

19BSSC203 : ELEMENTS IN NUTRITION AND METABOLISM

(FOR B.Sc SPORTS SCIENCE- FIRST YEAR STUDENTS)

UNIT-I

1. CONCEPTS OF NUTRITIONAL HEALTH

Nutrition, role of nutrition in health promotion

Good nutrition is an important part of leading a healthy lifestyle. Combined with physical activity, your diet can help you to reach and maintain a healthy weight, reduce your risk of chronic diseases (like heart disease and cancer), and promote your overall health.

Health promotion and disease prevention (HPDP) play a vital role in avoiding disease, delaying onset of signs and symptoms of disease, preventing premature death, promoting quality of life and decreasing economic liability on the healthcare system. Promoting a lifestyle that includes healthy eating patterns have been deemed to be cost effective for the prevention of diabetes, cardiovascular disease and an optimal nutrition status has been shown to be crucial in obesity prevention.

Chronic conditions related to eating patterns

In the past 100 years, the prevalence of essential nutrient deficiencies has decreased considerably due to treatment for most infectious diseases. The average life expectancy for Americans has changed from 54.5 years in 1916 to 78.7 years in 2012. Sadly, while incidence of communicable diseases has decreased, rates of chronic diet-related disease have increased. Chronic diseases like cardiovascular disease, high blood pressure, type 2 diabetes, some cancers and arthritis are the leading cause of disability and death. Poor eating and decreased physical activity patterns have resulted in substantial health challenges for the population. Under-nutrition and the associated chronic diseases come at a financial cost. In 2010, 86 percent of all healthcare spending was for individuals with one or more chronic medical conditions.⁸ The total costs of heart disease and stroke in 2010 were estimated to be \$315.4 billion. The total estimated cost of diagnosed diabetes in 2012 was \$245 billion.

General guidelines for healthy eating

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- Eat a variety of vegetables, especially dark green, red, and orange vegetables (3 or more servings a day).
- Eat a variety of fruits (2 or more servings a day).
- Eat whole-grain, high-fiber breads and cereals (3 to 6 servings a day). Reduce or eliminate refined or processed carbohydrates; most of the grains in your diet should be whole grains.
- Drink fat-free or low-fat milk and eat low-fat dairy products.
- Choose from a variety of low-fat sources of protein — including eggs, beans, poultry without skin, seafood, lean meats, unsalted nuts, seeds, and soy products. If you eat meat, eat white meat at least four times more often than red meat.
- Reduce intake of saturated fats and trans-fats (such as partially hydrogenated oil) as much as possible.
- Use vegetable oils (like olive or canola oil) instead of solid fats.
- Reduce daily intake of salt or sodium. Reduce to less than 1,500 mg. per day if you are older than 50, or have hypertension, diabetes or chronic kidney disease.
- Restrict or eliminate "junk food" — foods that contain refined white flour, solid fats or trans fats, added sugars, and are high in sodium.
- Restrict or eliminate sodas and other sugar-added drinks that are high in calories and contain few or no nutrients.
- If you drink alcoholic beverages, do so in moderation. Drink only when it doesn't put you or anyone else at risk.

Essential and Nonessential Nutrients

Essential nutrients are nutrients that the body cannot make or produce in sufficient quantities. Essential nutrients must be obtained through the diet. They include the building blocks of carbohydrates, lipids and proteins, certain vitamins and minerals, and water.

Nonessential nutrients can be made by the body or obtained from sources other than foods and beverages. These include biotin that is produced by gastrointestinal bacteria, cholesterol that is produced by the liver, vitamin K that is produced by intestinal bacteria, and vitamin D that is produced by sunlight. If a person consumes a broad-range diet with a variety of foods and beverages, then he or she should be able to obtain most of the essential and nonessential

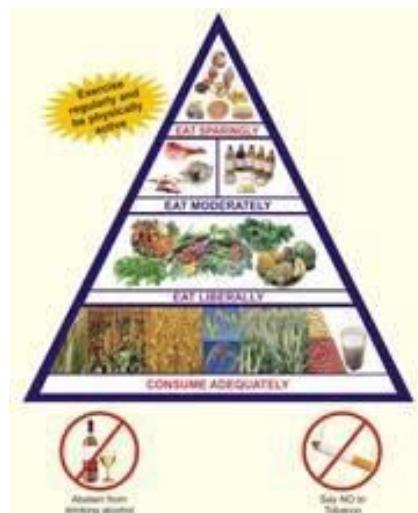
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nutrients they need. When people eliminate certain foods or food groups, restrict calories and/or skip meals on a regular basis, then they may run the risk of nutrient deficiencies. Nutrient knowhow may help to enlighten and guard against these deficiencies.

Food pyramid, Food plate, ICMR guidelines

India uses a number of graphical elements to represent the messages of its guidelines, one of them being a food pyramid. The pyramid is divided into four levels of foods according to recommended consumption: cereals and legumes/beans at the base should be eaten in sufficient quantity, vegetables and fruits on the second level should be eaten liberally, animal source foods and oils on the third level are to be eaten moderately, and at the apex, highly processed foods high in sugar and fat to be eaten sparingly. Accompanying the pyramid there is a recommendation to do regular physical activity and warnings against smoking and drinking alcohol.



ICMR Five Food Groups

Foods are grouped together because they provide similar amounts of the key nutrients of that food group. To meet the nutrient requirements essential for good health, you need to eat a

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variety from each of the five food groups daily, in the recommended amounts. It is not necessary to eat from each food group at every meal.

It is also important to enjoy a variety of foods within each of the Five food groups because different foods vary in the amount of the key nutrients that it provide. ‘Basic Five food group, suggested by ICMR can be used for planning diets.

Table 1.1 Basic Five Food Groups

Food groups	Nutrients
1.Cereal and products : Rice, Wheat, ragi, maize, bajra, rice flakes, wheat flour, sprouted cereal	Energy, protein, Invisible fat, B vitamins, iron, calcium, fiber
2.Pulses and legumes Bengal gram, black gram, cow pea, peas (dry), soybeans	Protein, energy , invisible fat, thiamine, riboflavin, folic acid, calcium, iron and fibre
3.Milk & Meat products: I) Milk and skimmed milk, cheese, curd II)Chicken, liver, fish, egg and meat	Protein, fat, riboflavin, calcium.
4.Fruits & vegetables : I) Mango, guava, tomato, papaya, orange, sweet lime, watermelon Green leafy vegetables : II) Amaranth,spinach, drumstick leaves, coriander leaves, fenugreek leaves Other vegetables : Carrot,onion,brinjal,ladiesfinger, beans, capsicum, cauliflower, drumstick	Carotenoids, vitamin C, riboflavin, folic acid, iron, fibre Riboflavin, folic acid, calcium, fibre, iron, carotenoids Carotenoids, folic acid, calcium and fibre
5.Fat & sugars : I) Fats :Butter, ghee, groundnut oil, coconut oil, hydrogenated fat, cooking oils II) Sugar and jaggery	Energy, Essential fatty acids and fat soluble vitamins Energy and iron

Recommended dietary guidelines for preventing chronic diseases, malnutrition

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Obesity:

The imbalance between declining energy expenditure due to physical inactivity and high energy in the diet (excess calories whether from sugar, starches or fat) is the main determinant of the obesity epidemic. Increasing physical activity, plus reducing intakes of foods high in fat and foods and drinks high in sugars, can prevent unhealthy weight gain. Taking these simple goals to concrete action requires major social and environmental changes in order to effectively promote and support healthier choices at the individual level.

Diabetes:

Excess weight gain, overweight and obesity and physical inactivity account for the escalating rates of type 2 diabetes, worldwide. Diabetes leads to increased risk of heart disease, kidney disease, stroke and infections. Increased physical activity and maintaining a healthy weight play critical roles in the prevention and treatment of diabetes.

Cardiovascular diseases:cardiovascular diseases, the major killers worldwide, are to a great extent due to unbalanced diets and physical inactivity. Risk of their main forms, heart disease and stroke, is reduced by eating less saturated and trans fats, and sufficient amounts of (n-3 and n-6) polyunsaturated fats, fruits and vegetables and less salt, as well as by physical activity and controlling weight. Reduction of salt intake helps reduce blood pressure, a major cause of cardiovascular diseases.

Cancer:

Tobacco is the number one cause of cancer, but dietary factors contribute significantly to some types of cancer. Maintaining a healthy weight will reduce the risk for cancers of the oesophagus, colorectum, breast, endometrium and kidney. Limiting alcohol intake will reduce risk for cancers of the mouth, throat, oesophagus, liver and breast. Ensuring an adequate intake of fruit and vegetables should further reduce risk for oral cavity, oesophagus, stomach and colorectal cancer.

Osteoporosis and bone fractures:

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Fragility fractures are a problem of older people. Adequate intakes of calcium (500 mg per day or more) and of vitamin D in populations with high osteoporosis rates helps to reduce fracture risk, so does sun exposure and physical activity to strengthen bones and muscles.

Dental disease:

Caries is preventable by limiting the frequency and amount of consumption of sugars and by appropriate exposure to fluoride. Erosion of teeth by dietary acids in beverages or other acidic foods may contribute to tooth destruction.

Malnutrition

Malnutrition refers to a state when your body doesn't get enough nutrients from the foods you eat to work properly. Nutrients include fats, carbohydrates, protein, vitamins, and minerals. These substances give your body energy and strengthen muscles. They help your body grow and repair tissues. They also regulate bodily functions such as breathing and the beating of your heart.

To improve your loved one's nutrition, try some of the following:

- **Encourage healthier food choices.** The best foods are those that are full of nutrients, such as fruits, vegetables, whole grains, and lean meats. Help your loved one limit his or her intake of solid fats, sugars, alcoholic beverages, and salt. Suggest ways to replace less healthy foods with healthier choices.
- **Snacking** on healthy foods is a good way to get extra nutrients and calories between meals. It may be especially helpful for older adults who quickly get full at mealtimes.
- **Make food taste good again.** If your loved one is on a restricted diet, herbs and spices can help restore flavor to bland foods. Just remember to avoid herb or spice blends that are heavy in salt.
- **Consider adding supplements to your loved one's diet.** He or she may benefit from a supplement shake or other nutritional supplements. Talk to their doctor about these options.
- **Encourage exercise.** Even a little bit of exercise can help improve your loved one's appetite and keep his or her bones and muscles strong.

