughout the lifespan (Academic Senate for California Community Colleges (ASCCC) Open Educational Resources Initiative, 2021).



## TRENDING TODAY

### Skin, Aging, and the Impact of Food

*As you work through this Trending Today feature, recall that nurses should rely on evidence-based practice (EBP), which uses scientific evidence rather than anecdotal evidence, to inform their practice and care of clients. Nurses should encourage clients to evaluate nutritional information on social media with the same scrutiny.*

Research shows a link between aging skin and nutrition (Cao et al., 2020). From water to protein and specific vitamins and trace elements, several elements play a crucial role not only in aging of the skin, but also in the ability of the skin to remain intact and function as a first line of defense against microorganisms.

On social media, TikTok influencer Joy McCarthy (@joyoushealth) promotes the use of sprouts for detoxifying the body, thus enhancing skin appearance. Similarly, Dr. Dray suggests the use of foods to promote collagen production, which assists in delaying the aging process by maintaining skin elasticity and moisture.

Take some time to review the following social media content and think critically about the information provided and its appeal to clients:

- [@joyoushealth \(https://openstax.org/r/joyoushealth\)](https://openstax.org/r/joyoushealth) (TikTok)
- [The Best Foods for Collagen Production | Dr. Dray \(https://openstax.org/r/collagen\)](https://openstax.org/r/collagen) (YouTube)

Now answer the following questions:

1. Which account did you prefer when viewing or reading? Explain.
2. What is the purpose of the content you viewed or read?
3. Do these sources adhere to EBP, and why are the recommendations realistic or unrealistic?
4. If a client came to you with this information, how would you educate them to critically use these sources?
5. What alternative sources would you recommend to clients to educate them about this topic?

The integumentary system is made up of the skin and accessory structures—such as hair, nails, sweat glands, and sebaceous glands—and is the largest organ system in the human body. The function of the integumentary system is to protect the body from invading microorganisms, chemicals, and other environmental irritants. The skin helps to control temperature and regulate electrolytes by preventing dehydration. The skin and its structures play a role in storing fats and synthesizing vitamin D. The integumentary system is susceptible to diseases and injuries, many of which are life threatening. Maintaining a healthy integumentary system is vital for maintaining good health. Musculoskeletal tissue is especially vulnerable to injury (ASCCC Open Educational Resources Initiative, 2021).

#### **Assessment of the Musculoskeletal and Integumentary Systems**

Nursing assessment of the musculoskeletal system involves the collection of subjective and objective data. Subjective data is gathered through a thorough interview of the client's past medical and surgical history, family medical history, current medical problems, lifestyle history, and nutritional history. The following interview questions are good examples that focus on the musculoskeletal system:

- Are you experiencing any pain, weakness, swelling, or stiffness in any of your bones/joints?
- Have you ever been told that you have a long-term musculoskeletal disease such as osteoarthritis or rheumatoid arthritis?
- Have you ever been diagnosed with nerve pain that affects the muscles of any of your extremities?
- Have you ever had any fractures, sprains, or strains that required medical treatment?
- Have you ever been told you had tendonitis or bursitis?
- Have you ever had any orthopedic surgeries?
- Have you ever had to undergo physical therapy for pain management?
- What is the list of your current medications including herbs and supplements?

Objective data is gathered as the nurse observes or inspects the client's posture, movements, gait, deformities, muscle tone, and range of motion. Range of motion reflects the client's ability to move their joints actively or passively.

General objective findings within the healthy musculoskeletal system are muscles with no wasting, no edema noted over bones and joints, and skin color appropriate for skin tone over bones, joints, ligaments, and muscles.

Assessment findings should include posture that is well balanced with the head positioned over the shoulders, a slight curve in the lower back, and a level pelvis. The knees are symmetrical, the toes face forward when standing, and the shoulders and extremities are all symmetrical.

In healthy individuals, the movement of the musculoskeletal system is not restricted. There is full **range of motion (ROM)**, which is defined as the movement potential of the joints using flexion and extension. Movement is fluid and smooth with no sounds heard from joints upon movement. There is full symmetrical muscle strength in all extremities. The gait is balanced with no shuffling or limping. A center of gravity is maintained when standing—there is no leaning or swaying, dragging feet, or waddling. Full ROM is evidenced by no pain.

The healthy musculoskeletal system is strong and symmetrical. Strong active movement is noted against gravity and resistance. **Muscle tone** is a measure of a muscle's resistance to stretching while at rest. Even when at rest, muscle fibers are at least partially contracted, so muscle tone should have no flaccidity.



## MUSCULOSKELETAL SYSTEM

[Access multimedia content \(<https://openstax.org/books/nutrition/pages/19-1-assess-and-analyze-the-impact-of-nutrition-on-the-musculoskeletal-and-integumentary-systems>\)](https://openstax.org/books/nutrition/pages/19-1-assess-and-analyze-the-impact-of-nutrition-on-the-musculoskeletal-and-integumentary-systems)

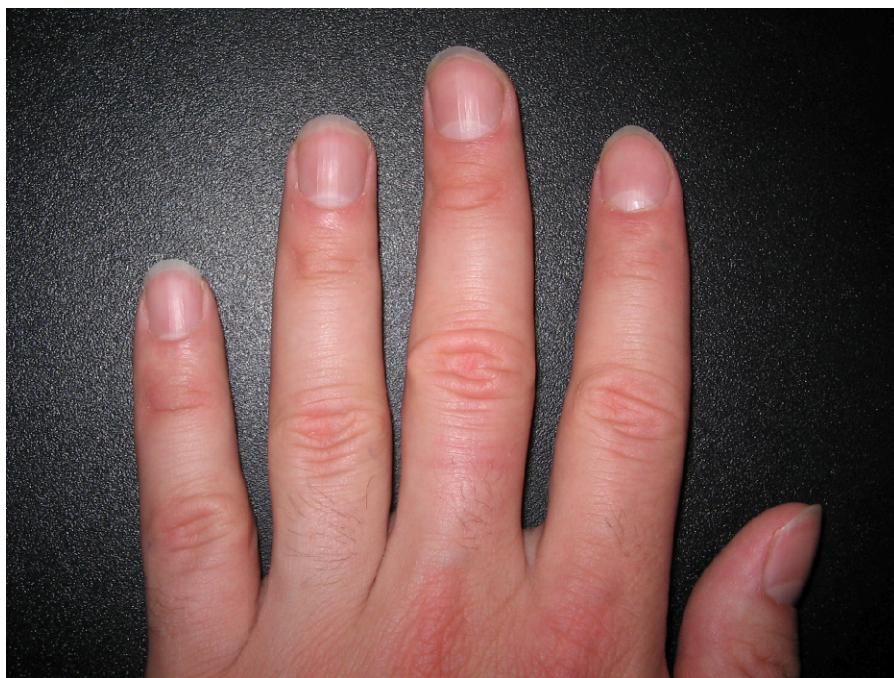
Nursing.com and Jon Haws, RN, provide a video review of how to perform a musculoskeletal assessment of the spine and upper and lower extremities.

Nursing assessment of the integumentary system can often be done simultaneously with the musculoskeletal system. In fact, observing for redness and swelling in the joints as already described relates both to the musculoskeletal and integumentary systems. This is why these systems are grouped together. One system influences the other and abnormal findings are typically related to both systems. Another example is for the sprain and strain mentioned earlier—the skin will reflect bruising (ecchymosis) and swelling.

General objective findings within the healthy integumentary system includes normal skin, hair, and nails. Skin should be distributed over the body in three tissue layers, all intact without any breaks in the skin. Healthy skin is free of lesions, ulcers, irritations, skin tears, blisters, and sores. The color is appropriate for race with no disturbances in pigmentation. Birthmarks and moles are smooth and consistent in color. Skin is warm and dry or appropriate for present environmental factors. Skin temperature does not vary from one site on the body to another. Normal moisture level is indicated by good skin turgor, with no **tenting**. To measure skin turgor, pinch up skin on the back of the hand and observe for tenting (when the skin stands up like a tent).

The hair of a healthy integumentary system is equally distributed in places where hair should be growing. There is no hair loss or hair growing where it does not belong. Texture is within normal limits for client per genetics, hormones, and chemical use. There are sufficient oils to prevent breakage. No parasite infestation is noted, and there is no fungus on the scalp.

The nails are translucent with pinkish tone. The base of the nail is about 160 degrees with normal sized fingertips. There is no clubbing and no spoon-shaped nails. The nails should be smooth and firm. The nails are clean, with no material growing under the nails. The cuticles are intact, and the surrounding skin is intact with no redness or edema ([Figure 19.2](#)).



**FIGURE 19.2** An assessment includes nail color and shape. (credit: "Fingernails, about 2 mm long, just the right length" by Kommissar/Wikimedia Commons, Public Domain)

### Tests Used in the Assessment of the Musculoskeletal and Integumentary Systems

During the assessment, nurses and providers use screening tests to determine objective findings in the

musculoskeletal and integumentary systems. The provider uses this information to determine the diagnostic tests needed. The provider combines subjective data with these objective findings to help make a diagnosis. Refer to [Table 19.1](#) for screening and diagnostic tests used for the musculoskeletal system.

Screening Tests for Musculoskeletal System	Diagnostic Tests for Musculoskeletal System
<ul style="list-style-type: none"> <li>• Neuropathy impairment score (NIS)</li> <li>• Active and passive ROM</li> <li>• Bilateral hand grip test</li> <li>• Bilateral foot push test</li> <li>• Morse, or other, fall risk assessment</li> <li>• Swollen joint count</li> <li>• Auscultation for crepitus</li> <li>• Gait assessment</li> <li>• Use of ambulatory device</li> <li>• Use of prosthesis</li> </ul>	<ul style="list-style-type: none"> <li>• Radiology and nerve studies <ul style="list-style-type: none"> <li>◦ X-ray</li> <li>◦ Computerized tomography (CT) scan</li> <li>◦ Magnetic resonance imaging (MRI)</li> <li>◦ Ultrasound</li> <li>◦ Arthroscopy</li> <li>◦ Electromyography (EMG)</li> <li>◦ Bone scan</li> <li>◦ Dual-energy x-ray absorptiometry (DXA)</li> <li>◦ Ultrasound</li> </ul> </li> <li>• Labs <ul style="list-style-type: none"> <li>◦ Creatinine kinase</li> <li>◦ Creatine Phosphokinase (CPK)</li> <li>◦ Anti-cyclic citrullinated peptide (anti-CCP) antibody</li> <li>◦ Erythrocyte sedimentation rate (ESR)</li> <li>◦ Antinuclear antibody (ANA)</li> <li>◦ Complete blood count (CBC)</li> <li>◦ Serum calcium</li> <li>◦ Rheumatoid factor</li> <li>◦ C-reactive protein (CRP)</li> <li>◦ Tissue biopsy</li> </ul> </li> </ul>

**TABLE 19.1** Screening and Diagnostic Musculoskeletal Tests (sources: LibreTexts Musculoskeletal Assessment; 2022; Pagana & Pagana, 2023)

The nurse's assessment of the integumentary system includes the skin, hair, and nails. Abnormalities found in this system often reflect a dysfunction in other body systems. See [Table 19.2](#) for screening tests and diagnostic tests for the integumentary system.

Screening Tests for Integumentary System	Diagnostic Tests for Integumentary System
<ul style="list-style-type: none"> <li>• Capillary refill</li> <li>• Skin turgor test</li> <li>• Grading of edema test (pitting test seen in <a href="#">Figure 19.3</a>)</li> <li>• Staging of pressure ulcers</li> <li>• <b>Braden Scale</b> (assessment tool using six categories to determine risk for pressure injury)</li> <li>• Burn classification</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Patch testing</b> (a skin test for allergies)</li> <li>• Biopsy</li> <li>• <b>Scraping</b> (a test for obtaining superficial dead skin for testing)</li> <li>• <b>Diascopy</b> (a test for determining blanchability of the skin)</li> <li>• <b>Wood light test</b> (a black light test used to diagnose lesions)</li> <li>• <b>Tzanck testing</b> (a test used to diagnose viral disease with active vesicles)</li> <li>• Culture and sensitivity</li> </ul>

**TABLE 19.2** Screening and Diagnostic Integumentary Tests (sources: Bendetti, 2021; Mazzasette, 2021)



**FIGURE 19.3** A recurrent erysipelas is evident on an edematous leg. (credit: “Recurrent erysipelas on edematous leg” by Mikael Häggström/Wikimedia Commons, Public Domain)



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Anne Wilson, a 70-year-old Black woman is referred by the primary care provider to a rheumatologist for complaints of pain and swelling in bilateral knees. Anne states that the ibuprofen that was earlier prescribed is no longer treating the pain. The nurse at the rheumatologist’s office notices that Anne appears anxious with a facial grimace. Anne states that she is having 8 out of 10 pain in both knees and that she only got a few hours of sleep last night due to the pain. Anne reports that she exercises daily by walking, but she admits that her nutritional plan (meal plan) could improve.

The provider enters the examination room to see Anne. On assessment, both knees are swollen with no redness or discoloration noted. The client denies injury to the knees or legs and has no history of falls. The client is taking short, tentative steps on observance of ambulation. The client admits that legs are stiff. No pain in both feet is reported. Anne said her primary doctor thinks she has arthritis and needs to see a rheumatologist. Client vitals are listed in the following table.

<b>Vital Signs</b>	
Temperature:	98.4°F
Blood pressure:	142/88 mm Hg
Heart rate:	82 beats/min
Respiratory rate:	20 breaths/min

**TABLE 19.3**

1. Based on these findings and client history, what screening tests should the nurse perform?
  - a. Morse fall risk assessment
  - b. NIS
  - c. Passive and active ROM

- d. Braden scale
2. What diagnostic testing would the nurse expect the rheumatology provider to order?
- a. X-ray of both knees
  - b. Vitamin D level
  - c. Tissue biopsy
  - d. Serum electrolyte panel

After x-rays, C-reactive protein, ESR, client history, and physical examination, the client was diagnosed with osteoarthritis in both knees.

Anne is treated with ibuprofen 600 mg, 3 times daily, and instructed to follow up with the provider in 6 weeks for re-evaluation to determine if the prescribed nonsteroidal anti-inflammatory drug (NSAID) is working. Anne is also referred to physical therapy for strengthening and gait training. The nurse plans to provide nutritional education before discharging the client.

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### Analysis of Nutrition and the Musculoskeletal and Integumentary Systems

A complete health history—including client dietary habits—is essential to any nursing assessment of the musculoskeletal and integumentary systems. A person’s diet impacts how the body remains in a state of homeostasis, how it heals, and how it helps to fight off diseases.

See [Table 19.4](#) for abnormal objective assessment findings for the musculoskeletal system and nutritional factors that are related to the abnormal assessment findings. Nutritional factors related to musculoskeletal disorders are shown in [Table 19.5](#).

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### Abnormal Objective Findings in the Musculoskeletal System

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- Posture
  - **Kyphosis** (an excessive outward curvature of the spine)
  - **Lordosis** (an excessive inward curvature of the spine)
  - **Scoliosis** (a sideways curvature of the spine)
  - **Intoeing** (foot turned inward)
  - **Genu varum** (bowing of legs)
- Asymmetry of shoulders and extremities
- Movement
  - Limited ROM
  - **Crepitus** (a grating sound produced by friction between bone and cartilage or bone and bone)
  - Popping
  - Limited muscle strength
  - Balance disturbance
  - Gait disturbance, including limping, leaning, falling or near falls, shuffling the feet, dragging the feet, waddling, swaying
  - Pain with movement
- Rheumatoid arthritis
- **Osteoarthritis** (a degenerative joint disease resulting in chronic pain and often edema)
- Scleroderma
- **Psoriatic arthritis** (a long-term inflammatory disease of the joints)
- SLE
- Inflammatory joint disease
- Cellulitis
- Sprains and strains
- Muscle soreness
- Strength
  - Alterations in muscle tone
  - Muscle atrophy, flaccid muscles
  - Asymmetry of strength in extremities
  - Fractures
  - Osteoporosis
  - Osteopenia
  - Paget's disease
- Observation
  - Pressure injuries
  - Skin tear
  - Muscle tear

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**TABLE 19.4** Nutritional Relationship to Musculoskeletal Abnormalities (sources: Bendetti, 2021; Nursing Skills, 2023; Saeg, 2021)

Disorder	Foods and Nutrients
Inflammation	<p>Anti-inflammatory foods:</p> <ul style="list-style-type: none"> <li>• Tomatoes</li> <li>• Olive oil</li> <li>• Leafy green vegetables</li> <li>• Nuts</li> <li>• Fatty fish</li> <li>• Fruits <ul style="list-style-type: none"> <li>◦ Pineapple (contains a group of enzymes called bromelain)</li> </ul> </li> </ul>
Muscle and tissue damage	<p>Foods that aid in the repair of muscle and tissue:</p> <ul style="list-style-type: none"> <li>• Protein-rich foods <ul style="list-style-type: none"> <li>◦ Lean turkey, chicken</li> <li>◦ Fish</li> <li>◦ Beans</li> <li>◦ Peas</li> <li>◦ Lentils</li> <li>◦ Tofu</li> <li>◦ Yogurt</li> <li>◦ Eggs</li> <li>◦ Cottage cheese</li> </ul> </li> <li>• Fiber-rich foods <ul style="list-style-type: none"> <li>◦ Fruits</li> <li>◦ Vegetables</li> <li>◦ Legumes</li> <li>◦ Whole grains</li> </ul> </li> <li>• Vitamin C <ul style="list-style-type: none"> <li>◦ Citrus fruits</li> <li>◦ Orange juice</li> </ul> </li> <li>• Omega-3 fatty acids <ul style="list-style-type: none"> <li>◦ Fatty fish (salmon, tuna)</li> </ul> </li> <li>• Zinc-rich foods <ul style="list-style-type: none"> <li>◦ Meat</li> <li>◦ Poultry</li> <li>◦ Seafood</li> <li>◦ Liver</li> </ul> </li> </ul>
Bone disorders	<p>Foods that aid in bone growth and repair:</p> <ul style="list-style-type: none"> <li>• Calcium-rich foods <ul style="list-style-type: none"> <li>◦ Milk</li> <li>◦ Cheese</li> <li>◦ Kale</li> <li>◦ Yogurt</li> </ul> </li> <li>• Vitamin D <ul style="list-style-type: none"> <li>◦ Egg yolk</li> <li>◦ Fatty fish</li> <li>◦ Milk</li> </ul> </li> </ul>

**TABLE 19.5** Nutritional and Musculoskeletal Relationship (sources: Bendetti, 2021; Meacham 2022; Saeg, 2021)

Pressure injuries must be treated with optimal nutrition for tissue healing. Using the guidelines from Johns Hopkins Medicine (2023), pressure injury assessment and classification includes:

- Stage 1: A red, blue, or purplish area appears on the skin. This area, which looks like a bruise, may be warm to the touch, burn, or itch.
- Stage 2: The area becomes an open sore that looks like an abrasion or blister and can be painful. The skin around the wound may be discolored.
- Stage 3: The wound deepens, with a crater-like appearance, and often has dark patches of skin around its edges.
- Stage 4: The wound extends even deeper to the muscle, bone, or joints. This can cause osteomyelitis, which is a serious bone infection. It may also lead to sepsis (a life-threatening inflammatory response to a massive infection).