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- **Plan social activities.** Make mealtimes and exercise a social activity. Take your loved one on a walk around the block. Encourage him or her to meet a neighbor or friend for lunch. Many restaurants offer discounts for seniors.
- **Talk to your loved one's hospital, retirement community or nursing home.** The staff may not notice that your loved one is malnourished. Bring it to their attention and create a plan to improve nutrition.

Vegetarianism

The simplest definition of vegetarianism is a diet free of meat, fish, and fowl flesh. But eating habits of vegetarians cover a wide spectrum. At one end are lacto-ovo vegetarians, who avoid animal flesh but eat eggs and milk products. At the other end are vegans, who forgo eating (and often wearing) all animal-based products, including honey. Raw foodists are vegans who eat mainly raw fruits, vegetables, legumes, sprouts, and nuts. There are also pescatarians, who eat fish and seafood; and lacto-vegetarians, who eat dairy products but not eggs. Fruitarians follow a diet that includes fruits, nuts, seeds, and other plant food. Those who follow a macrobiotic diet eat mostly grains but can also eat fish. They don't necessarily identify as vegetarians. Flexitarians refer to vegetarians who occasionally eat meat and fish

Common Nutritional Deficiencies

Vegan and vegetarian diets can be beneficial for your health, but completely cutting animal products might make you question where you're getting certain nutrients. Many people assume that getting enough protein on a plant-based diet will be a problem, but that is not necessarily true. There are plenty of plant protein sources such as lentils, beans, chickpeas, nuts, seeds, soy products, and whole grains.

The nutritional deficiencies that are most common with vegan and vegetarian diets include:

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Vitamin B12.

This particular vitamin is created by a bacteria and found primarily in animal products such as dairy, meat, insects, and eggs. However, many plant foods are fortified with b12 (like nutritional yeast and some plant milks) and supplementing with a B12 vitamin is a viable option.

Vitamin D

Vitamin D is the sunshine vitamin! Along with calcium, it plays an essential role in maintaining bone health. Vitamin D is easily obtained from sun exposure. But remember to limit your time in direct sun, it doesn't take much to get your vitamin D. For those with less outdoor time, such as individuals living through winter in northern climates, supplementation is also available.

Omega-3 Fatty Acids

This essential fatty acid is very important for maintaining heart health. While fish and eggs are commonly thought of as rich sources, you can also find omega-3 in chia seeds, flaxseeds, walnuts, and hempseeds!

Zinc

Zinc can be found in many beans, legumes, and whole grains. But it is important to note that phytic acid found in these plants can hinder zinc absorption. However, by soaking or sprouting grains and beans before cooking, the phytic acid is reduced.

Iron

Even though iron from plants is not as easily absorbed, eating a varied diet rich in whole plant foods should ensure enough iron. You can find iron in leafy green vegetables, whole grains, lentils, peas, and dried fruits! Adding foods rich in vitamin C will also help iron absorption.

Interpreting food labels, using food label to choose a healthier diet

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Learn what to look for on the label.



1 - Start with the serving information at the top.

This will tell you the size of a single serving and the total number of servings per container (package).

2 - Next, check total calories per serving and container.

Pay attention to the calories per serving and how many calories you're really consuming if you eat the whole package. If you double the servings you eat, you double the calories and nutrients.

The next section of information on a nutrition label is about the amounts of specific nutrients in the product.

3 - Limit certain nutrients.

Check key nutrients and understand what you're looking for. Not all fats are bad , and total sugars can include both natural and added sugars. Limit the amounts of added sugars , saturated fat and sodium you eat, and avoid *trans fat*. When choosing among different brands or similar products, compare labels and choose foods with less of these nutrients when possible..

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4 - Get enough of the beneficial nutrients.

Make sure you get enough of the nutrients your body needs, such as: calcium, choline, dietary fiber, iron, magnesium, potassium, and vitamins A, C, D and E.*

5 - Understand % Daily Value.

The % Daily Value (DV) tells you the percentage of each nutrient in a single serving, in terms of the daily recommended amount. If you want to consume less of a nutrient (such as saturated fat or sodium), choose foods with a lower % DV (5 percent or less). If you want to consume more of a nutrient (such as fiber), choose foods with a higher % DV (20 percent or more).

Food additives

Food additives have been used for centuries to improve and preserve the taste, texture, nutrition and appearance of food. Food additives and preservatives are used in today's food supply to prevent food borne illness, enable the transportation of food to areas that otherwise wouldn't be possible, and for the efficient manufacture of products to consistently meet the established quality standards from batch to batch.

Dietary supplement

A dietary supplement is a manufactured product intended to supplement the diet when taken by mouth as a pill, capsule, tablet, or liquid. A supplement can provide nutrients either extracted from food sources or synthetic, individually or in combination, in order to increase the quantity of their consumption. The class of nutrient compounds includes vitamins, minerals, fiber, fatty acids and amino acids. Dietary supplements can also contain substances that have not been confirmed as being essential to life, but are marketed as having a beneficial biological effect, such as plant pigments or polyphenols. Animals can also be a source of supplement ingredients, as for example collagen from chickens or fish. These are also sold individually and in combination, and may be combined with nutrient ingredients. In the United States and Canada, dietary supplements are considered a subset of foods, and are regulated accordingly.

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Sports nutrition

Sports nutrition is the study and practice of nutrition and diet with regards to improving anyone's athletic performance. Nutrition is an important part of many sports training regimens, being popular in strength sports (such as weightlifting and bodybuilding) and endurance sports (e.g. cycling, running, swimming, rowing). Sports nutrition focuses its studies on the type, as well as the quantity of fluids and food taken by an athlete. In addition, it deals with the consumption of nutrients such as vitamins, minerals, supplements and organic substances that include carbohydrates, proteins and fats

The importance of sports nutrition

Consuming the right balance of food and drink is important for everyone and those actively participating in sport need to be aware that it can also affect performance. For example, athletes may need more calories than the average person or individuals training for bodybuilding competitions may need to increase their protein intake: a good nutrition plan is key to your success.

Sports performance and energy

Fuelling your body with the right foods is essential for sports performance, importantly fats, protein and carbohydrates which maintain the body's energy.

- Carbohydrates are the primary fuel used by working muscles, so adequate intake is essential for preventing muscle fatigue.
- While it's important to monitor your fat intake, you shouldn't remove it from your diet completely. Fats provide fatty acids that can be used as a source of energy - especially if your exercise sessions last longer than one hour. Fats also provide the building blocks for hormones and the formation of cell walls.
- Protein can be used as a source of energy and is critical for building new muscle tissue. If you're taking part in resistance training, your body will require additional protein.

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Role of sports nutrition professional.

A sports nutritionist can create a tailored nutrition plan to support an individual's training regime and goals. The plan will incorporate both food and hydration integral to performance, but tailored nutrition can also help to:

- increase energy levels
- promote good health
- help manage weight
- improve concentration
- develop body composition and growth
- enhance recovery

To create the best nutrition strategy, a sports nutrition professional will assess not just an individual's training and diet but also their lifestyle, day to day habits, supplements and regular medication needs.

Weight management

To maintain a healthy weight, eating well is crucial. But with many diet promotions on offer, it can be hard to get correct, healthy advice. This is where a nutritionist can be helpful in advising on losing weight for sport and performance: it's common that people deciding to lose weight will strictly reduce protein, fat or calorie intake. This can not only have a negative impact on your performance, but it can severely harm your body.

The types of food that you should include in your diet for optimum sports nutrition include:

- vegetables
- whole grains
- fruit
- sources of lean protein and low-fat dairy produce
- healthy fats

2. Food sources of macro and micro nutrients

A. Carbohydrates

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Did you know there are three main types of carbohydrate in food? There are

- Starches (also known as complex carbohydrates)
- Sugars
- Fiber

You'll also hear terms like naturally occurring sugar, added sugar, low-calorie sweeteners, sugar alcohols, reduced-calorie sweeteners, processed grains, enriched grains, complex carbohydrate, sweets, refined grains and whole grains.

No wonder knowing what kind and how much carbohydrate to eat can be confusing!

On the nutrition label, the term "total carbohydrate" includes all three types of carbohydrates.

This is the number you should pay attention to if you are carbohydrate counting.

Starch

Foods high in starch include:

- Starchy vegetables like peas, corn, lima beans and potatoes
- Dried beans, lentils and peas such as pinto beans, kidney beans, black eyed peas and split peas
- Grains like oats, barley and rice. (The majority of grain products in the US are made from wheat flour. These include pasta, bread and crackers but the variety is expanding to include other grains as well.)

The grain group can be broken down even further into whole grain or refined grain.

A grain contains three parts:

- bran
- germ
- endosperm

The bran is the outer hard shell of the grain. It is the part of the grain that provides the most fiber and most of the B vitamins and minerals.

The germ is the next layer and is packed with nutrients including essential fatty acids and vitamin E.

The endosperm is the soft part in the center of the grain. It contains the starch. Whole grain means that the entire grain kernel is in the food.

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If you eat a whole grain food, it contains the bran, germ, and endosperm so you get all of the nutrients that whole grains have to offer. If you eat a refined grain food, it contains only the endosperm or the starchy part so you miss out on a lot of vitamins and minerals. Because whole grains contain the entire grain, they are much more nutritious than refined grains.

Sugar

Sugar is another type of carbohydrate. You may also hear sugar referred to as simple or fast-acting carbohydrate.

There are two main types of sugar:

- naturally occurring sugars such as those in milk or fruit
- added sugars such as those added during processing such as fruit canned in heavy syrup or sugar added to make a cookie

On the nutrition facts label, the number of sugar grams includes both added and natural sugars.

There are many different names for sugar. Examples of common names are table sugar, brown sugar, molasses, honey, beet sugar, cane sugar, confectioner's sugar, powdered sugar, raw sugar, turbinado, maple syrup, high-fructose corn syrup, agave nectar and sugar cane syrup.

You may also see table sugar listed by its chemical name, sucrose. Fruit sugar is also known as fructose and the sugar in milk is called lactose. You can recognize other sugars on labels because their chemical names also end in "-ose." For example glucose (also called dextrose), fructose (also called levulose), lactose and maltose.

If you are looking for information about artificial sweeteners, try this section.