An analysis of nutritional effects on abnormal findings within the integumentary system is listed in [Table 19.6](#). The nurse should understand the relationship between nutrition and abnormal findings in the integumentary system so that the client can receive appropriate nutritional education.

Abnormal Objective Findings in the Integumentary System	Related Nutritional Factors	Associated Foods
<b>Hair</b>		
• Alopecia (hair loss)	Overall hair health: biotin	• Liver, egg yolk, salmon, sweet potatoes, cauliflower
• Hirsutism (an abundance of hair in places where hair is normally scarce or absent)	Vitamin B <sub>12</sub> (cobalamin)	• Liver, salmon, tuna, yogurt, eggs
• Coarse texture	Folate	• Asparagus, oranges, white beans
• Fine texture		
• Breakage of hair	Iron	• Liver, beef, chicken, lamb, ham
<b>Hair – Parasite Infections</b>		
• Lice, nits, scabies	No related nutritional factors for parasite infestations	
• Scalp ringworm		
<b>Skin – Temperature</b>		
• Hot or warm, cold, or cool with variations in temperature	No related nutritional factors for skin temperature	
<b>Skin – Color</b>		
• Skin discoloration: blue, gray, red, white, yellow, darkened	Pigmentation: vitamin C	• Citrus fruits, strawberries, broccoli
• Presence of pigmentation disturbance ( <b>vitiligo</b> )		
• Moles or birthmarks		
<b>Skin – Moisture Level</b>		
• Dry, cracked skin	Zinc	• Eggs, meat and poultry, seafood, beans and lentils, whole grains, liver, potato with skin
• Diaphoretic		
• Clammy	Iron	• Liver, beef, chicken, lamb, ham
• Leathery		
	Niacin	• Liver, chicken, turkey, ground beef
	Vitamin D	• Egg yolks, fatty fish, milk
	Vitamin A	• Carrots, sweet potatoes, spinach

**TABLE 19.6** Nutritional Relationship to Integumentary (sources: Marriott et al., 2020; White, 2022)

Abnormal Objective Findings in the Integumentary System	Related Nutritional Factors	Associated Foods
<b>Skin – Tenting</b>		
• Tenting (when the skin remains raised when pinched on the back of the hand)	Dehydration	<ul style="list-style-type: none"> <li>• Water and other liquids</li> </ul>
<b>Skin – Integrity</b>		
• Lesions (pustules, vesicles, hives, wheals, cyst)	Vitamin A	<ul style="list-style-type: none"> <li>• Carrots, sweet potatoes</li> <li>• Spinach</li> </ul>
• Irritations	Vitamin B <sub>1</sub> (thiamin)	<ul style="list-style-type: none"> <li>• Barley</li> </ul>
• Broken skin	Vitamin B <sub>6</sub> (pyridoxine)	<ul style="list-style-type: none"> <li>• Fish, organ meats, potatoes</li> </ul>
• Pressure injuries	Vitamin B <sub>9</sub> (folate)	<ul style="list-style-type: none"> <li>• Asparagus, beans, peas</li> </ul>
• Skin ulcers	Vitamin B <sub>12</sub> (cobalamin)	<ul style="list-style-type: none"> <li>• Liver, salmon, tuna, yogurt, eggs</li> </ul>
• Skin tears	Vitamin C	<ul style="list-style-type: none"> <li>• Citrus fruits, orange juice</li> </ul>
• Blisters	Vitamin D	<ul style="list-style-type: none"> <li>• Egg yolks, fatty fish, milk</li> </ul>
	Vitamin E	<ul style="list-style-type: none"> <li>• Olive oil, almonds, peanuts</li> </ul>
	Zinc	<ul style="list-style-type: none"> <li>• Eggs, meat and poultry, seafood</li> <li>• Beans and lentils</li> </ul>
	Calcium	<ul style="list-style-type: none"> <li>• Cheese, milk, yogurt</li> </ul>
	Copper	<ul style="list-style-type: none"> <li>• Liver, oysters, nuts, seeds</li> </ul>
	Magnesium	<ul style="list-style-type: none"> <li>• Bananas, nuts, avocado, legumes</li> </ul>
	Selenium	<ul style="list-style-type: none"> <li>• Seafood, meat</li> </ul>
	Protein	<ul style="list-style-type: none"> <li>• Lean chicken, turkey, fish</li> <li>• Beans, peas, lentils, tofu</li> <li>• Nuts, peanut butter, seeds</li> <li>• Cheese, yogurt, cottage cheese, eggs</li> <li>• Milk or fortified soy</li> </ul>
<b>Nails</b>		
	Overall nail health: biotin	<ul style="list-style-type: none"> <li>• Liver, egg yolk, salmon, sweet potatoes, cauliflower</li> </ul>
<b>Nails – Discoloration</b>		
• Yellowing, blue, darkening, greenish black, white, reddish brown	Vitamin B <sub>12</sub> deficiency causes blue/black nails	<ul style="list-style-type: none"> <li>• Liver, salmon, tuna, yogurt, eggs</li> </ul>
	Folate deficiency causes pigmentation to change in nails	<ul style="list-style-type: none"> <li>• Asparagus, oranges, white beans</li> </ul>
	Iron deficiency causes pale nails	<ul style="list-style-type: none"> <li>• Liver, beef, chicken, lamb, ham</li> </ul>

TABLE 19.6 Nutritional Relationship to Integumentary (sources: Marriott et al., 2020; White, 2022)

Abnormal Objective Findings in the Integumentary System	Related Nutritional Factors	Associated Foods
<b>Nails – Shape</b>		
• Clubbing	Low oxygen levels	
• Spoon-shaped	Iron deficiency	• Liver, chicken, ham, lamb
	Vitamin B deficiency	• Legumes, nuts, dairy, fish, lean meats
<b>Nails – Texture</b>		
• Brittle • Coarse • Notched • Pitting • Ridges • Capillary refill: prolonged (more than 3 seconds)	• Brittle: vitamin A deficiency • Ridges: vitamin B <sub>12</sub> deficiency	• Sweet potatoes, pumpkin, carrots • Liver, salmon, tuna, yogurt, eggs
<b>Nails – Condition</b>		
• Fungus, dirt, lack grooming	No related nutritional factors	

TABLE 19.6 Nutritional Relationship to Integumentary (sources: Marriott et al., 2020; White, 2022)

## SPECIAL CONSIDERATIONS

### Vitiligo

Vitiligo—a skin condition where the skin loses its pigmentation—physically affects all races and sexes equally, about 1% of the population globally; however, the psychological impact on clients with darker skin tones is much greater. Because this skin disease is more visible in darker skin tones, many clients struggle with self-esteem and confidence after developing vitiligo (Cleveland Clinic, 2022). The nurse works to offer emotional support by recommending support groups for their clients with vitiligo.

Vitamin B<sub>12</sub> has been shown to be useful for repigmentation in clients with vitiligo. Meat, eggs, and dairy products are good sources of Vitamin B<sub>12</sub>. Folic acid has also been proven to treat vitiligo. Although Vitamin D is thought to play a role in vitiligo, there is insufficient evidence to indicate that a low Vitamin D could cause vitiligo. Zinc is thought to inhibit melanocyte destruction and may be a useful mineral in the treatment of vitiligo.

## 19.2 Plan Nutritional Strategies to Impact Musculoskeletal and Integumentary Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 19.2.1 Prioritize hypotheses of nutritional habits that optimize musculoskeletal and integumentary wellness.
- 19.2.2 Generate solutions to optimize musculoskeletal and integumentary wellness utilizing nutritional habits.

### Planning Nutritional Goals

The nurse is responsible for educating the client on nutritional strategies to impact musculoskeletal and integumentary wellness. Based on the client's history and current medical diagnosis, the nurse will prioritize hypotheses of nutritional habits (or assess expected client responses of nutritional habits) to optimize the well-being of the client. In doing so, the nurse will plan nutritional goals for the client and focus on assisting the client to

meet the goals.

Nutrition is an important lifestyle factor related to many long-term diseases. The musculoskeletal and integumentary systems are no exception. Long-term consumption of low nutrient foods may contribute to musculoskeletal pain and may also lead to obesity, homeostasis, inflammation, and sensitization of the central nervous system. Therefore, it is essential that proper nutrition be a priority in planning for better health that is related to the musculoskeletal and integumentary systems.

Calcium and vitamin D are essential to good bone health, and it is important that clients follow the recommended daily allowances. Because more foods are being fortified with calcium and vitamin D, clients may not realize they are consuming these micronutrients at unsafe levels. For example, a buildup of calcium can increase the risk for kidney stones, cardiac issues, and prostate cancer.

For people over age 50, at least 1200 mg of calcium per day is recommended. Excess vitamin D can cause kidney damage and dangerous serum calcium levels. Recommended vitamin D levels for adults to age 70 years is 600 IU and above 70 years, 800 IU (Mayo Clinic, 2021). See [Table 19.7](#) for calcium and vitamin D food sources.

Food Sources of Calcium	Food Sources of Vitamin D
Milk	Egg yolk
Yogurt	Mushrooms
Fortified orange juice	Oily fish (swordfish, herring)
Cheese	Fortified milk
Sardines	Fortified orange juice
Ice cream	Fortified cereals
Tofu	
Soy	
Bread	
Pudding	
Broccoli	

**TABLE 19.7** Food Sources of Calcium and Vitamin D (source: Campbell, 2021)

Other vitamins and minerals essential to include in planning nutritional goals for the musculoskeletal system are phosphorus, magnesium, vitamin K, vitamin C, and vitamin A. Phosphorus is a major mineral found in bone and needed for bone health. It can be consumed through such foods as dairy products and meat, as well as shellfish, beans, sunflower seeds, lentils, sardines, and cheese. Magnesium improves overall bone strength and is found in spinach, bananas, nuts and seeds, avocado, and chickpeas. Vitamin K is essential to bone formation, and it channels calcium into the bones. Foods containing vitamin K include leafy green vegetables, kiwi, and pumpkin. Vitamin C is necessary in the synthesis of collagen, which is the main protein in bone. Vegetables, citrus fruits, and tomatoes are high in vitamin C. Vitamin A is important for bone growth and can be found in liver, eggs, leafy green vegetables, and carrots (Campbell, 2021).

Planning nutritional goals for integumentary health is very important as related to wound healing, inflammation, and dermatologic disease processes. The primary focus is on protein because this is the important nutrient needed for tissue repair. An important nutritional goal during wound healing is to stay well hydrated. Hydration helps skin maintain its integrity; the loss of skin elasticity caused by dehydration makes the skin more susceptible to infections, thus impeding the healing process (Campbell 2023). In setting nutritional goals that include protein, these food items may be suggested:

- Salads (tuna, salmon, egg, and grilled chicken salad)
- Nuts
- Milk
- Cottage cheese
- Tuna and salmon
- Peanut butter

- Greek yogurt
- Whole grains
- Protein shakes (if food cannot be tolerated)

### Identifying Challenges to Nutritional Goals

One big challenge to any nutritional plan is making sure the client can understand and follow the plan. Does the client have financial means to purchase and prepare specific foods? Often, fast foods and non-nutritious foods are more convenient and much less expensive. Is the client able to read nutrition labels? Is there a challenge to finding necessary food items in the area in which the client lives? Does the client have transportation or internet services for ordering food? If the client is unable to follow the plan for any of the reasons listed, the nurse should provide information on assistance programs or make a referral to another agency to assist the client in these matters. Motivation is also often a challenge for any nutritional goal. The client must understand how they will benefit from the diet plan. The nurse should clearly identify potential complications the client ignores nutritional goals.

Maintaining a diet rich in vitamin D is challenging even if a client has the means and the motivation to follow the diet. Our bodies naturally make vitamin D in our skin when it is exposed to sunlight. However, because of the importance of protecting our skin by using sunscreen, we are blocking our skin's ability to make vitamin D. Therefore, vitamin D needs to come in the form of nutrition or added supplements for most people.

Consuming a diet with nutrient rich calories is often a challenge for the client during wound or tissue healing. The client is often more immobile during such times, and the client may worry about gaining weight. The nurse can be a vital resource for the client by educating them on the difference between consuming empty calories and nutrient-rich calories. The client must understand the importance of nutrition and the positive impact that nutrient-rich calories play in the tissue and wound healing process.

## 19.3 Implement Nutritional Strategies to Impact Musculoskeletal and Integumentary Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 19.3.1 Assess the client for readiness to learn.
- 19.3.2 Teach nutritional strategies to optimize musculoskeletal and integumentary wellness.

### Holistic Nursing Assessment of the Client

Maintaining overall health within the musculoskeletal and integumentary systems is critical to holistic health. One way to attain this goal is to review specific nutritional plans with the client. Some plans, such as gluten free or Mediterranean, are found to be helpful in decreasing the symptoms associated with musculoskeletal and integumentary disorders. Some research suggests there is an inflammatory immune response related to gluten—a protein found in wheat, barley, and rye grains. Some people may find that eating gluten makes their rheumatoid arthritis symptoms flare up and that reducing or eliminating gluten helps relieve their symptoms. Another anti-inflammatory nutritional plan, the Mediterranean diet, which emphasizes fresh fruits and vegetables, fish, whole grains, nuts, and mono- and polyunsaturated fats, is helpful for reducing inflammation and works well to reduce arthritis symptoms. This diet plan includes omega-3 fatty acids, vitamin C, fiber-rich foods, **polyphenols**, and other known inflammation fighters. Polyphenols, found in various foods, are organic compounds that contribute to the food's color and smell. The nurse should ensure the client understands the premise behind the nutritional plan and that they can read and interpret food labels and ingredients properly.

The client must also be assessed for readiness to learn. This can be accomplished through a holistic assessment—an in-depth client assessment that delves into:

- Physiological health—Physical condition, physical limitations, medical conditions, past medical and surgical history, and current medications
- Psychological health—Mental health condition, cognitive level, anxiety, stress
- Social and environmental—Support systems, living conditions, financial barriers, access to resources
- Cultural factors—Traditions, languages, set of beliefs
- Spiritual factors—Alcohol consumption, dietary choices, procedures allowed, advanced directives

By working with the client to establish holistic goals for good health, client/nurse communication is enhanced, and trust is established. Holistic nursing provides a deeper respect for the client and helps them gain control over their lifestyle changes.

As a part of the physiological health assessment, the nurse should determine the client's list of medications. As a part of client teaching, the nurse should educate the client about the medications that have been prescribed for treatment. Some of the most ordered medications for musculoskeletal disorders include NSAIDS like ibuprofen, diclofenac, naproxen, indomethacin, meloxicam, and others.

### **Client Teaching**

When a client is hospitalized, teaching starts at admission and is an ongoing process throughout the stay until discharge. Education should be provided in small segments for better client retention. Nurses should speak in a language that the client can understand, refraining from using complex medical terminology. In some instances, return demonstration is needed right before discharge. The nurse should educate according to the learning style of the client and should include the caretakers who will be assisting the client once home (Morris, 2022).

Client teaching should always include nutritionally related teaching strategies. Too often at discharge, the nurse focuses on the physical problem exclusively. Nutritional client education that focuses on the musculoskeletal and integumentary system is a more holistic approach to treatment. See [Table 19.8](#) for important nutritional teaching concerning both the integumentary and musculoskeletal systems.