Fiber

Fiber comes from plant foods so there is no fiber in animal products such as milk, eggs, meat, poultry, and fish.

Fiber is the indigestible part of plant foods, including fruits, vegetables, whole grains, nuts and legumes. When you consume dietary fiber, most of it passes through the intestines and is not digested.

For good health, adults need to try to eat 25 to 30 grams of fiber each day. Most Americans do not consume nearly enough fiber in their diet, so while it is wise to aim for this goal, any

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increase in fiber in your diet can be beneficial. Most of us only get about half of what is recommended.

Fiber contributes to digestive health, helps to keep you regular, and helps to make you feel full and satisfied after eating.

Additional health benefits, of a diet high in fiber — such as a reduction in cholesterol levels — have been suggested by some so may be an additional benefit.

Good sources of dietary fiber include:

- Beans and legumes. Think black beans, kidney beans, pintos, chickpeas (garbanzos), white beans, and lentils.
- Fruits and vegetables, especially those with edible skin (for example, apples, corn and beans) and those with edible seeds (for example, berries).
- Whole grains such as:
- Whole wheat pasta
- Whole grain cereals (Look for those with three grams of dietary fiber or more per serving, including those made from whole wheat, wheat bran, and oats.)
- Whole grain breads (To be a good source of fiber, one slice of bread should have at least three grams of fiber. Another good indication: look for breads where the first ingredient is a whole grain. For example, whole wheat or oats.) Many grain products now have "double fiber" with extra fiber added.
- Nuts — try different kinds. Peanuts, walnuts and almonds are a good source of fiber and healthy fat, but watch portion sizes, because they also contain a lot of calories in a small amount.

In general, an excellent source of fiber contains five grams or more per serving, while a good source of fiber contains 2.5 - 4.9 grams per serving.

Common food sources of carbohydrates

Dairy

Milk, yogurt, and ice cream

Fruit

Whole fruit and fruit juice

Grains

Bread, rice, crackers, and cereal

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Legumes

Beans and other plant-based proteins

Starchy Vegetables

Potatoes and corn

Sugary Sweets

Limit these!

Soda, candy, cookies, and other desserts

Metabolism of carbohydrates

Carbohydrate metabolism denotes the various biochemical processes responsible for the formation, breakdown and interconversion of carbohydrates in living organisms. The most important carbohydrate is glucose, a simple sugar that is metabolized by nearly all known organisms. Glucose and other carbohydrates are part of a wide variety of metabolic pathways across species: plants synthesize carbohydrates from carbon dioxide and water by photosynthesis storing the absorbed energy internally, often in the form of starch or lipids. Plant components are consumed by animals and fungi, and used as fuel for cellular respiration. Oxidation of one gram of carbohydrate yields approximately 4 kcal of energy and from lipids about 9 kcal. Energy obtained from metabolism is usually stored temporarily within cells in the form of ATP. Organisms capable of aerobic respiration metabolize glucose and oxygen to release energy with carbon dioxide and water as byproducts. Carbohydrates can be chemically divided into complex and simple. Simple carbohydrates consist of single or double sugar units. Sucrose or table sugar is a common example of a simple carbohydrate. Complex carbohydrates contain three or more sugar units linked in a chain. They are digested by enzymes to release the simple sugars. Starch, for example, is a polymer of glucose units and is typically broken down to glucose. Simple and complex carbohydrates are digested at similar rates, so the distinction is not very useful for distinguishing nutritional quality. Cellulose is also a polymer of glucose but it cannot be digested by most organisms. Some bacteria that produce enzymes for cellulose live inside the gut of some mammals such as cows, and when cows eat plants, the cellulose is broken down by the bacteria and some of it is released into the gut.

Functions of carbohydrates in human body

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Carbohydrates have six major functions within the body:

1. Providing energy and regulation of blood glucose
2. Sparing the use of proteins for energy
3. Breakdown of fatty acids and preventing ketosis
4. Biological recognition processes
5. Flavor and Sweeteners
6. Dietary fiber

Requirement of carbohydrate in daily diet for sedentary individuals, athletes

Carbohydrates are your body's main source of energy, especially during exercise. Although many low-carbohydrate diets consist of 50 to 150 grams of carbohydrates per day, the Institute of Medicine recommends adults eat at least 130 grams of carbohydrates every day. If you're physically active, you'll likely need additional carbohydrates.

Since carbohydrates are an athlete's main fuel source during training and competition, athletes need more carbohydrates and total calories than people who are sedentary. Endurance athletes should consume 2.3 to 4.5 grams of carbohydrates per pound of body weight each day, depending on the type of training they engage in. Athletes participating in races lasting longer than four hours may need up to 5.5 grams of carbohydrates per pound of body weight. Therefore, athletes participating in heavy training at high intensities, but in durations lasting less than four hours, require about 3.2 to 4.5 grams of carbohydrates per pound of body weight each day, or about 512 to 720 grams of carbohydrates for a 160-pound athlete.

Glycemic index

The **Glycemic Index (GI)** is a relative ranking of carbohydrate in foods according to how they affect blood glucose levels. Carbohydrates with a low **GI** value (55 or less) are more slowly digested, absorbed and metabolised and cause a lower and slower rise in blood glucose and, therefore usually, insulin levels.

Glycemic Load.

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Glycemic load is a measure that takes into account the amount of carbohydrate in a portion of food together with how quickly it raises blood glucose levels.

Your blood glucose levels rise and fall when you eat a meal containing carbohydrates. How high it rises and how long it stays high depends on the quality of the carbohydrates (the GI) as well as the quantity. Glycemic Load (or GL) combines both the quantity and quality of carbohydrates. It is also the best way to compare blood glucose values of different types and amounts of foods. The formula for calculating the GL of a particular food or meal is:

$$\text{Glycemic Load} = \text{GI} \times \text{Carbohydrate (g) content per portion} \div 100.$$

For example, a single apple has a GI of 38 and contains 13 grams of carbohydrates.

$$\text{GL} = 38 \times 13/100 = 5$$

Glycogenesis.

Glycogenesis is the process of glycogen synthesis, in which glucose molecules are added to chains of glycogen for storage. This process is activated during rest periods following the Cori cycle, in the liver, and also activated by insulin in response to high glucose levels.

- Glucose C₆H₁₂O₆ is converted to C₆H₁₃O₃P, or glucose 6-phosphate
- Glucose is converted into glucose 6-phosphate by the action of glucokinase or hexokinase with conversion of ATP to ADP.
- Glucose-6-phosphate is converted into glucose-1-phosphate by the action of phosphoglucomutase, passing through the obligatory intermediate glucose-1,6-bisphosphate.
- Glucose-1-phosphate is converted into UDP-glucose by the action of the enzyme UDP-glucose pyrophosphorylase. Pyrophosphate is formed, which is later hydrolysed by pyrophosphatase into two phosphate molecules.
- The enzyme glycogenin is needed to create initial short glycogen chains, which are then lengthened and branched by the other enzymes of glycogenesis. Glycogenin, a homodimer, has a tyrosine residue on each subunit that serves as the anchor for the reducing end of glycogen. Initially, about seven UDP-glucose molecules are added to each tyrosine residue by glycogenin, forming $\alpha(1 \rightarrow 4)$ bonds.
- Once a chain of seven glucose monomers is formed, glycogen synthase binds to the growing glycogen chain and adds UDP-glucose to the 4-hydroxyl group of the

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glucosyl residue on the non-reducing end of the glycogen chain, forming more $\alpha(1\rightarrow4)$ bonds in the process.

- Branches are made by glycogen branching enzyme (also known as amylo- $\alpha(1:4)\rightarrow\alpha(1:6)$ transglycosylase), which transfers the end of the chain onto an earlier part via α -1:6 glycosidic bond, forming branches, which further grow by addition of more α -1:4 glycosidic units

Glycogenolysis.

Glycogenolysis is the breakdown of glycogen (n) to glucose-1-phosphate and glycogen (n-1). Glycogen branches are catabolized by the sequential removal of glucose monomers via phosphorolysis, by the enzyme glycogen phosphorylase. It is the process by which process by which glycogen, the primary carbohydrate stored **in** the liver and muscle cells of animals, is broken down into glucose to provide immediate energy and to maintain blood glucose levels **during** fasting.

Neoglucogenesis

The formation of glucose, especially by the liver, from noncarbohydrate sources, such as amino acids and the glycerol portion of fats. **Gluconeogenesis (GNG)** is a metabolic pathway that results in the generation of glucose from certain non-carbohydrate carbon substrates. From breakdown of proteins, these substrates include glucogenic amino acids (although not ketogenic amino acids); from breakdown of lipids (such as triglycerides), they include glycerol, odd-chain fatty acids (although not even-chain fatty acids, see below); and from other steps in metabolism they include pyruvate and lactate. Although most gluconeogenesis occurs in the liver, the relative contribution of gluconeogenesis by the kidney is increased in diabetes and prolonged fasting.

Role of carbohydrates in exercise –muscle, glycogen stores

The main role of carbohydrates is to provide energy. When they are digested, carbohydrates are broken down into glucose to provide readily available energy for the body to use quickly and effectively. Carbohydrates are the most important form of fuel for exercise and sports activities. The body can store carbohydrates in the muscles and liver as glycogen,

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and use these stores as a source of fuel for the brain and muscles during physical activity. These glycogen stores are limited, so it is important to be fully fuelled at the start of any exercise. By not having adequate carbohydrate in your diet for exercise, you may feel tired and lacking in energy and not be able to perform at your best. So, regular intake of carbohydrate-rich foods is important to keep stores topped up. The correct food choices can help ensure the body has enough energy for activity, as well as help aid recovery.

Skeletal muscle and liver, both of which are essential to normal body function, store this important substance. Liver glycogen, for example, plays a role in regulating blood sugar levels and homeostasis. On the other hand, muscle glycogen helps in the contraction of skeletal muscle and thereby physical activity. The roles of carbohydrate and of glycogen stores in athletic performance and skeletal muscle are well documented. For this reason, sports drinks such as Gatorade and other workout drinks include some type of carbohydrate in their formula. The goal is to replenish carbohydrate stores during exercise to delay the onset of fatigue and sustain exercise longer.

Distance athletes have developed many techniques such as carbohydrate loading and training adaptations to influence athletic performance through glycogen availability.

Carbohydrate and its health implications

Stroke and Obesity

Researchers found a significant link between diets rich in refined grains and stroke risk and is linked with a high-carbohydrate diet with abdominal obesity. Fat that accumulates in this area is associated with heart disease, certain types of cancer and stroke.

Increased Triglycerides

Triglycerides are a type of fat found in your fat tissue and bloodstream. Eating a sugar-rich diet can increase your triglyceride levels, which may elevate your risk of heart disease. Many processed carbohydrate sources contain high amounts of added sugars such as high-fructose corn syrup, cane syrup and honey.

Risk of Chronic Diseases

Processed carbohydrates, such as white pasta, white bread and white rice, are rich in rapidly digested carbohydrates. That means they have a high glycemic index and glycemic

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load. Such foods cause rapid fluctuations in insulin and blood sugar, causing hunger to spike and leading to overeating. Over time, this increases the risk of diabetes and heart disease. In contrast, unprocessed carbohydrates are digested at a slower pace in your body than their refined counterparts. As a consequence, they have a gentler effect on your insulin and blood sugar, which may help you feel satiated.

B. PROTEINS

Proteins are macromolecules formed by amino acids. Proteins are large size molecules (macromolecules), polymers of structural units called amino acids. A total of 20 different amino acids exist in proteins and hundreds to thousands of these amino acids are attached to each other in long chains to form a protein.

Amino Acids.

Amino acids are organic compounds that combine to form proteins. Amino acids and proteins are the building blocks of life. When proteins are digested or broken down, amino acids are left. The human body uses amino acids to make proteins to help the body: Break down food.

Peptide Bonds.

A peptide bond is a chemical bond formed between two molecules when the carboxyl group of one molecule reacts with the amino group of the other molecule, releasing a molecule of water (H_2O). This is a dehydration synthesis reaction (also known as a condensation reaction), and usually occurs between amino acids

Essential and Non Essential Amino Acids

Nonessential amino acids can be made by the body, while essential amino acids cannot be made by the body so you must get them from your diet. You must have all of the amino acids so your body can build the wide variety of proteins it needs

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Essential and nonessential amino acids both produce energy and build proteins, and some form neurotransmitters and hormones. The unique chemical structure of each amino acid determines its function. Amino acids are primarily made of carbon, hydrogen, oxygen, and nitrogen. Every protein contains a specific sequence of a few to a thousand amino acids (source). Once your body digests proteins, it is left with amino acids. Your body then uses amino acids to make other beneficial proteins that help the body break down food, grow and repair tissue, and generate energy. Amino acids are classified into two main categories: essential and nonessential.

Essential Amino Acids

There are nine essential amino acids: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Since your body can't produce or store essential amino acids, it is important to regularly supply your body with these important building blocks. Fill your diet with chicken, eggs, fish, beef, tuna, soybeans, nuts, chia seeds and quinoa, and take a look at the amino acid content of your favorite protein-rich foods. To ensure your body is receiving enough essential amino acids, a good rule of thumb is to consume a minimum of 0.5 grams of protein per pound of lean body weight every day. Older adults, children, and pregnant women might require more protein and should consult with a dietitian or physician for advice. Finally, if you're an avid athlete 18 years or older, protein requirements are much higher and may range between 1.0 and 1.5 grams per pound of lean body weight to optimize recovery and lean muscle growth.

Nonessential Amino Acids

Nonessential amino acids support tissue growth and repair, immune function, red blood cell formation, and hormone synthesis. However, unlike essential amino acids, a healthy body can create these proteins if given enough protein sources with essential amino acids. There are 11 nonessential amino acids: arginine, glutamine, tyrosine, cysteine, glycine,

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proline, serine, ornithine, alanine, asparagine, and aspartate. Of these, eight are *conditional* amino acids. Typically your body will be able to synthesize these amino acids. However, if you are stressed, sick, or not consuming enough protein and carbohydrates, your body might not be able to produce enough of them. The conditional amino acids are arginine, glutamine, tyrosine, cysteine, glycine, proline, serine, and ornithine.

Different types of protein

In general, proteins can be divided into 2 large groups, according to their origin: proteins of animal or vegetable origin. Animal proteins come from meat, fish, eggs, milk and dairy products. Proteins of vegetable origin come mainly from cereals, such as rice and oats, legumes, such as soya and peas, and hemp.

Complete Proteins

Complete proteins provide all nine essential acids that our bodies can't make. The top sources of complete protein include animal products like meat, poultry and seafood. Examples include steak, turkey and salmon. Other animal products, such as eggs and low-fat dairy, are also good sources of complete protein. But, keep in mind that some high-protein foods may also be high in saturated fat. Steak, for example, has 40 grams of protein but 12 grams of saturated fat. To eat more nutritious complete proteins, the United States Department of Agriculture suggests choosing lean or low-fat meat and poultry. You can also eat seafood twice a week to increase intake of good fats. Using healthy cooking methods such as roasting and broiling will avoid the addition of extra fats.

Incomplete Proteins

Incomplete proteins lack one or more essential amino acids. Almost all plant proteins are incomplete. Beans, peas, seeds, nuts, soy products and some grains are plant proteins. Examples of beans and peas include white beans, chickpeas, hummus and green peas. Seeds and nuts include foods such as almonds, walnuts and sunflower seeds. The USDA recommends eating unsalted nuts and seeds to avoid extra sodium. Examples of soy products include tofu, tempeh and soy milk. Quinoa, a seed that's eaten as a grain, is an exceptionally

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rich source of protein. If you don't eat animal products, it's important to eat many different types of plant proteins to get enough essential amino acids.

Complementary proteins: These refer to two or more foods containing incomplete proteins that people can combine to supply complete protein. Examples include rice and beans or bread with peanut butter.

Protein from plant, animal sources, limiting amino acids in plant foods

In total, there are around 20 amino acids that the human body uses to build proteins. These amino acids are classified as either essential or non-essential. Your body can produce non-essential amino acids. However, it cannot produce essential amino acids, which need to be obtained through your diet. For optimal health, your body needs all the essential amino acids in the right ratios. Animal protein sources, such as meat, fish, poultry, eggs and dairy, are similar to the protein found in your body. These are considered to be complete sources of protein because they contain all of the essential amino acids that your body needs to function effectively. On the contrary, plant protein sources, such as beans, lentils and nuts are considered to be incomplete, as they lack one or more of the essential amino acids that your body needs. One of the main differences between plant and animal proteins involves their amino acid contents.

The body may need different amino acids at different times. Many people believe that the diet should include complete sources of protein, which contain all nine essential amino acids.

Some animal products are complete sources of protein, such as:

- fish
- various types of eggs
- dairy products, such as cheese, milk, and whey
- red meat from cows, bison, and deer
- poultry from sources such as chickens, turkeys, and quails
- meat from less common sources, including boars, hares, and horses

Most plant proteins are incomplete, which means that they are missing at least one of the essential amino acids.

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However, some plant-based foods, such as quinoa and buckwheat, are complete sources of protein.

It is important for vegetarians and vegans to mix their protein sources and ensure that they are getting all of the essential amino acids.

Also, keep in mind that some sources of plant protein may take longer for the body to digest and use.

The following are examples of plant-based foods rich in protein:

- grains
- lentils
- nuts
- beans
- legumes
- certain fruits, such as avocados
- soy
- hemp
- rice
- peas

Many other nuts, grains, and vegetables also contain high amounts of protein.

The major problem in most proteins of plant origin is the deficiency in certain essential amino acids, which makes them proteins of lower biological value compared to proteins of animal origin.

Dietary guidelines to ensure protein intake

The DRI (Dietary Reference Intake) is 0.8 grams of protein per kilogram of body weight, or 0.36 grams per pound. This amounts to: 56 grams per day for the average sedentary man. 46 grams per day for the average sedentary woman

For most people, a varied and healthful diet will provide enough protein.

Increasing protein intake does not necessarily mean eating more steak. There are other choices that can help you ensure a healthful protein intake.

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Here are some suggestions:

- Eat a variety of protein foods, choosing from fish, meat, soy, beans, tofu, nuts, seeds, and so on.
- Choose low-fat meat, poultry, and dairy products, and trim the fat from the meat. Opt for smaller portions and avoid processed meats, as they have added sodium.
- Use cooking methods that do not add extra fat, such as grilling.
- Check the ingredients in “protein bars,” as they can also be high in sugar.
- Opt for healthier versions of your usual favorites, for example, wholemeal rather than white bread and unsweetened peanut butter.
- Experiment with plant-based proteins, such as beans, lentils, and soy products.
- Choose nutrient-rich foods that provide other benefits, such as fiber.

Food combination, understanding complementary proteins

Protein is one of the essential nutrients, or macronutrients, in the human diet, but not all the protein we eat converts into proteins in our body. When people eat foods that contain amino acids, these amino acids make it possible for the body to create, or synthesize, proteins. If we do not consume some amino acids, we will not synthesize enough proteins for our bodies to function correctly. There are also nine essential amino acids that the human body does not synthesize, so they must come from the diet. All food proteins contain some of each amino acid, but in different proportions.

The nine essential acids that the human body does not synthesize are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Foods that contain these nine essential acids in roughly equal proportions are called complete proteins. Complete proteins mainly come from animal sources, such as milk, meat, and eggs. Soy and quinoa are vegetable sources of complete protein. Combining red beans or lentils with wholegrain rice or peanut butter with wholemeal bread also provides complete protein. The body does not need all the essential amino acids at each meal, because it can utilize amino acids from recent meals to form complete proteins. If you have enough protein throughout the day, there is no risk of a deficiency.

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Protein deficiency, excess intake and health risk

Worldwide, however, a lack of protein in the diet is a matter of concern, especially when it affects children. It can lead to problems of malnutrition, such as kwashiorkor and marasmus. These can be life-threatening.