Function	Nutritional Importance	Nutrients to Support System
<b>Integumentary System</b>		
<ul style="list-style-type: none"> <li>First line of defense for the body against environmental trauma and pathogens</li> <li>Skin has thermoregulation properties as well as sensory, endocrine and immune functions</li> </ul>	<ul style="list-style-type: none"> <li>Unhealthy eating impacts the skin and leads to malnutrition. This impacts the body's homeostasis in relation to protection, thermoregulation, sensory, endocrine and immune functions.</li> <li>A healthy diet helps to maintain and repair body tissue.</li> </ul>	<ul style="list-style-type: none"> <li>Foods high in water content such as fruits and vegetables help to prevent dehydration and dry skin, promoting skin integrity</li> <li>Foods with anti-inflammatory properties <ul style="list-style-type: none"> <li>Nuts</li> <li>Fruits (blackberries, blueberries, avocados, grapes, cherries)</li> <li>Turmeric</li> <li>Omega-3 fatty acids (salmon)</li> <li>Green tea</li> <li>Olive oil</li> </ul> </li> <li>Foods that promote wound healing <ul style="list-style-type: none"> <li>Proteins (cottage cheese, beef, salmon, tuna, chicken breast, beans, nuts)</li> <li>Whole grains</li> <li>Vitamin C (citrus fruits, broccoli)</li> <li>Vitamin A (carrots, apricots)</li> <li>Zinc (shellfish, eggs, poultry)</li> <li>Iron (red meat, dark green leafy vegetables)</li> </ul> </li> </ul>

**TABLE 19.8** Nutritional Teaching for Musculoskeletal and Integumentary Systems (sources: Campbell, 2023; Cleveland Clinic, 2023; Opentextbc.ca 2013)

Function	Nutritional Importance	Nutrients to Support System
<b>Musculoskeletal System</b>		
• Supports the body's weight and provides stability and movement	<ul style="list-style-type: none"> <li>Malnutrition can severely impair the musculoskeletal system.</li> <li>Proper nutrition is important to minimize normal bone loss that occurs over time.</li> <li>A healthy diet promotes healthy weight which decreases the strain on bones, joints, muscles and ligaments.</li> <li>Proper nutrition assists to decrease inflammation, promote bone marrow production, and maintain overall mobility.</li> </ul>	<ul style="list-style-type: none"> <li>Foods with anti-inflammatory properties: <ul style="list-style-type: none"> <li>Nuts</li> <li>Fruits (blackberries, blueberries, avocados, grapes, cherries)</li> <li>Turmeric</li> <li>Omega-3 fatty acids (salmon)</li> <li>Green tea</li> <li>Olive oil</li> </ul> </li> <li>Maintenance of bone and muscle mass and strengthens bones: <ul style="list-style-type: none"> <li>Vitamin D (milk, cheese)</li> <li>Fruits</li> <li>Vegetables</li> <li>Zinc (pumpkin seeds, lentils)</li> <li>Magnesium (bananas, dark chocolate, whole grains, leafy green vegetables)</li> <li>Phosphorus (whole wheat, cheese)</li> </ul> </li> <li>Promotes bone formation: <ul style="list-style-type: none"> <li>Proteins (cottage cheese, beef, salmon, tuna, chicken breast, beans)</li> <li>Greek yogurt</li> </ul> </li> </ul>

**TABLE 19.8** Nutritional Teaching for Musculoskeletal and Integumentary Systems (sources: Campbell, 2023; Cleveland Clinic, 2023; Opentextbc.ca 2013)

As seen in the table above, both the musculoskeletal and the integumentary systems are affected by inflammation. Therefore, anti-inflammatory foods are important to consider for both systems. The muscles of the musculoskeletal system can become inflamed due to injury, infection, or overuse. Likewise, the soft tissue and skin of the integumentary system can become inflamed due to injury or infection. The injured muscle often involves the surrounding tissue and skin. Bones that are injured (fractures) often manifest signs in the integumentary system, such as bruising and discoloration. The injured tendons and ligaments of the musculoskeletal system manifest signs in the integumentary system, such as ecchymosis and edema. These are just a few examples of how the musculoskeletal system and the integumentary system are connected to one another.



## UNFOLDING CASE STUDY

### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

The nurse prepares to instruct the client on nutritional strategies to manage her arthritis. Client teaching for Anne

includes the reinforcement teaching of a nutritional plan that has anti-inflammatory properties for her osteoarthritis with edema in the knees. Along with nutritional education, the nurse instructs the client to stay as active as possible, doing stretching exercises daily as prescribed by the physical therapist to maintain or gain ROM in lower extremities. The nurse instructs Anne to pay close attention to the skin surrounding her knees, observing for warmth or redness. Anne is encouraged to report these integumentary symptoms if they occur because they could indicate septic arthritis of the knees.

3. From what is known about nutrition and the impact that it has on the musculoskeletal system, which of the following foods would you expect the nurse to include in dietary teaching for the client?
  - a. Leafy green vegetables
  - b. Dairy products
  - c. Red meat
  - d. Protein shakes
4. After the nurse finishes the instructions, which of the following statements by the client indicates additional education is needed?
  - a. "I will try to incorporate more berries into my diet."
  - b. "I will stop eating nuts."
  - c. "I will try to eat more salmon and tuna."
  - d. "I will eat fewer carbohydrates."

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## 19.4 Evaluate Nutritional Strategies to Impact Musculoskeletal and Integumentary Wellness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 19.4.1 Evaluate a nutritional plan for its effectiveness on musculoskeletal and integumentary wellness.
- 19.4.2 Modify a nutritional plan to promote musculoskeletal and integumentary wellness.

### Evaluating the Client's Compliance with the Meal Plan

Evaluation is an important part of the nursing process. After the client has integrated nutritional strategies into their eating habits, the nurse should go back and evaluate the effectiveness of the plan. This is accomplished through objective and subjective findings. Barriers to compliance may include a client's inability to read, write, and perform simple math. Finances, resources, transportation, and support are also barriers to client nutritional compliance.

A client's compliance with the meal plan can, to some degree, be evaluated through their improvement of symptoms related to the musculoskeletal and integumentary systems. Objective ways to evaluate compliance with a meal plan are monitoring client weight and laboratory test results. Other objective findings include improvement in wounds, fractures, injuries, and nail and hair quality. Radiology procedures showing regeneration of bone or no extension in bone loss are also objective findings.

Subjective data from the client or caregivers must also be considered in determining client nutritional compliance. In other words, the nurse needs to listen to the client and caregivers to determine if compliance is being met.

### Evaluating the Effectiveness of a Nutritional Plan

The effectiveness of a nutritional plan can be determined by many factors such as weight variance, changes in pain and edema, alterations in muscle strength and tone, and absence or presence of fatigue. DEXA (dual x-ray absorptiometry) scans that measure bone density can be used as a follow up to the initial scan to determine if bone loss is stable or progressing. Continual monitoring of client labs is an effective way to evaluate whether the nutritional plan is working. Labs for the musculoskeletal and integumentary systems are outlined in [Table 19.9](#).

Labs for Musculoskeletal and Integumentary Systems	Indications
<ul style="list-style-type: none"> <li>White blood count (WBC)</li> <li>Erythrocyte sedimentation rate (ESR)</li> <li>C-reactive protein (CRP)</li> <li>Culture and sensitivity</li> </ul>	<ul style="list-style-type: none"> <li>Inflammation and infection</li> <li>Inflammation</li> <li>Infection</li> </ul>
<ul style="list-style-type: none"> <li>Vitamins A and D, and calcium</li> </ul>	<ul style="list-style-type: none"> <li>Fractures</li> <li>Osteoporosis</li> <li>Osteopenia</li> <li>Paget's disease</li> </ul>
<ul style="list-style-type: none"> <li>Antinuclear antibody (ANA)</li> <li>Rheumatoid factor (RF)</li> <li>Anti-cyclic citrullinated peptide (CCP)</li> <li>Alanine aminotransferase (ALT)</li> <li>Aspartate aminotransferase (AST)</li> </ul>	<ul style="list-style-type: none"> <li>Autoimmune disorders</li> </ul>
<ul style="list-style-type: none"> <li>Alkaline phosphatase (ALP)</li> </ul>	<ul style="list-style-type: none"> <li>Bone formation</li> </ul>
<ul style="list-style-type: none"> <li>Plasma histamine</li> </ul>	<ul style="list-style-type: none"> <li>Immune disorders</li> </ul>

**TABLE 19.9** Labs for Musculoskeletal and Integumentary Systems (source: Pagana & Pagana, 2023)

## Chapter Summary

- The musculoskeletal system includes the bones of the skeleton and the cartilage, ligaments, and other connective tissues and muscles.
- The integumentary system includes the skin, hair, nails, sweat glands, sebaceous glands, and nerves on the skin.
- There is a relationship between the neurological system and the musculoskeletal system in that the brain and nerves tell the voluntary muscles what to do.
- Nutrition plays a key role in the development and maintenance of a healthy musculoskeletal and integumentary system.
- Within the musculoskeletal and integumentary systems, nutrition affects a person's immune system, inflammatory response, level of edema,

- bone formation, bone health, fracture healing, wound healing, and hair and nail health.
- Nurse assessment and screening tests for the musculoskeletal and integumentary systems are essential for the overall success of client care.
- Client teaching, including nutritional meal planning, is important to the overall care of the musculoskeletal and integumentary systems.
- The client must be assessed for readiness to learn before educating the client about lifestyle changes including nutrition.
- Evaluation of nutritional strategies include client adherence. The nurse must be able to recognize barriers to adherence with overall client health care.

## Key Terms

**alopecia** hair loss

**autoimmune disorder** occurs when the body's immune system attacks and destroys healthy body tissue

**basal ganglia** a part of the brain that starts and coordinate movements; diseases of the cells leading into the basal ganglia include Parkinson's disease that results in tremors

**Braden scale** an assessment tool using six categories to determine pressure injury risk

**crepitus** a grating sound produced by friction between bone and cartilage or bone and bone

**diascopy** a test for determining how quickly the skin blanches under pressure

**genu varum** bowing of legs

**hirsutism** an abundance of hair in places where hair is normally scarce or absent

**integumentary system** the body system that includes the skin, hair, nails, sweat glands, sebaceous glands, and nerves on the skin

**intoeing** foot turned inward

**kyphosis** an excessive outward curvature of the spine

**lordosis** an excessive inward curvature of the spine

**muscle tone** a measure of a muscle's resistance to

stretching while in a passive resting state

**musculoskeletal system** the bones of the skeleton and the cartilages, ligaments, and other connective tissues and muscles

**osteoarthritis** a degenerative joint disease resulting in chronic pain and often edema

**patch testing** a skin test for allergies

**polyphenols** beneficial plant compounds with antioxidant properties

**psoriatic arthritis** a long-term inflammatory disease of the joints

**range of motion (ROM)** reflects the client's ability to move their joints actively or passively

**scoliosis** a sideways curvature of the spine

**scraping** a technique for obtaining superficial dead skin for testing

**tenting** when the skin remains raised after being pinched on the back of the hand

**Tzanck testing** a test used to diagnose viral disease with active vesicles

**vitiligo** skin pigmentation disturbance

**wood light test** a black light test used to diagnose lesions

## Review Questions

- The nurse is educating a client on ways to promote bone health after the client suffered a stress fracture. Foods containing which of the following vitamins are the priority for this client?
  - Vitamin D
  - Vitamin B<sub>12</sub>
  - Vitamin C
  - Vitamin E
- During an assessment, the nurse notes the client has tenting. What does this indicate?

- a. Poor muscle tone
  - b. Poor circulation
  - c. Poor skin integrity
  - d. Poor hydration
3. The nurse is educating the client with a torn bicep muscle on the effects of nutrition on musculoskeletal health. What recommendation do you expect the nurse to make?
- a. Increase protein intake
  - b. Increase vitamin D intake
  - c. Include foods high in biotin
  - d. Include foods high in iron
4. Which client would most likely benefit from consuming bromelain?
- a. A 40-year-old marathon runner with sore muscles in legs
  - b. A 78-year-old client with a stage 3 pressure ulcer
  - c. An 83-year-old client with osteoporosis
  - d. A 65-year-old client with edema in their right knee due to osteoarthritis
5. A client with a stage 2 pressure injury was prescribed protein shakes twice daily. Upon return to the office for a recheck, the pressure ulcer changed to stage 1. Which of the following findings supports the conclusion the client has improved?
- a. A blister has now formed at the site of the pressure injury.
  - b. The site of the pressure injury shows some healthy adipose tissue.
  - c. The site of the pressure injury is red but intact.
  - d. The pressure injury diameter is smaller but deeper.
6. The client has returned to the clinic for a follow-up appointment after being diagnosed with osteoporosis. Which of the following statements by the client indicates they have followed the recommended diet to manage their condition?
- a. "I have been eating more fruit than I used to."
  - b. "I try to eat several servings of dairy products each day."
  - c. "I don't like to eat fish."
  - d. "I have switched from eating French fries to baked potatoes."
7. The nurse is caring for a client who is prescribed a gluten-free diet to manage their dermatitis herpetiformis. Which foods require modification when conforming to a gluten-free diet?
- a. Fresh fruit and vegetables
  - b. Bread and pasta
  - c. Brown and wild rice
  - d. Fish and poultry
8. During an admission assessment, the nurse is assessing the client's fingernails. Which of the following findings would be concerning?
- a. Capillary refill < 2 seconds
  - b. Smooth nails
  - c. Clubbing of nails
  - d. Translucent color with pinkish tone
9. The nurse is providing nutritional instruction to a client with a surgical wound that is slow to heal. Which of the following statements by the client indicates the client understands the recommended diet strategies?
- a. "I will eat smaller, more frequent meals."
  - b. "I will drink water throughout the day."
  - c. "I will limit my intake of dairy products."

- d. "I will eat several servings of fruits and vegetables each day."
- 10.** The nurse is working with a client who is experiencing alopecia. Which of the following nutrients, found in liver and egg yolks, could the nurse recommend?
- Folate
  - Zinc
  - Selenium
  - Biotin

## Suggested Reading

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## CHAPTER 20

# Special Nutritional Considerations for Musculoskeletal and Integumentary Health



**FIGURE 20.1** Tomatoes contain essential micronutrients such as vitamin A, vitamin C, phosphorus, and potassium. (credit: modification of work “Foods Vegetables in Bulacan displayed for sale in Baliuag, Bulacan Public Market” by Judgefloro/Wikimedia Commons, CC0 1.0)

### CHAPTER OUTLINE

20.1 The Impact of Nutrition on Musculoskeletal and Integumentary Wellness Across the Lifespan

20.2 Nutrition and Chronic Musculoskeletal and Integumentary Illness

20.3 Treatments and Nutrition

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**INTRODUCTION** Musculoskeletal and integumentary changes can affect other organ systems, and they also become evident as the body ages. Aging muscles and skin can cause changes in a person’s mobility and overall wellness. Decreases in bone mass and density can result in fractures and illness. The chapter on [Applying Clinical Judgment to Promote Nutrition for Musculoskeletal and Integumentary Wellness](#) covers the important role of nutrition in musculoskeletal and integumentary health and wellness. This chapter will introduce special considerations across the lifespan because nutritional needs change over time. Preventing and mitigating complications of the musculoskeletal and integumentary systems, such as fractures, poor wound healing, physical disability, disease progression, poor quality of life, and hospital admissions, can often be achieved through implementing appropriate nutrition and adequate physical activity.

Consider this case: Meet Maria, a 20-year-old, and her newborn baby, Jose. To explore the concepts presented in this chapter, the unfolding case study will follow Jose as he grows from a newborn to an older adult.

## 20.1 The Impact of Nutrition on Musculoskeletal and Integumentary Wellness Across the Lifespan

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 20.1.1 Describe the impact of nutrition on the musculoskeletal and integumentary systems during pregnancy.
- 20.1.2 Describe the impact of nutrition on the musculoskeletal and integumentary systems during infancy.
- 20.1.3 Describe the impact of nutrition on the musculoskeletal and integumentary systems during childhood.
- 20.1.4 Describe the impact of nutrition on the musculoskeletal and integumentary systems during adolescence.
- 20.1.5 Describe the impact of nutrition on the musculoskeletal and integumentary systems during adulthood.
- 20.1.6 Describe the impact of nutrition on the musculoskeletal and integumentary systems during later adulthood.

### The Healthy Pregnant Client and Fetus

Pregnant clients are encouraged to eat a healthy, balanced diet, not just for their own health and well-being but also for the health and well-being of the growing fetus. Nutrition plays a critical role in maintaining musculoskeletal and integumentary health during pregnancy.

Adequate intake of calcium and vitamin D is essential for developing and maintaining healthy bones and teeth in both the pregnant client and the developing fetus (Azzolino et al., 2021). During pregnancy, the demand for calcium increases to support fetal skeletal development. Insufficient calcium intake may lead to decreased maternal bone density as well as decreased bone density and teeth firmness of the child later in life (Tihonen et al., 2021).

Protein is vital for the growth and repair of muscles and the development of the fetal musculoskeletal system. Adequate protein intake is necessary to meet these demands for both the pregnant client and the fetus.

Maintaining proper hydration during pregnancy helps keep the skin hydrated, reducing the risk for dryness, itching, and stretch marks. Moreover, sufficient water intake is crucial for fetal development. [Table 20.1](#) highlights some of the important ways staying hydrated during pregnancy benefits the growing fetus.

Benefit to the Fetus	Explanation
Collagen production	Water is essential to produce collagen, a protein needed for the development of skin and bones.
Nutrient transport	Proper hydration enables efficient transport of essential nutrients to the growing fetus. Adequate maternal blood volume and circulation to and from the placenta are necessary for nutrients to be transported to the growing fetus and waste products removed.
Amniotic fluid production	The amniotic fluid is responsible for thermoregulation in utero, and a stable temperature ensures appropriate fetal growth and development. Additionally, amniotic fluid cushions the growing fetus, allowing for essential movements that allow the fetus to develop strong bones and muscles.

**TABLE 20.1** Hydration Benefits for the Fetus

Consuming a well-balanced diet rich in essential nutrients such as vitamins A, C, and E and the mineral zinc can promote healthy skin during pregnancy. These nutrients play a role in collagen synthesis, essential for skin elasticity and wound healing. Foods such as fruits, vegetables, whole grains, lean proteins, and healthy fats can provide these necessary nutrients.