A deficiency can also arise if a person has a health condition, such as:

- an eating disorder, for example, anorexia nervosa
- certain genetic conditions
- the later stages of cancer
- difficulty absorbing nutrients, due, for example, to irritable bowel syndrome (IBS) or gastric bypass surgery

Very low protein intake can lead to:

- weak muscle tone
- edema, which is swelling due to fluid retention
- thin and brittle hair
- skin lesions
- in adults, loss of muscle mass
- in children, stunted growth

Health risk

Protein has been unfairly blamed for a number of health problems. Some people believe that a high-protein diet can cause kidney damage and osteoporosis. Though protein restriction is helpful for people with pre-existing kidney problems, protein has never been shown to cause kidney damage in healthy people). In fact, a higher protein intake has been found to lower blood pressure and help fight diabetes, which are two of the main risk factors for kidney disease. Any assumed detrimental effects of protein on kidney function are outweighed by its positive effects on these risk factors. Protein has also been blamed for osteoporosis, which seems strange considering that studies show that it can, in fact, prevent this condition. Overall, there is no evidence that a reasonably high protein intake has any adverse effects in healthy people trying to stay healthy.

Role of protein in exercise

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Protein is responsible for rebuilding your muscle tissues after exercise and also plays a minor role in producing energy under more extreme training conditions. The complete proteins we consume (e.g. meats, fish, dairy, eggs, etc.) are made up of the same amino acids that make up our muscles.

Protein is responsible for rebuilding your muscle tissues after exercise and also plays a minor role in producing energy under more extreme training conditions. The complete proteins we consume (e.g. meats, fish, dairy, eggs, etc.) are made up of the same amino acids that make up our muscles. After we consume the protein, our body breaks it down to amino acids and incorporates them into our tissues as needed. Exercise causes muscles to demand more protein than under sedentary conditions because exercise, and especially unaccustomed exercise, does structural damage to the tissues. The structural damage gives to body a reason to rebuild the tissues stronger and/or bigger so that they can handle the continuing challenges. Without protein, the body cannot perform this function and therefore you must supply it through the diet if you want to recover and build properly. Exercisers and athletes generally have a higher protein requirement than their sedentary counterparts. Additionally, proper timing of protein ingestion around the workout (30 minutes before and immediately after) and spread evenly throughout the day can dramatically enhance exercise-induced results. The Sharecare Fitness Application has the ideal athletic menus individualized for each person including proper protein requirements, meal timing and complete food plans. Simply fill in your personal statistics and create your program. As a simple “rule of thumb,” if you consume 1 gram of protein per pound of body weight, you will cover all your protein needs and more will not add more muscle. Below are the protein recommendations for exercisers and athletes:

Active Recreational Athletes:

- Minimum -- 1 g/kg/d of body weight
- Adaptation period -- 1.2 - 1.8 g/kg/d

Strength Athletes/Off-season Bodybuilders:

- Minimum -- 1 g/kg/d of body weight
- Adaptation period -- 1.6 - 2.0 g/kg/d

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Endurance Athletes:

- Minimum -- 1.4 g/kg/d of body weight
- Adaptation period -- 1.6 - 2.0 g/kg/d
- Protein is absolutely essential to the maintenance and functionality of your cells at a micro level and for strength and muscle construction on a macro level. Protein chains inside your cells perform a wide variety of functions, from breaking down other organic structures to moving resources around the cells, as well as moving them between cells to different parts of the body. Once the protein chain is constructed the protein only has a short lifespan before it begins to break down and degrade.
- Protein can be mostly found in animal products, such as red and white meats, eggs, cheese and yogurts, these proteins are rich in an amino acid called Leucine that is responsible for the translation of muscle protein synthesis (MPS). This is essential for ongoing muscle growth, repair and maintenance. Other great sources of protein can be found in nuts, legumes, beans and tofu – providing vegans with protein options as well. Recommended daily allowances for protein vary, however studies do suggest that athletes will benefit from consuming protein in the range of 1g per 1-1.5kg of body mass.

Protein is needed even when not exercising

- Proteins are essential for maintaining energy levels because they are essential to the transportation of energy to the body, this process is necessary to have the energy just to go about your daily life, concentrate at work etc. Protein is also useful in the immune system, protein works in conjunction with other vitamins and minerals to ward off a variety of diseases and conditions.
- Replacing cells is the biggest use for protein, when the body replaces a cell it looks for the material in your diet. When there is not enough in the diet to supply the body's need for protein it then goes looking for it in other places. The body doesn't store protein like it does with fats or carbohydrates, so it goes to places that utilise protein and strips it away. This can leave you feeling lethargic, as the lack of readily available protein will have your body overworking itself trying to find enough protein to create new cells.

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Why we need protein after exercise

- During workout the body suspends most immune system responses as it deals with the increased strain on the body. Protein is needed to kick start the immune system and bring it back to working normally. If this doesn't happen just right then next time you exercise, the effectiveness of the exercise will be reduced.
- During exercise your muscles are tested to great length, they can then stretch and tear. The brain communicates this in the form of pain, generally called either a stitch or muscle pains the next day. Protein is needed to build up and repair muscles, helping to strengthen them.

C. LIPIDS

Dietary fats are naturally occurring molecules that are part of our diet. They belong to a larger group of compounds named *lipids* that also include waxes, sterols (e.g. cholesterol) and fat-soluble vitamins. However, this distinction is not always clear, and sometimes the term fats also include other lipids, such as cholesterol.

Dietary fats molecules originate from plants and animals. In plants, they are found in seeds (e.g. rapeseed, cottonseed, sunflower, peanut, corn and soybean), fruits (e.g. olive, palm fruit and avocado) and nuts (e.g. walnuts and almonds). Common animal fat sources are meat, (oily) fish (e.g. salmon, mackerel), eggs and milk. Both plant, or, as often called, vegetable fats, and animal fats can be consumed as they naturally occur, but also indirectly, for example in pastry and sauces, where they are used to improve texture and taste. Milk yields many popular animal fat products, such as cheese, butter, and cream. Apart from milk, animal fat is extracted primarily from rendered tissue fats obtained from livestock animals.

Classification of fats, different types, importance of Omega 3, 6 fatty acids

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Fats are classified into 4 categories as follows:

1. On the basis of chemical composition
2. On the basis of fatty acids
3. On the basis of requirement
4. On the basis of sources

1. On the basis of chemical composition

Fats can be classified into 3 main groups as follows:

1. Simple lipids

These are esters of fatty acids and glycerol. They are also called as neutral fats or triglycerides. These neutral fats make up 98 -99% of food and body fats.(e.g) fats and oils

Waxes: A wax is a simple lipid which is an ester of fatty acids and long chain aliphatic alcohols. The alcohol may contain 12-32 carbon atoms. Waxes are found in nature as coatings on leaves and stems. The wax prevents the plant from losing excessive amounts of water.

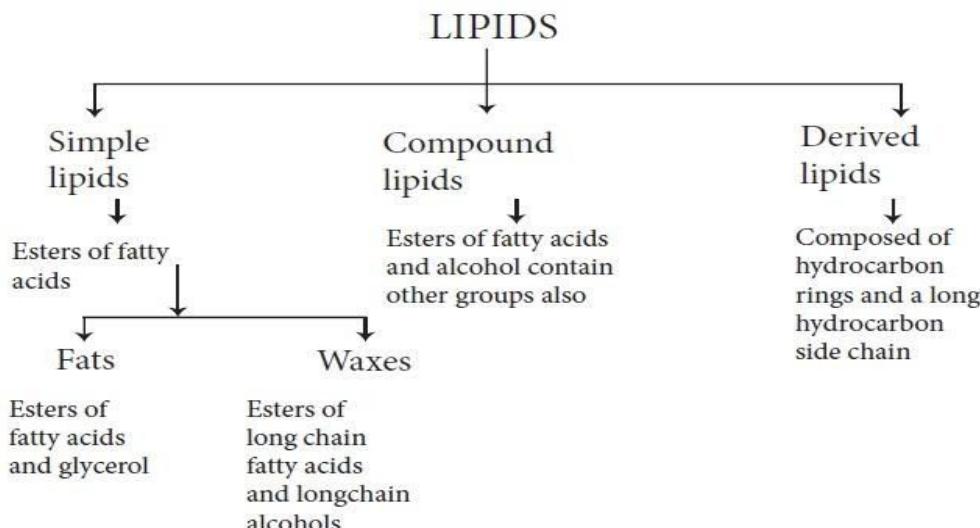


Fig 10.13: Classification of fats based on fatty acids

2. Compound lipids

The compound lipids contain, in addition to fatty acids and glycerol,some other organic compounds.

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1. **Phospholipids:** These contain phosphoric acid and a nitrogenous base in addition to fatty acids and glycerol(e.g.)Lecithin and cephalin
2. **Glycolipids:** Complex lipids containing carbohydrates in combination with fatty acids and glycerol(e.g) Cerebrosides
3. **Lipoproteins:** Lipoproteins are the most important as they are the carriers of lipids in the blood and form cell membranes.

3. Derived lipids

These are substances liberated during hydrolysis of simple and compound lipids which still retain the properties of lipids. The important members of this group are sterols, fatty acids and alcohol.

i. **Sterols :** Sterols are solid alcohols and form esters with fatty acids. In nature they occur in the free state in the form of esters. Based on their origin sterols are classified as cholesterol (animal origin) and phytosterol (in plants).

Cholesterol is a waxy, fat-like substance found in all cells of the body and has several important functions in the body. It is synthesized in the body by the liver independent of the dietary intake. The body normally synthesizes about 2 grams of cholesterol. The dietary sources of cholesterol includes animal foods. It is used in the body for synthesizing hormones, Vitamine D and substances which help digest foods. High blood cholesterol is a risk factor for heart disease. Rich sources of dietary cholesterol include meat, poultry(with skin), organ meats like brain, kidney, liver and full fat dairy products.

ii. **Fatty acids:** They are the key, refined fuel form of fat that the cell burns for energy. They are the basic structural unit of fats and they may be saturated or unsaturated. (e.g) Oleic acid, linoleic acid, linolenic acid, palmitic acid and myristic acid.