Omega-3 fatty acids, particularly docosahexaenoic acid (DHA), are crucial for developing the fetal skin and nervous system. Including dietary sources of omega-3 fatty acids, such as fatty fish and flaxseed, can support the integumentary health of both the pregnant client and the developing baby (American College of Obstetricians and Gynecologists, 2023).

The nurse should encourage pregnant clients to maintain a balanced and varied diet that includes a wide range of nutrients. Referral to a registered dietitian may be recommended to ensure proper nutritional intake during pregnancy.



## UNFOLDING CASE STUDY

### Part A

Read the following clinical scenario and then answer the questions that follow. This case study will evolve throughout the chapter.

Maria delivers a healthy baby and names him Jose. Maria's diet was suboptimal during pregnancy because of hyperemesis gravidarum and lack of appetite, and it lacked adequate folic acid, vitamin D, and calcium. Because of her severe vomiting, Maria could not take her prenatal vitamin supplements. Maria has decided that she will breastfeed.

- 1.** What information might indicate that the baby is at increased risk for musculoskeletal and integumentary issues later in infancy and throughout adulthood?
  - a. The baby will be breastfed.
  - b. The mother did not consume enough whole grains during the pregnancy.
  - c. The mother did not consume many dairy products during the pregnancy.
  - d. The baby is male.
  
- 2.** Which body system might be most affected by suboptimal intake of vitamin D and calcium?
  - a. Musculoskeletal
  - b. Neurologic
  - c. Integumentary
  - d. Hematologic

### Vitamin D

Approximately 99% of the calcium within the body is stored in bone (American Academy of Pediatrics, 2022). Vitamin D mediates the storage and uptake of maternal calcium and, as such, is essential for fetal bone development. Vitamin D is absorbed through the skin and ingested in various foods. There is a correlation between low maternal vitamin D and osteopenia in newborns and decreased bone density in childhood (Azzolino et al., 2021). Consequently, it is important to monitor vitamin D levels in the pregnant client. Supplementation may be necessary when levels are not in the expected range.

### The Pregnant Client with Integumentary or Musculoskeletal Illness

[Table 20.2](#) outlines some of the musculoskeletal and integumentary conditions that can develop because of physiologic changes during pregnancy.

Condition	Manifestations	Treatments
<b>Musculoskeletal System</b>		
Diastasis recti	The growing uterus can put pressure on the abdominal muscles, leading to separation and a visible bulge in the abdomen. The client is who pregnant client may experience weakness and back pain and may have difficulty regaining physical strength following delivery.	The pregnant client may wear an abdominal binder for support.
Carpal tunnel syndrome	Hormonal changes and fluid retention in the pregnant client can lead to overly stretchy joints and tendons, swelling, and compression of the median nerve in the wrist. This often manifests as numbness, tingling, or pain in the hands and fingers.	This condition usually resolves after delivery, but the pregnant client may wear a hand and wrist brace for support.

**TABLE 20.2** Musculoskeletal and Integumentary Conditions Resulting from Physiologic Changes During Pregnancy

Condition	Manifestations	Treatments
<b>Musculoskeletal System</b>		
Lower back and pelvic girdle pain	Weight gain, changes in posture, and hormonal shifts can lead to lower back pain and stretching of the pubic symphysis.	The pregnant client may wear a pelvic and abdominal support belt and rest whenever necessary but should avoid NSAIDs for pain relief.
<b>Integumentary System</b>		
<b>Pruritic urticarial papules and plaques of pregnancy (PUPPP)</b>	PUPPP is a skin condition of unknown origin that occurs in some pregnant clients, most commonly during the third trimester. It is characterized by itchy, red, raised bumps and hives that most commonly appear on the abdomen, thighs, buttocks, and arms.	There is no significant health risk for the pregnant client or the fetus, so treatment is supportive and may include creams and emollients, corticosteroids, antihistamines, and cool compresses.
Stretch marks	Because the skin naturally stretches to accommodate weight gain and the growing breasts and abdomen, stretch marks often develop.	Stretch marks appear as purplish-red lines that, with time, fade to silvery-white lines. They are permanent.
Linea nigra	Hormonal changes in some pregnant clients cause a benign dark line to form down the center of the abdomen from the umbilicus to the pubis symphysis ( <a href="#">Figure 20.2</a> ).	During the postpartum period, the linea nigra will disappear slowly over a few months as the hormones of pregnancy exit the individual's system.

**TABLE 20.2** Musculoskeletal and Integumentary Conditions Resulting from Physiologic Changes During Pregnancy



**FIGURE 20.2** This individual in third trimester exhibits a linea nigra, a dark line that appears on the abdomen from the umbilicus to the pubis symphysis. (credit: “photo of hand, woman, round, trunk, female, leg, love, finger, child, arm, baby, muscle, chest, pregnancy, maternity” by PxHere, CC0 Public Domain)

### Impact of Maternal Health During Pregnancy

Proper nutrition in pregnancy is even more important for pregnant clients in poor health, which can result from underlying medical conditions or malnutrition. A pregnant client in poor health may be at higher risk for nutrient deficiencies, such as deficiencies of calcium or vitamin D, which can negatively affect bone strength and density. Insufficient nutrient intake may increase the likelihood of conditions such as osteoporosis, fractures, or impaired bone formation in the pregnant client and the developing fetus. Inadequate protein intake can lead to muscle wasting, weakness, and reduced muscle function in pregnant clients with poor health, thereby affecting their overall physical strength and ability to perform daily activities (Azzolino et al., 2021).

Poor health may also increase the risk for nutrient deficiencies, such as iron, folate, vitamin B<sub>12</sub>, or vitamin C. These nutrients are essential for various processes, including red blood cell formation, collagen synthesis, and tissue repair. Deficiencies in these nutrients can lead to anemia, impaired wound healing, weakened connective tissues, and compromised overall musculoskeletal health.

Some important foods for musculoskeletal health in pregnancy that the nurse can recommend include beans, peas, beef, pork, fish, poultry, milk, cheese, dairy products, nuts, and seeds (March of Dimes, 2020).

Prenatal vitamins play a key role in supporting the maternal and fetal musculoskeletal systems during pregnancy and in the postpartum period. [Table 20.3](#) highlights the importance of prenatal vitamins and their impact on the musculoskeletal systems of the pregnant client and the fetus.

Benefit	Explanation
Fetal bone development	Adequate calcium intake during pregnancy is essential for the developing fetus's bones.
Prevention of birth abnormalities	Folic acid may prevent neural tube abnormalities in the fetus.
Maternal calcium stores	If maternal calcium stores are low during pregnancy, the fetus may draw calcium from maternal calcium stores, further exacerbating hypocalcemia in the pregnant client and increasing the risk for fractures. Additionally, maternal calcium levels drop during lactation. Continuing prenatal vitamins in the postpartum period is one way to increase maternal calcium intake and stores.

**TABLE 20.3** Prenatal Vitamin Benefits Related to the Musculoskeletal System

### Infancy

Infancy is a time of rapid musculoskeletal and integumentary growth, so dietary considerations are critical to ensure healthy bones, muscles, and skin. Breastfeeding does not provide an infant with enough vitamin D. To prevent musculoskeletal disorders and to promote healthy skeletal growth, it is recommended that all breastfed infants receive vitamin D supplementation. Supplementation with 400 IU of vitamin D per day should begin in the first few days of life and should be provided to exclusively breastfed infants and breastfed infants supplemented with commercial formula (Centers for Disease Control and Prevention, 2021). Vitamin D supplementation should continue until the infant is weaned and has adequate intake of vitamin D-rich foods.

Regular dental checkups are important for the infant. The infant should see a dentist as soon as their first tooth erupts, and some dentists recommend a visit even before this time to help them get used to the environment. Regular fluoride supplementation becomes necessary through water or toothpaste when an infant begins to eat solid foods. Standard formulas contain fluoride that a breastfed infant does not receive, so breastfed infants need supplemental fluoride after 6 months of age. Nurses should encourage parents to begin brushing their infant's teeth as they erupt, using fluoride toothpaste according to their dentist's recommendations (American Academy of Pediatric Dentistry, 2023).

It is also important for infants to begin to “exercise” their muscles and bones as soon as possible for optimal growth and development. As soon as a baby is born, a parent should encourage supervised “tummy time.” This activity helps infants build the strength necessary for rolling over, crawling, and exploring the world. It also helps infants strengthen their neck muscles and develop head control and can be introduced around 3–4 months old.

**Osteopenia**, or low bone density, is common in preterm newborns. It can also occur in newborns whose mothers were deficient in calcium and vitamin D. Osteopenia is most likely in an infant born before 30 weeks’ gestation because the majority of calcium uptake occurs during the third trimester of fetal life. A preterm newborn with osteopenia may exhibit no symptoms but is at increased risk for fractures. Osteopenia and the risk for fracture continue through the preterm infant’s first year of life.

Newborns identified as high risk for developing osteopenia or fractures, such as preterm infants, are monitored and may receive fortifiers with their feedings to help them retain calcium and phosphorus (American Academy of Pediatrics, 2022).



## UNFOLDING CASE STUDY

### Part B

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Part A.

Maria's infant, Jose, is now 6 months old and is still being breastfed.

3. Which statement by the client indicates that further nursing education is necessary regarding the child's musculoskeletal health?
  - a. "My baby is now 6 months old and does not need to continue their vitamin D supplement."
  - b. "My baby will not be walking for some time but putting them in a bouncer seat can help them develop the skill."
  - c. "I like to provide lots of opportunities for play for my baby, and they love to be on their tummy."
  - d. "My baby doesn't have any teeth yet, but I'll make a dentist appointment as soon as they get them!"
  
4. The client asks the nurse if the baby needs vitamin D supplementation if the baby is given commercial formula from time to time. How should the nurse respond?
  - a. "You will need to continue vitamin D supplementation until the baby is fully weaned and taking in adequate vitamin D-rich foods regardless of whether or not you are supplementing."
  - b. "Commercial formula contains adequate vitamin D, so you do not need to give the baby vitamin D on the days you supplement with formula."
  - c. "Commercial formula does not contain any vitamin D."
  - d. "You should not supplement your baby with commercial formula and should exclusively breastfeed, as that is what's best for a growing infant."

### Childhood

During childhood, the bones and muscles grow and develop rapidly. The effect of malnutrition in these body systems can have lifelong effects. Therefore, nurses should teach parents and caregivers about essential nutrients and ways to ensure that their children receive adequate amounts for growth.

#### Vitamin D and Calcium

Vitamin D and calcium levels are not routinely monitored in children, so the nurse must assess for any signs of deficiency and instruct parents on appropriate intake. Children with vitamin D deficiency can develop a condition known as rickets, characterized by frequent fractures and weak bones, although this condition is rare. Children with rickets are at increased risk for fractures (Chanchlani et al., 2020). [Table 20.4](#) lists foods that are high in vitamin D and calcium.

Foods High in Vitamin D	Foods High in Calcium
Vitamin D-fortified foods, such as milk, orange juice, and cereal	Dairy products
Fatty fish, such as salmon, trout, and sardines	Sardines
Egg yolks	Leafy green vegetables
Mushrooms	Tofu
Cod liver oil	Almonds

**TABLE 20.4** Foods High in Vitamin D and Calcium

#### Fluoride

**Fluoride** is an important mineral for bone health and for dental health in particular because it stimulates new bone formation and inhibits the progression of dental caries (cavities). It is naturally present in water and many foods. However, since 1962 the U.S. Public Health Service has recommended that public water be supplemented with fluoride to promote oral hygiene and tooth health in the overall U.S. population (Office of Dietary Supplements, 2022). Though fluoride occurs in water naturally, the fluoridation of public water supplies first began in 1945. Well

water may not contain adequate fluoride, which is important information for nurses to give clients who have private well water as their main water source. Most bottled water does not contain fluoride. The American Academy of Pediatric Dentistry (2023) recommends the use of fluoride for children and has determined that it is a safe and effective way to reduce the incidence of dental caries.

Nurses should teach parents to begin brushing their child's teeth twice a day as soon as a tooth erupts. [Table 20.5](#) provides guidelines on the amount of toothpaste to use.

Age Range	Amount of Toothpaste
Younger than 3 years old	Use a small smear of fluoride toothpaste no larger than a grain of rice twice a day.
3–6 years old	Use a pea-sized amount of fluoride toothpaste twice a day.
Older than 6 years old	Use fluoride toothpaste according to the manufacturer's recommendations.

**TABLE 20.5** Amount of Toothpaste to Use According to Age (source: Thornton-Evans et al., 2019)

### Protein and Iron

Protein, one of the body's major tissue building blocks, is essential for muscle development, maintenance, and repair. Children are constantly growing; therefore, ensuring a diet that includes adequate amounts of protein is essential for adequate muscle growth. Meats, beans, tofu, and peanut butter all contain protein.

Protein also helps bones grow and develop. Collagen, for example, is a protein that provides bone strength and flexibility. It is also important for healthy skin. Children need to consume foods that contain the building blocks of collagen, such as fish, poultry, meat, eggs, dairy, legumes, and soy.

Iron is necessary to produce hemoglobin, which carries oxygen to all parts of the body. Muscles are vascular and need an adequate oxygen supply during growth and development. Foods rich in iron include red meats, leafy green vegetables, lentils, and iron-fortified cereals.

### Obesity in Childhood

Obesity is on the rise across all populations and is especially dangerous in childhood because health habits are established early in life. The development of obesity in childhood is complicated. Social determinants of health as well as lifestyle choices have contributed to obesity in children.

Obesity leads to multisystemic issues, but two notable factors influence the healthy development of bones in obese children. First, inactivity due to obesity can prevent a child from participating in healthy activities. This continuing inactivity affects metabolism as well as the healthy development of bone during weight-bearing exercises. Second, an overweight child may have an unbalanced diet and could be lacking in vitamin D, calcium, and other nutrients essential for healthy bone development.

Children who are overweight or obese have additional stress on their skeletal system. In addition to increasing the risk for acute injuries, the additional weight can lead to chronic musculoskeletal conditions in the bones and joints and may increase the individual's risk for early orthopedic surgery (Nowicki et al., 2019).



## UNFOLDING CASE STUDY

### Part C

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up to Case Study Parts A and B.

Jose is now 6 years old and has presented for a yearly checkup. Jose is overweight for their height. The nurse is doing a diet review with Maria, and learns that Jose's daily diet includes the following:

- Breakfast – toaster pastries
- Lunch – boxed macaroni and cheese, a juice box, and mandarin oranges from a can
- Dinner – chicken nuggets, french fries, and a juice box

Jose does not like to participate in gym class because the activities are "too hard" and prefers to play on a tablet for

about 2 hours a day.

5. Which of the following is the highest priority right now to promote the child's musculoskeletal health?
  - a. The child should begin exercising twice daily.
  - b. The nurse should teach the mother about components of a healthy diet for children.
  - c. The child should be excused from gym class and referred to a specialist.
  - d. The child should drink whole milk instead of juice boxes with meals.
  
6. The mother asks the nurse to recommend foods that promote healthy bone development. Which of the following foods would be the best choice?
  - a. Brown rice
  - b. Legumes
  - c. Red meats
  - d. Spinach

## Adolescence

Adolescence is an important time for musculoskeletal development in an individual's life. Maintaining an active lifestyle during adolescence has been shown to positively influence skeletal development. During adolescence, bone mass and density are especially receptive to exercise, making this period crucial for skeletal development. Females achieve up to 90% of their peak bone mass by age 18 and males by age 20. Calcium, vitamin D, and vitamin C are essential during these years. Musculoskeletal injuries are a leading cause of hospitalization for adolescents and children. Both underlying conditions and sports injuries contribute to such injuries during adolescence (American Academy of Orthopaedic Surgeons, 2016).

Adolescence is also thought to be a key time for muscle development. Leading an active lifestyle and avoiding saturated fats and highly processed sugars during adolescence can promote healthy body mass distribution later in life (Azzolino et al., 2021).

## SPECIAL CONSIDERATIONS

### Increased Nutritional Needs for Adolescent Athletes

Adolescent athletes have increased nutritional needs because they are performing intense physical activity while still growing and developing. As a result of their increased energy needs, they must consume adequate amounts of carbohydrates, proteins, and fats. Carbohydrates come in a variety of forms, but it is important that adolescent athletes avoid highly processed sugars, which increase risk for diabetes and obesity. For optimal performance, they should strive to consume whole grains, fruits, legumes, and vegetables.

Protein helps restore muscle lost through exercise, so the athlete should consume adequate amounts of fish, poultry, meat, and other protein sources. The protein needs of adolescent athletes can vary depending on factors such as age, sex, body size, activity level, and training intensity. However, in general, the protein requirements for adolescent athletes are higher than those of their more sedentary peers because of the increased demands of physical activity and muscle development. Nurses can estimate the recommended daily protein intake for adolescent athletes based on their body weight; adolescent athletes should consume approximately 10–30% of their daily calories from protein (Klemm, 2020). Protein shakes are not necessary for healthy adolescent athletes, and they should strive to get their protein from natural food sources.

## Adulthood

Adulthood is a time for optimal health and health preservation. During adulthood, it is important to eat a variety of nutrient-rich foods containing protein, calcium, and vitamin D and remain physically active to maintain bone density and mass. Healthy adults have no special requirements for supplementation, but they should aim to ingest adequate micronutrients and macronutrients to maintain healthy bones, muscles, and skin.

Barriers to physical activity during adulthood include increased pressures and time constraints, especially for students, working adults, and those with families. The convenience of highly processed foods has contributed to a

rise in cancers and obesity throughout the world (Isaksen & Dankel, 2023; Hall et al., 2019). Choosing healthier alternatives to fast food is a great way for adults to improve their overall nutrition and well-being and to set a healthy example for children.

Many adults now reach for shakes and protein powders for convenience over whole foods. While protein powders are convenient, they are unnecessary for most individuals (Gelsomin, 2020). Most individuals, even active athletes, can obtain the necessary protein requirements for a healthy musculoskeletal system through diet alone. The risks and disadvantages of using protein supplements are related to the actual content of the product (Harvard Health Publishing, 2022). The FDA does not regulate the nutritional content of these products, so the actual ingredients may vary from the label and may include contaminants. In addition to the protein, the supplements may contain a lot of sugar and calories.

[Table 20.6](#) lists ways that adults can strive to maintain optimal musculoskeletal and integumentary health and prevent illness.

Action	Rationale
Good posture	Developing good posture helps keep core muscles toned and can prevent injury and back and neck pain.
Workplace ergonomics	The average adult who works full time spends many of their waking hours at work. They should try to incorporate physical activity into their daily routine. Employers should be encouraged to promote healthy practices, such as workstations that promote proper posture.
Regular physical activity	Regular physical activity, at any age, helps maintain strong muscles, which support healthy bones, and prevent pain and injury associated with aging.
Use of sunscreen	Using sunscreen helps keep the skin from prematurely aging and can help prevent skin cancers associated with sun exposure.
Regular checkups	Getting regular checkups by primary care providers and dermatologists can help individuals ensure optimal health.
Weight management	Maintaining a healthy weight prevents musculoskeletal injury due to malnourishment or increased pressure of joints due to extra weight.
Avoidance of alcohol, substance misuse, and smoking	Avoiding alcohol, drugs, and smoking can prevent many illnesses associated with the musculoskeletal and integumentary systems and may decrease the risk for some cancers.

**TABLE 20.6** Actions for Optimal Musculoskeletal and Integumentary Health

### Lactation

Dietary considerations for a client who is breastfeeding consist of increasing caloric intake by an additional 330–400 calories per day to a total of 2,000–2,800 calories per day (CDC, 2022). Additionally, clients who are lactating women may need iodine and choline supplements because increased amounts of those nutrients are needed—290 mcg of iodine and 550 mg of choline (CDC, 2022). Maternal bone density temporarily decreases during lactation, but bone loss is usually regained following weaning. Cases of osteoporosis are rare (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2023b).

The impact of breastfeeding on the musculoskeletal system is highly individualized and depends on overall diet, hydration, and physical activity. During lactation (and throughout the lifespan), individuals should strive for adequate nutrition, including calcium and vitamin D, regular weight-bearing exercise, and a healthy lifestyle (CDC, 2021).

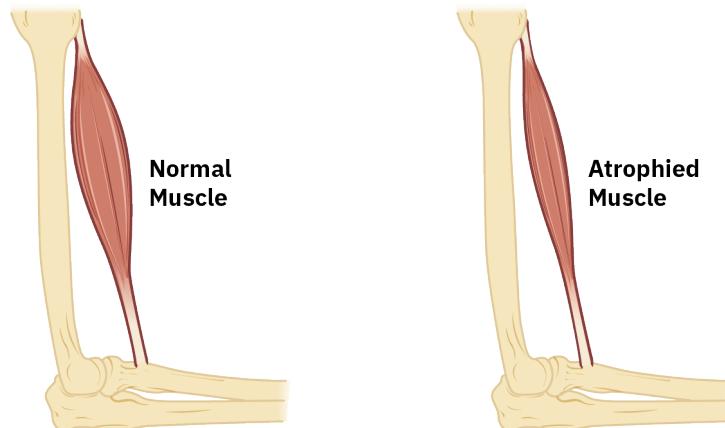
### Menopause

**Menopause** occurs in middle adulthood and is associated with an increased risk for osteoporosis. During menopause, estrogen, which helps prevent bone breakdown, decreases, which in turn leads to decreases in bone density and bone mass. Some clients may develop fractures as a result. Therefore, the health care provider should monitor bone density and encourage women to consume the recommended daily intake for calcium and vitamin D. Weight-bearing exercise and maintenance of a healthy weight also help prevent age-related osteoporotic changes during and after menopause. This is important because bone fractures are associated with significant decreases in

quality of life as well as increased mortality risk (Endocrine Society, 2022).

### Later Adulthood

As the body ages, muscle mass progressively declines. This breakdown of skeletal muscle mass is known as **sarcopenia** (Azzolini et al., 2021). The strength and functionality of the muscles begin to decline as well (Figure 20.3). Bone mass and density also begin to diminish, which can lead to increased risk for fractures and decreased mobility (Azzolini, 2021). For older adults with sarcopenia, dietary interventions are effective for building muscle mass. [Table 20.7](#) highlights some effective ways the older adult with sarcopenia can increase muscle mass.



**FIGURE 20.3** Muscle atrophy that occurs with aging can lead to joint problems because the muscles that stabilize bones and joints are weakened. This can cause problems with locomotion and balance and can cause various injuries due to falls. (modification of work from OpenStax: Anatomy and Physiology 2e. attribution: Copyright Rice University, OpenStax, under CC BY 4.0 license)

Action	Result
Manage chronic conditions.	Many chronic conditions can lead to a sedentary lifestyle, which, in turn, can lead to muscle loss. By managing these conditions, the older adult may be able to become more active.
Spread protein intake throughout the day.	Spreading protein intake throughout the day may stimulate muscle protein synthesis more efficiently.
Incorporate leucine-rich foods.	Leucine is an essential amino acid and stimulates muscle synthesis. Soy products, dairy products, turkey, fish, and chicken are leucine-rich foods.
Drink protein shakes.	Protein shakes can be a convenient way to increase protein consumption. However, they should be part of a comprehensive plan for sarcopenia and not the only treatment.

**TABLE 20.7** Interventions for Older Adults With Sarcopenia (source: Jang et al., 2023)

In addition to musculoskeletal breakdown, the skin becomes thinner and more fragile with age. When older adults lack adequate protein intake, several factors can lead to the development of pressure ulcers: Because protein intake is needed for the development of collagen, which is itself a protein that provides structural support to the skin, insufficient protein can lead to skin that is thinner and more fragile, increasing the risk for shearing and wounds. Older adults who are bedbound or use a wheelchair are at even greater risk for pressure ulcers and wounds. In addition, protein plays an important role in skin regeneration and wound healing; if wounds and tissue are not regenerating fast enough, pressure ulcers are more likely to develop. For these reasons, nurses should encourage adequate protein intake to help promote integumentary health in this population.

### Osteoporosis

Osteoporosis in older adults results from natural decreases in bone mass and bone mineral density. It develops when the osteoclasts outpace the osteoblasts, resulting in more bone breakdown than buildup. These changes increase the risk for fracture in the older adult. Osteoporosis is a silent disease in which symptoms typically do not appear until an acute fracture occurs. Although it can occur in all people, osteoporosis is much more common in older females, and the risk for fracture is higher in older females than in older males. Modifiable risk factors for osteoporosis include vitamin D deficiency, low calcium intake, excessive consumption of alcohol, and smoking.

Individuals with an average risk for fractures should perform 150–300 minutes of weight-bearing exercise a week, and consume the recommended daily allowance of dietary calcium and vitamin D for bone health (The American College of Obstetricians and Gynecologists, 2021). There is insufficient evidence to support the routine use of calcium and vitamin D supplements for average-risk individuals. Clients at higher risk for fractures because of comorbid conditions or medication regimens, should consult with their health care provider regarding their need for supplementation. Combined calcium and vitamin D supplementation is recommended for individuals at high risk for vitamin C and vitamin D insufficiency (Reid & Bolland, 2020).

Several tools are available for osteoporosis screening in older adults. One of the most common risk assessments is the **FRAX assessment**, which is used to estimate a person's risk for a bone fracture within 10 years. This information can help the nurse and client plan care and implement strategies to help mitigate risks in the home and other environments (University of Sheffield, n.d.).



## FRAX ASSESSMENT

The [FRAX assessment](https://openstax.org/r/frax) is a widely used tool (<https://openstax.org/r/frax>) to identify an individual's risk for a major fracture within 10 years. It is used together with bone mineral density testing. This tool was developed through a collaborative effort led by the World Health Organization and the Centre for Metabolic Bone Diseases at the University of Sheffield in the United Kingdom. It is continually updated to include current research and best practices.

### Osteoporosis in Males

Osteoporosis is more common in postmenopausal females, but following a fracture later in life, males statistically experience more significant morbidity and mortality than females do (Burmeister et al., 2021). The increase in age-related fractures starts later in males because they start with greater bone mass and their rate of bone loss is slower (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2023a). The older adult male should strive to consume 1200–1500 mg of calcium daily and between 800–2000 IU of vitamin D daily to help decrease their risk for osteoporosis (Burmeister et al., 2021).

## 20.2 Nutrition and Chronic Musculoskeletal and Integumentary Illness

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 20.2.1 Discuss the impact of nutrition on musculoskeletal and integumentary illness.

### Nutritional Requirements for Optimal Musculoskeletal and Integumentary Health

Diet is an important factor to consider for preserving muscle mass. Protein and amino acids support muscle synthesis and help maintain healthy muscle mass in all individuals. The nurse should teach the client with decreased muscle mass the importance of maintaining adequate protein intake. Additionally, various studies have shown that certain individuals experiencing low muscle mass due to malnutrition can benefit from oral nutritional supplements (Prado et al., 2022). An assessment by a health care provider will allow them to help a client decide which supplements are appropriate for their individualized needs.

One of the most important ways an individual of any age can maintain optimal musculoskeletal and integumentary health is through a healthy diet and exercise and by maintaining a healthy body weight and composition. In addition to monitoring a client's weight, measuring body mass index (BMI) and waist-hip ratio (WHR) are examples of noninvasive tools used to screen clients for obesity. Not only do underweight and overweight individuals have a greater risk for musculoskeletal problems, but because adipose tissue is part of the integumentary system, weight is intimately tied to this body system.

### Nutrition and Skin Integrity

As explained previously, the relationship between pressure injuries (also known as pressure ulcer, pressure injury, decubitus) and the aging process in the older adult is complex. Although aging results in thinner and more fragile skin, other variables can add to an older adult's increased risk for skin breakdown and wounds. Some older adults live sedentary lifestyles that contribute not only to increased pressure on certain areas of the skin but also to

deconditioning of the muscles. Older adults may have unintended weight loss. In addition, older adults can experience malnutrition for many reasons, leading to insufficient intake of macronutrients and micronutrients. Because nutrition and adequate hydration are essential for wound healing, malnutrition can in turn increase the risk for developing wounds and pressure injuries and may interfere with wound healing (Munoz, 2019).

Even small periods of malnutrition can cause delayed wound healing. Therefore, in addition to a healthy, balanced diet, health care providers usually recommend oral nutritional supplements with added protein and amino acids for clients with delayed wound healing due to malnutrition (Manley & Mitchell, 2022).

Nurses should encourage the use of a **standardized nutritional risk assessment tool** for older adults with wounds in their care practice setting. These tools, such as the Mini Nutritional Assessment (MNA), can help the nurse identify clients at risk for delayed wound healing and can help identify targeted areas of nutrition education for older adults with delayed wound healing (Fulton et al., 2016).

The MNA has been validated and is highly sensitive; it has demonstrated good reliability and accuracy in identifying older adults who are malnourished or at risk for malnutrition. It is typically administered by health care professionals, and it can be used in various health care settings, including hospitals, nursing homes, and community care settings. The assessment considers various factors that influence nutritional status, including dietary intake, mobility, weight loss, and psychological factors. The MNA questionnaire portion consists of questions that cover a range of topics, such as appetite, weight loss, mobility, and chronic diseases. The questions aim to gather information about the individual's dietary habits, recent weight changes, and ability to perform daily activities. Additionally, the MNA includes anthropometric measurements such as BMI, calf circumference, and mid-arm circumference, which provide objective data on muscle and fat stores.

Based on the responses to the MNA questionnaire and the measurements taken, individuals are categorized into one of three groups:

- Well-nourished: Individuals who have good nutritional status and no apparent risk for malnutrition
- At risk for malnutrition: Individuals who show signs of poor nutritional status or have certain risk factors for malnutrition
- Malnourished: Individuals who are already malnourished or have severe nutritional deficiencies

The MNA can help health care professionals make informed decisions regarding nutritional interventions for clients, such as the need for dietary modifications, oral nutritional supplements, or referral to a dietitian for further assessment and management.



## MINI NUTRITIONAL ASSESSMENT

The MNA was developed more than two decades ago by the Nestlé Nutrition Institute. Nurses can use this tool in a variety of settings to identify clients at risk for malnutrition or delayed wound healing and to implement appropriate interventions. The [short version of the assessment is available at this site \(<https://openstax.org/r/whttps>\)](https://openstax.org/r/whttps), which includes a video on its use.



## UNFOLDING CASE STUDY

### Part D

Read the following clinical scenario and then answer the questions that follow. This case study is a follow-up from Case Study Parts A, B, and C.

Time flies! Jose is now 74 years old and has a pressure injury. Read through the following summary of Jose's visit to the wound clinic.

Vital Signs		Nurse's Note
Temperature:	98.6° F	
Blood pressure:	122/68 mm Hg	
Heart rate:	80 beats/min	
Respiratory rate:	14 breaths/min	
Pain:	6/10 in right hip decubitus	
BMI:	18.5	
Calf circumference:	29 cm	

TABLE 20.8

7. Which of the following interventions would promote a healthy integumentary system and better wound-healing outcomes?
- Taking prescribed oral nutritional supplements
  - Repeating the MNA screening at regular intervals
  - Switching from skim milk to 2% milk
  - Eating less red meat
8. The nurse is preparing to complete the Mini Nutrition Assessment (MNA) for the client. Which of the following is a potential classification based on the results?
- Obese
  - Underweight
  - Overweight
  - Malnourished

## 20.3 Treatments and Nutrition

### LEARNING OUTCOMES

By the end of this section, you should be able to:

- 20.3.1 Identify drug–food interactions related to musculoskeletal and integumentary disorders.
- 20.3.2 Identify treatments and medications that can cause nutritional deficiencies in clients with musculoskeletal and integumentary disorders.

### Drug–Food Interactions in Musculoskeletal and Integumentary System Disorders

Drug–food interactions can occur in individuals with musculoskeletal and integumentary system disorders. The most common medications that often interact with food are bisphosphonates and tetracycline antibiotics.

**Bisphosphonates** are medications commonly used to treat osteoporosis and other bone-related conditions. Nurses should instruct clients to take these medications on an empty stomach with a full glass of water; avoid consuming any food, beverages (except water), or other medications for at least 30 minutes to an hour after taking the medication; and remain upright for at least 30 minutes after taking these medications because they may irritate the esophagus. Food, especially calcium-rich foods, can interfere with the absorption of bisphosphonates (Ganesan et al., 2023).

Tetracycline antibiotics, such as doxycycline, can form insoluble complexes with calcium found in dairy products and calcium supplements. These complexes reduce the absorption of the antibiotic and decrease its effectiveness. To avoid this interaction, nurses should instruct clients to avoid taking tetracycline antibiotics within 2 hours of ingesting calcium-rich foods or supplements. In addition, nurses should inform pregnant clients that tetracycline

staining of teeth may occur in the children of individuals who take this medication during pregnancy (DailyMed, 2018).

### Medications That Can Cause Nutritional Deficiencies

Nurses should know that chronic use of certain medications can cause nutritional deficiencies and negatively affect the musculoskeletal system. Not all individuals who take these drugs will develop nutritional deficiencies or musculoskeletal problems, but the risk increases with long-term use. [Table 20.9](#) outlines some of the most common medications that can cause nutritional deficiencies related to the musculoskeletal system.

Medication/ Class	Musculoskeletal Effect	Considerations
Corticosteroids	Long-term use of corticosteroids, such as prednisone, can lead to decreased calcium absorption and increased calcium excretion, which can result in bone loss and osteoporosis.	These medications can interfere with vitamin D metabolism, further affecting bone health.
Antacids and proton pump inhibitors (PPIs)	Long-term use of antacids or PPIs can impair the absorption of calcium, magnesium, and vitamin B <sub>12</sub> , which are important for maintaining bone health.	PPI use may lead to hypomagnesemia and hypocalcemia due to decreased absorption of these minerals; therefore, magnesium and calcium levels may need to be monitored in some individuals.
Loop diuretics	Loop diuretics (such as furosemide) can increase urinary excretion of calcium, magnesium, and potassium. Prolonged use of these medications may lead to electrolyte imbalances and negatively affect bone density.	Electrolyte levels should be monitored in clients taking loop diuretics.
Anticonvulsant medications	Some anticonvulsant drugs, including phenytoin and phenobarbital, may interfere with the metabolism of vitamin D and calcium, potentially leading to bone loss and an increased risk for fractures.	Nurses should inform clients about the increased risk for fractures and teach ways to modify activities as appropriate.