2. On the basis of fatty acids

Fats can be classified based on the fatty acids present in them as follows:

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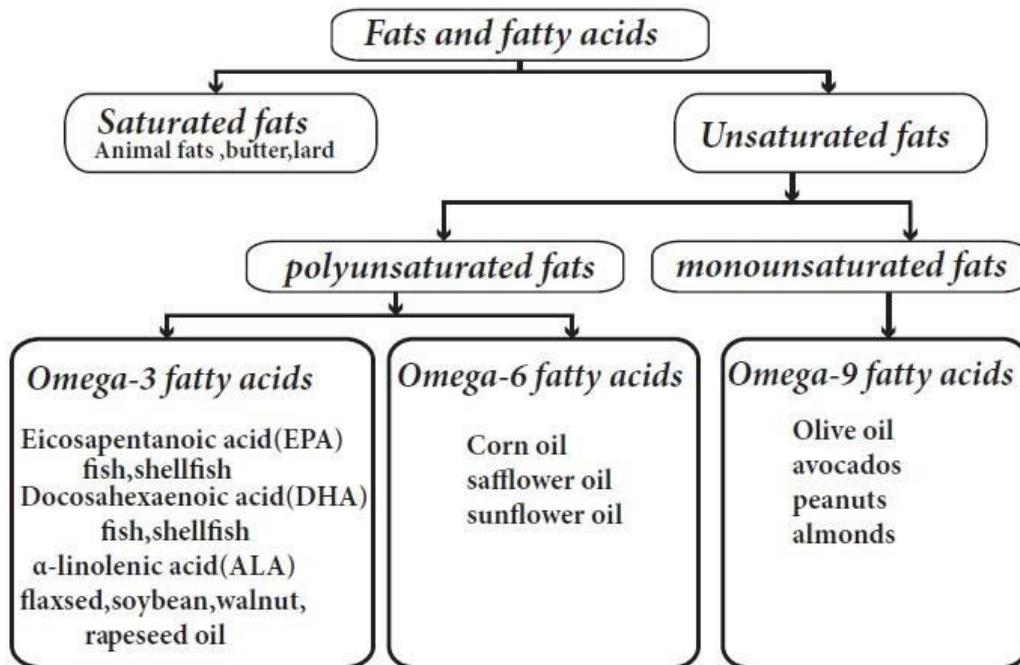


Fig 10.15: Classification of fats based on fatty acids

1. Saturated fatty acids

A saturated fat is a type of fat in which the fatty acid chains have all or predominantly single bonds. Various fats contain different proportions of saturated fat.

Saturated fatty acids, especially palmitic and stearic acids are found in animal products such as cream, cheese, butter, other whole milk dairy products and fatty meats which also contain dietary cholesterol. Certain vegetable products have high saturated fat content, such as coconut oil and palm kernel oil. Many prepared foods are high in saturated fat content, such as pizza, dairy desserts and sausage.

2. Unsaturated fatty acids

An unsaturated fat is a fat or fatty acid in which there is at least one double bond within the fatty acid chain.

i. **Monounsaturated fatty acid (MUFA):** A fatty acid chain is monounsaturated if it contains one double bond. Monounsaturated fats are good fats. A diet high in MUFA can reduce blood cholesterol levels, lowers risk of heart disease, stroke and breast cancer, reduces pain in rheumatoid arthritis and helps in weight loss. Foods which contain MUFA (Oleic acid) are avocados, olives, olive oil, peanut butter and peanut oil. It is also known as omega-9 fatty acid.

(ii) **Polyunsaturated fatty acid (PUFA):** A fatty acid is polyunsaturated if it contains more than one double bond. They are of 2 types, namely Omega-3 and omega-6 fatty acids.

a. Omega-3: It is also called ω -3 fatty acids or n-3 fatty acids with a double bond (C=C) at the third carbon atom from the end of the carbon chain. The three types of omega-3 fatty acids involved in human physiology are α -linolenic acid (ALA) [found in plant oils], eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) [both commonly found in marine oils]. Common sources of plant oils containing the omega-3 ALA fatty acid include walnut, flaxseed, flaxseed oil, soybeans and chia seeds. The sources of animal omega-3 EPA and DHA fatty acids include fish and fish oils.

The health benefits of omega-3 fatty acids are immense and they have been proven effective in the treatment and prevention of hundreds of medical conditions which includes high cholesterol, depression, anxiety, cancer, diabetes mellitus, inflammatory diseases, arthritis and cardiovascular diseases.

b. Omega-6: Omega-6 fatty acids (also referred to as ω -6 fatty acids or n-6 fatty acids) are a family of pro-inflammatory and anti-inflammatory polyunsaturated fatty acids that have in common a final carbon-carbon double bond in the n-6 position, that is the sixth bond, counting from the methyl end.

Omega-6 fats, also known as linoleic acid, are available only in food. The human body cannot make them, so they are considered essential fats. They support brain function, bone health, reproductive health, hair growth and regulation of metabolism. Good sources of linoleic acid include vegetable oils.

3. On the basis of requirement

Fatty acids are of 2 types:

1. Essential fatty acids

Fatty acids which are essential to be taken in our diet because they cannot be synthesized in our body are known as essential fatty acids. (eg.) Linoleic, linolenic and arachidonic acids.

2. Non-essential fatty acids

Non-essential fatty acids are those which can be synthesized by the body and which need not be supplied through the diet. Palmitic acid, oleic acid and butyric acid are examples of non-essential fatty acids.

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4. On the basis of sources

Fats are divided into 2 types based on their source, namely visible and invisible fats. Some fats and oils added to food or used for frying are visible fats.

These are also known as pure fats. Many foods like milk, cream, egg yolk, meat, fish and even cereals and legumes contribute substantial amount of invisible fats (not visible in the food) to the diet.

Understanding triglycerides, phospholipids

Triglycerides

Triglycerides are a type of fat (lipid) found in your blood. When you eat, your body converts any calories it doesn't need to use right away into triglycerides. The triglycerides are stored in your fat cells. Later, hormones release triglycerides for energy between meals.

Phospholipids

Phospholipids are a class of lipids that are a major component of all cell membranes. They can form lipid bilayers because of their amphiphilic characteristic. The structure of the phospholipid molecule generally consists of two hydrophobic fatty acid "tails" and a hydrophilic "head" consisting of a phosphate group.

Calculating fat calories in food

To calculate this, divide a food or drink's calories from fat by total calories (this information is on the product's food label) and then multiply by 100. For example, if a 300-calorie food has 60 calories from fat, divide 60 by 300 and then multiply by 100.

Understanding cholesterol, food sources, functions in human body, health implications

Cholesterol is a waxy, fat-like substance that's found in all the cells in your body. Your body needs some cholesterol to make hormones, vitamin D, and substances that help you digest foods. Your body makes all the cholesterol it needs.

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How Fat Moves from Food to the Bloodstream

Fat and cholesterol can't dissolve in water or blood. Instead, the body packages fat and cholesterol into tiny, protein-covered particles called lipoproteins. Lipoproteins can transport a lot of fat; they mix easily with blood and flow with it. Some of these particles are big and fluffy, while others are small and dense. The most important ones are low-density lipoproteins (LDL), high-density lipoproteins (HDL) , and triglycerides.

Low Density lipoproteins

Low-density lipoproteins (LDL) carry cholesterol from the liver to the rest of the body. Cells latch onto these particles and extract fat and cholesterol from them. When there is too much LDL cholesterol in the blood, these particles can form deposits in the walls of the coronary arteries and other arteries throughout the body. Such deposits, called plaque, can narrow arteries and limit blood flow. When plaque breaks apart, it can cause a heart attack or stroke. Because of this, LDL cholesterol is often referred to as bad, or harmful, cholesterol.

High-density lipoproteins

High-density lipoproteins (HDL) scavenge cholesterol from the bloodstream, from LDL, and from artery walls and ferry it back to the liver for disposal. Think of HDL as the garbage trucks of the bloodstream. HDL cholesterol is often referred to as good, or protective, cholesterol.

Triglycerides

Triglycerides make up most of the fat that you eat and that travels through the bloodstream. As the body's main vehicle for transporting fats to cells, triglycerides are important for good health, though high levels of triglycerides can be unhealthy.

In general, the lower your LDL and the higher your HDL, the better your chances of preventing heart disease and other chronic conditions.

Health risks associated with high cholesterol

Evidence strongly indicates that high cholesterol can increase the risk of:

- narrowing of the arteries (atherosclerosis)

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- heart attack
- stroke
- transient ischaemic attack (TIA) – often known as a "mini stroke"
- peripheral arterial disease (PAD)

This is because cholesterol can build up in the artery wall, restricting the blood flow to your heart, brain and the rest of your body. It also increases the risk of a blood clot developing somewhere in your body.

Your risk of developing coronary heart disease also rises as your blood's cholesterol level increases. This can cause pain in your chest or arm during stress or physical activity (angina).

Fat requirements for sedentary Individuals

Fat is an essential nutrient for the body, but it is also a rich source of energy. Consuming too much fat can lead to excess energy intake which can lead to weight gain over time. It is important to follow current healthy eating guidelines, ensuring fat intakes are no more than 35% of total energy intake from food, with saturated fat intakes not exceeding 11% of total energy intake from food. Fats in foods typically contain a mixture of saturated and unsaturated fatty acids, but choosing foods which contain higher amounts of unsaturated fat, and less saturated fat, is preferable. Most of us eat too much saturated fat so to cut back on intakes, limit foods such as:

- Pastries, cakes, puddings
- Chocolate and biscuits
- Some savoury snacks
- Cream, coconut cream and ice-cream
- Hard cheeses including cheddar
- Butter, lard, ghee, suet, palm oil and coconut oil
- Processed meats like sausages, ham, burgers and fatty cuts of meat
- Fried foods including fried chips

Choose low fat options and foods containing unsaturated fat where possible. Replacing saturated fat with some monounsaturated and polyunsaturated fat helps to maintain healthy cholesterol levels. Good sources of these fats include vegetable oils such as olive, rapeseed

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and sunflower oils, avocados, nuts and seeds. Polyunsaturated fats provide us with essential fatty acids like omega 3 which are found in sunflower, flaxseed and linseed oil and walnuts, but it is the long chain omega 3 fatty acids which are associated with heart health and these are found in oily fish (e.g. mackerel, salmon and sardines).

Role of hydrogenated fats

Hydrogenated fats are liquid vegetable oils made creamy when manufacturers convert some of the unsaturated fats into saturated ones through a process called "hydrogenation." This process also rearranges the molecular shape of the remaining unsaturated fats. The resulting shape is an abnormal "trans" shape. Trans fats raise your bad (LDL) cholesterol levels and lower your good (HDL) cholesterol levels. Eating trans fats increases your risk of developing heart disease and stroke. It's also associated with a higher risk of developing type 2 diabetes

Role of fat in exercise

Fat provides the main fuel source for long-duration, low- to moderate-intensity exercise (think endurance sports such as marathons). Even during high-intensity exercise, where carbohydrate is the main fuel source, fat is needed to help access the stored carbohydrate (glycogen). One gram of dietary fat equals nine calories and one pound of stored fat provides approximately 3,600 calories of energy. This calorie density (the highest of all nutrients), along with our seemingly unlimited storage capacity for fat, makes it our largest reserve of energy. While these calories are less accessible to athletes performing quick, intense efforts like sprinting or weight lifting, fat is essential for longer, slower, lower intensity and endurance exercise, such as easy cycling and walking.