TABLE 20.9 Medications That May Cause Nutritional Deficiencies

### SPECIAL CONSIDERATIONS

#### Medications That Increase the Risk for Osteoporosis

In addition to knowing which medications may cause vitamin and nutrient deficiencies, the nurse should be aware that certain medications increase a person's risk for osteoporosis. These medications include:

- Corticosteroids, which are used to treat inflammation
- Antiseizure medications, which are used to prevent seizures and treat other conditions such as neuropathic pain
- Gonadotropin-releasing hormone agonists, which are used for cancers and some gender-affirming treatments
- Depot medroxyprogesterone acetate, which is a contraceptive injection containing the hormone progestin
- Some medications used to treat cancer (American College of Obstetricians and Gynecologists, 2022)

## Chapter Summary

- Clients who are pregnant should consume the recommended daily amounts of calcium and vitamin D to support fetal skeletal development.
- Infants who are breastfed should receive 400 IU vitamin D daily to prevent musculoskeletal disorders and promote healthy skeletal growth.
- Consuming calcium and vitamin D to promote bone growth continues to be important throughout childhood as females achieve up to 90% of their peak bone mass by age 18 and males by age 20.
- In adulthood, females have a higher risk for osteoporosis and fractures. Temporary declines in bone density occur during lactation, and progressive declines occur as part of the hormonal changes related to menopause.
- Clients with impaired skin integrity may need oral supplements containing protein to promote wound-healing.
- Bisphosphonates are a class of medications used to treat osteoporosis and other bone-related conditions.
- Some medications including corticosteroids, antacids, proton pump inhibitors, and loop diuretics, and some anticonvulsant medications can cause nutritional deficiencies that can negatively affect the musculoskeletal system.

## Key Terms

**bisphosphonates** medications commonly used to treat osteoporosis and other bone-related conditions

**fluoride** an important mineral for bone health; it stimulates new bone formation and inhibits the formation and progression of cavities

**FRAX assessment** a standardized assessment used to estimate a person's risk for a bone fracture within 10 years

**menopause** a shift in hormones in a middle adult woman's life that results in physiologic changes, including cessation of the menstrual cycle

**osteopenia** low bone density

**pruritic urticarial papules and plaques of pregnancy (PUPPP)** a skin condition of unknown origin that

occurs most commonly during the third trimester of pregnancy and is characterized by itchy, red, raised bumps and hives that most commonly appear on the abdomen, thighs, buttocks, and arms

**sarcopenia** loss of skeletal muscle mass

**standardized nutritional risk assessment tool** a research-based tool used to assess clients' nutritional status

## Review Questions

1. The nurse is educating a client about the FRAX assessment. Which statement by the client indicates the need for further teaching?
  - a. "The FRAX will tell my doctor if I have osteoporosis."
  - b. "The FRAX will tell my doctor if I'm at risk for a fracture."
  - c. "The results of the FRAX will help the nurse develop my plan of care."
  - d. "The FRAX is a risk assessment for osteoporosis."
2. The nurse is reviewing a client's chart and notes their current medications. Which classification of medication increases the client's risk for fracture?
  - a. Antibiotics
  - b. Antidepressants
  - c. NSAIDs
  - d. Corticosteroids
3. The nurse is teaching ways to promote healthy teeth in children. Which of the following practices is recommended for children?
  - a. Brush teeth once a day in the morning.
  - b. Introduce fluoride toothpaste at 3 years of age.
  - c. Brush teeth with a fluoride toothpaste.
  - d. Schedule the first dental visit at 1 year of age.
4. The nurse is evaluating a client with PUPPP at a postpartum appointment. The client reports being very itchy. Which objective data support the diagnosis of PUPPP?

- a. Flat lesions in the vaginal area
  - b. No visible rash, but the client reports itchy skin
  - c. Silvery-white lines on the breasts
  - d. Raised hives on the torso
5. The nurse is caring for an adolescent client who participates in sports after school 4 or 5 times a week for 2–4 hours. The adolescent reports fatigue and sore muscles. What should the nurse suggest to this client?
- a. “Drink a soda to increase your energy level after exercise.”
  - b. “Don’t exercise until your symptoms go away.”
  - c. “Try to eat a combination of protein and complex carbohydrates.”
  - d. “Avoid whole grains, fruits, legumes, and vegetables.”
6. The nurse is caring for a client with newly diagnosed osteoporosis who was prescribed bisphosphonate. Which of the following should the nurse teach the client to avoid eating after taking the medication because it can interfere with the medication’s absorption?
- a. Coffee
  - b. Oranges
  - c. Milk
  - d. Grapefruit
7. The nurse is caring for a pregnant client who lives in a higher latitude part of the country that receives less direct sunlight. Which laboratory value should the nurse expect the health care provider to be monitoring as a priority of care with this client?
- a. Albumin level
  - b. Calcium level
  - c. Magnesium level
  - d. Vitamin D level
8. The nurse is caring for a menopausal client who had a FRAX assessment that indicated a high risk for fracture in the next 10 years. What should the nurse encourage the client to do now to help mitigate this risk?
- a. Ask their health care provider to prescribe an estrogen supplement.
  - b. Ask their health care provider to check their calcium and vitamin D levels.
  - c. Include extra protein in their diet.
  - d. Get daily weight-bearing exercise such as walking.
9. The nurse is caring for an older adult client and recognizes which musculoskeletal manifestation is most likely to benefit from increasing leucine consumption?
- a. Osteomyelitis
  - b. Sarcopenia
  - c. Fractures
  - d. Osteopenia
10. The nurse is caring for a preterm newborn born at 28 weeks’ gestation. Which musculoskeletal manifestation is most likely to be observed in this infant?
- a. Osteoporosis
  - b. Osteopenia
  - c. Hip dysplasia
  - d. Club foot

## Suggested Reading

Centers for Disease Control and Prevention. (n.d.). *Cow’s milk and milk alternatives*. <https://www.cdc.gov/nutrition/infantandtoddlnutrition/foods-and-drinks/cows-milk-and-milk-alternatives.html>

Cleveland Clinic. (2022). *Vitamin deficiency*. <https://my.clevelandclinic.org/health/diseases/15050-vitamin-d-vitamin-d-deficiency>

Cleveland Clinic. (2023, January 31). *What to eat when you're trying to heal*. <https://health.clevelandclinic.org/foods-to-help-healing/>

Nestlé Nutrition Institute. (n.d.). What is the MNA®? <https://www.mna-elderly.com>



# APPENDIX A

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## Apps Frequently Used to Support Nutrition Wellness

The apps in [Table A1](#) were identified by various sources, such as BuyersGuide.org, Medical News Today, and Active.com. This table does not serve as an exhaustive list.

<b>Overall Nutrition Apps</b>	
<a href="https://openstax.org/r/PlateJoy">PlateJoy</a> ( <a href="https://openstax.org/r/PlateJoy">https://openstax.org/r/PlateJoy</a> )	Develops nutritionally sound meal plans with associated shopping lists based on personal data input.
<a href="https://openstax.org/r/yummly">Yummly</a> ( <a href="https://openstax.org/r/yummly">https://openstax.org/r/yummly</a> )	Offers meal planning, recipes, and easy reads to introduce food exploration.
<a href="https://openstax.org/r/lifesum">Lifesum</a> ( <a href="https://openstax.org/r/lifesum">https://openstax.org/r/lifesum</a> )	Focuses on healthy weight through self-care and better food selection options; tracks food and exercise and develops health goals. Recipes available.
<a href="https://openstax.org/r/youte">Ate</a> ( <a href="https://openstax.org/r/youte">https://openstax.org/r/youte</a> )	Food journal that promotes mindful eating, exploring driving forces behind food selection and consumption.
<b>Weight-Loss Programs</b>	
<a href="https://openstax.org/r/noom">NOOM</a> ( <a href="https://openstax.org/r/noom">https://openstax.org/r/noom</a> )	Exploring the psychology behind what, when, and why certain foods are eaten. Provides challenges to promote healthy weight and lifestyle with the goal of integration into consistent healthy decisions.
<a href="https://openstax.org/r/nutrisystem">Nutrisystem</a> ( <a href="https://openstax.org/r/nutrisystem">https://openstax.org/r/nutrisystem</a> )	Provides meal and snack delivery based on healthy weight goal. Promotes healthy food substitution.
<a href="https://openstax.org/r/ketocycle">Keto Cycle</a> ( <a href="https://openstax.org/r/ketocycle">https://openstax.org/r/ketocycle</a> )	Focus on weight loss via mindful integration of ketogenic diet. Meal prep included. Keto-nutritional approaches are not appropriate for everyone.
<a href="https://openstax.org/r/dofasting">DoFasting</a> ( <a href="https://openstax.org/r/dofasting">https://openstax.org/r/dofasting</a> )	Promotes intermittent fasting to lose weight, attain healthy BMI, and improve gut health. Provides recipes, education, and workouts. Fasting nutritional approaches are not appropriate for everyone.
<b>Recipes for Specific Pathologies</b>	
<a href="https://openstax.org/r/playdiabetic">Diabetic App</a> ( <a href="https://openstax.org/r/playdiabetic">https://openstax.org/r/playdiabetic</a> )	Diabetic food recipes that assist with blood glucose stabilization.
<a href="https://openstax.org/r/playkidney">Kidney Diet</a> ( <a href="https://openstax.org/r/playkidney">https://openstax.org/r/playkidney</a> )	Renal recipes focusing on tracking phosphorus, protein, and potassium.
<a href="https://openstax.org/r/playanti">Anti Inflammatory Diet Recipes</a> ( <a href="https://openstax.org/r/playanti">https://openstax.org/r/playanti</a> )	Anti-inflammatory recipes designed to maximize gut health as a precursor to holistic health promotion.
<b>Meal Tracking</b>	

**TABLE A1** Nutritional Wellness Apps and Websites

<u><a href="https://openstax.org/r/weightwatchers">Weight Watchers</a></u> ( <a href="https://openstax.org/r/weightwatchers">https://openstax.org/r/weightwatchers</a> )	Provides personal, flexible, nutritionally sound meal plans while encouraging lifestyle changes to promote health habits.
<u><a href="https://openstax.org/r/gplanscom">G-Plans</a></u> ( <a href="https://openstax.org/r/gplanscom">https://openstax.org/r/gplanscom</a> )	Meal tracking and planning with focus on metabolic body type, exercise tracking, peer support, and artificial intelligence interactions.
<u><a href="https://openstax.org/r/myfitnesspal">MyFitnessPal</a></u> ( <a href="https://openstax.org/r/myfitnesspal">https://openstax.org/r/myfitnesspal</a> )	Food diary that includes the ability to scan barcodes, provides recipes, tracks health habits, and provides peer support.
<b>Other</b>	
<u><a href="https://openstax.org/r/healthharvardedu">BMI Calculator</a></u> ( <a href="https://openstax.org/r/healthharvardedu">https://openstax.org/r/healthharvardedu</a> )	Allows for quick BMI calculation.
<u><a href="https://openstax.org/r/playgooglestore">Water Reminder</a></u> ( <a href="https://openstax.org/r/playgooglestore">https://openstax.org/r/playgooglestore</a> )	Promotes mindfulness of hydration.
<u><a href="https://openstax.org/r/quenzacomblog">Quenza</a></u> ( <a href="https://openstax.org/r/quenzacomblog">https://openstax.org/r/quenzacomblog</a> )	Designed for the personal nutrition coach, provides a digital format to share exercises and track client progress; includes video support; and offers peer inspiration. Offers a 30-day free trial.
<u><a href="https://openstax.org/r/heatherbauer">Nutrition coaching</a></u> ( <a href="https://openstax.org/r/heatherbauer">https://openstax.org/r/heatherbauer</a> )	Provides virtual nutritional coaching from a registered dietitian using a personalized plan, coaching, and compliance monitoring.
<u><a href="https://openstax.org/r/whiskcom">Whisk</a></u> ( <a href="https://openstax.org/r/whiskcom">https://openstax.org/r/whiskcom</a> )	A free meal planner tool with recipes, meal planning, and grocery list creation tools.

TABLE A1 Nutritional Wellness Apps and Websites

# ANSWER KEY

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## Chapter 1

### Review Questions

1. b. 10 grams of added sugars indicates this food has a significant amount of added sugar (20% of the recommended amount). Current dietary guidelines recommend limiting sugar consumption.
2. b. According to MyPlate, carbohydrates (fruits and vegetables) comprise the largest portion of the plate.
3. c. Although all the clients have nutritional concerns, a client recently diagnosed with a myocardial infarction ("heart attack") has an immediate need for diet instruction related to their new diagnosis.
4. b. WIC is designed to provide food assistance to low-income pregnant, breastfeeding, and non-breastfeeding postpartum women and infants and children up to age 5 who are at nutritional risk.
5. b. Diets and nutritional counseling should reflect scientific findings supported by research.
6. a. Clients who do not have a steady income may not be able to get food when needed. These clients should be screened for food insecurity.
7. d. Measuring the client's WHR at a follow-up visit can provide objective data that reflects the client's progress toward a nutrition-related goal.
8. c. Employment status is a nonmedical factor that influences health.
9. a. Educational materials should be developed so that readers with lower literacy levels can understand the content.
10. d. This response acknowledges the client's feelings and initiates the process of educating the client on how to evaluate nutrition information on social media.

## Chapter 2

### Review Questions

1. d. Arsenic is heavy metal and will not clear by boiling, so purchasing water is the best choice.
2. a. Water does not contain any energy and is calorie free.
3. b. The Mediterranean diet is high in complex carbohydrates (fruits, vegetables, beans, legumes, nuts, and seeds) as well as fish, seafood, and poultry and includes moderate amounts of dairy products.
4. a. The individual who is lactose intolerant should consume lactose-free dairy products.
5. d. Omega-3 fatty acids play a role in heart health and are found in salmon, eggs, soybeans, flaxseed, and canola oil.
6. d. The client who is well hydrated will have pale or light-colored urine.
7. c. Soy is the only complete protein listed. Oats, barley, and wheat are incomplete proteins and do not include all essential amino acids.
8. c. Pasta with a plain red sauce is the lowest-fat item on the list and contains less than 3 g of fat per serving.
9. a. During exercise, circulating glucose is the first source of energy used. When this energy source is depleted, glycogen stored in skeletal muscle is used, followed by fat.
10. b. The client with stage 3 chronic kidney disease should consume no more than 0.6 g/kg of body weight daily. Therefore,  $0.6 \text{ g/kg} \times 75 \text{ kg} = 45 \text{ g}$  of protein daily.

## Chapter 3

### Unfolding Case Study

1. d. The RDA for sodium is 2300 mg. The client's diet consists of highly processed foods, all of which are high in sodium.
2. c. Fruits and vegetables contain high amounts of vitamins A and C.
3. d. Fruit and vegetable smoothies provide a nutrient-dense alternative to a processed food (macaroni and cheese and toaster pastries) without resorting to a supplement (gummy vitamin).

4. a. Vitamins C and E have direct influence on creating a robust immune system.

### Review Questions

1. a. Vitamin A is the only fat-soluble vitamin listed and is stored in the tissue. It can result in toxicity.
2. a. Chromium may facilitate the metabolism of carbohydrates, lipids, and proteins by increasing the effectiveness of insulin. The precise mechanism for this activity has yet to be identified.
3. d. Supplement labels are limited in the health claims they can make. They cannot mention a specific health condition.
4. c. Vitamin D deficiency is related to rickets in young children.
5. d. Excess water-soluble vitamins are excreted in the urine; they are not stored in fatty tissue or the liver.
6. c. To reduce the risk for fetal neural tube defects in early pregnancy, clients of childbearing age and clients who are pregnant should consume adequate amounts of folate.
7. c. Calcium and phosphorus contribute to the structure of healthy bones and teeth.
8. b. Iodine deficiency is the most common cause of goiter. Iodine is required to produce thyroid hormone, without which the thyroid overworks and increases in size.
9. a. For the best retention of a vitamin, use less water, cook for a shorter time, and lower the temperature.
10. d. The client with chronic alcohol exposure is likely to have a thiamine deficiency.

## Chapter 4

### Review Questions

1. a. Because the gastrointestinal tract is a long, hollow tube, closing off the tube in any area causes any contents to flow backward. Stool will backflow into the stomach because it cannot move forward to the anus to exit the body.
2. c. Tympany on percussion signifies air, and emptiness in an area would indicate flatus.
3. a. The client's symptoms are associated with epiglottitis, and using a tongue blade, depressor, or laryngoscope to exam the throat or mouth could trigger a laryngospasm and respiratory distress.
4. d. The large intestine, or colon, is where the most water is absorbed.
5. b. The guaiac test detects blood in the stool.
6. b. Hyposecretion of hydrochloric acid and protective mucus occurs in older adults and decreases absorption of vitamin B<sub>12</sub>.
7. a. Palm oil is a saturated fat that can cause gut imbalance, raise bad cholesterol, increase the risk for colon cancer, and promote heart disease.
8. b. Yogurt with active yeast cultures has been shown to support the microbiome and prevent some of the side effects related to long-term antibiotic use.
9. c. Lactobacillus has been shown to be supportive of the microbiome while the others are known to be harmful.
10. d. Gut homeostasis is supported by eating whole grains, unless the person has a sensitivity to gluten.

## Chapter 5

### Unfolding Case Study

1. d. Diets high in processed foods, red meats, and refined sugars have all been shown to lead to cognitive decline.
2. b. Cerebral blood flow should be evaluated with a PET scan to determine whether poor blood flow could be contributing to changes in cognitive status.
3. a. Consuming 1.1–1.6 g of omega-3 fatty acids daily has been shown to optimize brain function in clients over 51 years of age.
4. c. Omega-3 fatty acids are found largely in colorful fruits and vegetables, as well as in fortified cereals and beverages. Fruits, such as grapes, apples, pears, cherries, and berries; dark chocolate; legumes; red wine; tea; and coffee are also good sources.
5. c. The client's going to their dietitian appointment shows adherence to the prescribed plan. Signs of nonadherence include alcohol use; increased BMI; increased total cholesterol; increased blood pressure; low

- intake of fruits, vegetables, and fiber; and high intake of processed sugars.
6. c. Tau proteins can become tangled and accumulate in the brain and cause dysfunction.
  7. b. Because of rising food costs, it may be helpful to use an air fryer to avoid deep-frying foods while maintaining the client's current food preferences, such as fried foods, and increasing adherence to the meal plan.
  8. b. Cerebral blood flow should be evaluated with a PET scan to determine whether poor blood flow could be contributing to Jamal's changes in cognitive status.

### Review Questions

1. b. Supplements given via nasogastric tube can provide enteral nutrition for clients with dysphagia who are at risk for aspiration.
2. c. The client is hyponatremic due to the head injury and is conserving fluids. In addition to fluid restriction, medications may be administered to correct SIADH.
3. a. The progression of Alzheimer's disease may be slowed by the consistent intake of polyphenols, and colored berries are a rich source of polyphenols.
4. a. All other choices may result in inflammation and can cause further damage to the myelin sheath of nerve cells.
5. b. The ketogenic diet is low in carbohydrates, and a low-carbohydrate diet has been shown to reduce the incidence of seizures.
6. b. Dehydration is common among older adults because of a diminished sense of thirst; vigorous exercise can cause rapid dehydration, and hydration is the priority to assess.
7. d. Although supplements may be beneficial in some cases, most nutrients are best absorbed when they are consumed as regular food. Even though many Americans do not eat a healthy diet, it is best to evaluate current dietary patterns and offer changes before recommending dietary supplements.
8. c. Evidence supports a cognitive benefit of intermittent fasting in Parkinson's disease as well as epilepsy, stroke, and Alzheimer's disease.
9. c. The National Institutes of Health recommends 1.1–1.6 g of omega-3 fatty acids daily for a 52-year-old adult.
10. c. Tau proteins provide structural support to the microtubules in the neuron but can become tangled due to phosphorylation.

## Chapter 6

### Unfolding Case Study

1. b. Decreased muscle mass is associated with the aging process.
2. a. Older adults are at high risk for dehydration which can affect the body's ability to absorb nutrients.
3. b. Complex carbohydrates, such as those found in fresh fruit, vegetables, and high-fiber cereal grains, are recommended for the management of cognitive decline.
4. d. Supplementing the diet with micronutrients has been shown to improve cognition in some studies of clients with Alzheimer's disease, but the best health benefits have been verified with a varied multinutrient-rich diet rather than with supplements alone.

### Review Questions

1. d. Chicken and lentils are two sources of protein; 71 g of protein a day is often recommended during the first trimester of pregnancy to promote fetal neurological development.
2. c. The ketogenic diet is low in carbohydrates, and carbohydrates are associated with increased symptoms among clients with MS. A ketogenic diet may improve their concentration, attention, and memory.
3. a. Clients taking phenytoin are at risk for vitamin D and biotin deficiencies.
4. b. Nutritional deficiencies, especially of the omega-3 fatty acids, iron, zinc, and B<sub>12</sub>, are more common among vegetarians and vegans.
5. a. Drooling and coughing are symptoms of dysphagia, and the client will require a dysphagia screening.
6. d. Polyphenols obtained from fresh fruits and vegetables have been shown to improve neurological function and slow cognitive decline in clients with degenerative conditions including Alzheimer's disease.

7. b. Ketogenic diets can reduce seizures that have not previously responded to drug therapy.
8. c. Lactating mothers should not restrict carbohydrate intake. They need to eat fruits, vegetables, and complex carbohydrates including whole-grain foods, such as cereals, breads, pastas, and oatmeal.
9. a. Flavonoids inhibit growth of pathogens in the gut microbiome and have a strong antioxidant effect.
10. d. Follow a balanced diet to decrease the risk for weight gain. Taking antidepressants is associated with weight gain.

## Chapter 7

### Unfolding Case Study

1. a. Although all these questions can provide information about the client's nutrition, it is most important to identify if the client has had changes in their weight or appetite which can directly reflect her current physical health.
2. c. The client is presenting with symptoms of hypothyroidism. Sea salt, kosher salt, and other specialty salts either do not contain iodine or contain only minimal amounts. Using iodized table salt is necessary to maintain adequate iodine intake to promote thyroid health.
3. b. Although iodine deficiency is not the primary cause of the client's hypothyroidism, ensuring adequate iodine intake can still be beneficial for thyroid health. Educating the client about incorporating iodine-rich foods, such as dairy products, and iodized salt into her diet can help support her thyroid function alongside her medical treatment for hypothyroidism. Seafood is another good source of iodine, but the client's cultural background may limit the amount of seafood she consumes.
4. a. A low-sodium diet can help manage the client's elevated blood pressure alongside other lifestyle changes. Educating her on sodium reduction strategies, such as limiting processed foods and using herbs and spices instead of salt, will empower her to make healthier choices.
5. a. Eating more fruits and vegetables while reducing processed food intake is a positive dietary change that supports the client's endocrine health. This statement indicates that she has successfully incorporated the recommended changes to her diet to manage her hypothyroidism and type 2 diabetes.
6. a. A decrease in TSH level would indicate an improvement in the client's hypothyroidism management, while improved blood glucose control would reflect better management of her type 2 diabetes. These outcomes would demonstrate the effectiveness of the care plan in addressing her endocrine health concerns.

### Review Questions

1. c. Clients with Cushing's syndrome should limit carbohydrate and salt intake. Increased salt intake can worsen fluid retention and weight gain. Protein intake is recommended to promote structural integrity and wound healing in these clients.
2. a. Tuna and salmon, and other fatty fish, are good sources of vitamin D. The client should try to incorporate these foods into their diet.
3. b. Diabetes is a condition characterized by high blood glucose levels, and a diet high in fiber and complex carbohydrates can help to regulate blood glucose levels and optimize endocrine wellness.
4. d. Eating a diet low in processed and packaged foods helps to optimize endocrine wellness. PCOS is a condition characterized by hormonal imbalances, and a diet low in processed and packaged foods can help to optimize endocrine wellness by reducing the intake of harmful additives and stabilizing blood glucose levels.
5. c. Hypoglycemia is characterized by low blood glucose levels, and a diet high in protein and healthy fats can help to optimize endocrine wellness by stabilizing blood glucose levels.
6. c. Clients with Addison's disease should increase their calcium and vitamin D intake to help decrease their risk of osteoporosis secondary to corticosteroid use.
7. b. Assessing a client's prior knowledge of a condition and associated interventions is an appropriate method to determine their readiness to learn.
8. c. Hemoglobin A1C is a lab test that measures how well the client's glucose has been controlled over a 3-month period. An increased hemoglobin A1C level indicates that the client's diet needs to be adjusted.
9. d. Cabbage and other cruciferous vegetables can interfere with the body's ability to use iodine.
10. d. Unsalted nuts do not have iodized salt, making it a low-iodine food choice. Clients with hyperthyroidism need to limit their sources of iodine.

## Chapter 8

### Unfolding Case Study

1. d. Blood glucose levels are heavily influenced by carbohydrate intake.
2. a. A healthy diet includes protein from lean sources such as chicken or seafood. Cheeseburgers are high in saturated fat, which can worsen insulin resistance.
3. d. Having gestational diabetes increases a person's risk for developing type 2 diabetes later in life.
4. b. Nuts include both healthy dietary fiber and healthy fats.
5. c. Sarah's hemoglobin A1C result indicates that she may have developed diabetes.
6. b. Sarah will need to continue to eat lean proteins, fruits, vegetables, and high-fiber foods to manage her blood glucose levels.

### Review Questions

1. c. Protein, in the form of lean meat and dairy products, is essential for growth and development. It plays an anabolic role similar to that of growth hormone and insulin-like growth factor.
2. a. Kale is a leafy green vegetable that is a key source of anti-inflammatory micronutrients.
3. d. Clients can take antagonist medications to lower cholecystokinin levels to stimulate appetite.
4. b. Fish is an iodine-rich food and a good choice for a client with Hashimoto's thyroiditis.
5. c. Sodium should be limited to 2300 mg/day to decrease the risk for cardiovascular disease and hypertension associated with diabetes.
6. b. Clients with diabetes should restrict saturated fats to less than 10% of daily intake.
7. a. Alcohol consumption causes variability in blood glucose levels.
8. b. Insulin and other medications used to manage diabetes require coordination with meals to maintain proper blood glucose levels.
9. d. Levothyroxine should be taken on an empty stomach and timed to avoid interaction with certain foods and supplements that can inhibit absorption.
10. c. Loop diuretics, such as furosemide, cause the parathyroid gland to decrease the production of parathyroid hormone, which is important in maintaining bone stability.

## Chapter 9

### Unfolding Case Study

1. c. The Mini Nutritional Assessment is a nutritional screening tool for older clients.
2. a. The client will need education regarding foods rich in iron to consume at home.
3. b. Using Maslow's hierarchy of needs framework, understanding the physical environment should be the first consideration. It is essential to understand if the client will be cooking or eating prepared meals before considering other options.
4. d. Eating smaller portions more frequently is a strategy that can overcome decreased food intake that occurs due to getting full quickly. Although hypertension and diabetes are not risk factors for worsening anemia, decreased taste is a physiological consequence of the change in density of taste buds that occurs with aging.
5. a. A holistic approach to client teaching includes spiritual influences, emotional influences, physical influences, and social determinants of health.
6. b. The client's cognitive functioning will determine if a caregiver needs to be present for the educational session.
7. c. Ms. Foster is choosing food options and making plans for meals. She will be in the action stage of change once she begins modifying her diet.
8. a. The nurse should recognize that change is a cyclic process and that successes and failures are expected.

### Review Questions

1. a. Vitamin K is a fat-soluble vitamin necessary for the synthesis and activation of coagulation factors II (prothrombin), VII, IX, and X.
2. c. Folate deficiency in pregnancy can lead to macrocytic anemia in mothers and neural tube defects in fetuses.

3. b. Long-term alcohol use can cause the malabsorption of Vitamin B<sub>12</sub>.
4. c. These are all possible signs of scurvy, or vitamin C deficiency.
5. c. Iron is better absorbed when taken with vitamin C, found in orange juice, and on an empty stomach.
6. a. An older adult with anemia is likely to experience hypotension and/or lightheadedness, which is a significant risk for falls.
7. a. Animal meat, fish, eggs, and dairy are sources of vitamin B<sub>12</sub>.
8. a. Health literacy is the only modifiable psychosocial factor listed.
9. a. Providing written material before determining the client's preferred learning style, without assessing their preference and without giving time to ask questions, is not consistent with holistic nursing care.
10. a. The nurse should consider that a change in behavior typically takes 6 months to achieve.

## Chapter 10

### Unfolding Case Study

1. a. The recommended dose is 3–6 mg/kg/day for 2–3 months; 3 mg/kg/dose twice daily is equal to 6 mg/kg/day. Dividing the total daily dose will decrease gastrointestinal side effects.
2. a. Having the client identify their food likes and dislikes is a collaborative strategy the nurse can use to develop a diet plan. Adolescents are more likely to adhere to diet modifications if they are partners in developing their nutritional plan.
3. d. Taking iron with orange juice will increase gastrointestinal absorption. Taking iron with milk, tea, or coffee can decrease its absorption. Antacids should be taken 2 hours before or 4 hours after taking iron for better absorption because iron is better absorbed in an acidic environment. Missed doses of iron should not be made up.
4. c. Feeling weak and dizzy may be a sign of low hemoglobin or worsening anemia. This can occur if oral iron is not absorbed sufficiently by the body.

### Review Questions

1. b. Common nutritional deficiencies affecting all ages include iron; vitamins B<sub>12</sub>, D, and K; and folate.
2. a. The groups most frequently affected by anemia are pregnant individuals, infants and toddlers, female adolescents, and older adults.
3. b. Infants and children have increased nutrient demands due to rapid physical and cognitive growth, resulting in rapid cell turnover.
4. b. Decreased sun exposure is one of several risk factors for vitamin D deficiency.
5. b. Zinc deficiency occurs in 31% of children between ages 1 and 3 years and can cause decreased immunity and increased infections. Foods rich in zinc include eggs and dairy products, which the child is not consuming.
6. c. Clients with sickle cell disease are at high risk for vitamin D deficiency, which can increase their risk of disease-related effects.
7. c. Older adults who consume excessive amounts of alcohol, live alone, smoke, or are obese are at risk for folate deficiency.
8. b. Sickle cell disease is the most common inherited blood disorder in the United States. Clients with this disease are prone to micronutrient and macronutrient deficiencies.
9. d. Iron-fortified foods such as breakfast cereals should be limited because this client is at risk for iron overload after the transfusion.
10. c. The Mediterranean diet includes various foods and spices with anti-inflammatory and antioxidant properties.

## Chapter 11

### Unfolding Case Study

1. c. The client's blood pressure meets the criteria for hypertension, which is a systolic blood pressure greater than or equal to 129 mm Hg and/or a diastolic blood pressure greater than or equal to 80 mm Hg. Peripheral vascular disease causes blood return issues, while peripheral arterial disease will cause ischemia and blood flow restrictions. This client has symptoms of erectile dysfunction which can be directly related to the

decreased blood flow caused by hypertension.

2. a. An electrocardiogram evaluates the electrical function of the heart and can provide initial indication of heart disease or heart damage.
3. c. Increasing fiber intake has several health benefits. It lowers cholesterol and blood pressure and decreases the risk of heart disease.
4. d. A cheeseburger contains red meat and cheese, both of which contain saturated fats that contribute to heart disease.
5. a. It appears that the changes are effective, as the client's blood pressure is coming down. The goal of the diet is to reduce blood pressure and, secondarily, cholesterol levels. Cholesterol can be affected by much more than just diet, and it may take more than 3 months for levels to decrease.
6. a. The client's BMI was never an issue, so they do not have to lose a lot of weight. However, the client needed to lessen their waist size and is currently on track with that goal.

### Review Questions

1. a. The DASH diet has beneficial effects for clients with heart disease, including decreasing sodium intake to control hypertension.
2. d. Hypertension is defined as a systolic blood pressure greater than 129 mm Hg and/or a diastolic blood pressure greater than 80 mm Hg.
3. c. A heart-healthy diet, such as the DASH diet, promotes increasing intake of fruits, including pineapple.
4. a. The client's body mass index (BMI) has decreased from  $30 \text{ kg/m}^2$ , in the obese range, to  $29 \text{ kg/m}^2$ , in the overweight range.
5. c. The HDL level of 48 mg/dL falls within the normal range of greater than 40 mg/dL.
6. a. Coffee should be avoided because caffeine can trigger or aggravate atrial fibrillation.
7. c. Torsades de pointes is primarily caused by an extremely low magnesium level, so the priority of care with this client is to monitor their serum magnesium level.
8. d. A high serum potassium level may cause peaked tall or high T-wave ECG.
9. b. Oatmeal is not only low in cholesterol but is high in fiber, which helps to lower LDL.
10. a. Whole milk is high in fat and cholesterol. The DASH diet promotes fat-free or low-fat dairy products.

## Chapter 12

### Unfolding Case Study

1. b. The client's hypertension is concerning, because individuals who are already predisposed to high blood pressure before pregnancy are at an increased risk for having more complications during pregnancy due to the increase in vascular volume and increased stress on the body.
2. d. Tara needs to avoid fried foods, undercooked foods, and foods high in fat. The steak is cooked properly and broccoli is a good source of nutrients.
3. c. To help with heart health in both the client and fetus, the best answer choice is to increase fruits and vegetables.
4. b. High blood pressure is associated with pre-eclampsia, which can cause premature birth.
5. a. The client's BMI places them in the severe obesity BMI category.
6. b. To help encourage good food choices, involve children in preparing meals.
7. d. Apples would be the best choice, because the other options are high in fat and sodium.
8. a. Foods high in fiber can help lower cholesterol levels.
9. d. The client is taking furosemide, which is a diuretic. Diuretics increase the risk for water-soluble vitamin deficiencies particularly if the client is not able to eat a varied, nutrient-rich diet.
10. b. The choice for a healthy heart diet is to choose grilled or baked protein with vegetables and low to no sugar substances.

### Review Questions

1. b. The pregnant client who has a pre-existing heart condition will need to increase calories by 340 calories daily to gain the necessary amount of weight but not an excessive amount that can strain their cardiovascular system.

2. b. Infants can be introduced to pureed fruits and vegetables and infant cereals at 6 months.
3. c. The banana is the best choice for the snack as it is low in fat and sugar.
4. b. Adults should strive for an intake of less than 2300 mg of sodium daily.
5. a. Social media and peers can strongly influence adolescent eating habits.
6. c. Long-term complications of eating disorders cause electrolyte imbalances, prolong QT intervals, which can cause arrhythmias, and can eventually lead to heart failure due to the stress on the heart.
7. b. Red meat and full-fat dairy products can elevate cholesterol levels.
8. c. Shrimp is a lean source of protein, whole grain rice is a complex carbohydrate, and vegetables are an excellent source of nutrients.
9. a. Clients who are taking warfarin should be instructed to have a consistent intake of leafy green vegetables, which can affect the clotting factors associated with the warfarin.
10. d. A meal of grilled chicken, onions, green peppers, and avocado with corn tortillas is lower in fat than the other choices.