Lipid fuel sources are important energy substrates for skeletal muscle metabolism during endurance exercise, especially prolonged exercise of low to moderate intensity. Their contribution to total oxidative metabolism is dependent on a variety of factors, including exercise intensity and duration, training, and dietary status. Oxidizable lipid fuels include circulating plasma triacylglycerols (TG), free fatty acids (FFAs), and muscle TG. Although

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circulating albumin-bound FFAs mobilized from adipose tissue contribute in significant proportion to lipid metabolism in skeletal muscle during exercise, the conditions during which FFA hydrolyzed from muscle and plasma TG contribute to lipid metabolism during exercise are less clearly defined. This article examines the contribution made by each of these lipid fuel sources to skeletal muscle metabolism during exercise and the regulatory mechanisms that control variations in their contributions

D. VITAMINS

Role of vitamins in general health

Vitamins are a group of substances that are needed for normal cell function, growth, and development. There are 13 essential vitamins. This means that these vitamins are required for the body to work properly. They are:

- Vitamin A
- Vitamin C
- Vitamin D
- Vitamin E
- Vitamin K
- Vitamin B1 (thiamine)
- Vitamin B2 (riboflavin)
- Vitamin B3 (niacin)
- Pantothenic acid (B5)
- Biotin (B7)
- Vitamin B6
- Vitamin B12 (cyanocobalamin)
- Folate (folic acid and B9)

Function of vitamins

Each of the vitamins listed below has an important job in the body. A vitamin deficiency occurs when you do not get enough of a certain vitamin. Vitamin deficiency can

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cause health problems. Not eating enough fruits, vegetables, beans, lentils, whole grains and fortified dairy foods may increase your risk for health problems, including heart disease, cancer, and poor bone health (osteoporosis).

- Vitamin A helps form and maintain healthy teeth, bones, soft tissue, mucous membranes, and skin.
- Vitamin B6 is also called pyridoxine. Vitamin B6 helps form red blood cells and maintain brain function. This vitamin also plays an important role in the proteins that are part of many chemical reactions in the body. The more protein you eat the more pyridoxine your body requires.
- Vitamin B12, like the other B vitamins, is important for metabolism. It also helps form red blood cells and maintain the central nervous system.
- Vitamin C, also called ascorbic acid, is an antioxidant that promotes healthy teeth and gums. It helps the body absorb iron and maintain healthy tissue. It is also essential for wound healing.
- Vitamin D is also known as the "sunshine vitamin," since it is made by the body after being in the sun. Ten to 15 minutes of sunshine 3 times a week is enough to produce the body's requirement of vitamin D for most people at most latitudes. People who do not live in sunny places may not make enough vitamin D. It is very hard to get enough vitamin D from food sources alone. Vitamin D helps the body absorb calcium. You need calcium for the normal development and maintenance of healthy teeth and bones. It also helps maintain proper blood levels of calcium and phosphorus.
- Vitamin E is an antioxidant also known as tocopherol. It helps the body form red blood cells and use vitamin K.
- Vitamin K is needed because without it, blood would not stick together (coagulate). Some studies suggest that it is important for bone health.
- Biotin is essential for the metabolism of proteins and carbohydrates, and in the production of hormones and cholesterol.
- Niacin is a B vitamin that helps maintain healthy skin and nerves. It also has cholesterol-lowering effects at higher doses.
- Folate works with vitamin B12 to help form red blood cells. It is needed for the production of DNA, which controls tissue growth and cell function. Any woman who

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is pregnant should be sure to get enough folate. Low levels of folate are linked to birth defects such as spina bifida. Many foods are now fortified with folic acid.

- Pantothenic acid is essential for the metabolism of food. It also plays a role in the production of hormones and cholesterol.
- Riboflavin (vitamin B2) works with the other B vitamins. It is important for body growth and the production of red blood cells.
- Thiamine (vitamin B1) helps the body cells change carbohydrates into energy. Getting enough carbohydrates is very important during pregnancy and breastfeeding. It is also essential for heart function and healthy nerve cells.
- Choline helps in normal functioning of the brain and nervous system. Lack of choline can cause swelling in liver.
- Carnitine helps the body to change fatty acids into energy.

Classification of vitamins

Vitamins are grouped into two categories:

- Fat-soluble vitamins are stored in the body's fatty tissue. The four fat-soluble vitamins are vitamins A, D, E, and K. These vitamins are absorbed more easily by the body in the presence of dietary fat.
- There are nine water-soluble vitamins. They are not stored in the body. Any leftover water-soluble vitamins leave the body through the urine. Although, the body keeps a small reserve of these vitamins, they have to be taken on a regular basis to prevent shortage in the body. Vitamin B12 is the only water-soluble vitamin that can be stored in the liver for many years.

Some “vitamin-like factors” are also needed by the body such as:

- Choline
- Carnitine

Fat soluble vitamins & food sources

Fat-soluble vitamins

Fat-soluble vitamins are stored in the body's cells and are not excreted as easily as water-soluble vitamins. They do not need to be consumed as often as water-soluble vitamins,

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although adequate amounts are needed. If you take too much of a fat-soluble vitamin, it could become toxic. A balanced diet usually provides enough fat-soluble vitamins. You may find it more difficult to get enough vitamin D from food alone and may consider taking a vitamin D supplement or a multivitamin with vitamin D in it.

Fat-soluble vitamins		
Nutrient	Function	Sources
Vitamin A (and its precursor*, beta-carotene) *A precursor is converted by the body to the vitamin.	Needed for vision, healthy skin and mucous membranes, bone and tooth growth, immune system health	Vitamin A from animal sources (retinol): fortified milk, cheese, cream, butter, fortified margarine, eggs, liver Beta-carotene (from plant sources): Leafy, dark green vegetables; dark orange fruits (apricots, cantaloupe) and vegetables (carrots, winter squash, sweet potatoes, pumpkin)
Vitamin D	Needed for proper absorption of <u>calcium</u> ; stored in bones	Egg yolks, liver, fatty fish, fortified milk, fortified margarine. When exposed to sunlight, the skin can make vitamin D.
Vitamin E	Antioxidant; protects cell walls	Polyunsaturated plant oils (soybean, corn, cottonseed, safflower); leafy green vegetables; wheat germ; whole-grain products; liver; egg yolks; nuts and seeds
Vitamin K	Needed for proper blood clotting	Leafy green vegetables such as kale, collard greens, and spinach; green vegetables such as broccoli, Brussels sprouts, and asparagus; also produced in <u>intestinal</u> tract by bacteria

Water-soluble vitamins

Water-soluble vitamins travel freely through the body, and excess amounts usually are excreted by the kidneys. The body needs water-soluble vitamins in frequent, small doses. These vitamins are not as likely as fat-soluble vitamins to reach toxic levels. But niacin, vitamin B6, folate, choline, and vitamin C have upper consumption limits. Vitamin B6 at high levels over a long period of time has been shown to cause irreversible nerve damage.

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A balanced diet usually provides enough of these vitamins. People older than 50 and some vegetarians may need to use supplements to get enough B12.

Water-soluble vitamins		
Nutrient	Function	Sources
Thiamine (vitamin B1)	Part of an enzyme needed for energy metabolism; important to nerve function	Found in all nutritious foods in moderate amounts: pork, whole-grain or enriched breads and cereals, legumes, nuts and seeds
Riboflavin (vitamin B2)	Part of an enzyme needed for energy metabolism; important for normal vision and skin health	Milk and milk products; leafy green vegetables; whole-grain, enriched breads and cereals
Niacin (vitamin B3)	Part of an enzyme needed for energy metabolism; important for nervous system, digestive system, and skin health	Meat, poultry, fish, whole-grain or enriched breads and cereals, vegetables (especially mushrooms, asparagus, and leafy green vegetables), peanut butter
Pantothenic acid	Part of an enzyme needed for energy metabolism	Widespread in foods
Biotin	Part of an enzyme needed for energy metabolism	Widespread in foods; also produced in intestinal tract by bacteria
Pyridoxine (vitamin B6)	Part of an enzyme needed for protein metabolism; helps make red blood cells	Meat, fish, poultry, vegetables, fruits
Folic acid	Part of an enzyme needed for making DNA and new cells, especially red blood cells	Leafy green vegetables and legumes, seeds, orange juice, and liver; now added to most refined grains
Cobalamin (vitamin B12)	Part of an enzyme needed for making new cells; important to nerve function	Meat, poultry, fish, seafood, eggs, milk and milk products; not found in plant foods
Ascorbic acid (vitamin C)	Antioxidant; part of an enzyme needed for protein metabolism; important for immune system health; aids in iron absorption	Found only in fruits and vegetables, especially citrus fruits, vegetables in the cabbage family, cantaloupe, strawberries, peppers, tomatoes, potatoes, lettuce, papayas, mangoes, kiwifruit

Vitamin needs

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Our body only needs a small amount of vitamins and minerals every day. A varied diet generally provides enough of each vitamin and mineral. However, some people may need supplements to correct deficiencies of particular vitamins or minerals.

People who may benefit from vitamin and mineral supplements include:

- pregnant women
- women who are breastfeeding
- people who drink alcohol above the amount that is recommended for reducing risk of disease (one standard drink a day for non-pregnant women and two for men)
- cigarette smokers
- illegal drug users
- crash dieters or people on chronic low-calorie diets
- the elderly (especially those who are disabled or chronically ill)
- some vegetarians or vegans
- women with excessive bleeding during menstruation
- people with allergies to particular foods
- people with malabsorption problems such as diarrhoea, coeliac disease or pancreatitis.

Women planning a pregnancy should consider taking folic acid (folate) supplements to reduce the risk of neural tube defects in the baby. Folic acid can also be found in some fortified foods such as some breads. Foods fortified with folic acid have the nutrient added to them during production to boost their nutritional value.