## Chapter 13

### Unfolding Case Study

1. b. The pulmonary or respiratory system comprises the upper airways, the lower airways, lungs, and alveolar sacs. The primary function of the pulmonary system is to ensure adequate oxygenation throughout the body.
2. c. Aspirin and other nonsteroidal anti-inflammatory medications (NSAIDs) can induce bronchospasm in clients who are sensitive and have had reactions to these medications in the past.
3. b. Processed meats and aged cheeses are high in histamines and can cause increased mucus production, which can worsen asthma symptoms.
4. a. Protein drinks provide high protein amounts in low-volume portions to provide the nutritional components necessary for muscle synthesis and improved muscle strength.
5. a. Eating protein, found in foods like cheese and nuts, at least twice daily will help with strong respiratory muscles.
6. c. Obesity alters the mechanics of the pulmonary system leading to dyspnea, wheezing, airway hyperresponsiveness, and increased work of breathing.

### Review Questions

1. c. Fatigue is a common symptom of COPD that can make it difficult for the client to prepare and eat nutritious foods.
2. c. Albumin is the primary protein of the body. Decreased levels may indicate chronic disease, malabsorption, malnutrition with low protein, or dilution by IV fluids. Follow-on diagnostics would be pre-albumin and blood urea nitrogen.
3. b. The process of gas exchange is when oxygen and carbon dioxide are exchanged in the alveoli of the lungs.
4. a. Calcium and vitamin D intake reduce the risk of osteoporosis and kyphoscoliosis that decrease the size and diameter of the rib cage and reduce lung capacity.
5. c. The client should eat high-protein, calorie-dense meals to maintain nutritional status and prevent weight loss that results from increased work of breathing.
6. a. A primary goal of nutrition therapy for pulmonary wellness is to maintain adequate respiratory function to decrease or prevent malnutrition and obesity. Healthy body weight will help preserve muscle strength and help maintain the integrity of the immune system.
7. d. The client should eat smaller, more frequent meals. Larger meals should be consumed earlier in the day when the client is less tired.
8. c. Crackles indicate crepitus, or air trapped in and under the skin.
9. d. While all of these findings can indicate the client is knowledgeable of and is following the prescribed nutritional plan, actually maintaining the recommended weight is an objective measure that indicates adherence.
10. d. ACE inhibitors are known to induce nighttime coughing.

## Chapter 14

### Unfolding Case Study

1. b. The client grew up eating foods from their sources and cooking at home, and he participated in frequent exercise that provided him with a solid foundation in healthy lifestyle choices.
2. a. The client grew up with the foundational knowledge of eating healthy food and exercising, so the nurse can use this information in the dietary education plan.
3. a. Construction work, smoking, and selecting fast food are risk factors for chronic respiratory disease.
4. b. Smoking cessation and eating better improves pulmonary health.
5. c. The client's note from last year indicates altered respiratory function and a low-quality diet, and since nutritional counseling was not addressed during that visit, the nurse should instruct the client during this visit.
6. d. Pneumonia is a potential complication as the mucosal lining thickens and cough pressure declines in clients with COPD.

### Review Questions

1. c. Pregnant women should consume a balanced diet that includes protein to support the physiological changes of the mother and the growth of the fetus.
2. d. Omega-3 fatty acids are essential to the development and function of the pulmonary system during infancy.
3. c. Cognitive and behavioral defects may occur in the fetus whose mother is malnourished.
4. b. Foods containing caffeine, like coffee, can potentiate the effects of the bronchodilator leading to tremors, nervousness, anxiety, and heart palpitation.
5. a. A pregnant client needs protein, vitamins A, D, E, and omega-3 fatty acids for proper lung function and development of the fetus.
6. d. Nutrition plays a role in supporting the immune system, which prevents and treats infections while also repairing lung tissue.
7. c. Consuming fruits and vegetables is linked to a decreased risk for developing asthma and a decreased risk for experiencing asthma symptoms such as wheezing.
8. a. A diet high in saturated fats has been linked with worsening airway inflammation and lung function.
9. d. The main goal of an anti-inflammatory diet is to minimize the duration of and decrease the risk for infection. An anti-inflammatory diet supports the immune system and lung function and decreases oxidation.
10. a. Long-term oxygen therapy in COPD clients causes nutritional deficiencies, because low oxygenation to the gastrointestinal tract decreases its ability to function and absorb nutrients.

## Chapter 15

### Unfolding Case Study

1. a. Lunch meats are high in sodium and fat which should be avoided in clients with CKD stage 2, hypertension, obesity, and diabetes.
2. b. Fruit salad has the lowest added sugar and carbohydrates. It also is better for the client's weight.
3. c. Subjective and objective data illustrate that the client is doing what the plan requires, but the plan clearly is not adequate for the client's needs. The client has advanced from stage 2 CKD to stage 3 CKD despite having lost weight, having blood pressure and blood sugar levels within defined limits, presenting no symptoms of fluid overload even with the advancement in CKD stage, and using a food log to demonstrate dietary adherence.
4. a. The client does not have symptoms of heart failure, fluid overload, or edema, and will need a diet high in calcium and magnesium.
5. b. Symptoms of heart failure create a need to change the plan. In stage 3, if heart failure is present, additional dietary measures are implemented. If they are not present, the same diet can be followed.
6. a. Proteins should be restricted to plant-based proteins and lean, low-fat meat sources.

### Review Questions

1. a. Calcium levels are affected by the kidney through its relationship with the parathyroid gland and the

production of calcitriol, but not from direct reabsorption.

2. a. A serum creatinine level of 1.5 mg/dL is above the normal range of 0.74–1.35 mg/dL for adult males and requires prompt attention. The other laboratory values are within normal range.
3. b. Since the PVR is the amount of urine left in the bladder after the client has urinated, the nurse should scan the bladder immediately after the client has urinated.
4. d. Complex carbohydrates are found in foods such as whole grains, fruits, and vegetables.
5. b. The client with CKD should be instructed to use plant sources of protein before animal sources.
6. a. Engagement and participation in creating the plan is the single most important step toward client adherence to the plan because if the client has no desire or motivation to follow the plan it will not matter if they have the means to or not.
7. c. The client with CKD who is on dialysis should restrict fluid intake.
8. d. They should sip fluids slowly and savor them and not gulp them down quickly.
9. a. Vanilla ice cream is low in phosphorus.
10. a. Salt substitutes are dangerously high in potassium and should always be avoided when on a potassium restricted diet. Salt substitutions are acceptable.

## Chapter 16

### Unfolding Case Study

1. a. 130 kcal/kg/day is the highest daily recommended amount for a preterm infant.  $130 \times 1 \text{ kg} = 130$  calories daily
2. d. Carbohydrate is the preferred energy source for the body.
3. a. Protein and calories will be the biggest concerns at this age because she will need them to develop and grow appropriately; however, she cannot take in so much that her kidneys will be overloaded and her glucose out of range.
4. d. To prevent additional issues like UTIs, kidney stones, and hypertension, which can impact already-poor kidney health, the client should eat a low-sodium, heart-healthy, high-fiber diet, and Ramen noodles are extremely high in sodium.
5. b. Education on preventing STIs should start at age 10 to help ensure renal health. UTIs resulting from STIs can spread silently and asymptotically, depending on the cause, which could lead to pyelonephritis and damage Kayla's already weakened kidneys.
6. a. The requirement is 2,000 calories daily for an adolescent female.
7. d. Fetal intrauterine growth restriction (IUGR) is a risk for a client with these health conditions.
8. b. The client's original CKD stage was stage 3, which is associated with the GFR range of 30 to 59 mL/min/ $1.73 \text{ m}^2$ . During pregnancy, the range is expected to increase, so a lower range would be something to address immediately. At 15 mL/min/ $1.73 \text{ m}^2$ , the client would require dialysis as an immediate intervention.

### Review Questions

1. a. The GFR increases in early pregnancy, causing a hyperfiltrative state, so a decreased GFR would be considered abnormal.
2. c. The pregnant client should avoid or limit caffeine intake to promote fetal health.
3. d. Protein is extremely important in growth and development and in repair of muscles and injury, but it is still restricted in the diet of clients with CKD.
4. d. Females are at risk for anemia. The recommended daily iron intake for female adolescents aged 14 to 18 years, including those with CKD, is 15 mg.
5. a. Coffee, tea, colas, energy drinks, and brown chocolate all contain caffeine, which contains an acid that acts as a bladder irritant and can aggravate OAB symptoms.
6. b. The client with calcium stones should avoid foods high in oxalate, such as rhubarb, beets, and potatoes.
7. c. Protein intake, particularly from red meat or canned sources, can increase the risk of kidney stone development.
8. a. Increased intake of vegetables, especially cruciferous vegetables, decreases the risk of developing renal cancer.
9. c. The client with stage 4 CKD should restrict intake of potassium as well as that of magnesium, phosphorus,

and sodium.

- 10.** a. The Mediterranean diet, which includes an emphasis on fresh fruits, can decrease lower urinary tract symptoms.

## Chapter 17

### Unfolding Case Study

1. a. Vitamin A deficiency is not associated with any of the client's symptoms and could be ruled out based on the assessment data. Based on the findings, the health care provider orders laboratory tests to determine the client's potassium, magnesium, and vitamin B<sub>12</sub> levels.
2. a. The health care provider would be expected to check the client's iron level. Iron deficiency can cause tongue redness and inflammation and pallor. The provider decides to order a complete metabolic panel and vitamin B<sub>12</sub>, iron, and magnesium levels.
3. d. Protein deficiency can cause weight loss, poor appetite, pallor, hair loss, and dry, brittle nails.
4. b. Quinoa is a seed grouped with whole grain that is high in protein and is a good protein option in a vegetarian diet.
5. d. With Crohn's disease, and when a client has many bowel movements daily, absorption becomes a problem. In particular, iron, calcium, and vitamin D are not absorbed properly in this disease process.
6. c. The nurse should expect supplementation to be ordered. Enteral supplementation will likely be used, but if that is not sufficient, parenteral supplementation may be considered.

### Review Questions

1. b. Digestion includes mastication, which requires the teeth to be in working condition.
2. c. Palpating the abdomen can reveal any pain, guarding, or tenderness present in the gastrointestinal organs.
3. b. Angular cheilitis, or fissures and crusts in the corners of the lips, can indicate vitamin B<sub>1</sub> (thiamine), vitamin B<sub>12</sub>, or iron deficiency.
4. c. Tofu is a plant-based protein that can be an option in a vegetarian diet.
5. a. Edamame is a plant-based source of both protein and iron.
6. b. Eating yogurt and other probiotic foods supports the gut's normal microbial growth.
7. d. Oranges have vitamin C and help create an acidic environment that increases iron absorption.
8. b. Vitamin C assists with iron absorption and should be included in the nutritional plan.
9. b. Ecchymosis, or bruising, is consistent with vitamin K deficiency because vitamin K is needed for adequate blood clotting.
10. a. For vegan clients, protein options such as quinoa, tofu, and edamame are appropriate suggestions.

## Chapter 18

### Unfolding Case Study

1. a. Breastfeeding increases the chances that an infant will absorb the proper nutrients because the nutrients provided in breast milk are more bioavailable than those in formula.
2. d. Children with galactosemia need to be on a lactose-free diet their entire lives to prevent life-threatening problems.
3. b. The problems that Hein faced in pregnancy drastically altered her microbiome and contributed to her infant's low birth weight and birth at 37 weeks' gestation. These complications all increased her infant's risk for Crohn's disease.
4. a. High-fiber foods such as beans should be avoided during inflammatory phases of the disease because they can irritate the inflamed intestinal lining.

### Review Questions

1. a. The father's microbiome is not shown to be a contributing factor to the child's microbiome.
2. b. Premature newborns need more calories per kilogram of body weight than a full-term infant does and should get 110–135 kcal/kg/day.
3. d. Galactosemia is a genetic disease in which the individual lacks the proper enzymes to convert lactose into

glucose.

4. c. Adolescents like to be autonomous, but many tend to prefer convenience foods such as fast food. Parents should be instructed to provide a healthy diet whenever possible rather than simply incorporating healthy items into unhealthy diet.
5. d. Consuming prebiotic or probiotic foods is conducive to maintaining good gut bacteria. Yogurt, kimchi, and honey are examples of prebiotic foods.
6. d. Increasing water and fiber intake is important to prevent and manage constipation, a frequent problem among older adults.
7. b. The client should be on a high-fiber diet when not in exacerbation but should be on a low-fiber diet due to inflammatory cycles.
8. c. Kefir has anti-inflammatory properties that will help protect the microbiome.
9. b. Ciprofloxacin, frequently used for diverticulitis, should not be taken with calcium-rich or calcium-fortified foods because the calcium can hinder ciprofloxacin's absorption.
10. d. Kale can help prevent vitamin K deficiency. Amoxicillin is known to deplete vitamin K and vitamin B<sub>12</sub>.

## Chapter 19

### Unfolding Case Study

1. c. Often, a client with age-related degenerative disorders such as osteoarthritis will have limited ROM and increased pain upon ROM of the joints. This simple screening provides valuable information for the diagnosis of osteoarthritis as well as the treatment parameters for the client.
2. a. The provider would start with an x-ray of both knees to evaluate for any soft tissue changes and signs of arthritis.
3. a. Leafy green vegetables have anti-inflammatory properties. Because the client has osteoarthritis with edema in both knees, these nutrients should be included in the diet.
4. b. Nuts and seeds have anti-inflammatory properties that can be beneficial for clients with arthritis.

### Review Questions

1. a. Adequate vitamin D intake is necessary for strong bones and the prevention and treatment of osteoporosis.
2. d. Good skin turgor indicates a normal moisture level in the skin. Tenting, when the skin remains stretched out like a tent when pinched, is a sign of decreased moisture in the skin.
3. a. Protein aids in the repair of muscles and tissue.
4. d. Bromelain is a group of enzymes found in pineapples and is believed to reduce swelling and pain.
5. c. The pressure ulcer changed from a stage 2 ulcer to a stage 1 ulcer, which indicates improvement. Stage 1 pressure injuries are reddened, but not open.
6. b. Foods rich in calcium and vitamin D, such as dairy products, are important for bone health and the treatment of osteoporosis.
7. b. Bread and pasta contain gluten and would not be included in a gluten-free diet.
8. c. Clubbing of nails, when nails look wider or swollen, is often seen with chronic obstructive pulmonary disease (COPD).
9. b. The client understands hydration, like drinking water throughout the day, promotes skin integrity and wound healing.
10. d. Biotin is found in foods such as liver and cooked egg yolks, and it is important in the promotion of hair and nail health.

## Chapter 20

### Unfolding Case Study

1. c. Adequate intake of dairy products helps ensure that enough calcium is consumed, which is necessary to support musculoskeletal and integumentary growth and development in the fetus.
2. a. Adequate intake of calcium and vitamin D is essential for developing and maintaining healthy bones and teeth in both the pregnant client and the developing fetus.
3. a. Breastfed infants should continue vitamin D supplementation until they are taking in enough vitamin

D-fortified solids or vitamin D-rich foods.

4. a. Breastfeeding does not provide an infant with enough vitamin D. To prevent musculoskeletal disorders and to promote healthy skeletal growth, experts recommend that all infants receive vitamin D supplementation.
5. b. The mother urgently needs to change this child's diet so that they can achieve a healthy weight. Being overweight places additional strain on a child's skeletal system putting them at increased risk for injury and may make them reluctant to participate in physical activity.
6. d. Leafy green vegetables are a good source of calcium, which promotes healthy bone development in the growing child.
7. a. Oral nutritional supplements with added protein and amino acids are recommended for clients with delayed wound healing due to malnutrition.
8. d. Based on the findings, the MNA classifies individuals as either well-nourished, at risk for malnutrition, or malnourished.

### Review Questions

1. a. The FRAX does not diagnose osteoporosis, but it can estimate a person's risk for a bone fracture within 10 years. This information can help the nurse and client plan care and implement strategies to help mitigate risks in the home and other environments.
2. d. Corticosteroids, as well as antacids, proton pump inhibitors, anticonvulsants, and loop diuretics, can affect bone health with long-term use.
3. c. Starting in infancy, parents should brush their children's teeth at least twice a day with a fluoride toothpaste according to their dentist's recommendations. The first dental visit should occur no later than the eruption of the first tooth, which happens well before 1 year of age in most children.
4. d. Pruritic urticarial papules and plaques of pregnancy (PUPPP) is characterized by itchy, red, raised bumps and hives that most commonly appear on the abdomen, thighs, buttocks, and arms.
5. c. Adolescent athletes have increased nutritional needs and should consume adequate amounts of complex carbohydrates, proteins, and fats while avoiding processed sugars.
6. c. Food, especially calcium-rich foods, can interfere with the absorption of bisphosphonates.
7. d. There is a correlation between low maternal vitamin D and osteopenia in newborns and decreased bone density in childhood. Consequently, it is important to monitor vitamin D levels in the pregnant client.
8. d. Weight-bearing exercise and maintenance of a healthy weight help prevent age-related osteoporotic changes in menopausal individuals.
9. b. Older adults with sarcopenia, or low muscle mass, should incorporate leucine-rich foods to stimulate muscle synthesis.
10. b. Osteopenia may be present in an infant born before 30 weeks' gestation because the majority of calcium uptake occurs during the third trimester of fetal life.



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## **Chapter 2 A Holistic View of Macronutrients**

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### Chapter 3 A Holistic View of Micronutrients

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## Chapter 4 The Digestive Process

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## Chapter 6 Special Nutritional Considerations for Neurological Health

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## Chapter 7 Applying Clinical Judgment to Promote Nutrition for Endocrine Wellness

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## **Chapter 8 Special Nutritional Considerations for Endocrine Health**

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## Chapter 11 Applying Clinical Judgment to Promote Nutrition for Cardiovascular Wellness

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## Chapter 13 Applying Clinical Judgment to Promote Nutrition for Pulmonary Wellness

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## Chapter 15 Applying Clinical Judgment to Promote Nutrition for Renal Wellness

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