Older individuals, who need adequate amounts of vitamin D and synthetic vitamin B12. Individuals who do not drink enough milk and/or do not have adequate sun exposure to meet their vitamin D needs. Individuals on low-calorie diets that limit the amount of vitamins and minerals they can consume through food.

E. MINERALS

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Minerals and their importance to humans

Minerals- Functions and Sources

The body needs many minerals; these are called essential minerals. Essential minerals are sometimes divided up into major minerals (macrominerals) and trace minerals (microminerals). These two groups of minerals are equally important, but trace minerals are needed in smaller amounts than major minerals. The amounts needed in the body are not an indication of their importance.

A balanced diet usually provides all of the essential minerals. The two tables below list minerals, what they do in the body (their functions), and their sources in food.

Functions of essential metals

Many metals are used to make strong and durable everyday objects, like copper pipes or iron skillets. But they don't form such strong and durable objects in our bodies. Instead, many essential metals are needed to activate enzymes — molecules with important jobs in the body. And metals have many other essential roles as well. For example:

- **Calcium** builds bones and teeth; activates enzymes throughout the body; helps regulate blood pressure; and helps muscles to contract, nerves to send messages, and blood to clot.
- **Chromium** helps maintain normal blood sugar levels and helps cells draw energy from blood sugar.
- **Copper** assists with metabolizing fuel, making red blood cells, regulating neurotransmitters, and mopping up free radicals.
- **Iron** helps make hemoglobin (the oxygen-carrying chemical in the body's red blood cells) and myoglobin (a protein in muscle cells). Iron is essential for activating certain enzymes and for making amino acids, collagen, neurotransmitters, and hormones.
- **Magnesium**, like calcium, builds bones and teeth. It also helps to regulate blood pressure and blood sugar and enables muscles to contract, nerves to send messages, blood to clot, and enzymes to work.
- **Manganese** helps form bones and helps metabolize amino acids, cholesterol, and carbohydrates.

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- **Molybdenum** activates several enzymes that break down toxins and prevents the buildup of harmful sulfites in the body.
- **Potassium** balances fluids in the body, helps to maintain a steady heartbeat and to make muscles contract, and may benefit bones and blood pressure.
- **Sodium** balances fluids in the body, helps send nerve impulses, and helps make muscles contract.
- **Zinc** helps blood clot, helps make proteins and DNA, bolsters the immune system, and helps with wound healing and cell division.

Mineral deficiency and its influence on health, physical performance

Mineral deficiency.

Minerals are specific kinds of nutrients that your body needs in order to function properly. A mineral deficiency occurs when your body doesn't obtain or absorb the required amount of a mineral. The human body requires different amounts of each mineral to stay healthy. Specific needs are outlined in recommended daily allowances (RDA). The RDA is the average amount that meets the needs of about 97 percent of healthy people. They can be obtained from food, mineral supplements, and food products that have been fortified with extra minerals.

A deficiency often happens slowly over time and can be caused by a number of reasons. An increased need for the mineral, lack of the mineral in the diet, or difficulty absorbing the mineral from food are some of the more common reasons.

Mineral deficiencies can lead to a variety of health problems, such as weak bones, fatigue, or a decreased immune system.

Calcium deficiency

Calcium is needed for strong bones and teeth. It also supports proper function of your blood vessels, muscles, nerves, and hormones. Natural sources of calcium include milk, yogurt, cheese, and small fish with bones, beans, and peas. Vegetables such as broccoli, kale,

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and Chinese cabbage also provide calcium. Some foods are also fortified with the mineral, including tofu, cereals, and juices.

A calcium deficiency produces few obvious symptoms in the short term. That's because your body carefully regulates the amount of calcium in the blood. Lack of calcium over the long term can lead to decreased bone mineral density called osteopenia. If left untreated, osteopenia can turn to osteoporosis. This increases the risk of bone fractures, especially in older adults.

Severe calcium deficiency is usually caused by medical problems or treatments, such as medications (like diuretics), surgery to remove the stomach, or kidney failure. Symptoms of a severe deficiency include:

- cramping of the muscles
- numbness
- tingling in the fingers
- fatigue
- poor appetite
- irregular heart rhythms

Iron deficiency

More than half of the iron in your body is in red blood cells. Iron is an important part of hemoglobin, a protein that carries oxygen to your tissues. Iron is also a part of other proteins and enzymes that keep your body healthy. The best sources of iron are meat, poultry, or fish. Plant-based foods such as beans or lentils are also good sources.

Iron deficiency develops slowly and can cause anemia. It's considered uncommon in the United States and in people with healthy diets. But, the World Health Organization estimated in a 2008 report that iron deficiency causes approximately half of all anemia cases worldwide. The symptoms of iron-deficiency anemia include feeling weak and tired. You may be performing poorly at work or school. Children may exhibit signs through slow social and cognitive development.

Magnesium deficiency

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The body needs magnesium for hundreds of chemical reactions. These include responses that control blood glucose levels and blood pressure. Proper function of muscles and nerves, brain function, energy metabolism, and protein production are also controlled by magnesium. Roughly 60 percent of the body's magnesium resides in the bones while nearly 40 percent resides in muscle and soft tissue cells. Good sources of magnesium include:

- legumes
- nuts
- seeds
- whole grains
- green leafy vegetables, such as spinach

Magnesium deficiency is uncommon in healthy people. The kidneys can keep magnesium from leaving the body through the urine. Still, certain medications and chronic health conditions like alcoholism may cause magnesium deficiency. Magnesium needs are also highly influenced by the presence of disease. In this situation, the RDA for magnesium may not be sufficient for some individuals.

Early signs of magnesium deficiency include:

- fatigue
- weakness
- loss of appetite
- nausea
- vomiting

Magnesium deficiency can lead to the following symptoms if left untreated:

- numbness
- tingling
- muscle cramps
- seizures
- abnormal rhythms of the heart

Potassium deficiency

Potassium is a mineral that functions as an electrolyte. It's required for muscle contraction, proper heart function, and the transmission of nerve signals. It's also needed by a

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few enzymes, including one that helps your body turn carbohydrates into energy. The best sources of potassium are fruits and vegetables, such as bananas, avocado, dark leafy greens, beets, potatoes, and plums. Other good sources include orange juice and nuts.

The most common cause of potassium deficiency is excessive fluid loss. Examples can include extended vomiting, kidney disease, or the use of certain medications such as diuretics. Symptoms of potassium deficiency include muscle cramping and weakness. Other symptoms show up as constipation, bloating, or abdominal pain caused by paralysis of the intestines. Severe potassium deficiency can cause paralysis of the muscles or irregular heart rhythms that may lead to death.

Zinc deficiency

Zinc plays a role in many aspects of the body's metabolism. These include:

- protein synthesis
- immune system function
- wound healing
- DNA synthesis

It's also important for proper growth and development during pregnancy, childhood, and adolescence. Zinc is found in animal products like oysters, red meat, and poultry. Other good sources of zinc include:

- beans
- nuts
- whole grains
- dairy products

Zinc deficiency can cause loss of appetite, taste, or smell. Decreased function of the immune system and slowed growth are other symptoms. Severe deficiency can also cause diarrhea, loss of hair, and impotence. It can also prolong the process that your body takes to heals wounds.

symptoms of mineral deficiency.

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The symptoms of a mineral deficiency depend upon which nutrient the body lacks. Possible symptoms include:

- constipation, bloating, or abdominal pain
- decreased immune system
- diarrhea
- irregular heart beat
- loss of appetite
- muscle cramping
- nausea and vomiting
- numbness or tingling in the extremities
- poor concentration
- slow social or mental development in children
- weakness or tiredness

You may display one or more of these symptoms, and the severity may vary. Some symptoms may be so minor that they go unnoticed and undiagnosed. Contact your healthcare provider if you experience prolonged fatigue, weakness, or poor concentration. The symptoms may be a sign of a mineral deficiency or another health condition.

Macro minerals & food sources

Macrominerals

Major minerals		
Mineral	Function	Sources
Sodium	Needed for proper fluid balance, nerve transmission, and muscle contraction	Table salt, soy sauce; large amounts in processed foods; small amounts in milk, breads, vegetables, and unprocessed meats
Chloride	Needed for proper fluid balance, stomach acid	Table salt, soy sauce; large amounts in processed foods; small amounts in milk, meats, breads, and vegetables
Potassium	Needed for proper fluid balance, nerve transmission, and muscle contraction	Meats, milk, fresh fruits and vegetables, whole grains, legumes

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Calcium	Important for healthy bones and teeth; helps muscles relax and contract; important in nerve functioning, blood clotting, blood pressure regulation, immune system health	Milk and milk products; canned fish with bones (salmon, sardines); fortified tofu and fortified soy milk; greens (broccoli, mustard greens); legumes
Phosphorus	Important for healthy bones and teeth; found in every cell; part of the system that maintains acid-base balance	Meat, fish, poultry, eggs, milk, processed foods (including soda pop)
Magnesium	Found in bones; needed for making protein, muscle contraction, nerve transmission, immune system health	Nuts and seeds; legumes; leafy, green vegetables; seafood; chocolate; artichokes; "hard" drinking water
Sulfur	Found in protein molecules	Occurs in foods as part of protein: meats, poultry, fish, eggs, milk, legumes, nuts

Trace minerals & food sources

Trace minerals (microminerals)

The body needs trace minerals in very small amounts. Note that **iron** is considered to be a trace mineral, although the amount needed is somewhat more than for other microminerals.

Trace minerals		
Mineral	Function	Sources
Iron	Part of a molecule (hemoglobin) found in red blood cells that carries oxygen in the body; needed for energy metabolism	Organ meats; red meats; fish; poultry; shellfish (especially clams); egg yolks; legumes; dried fruits; dark, leafy greens; iron-enriched breads and cereals; and fortified cereals
Zinc	Part of many enzymes; needed for making protein and genetic material; has a function in taste perception, wound healing, normal fetal development, production of sperm, normal growth and sexual maturation, immune system health	Meats, fish, poultry, leavened whole grains, vegetables
Iodine	Found in thyroid hormone, which helps regulate growth, development, and metabolism	Seafood, foods grown in iodine-rich soil, iodized salt, bread, dairy products

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Selenium	Antioxidant	Meats, seafood, grains
Copper	Part of many enzymes; needed for iron metabolism	Legumes, nuts and seeds, whole grains, organ meats, drinking water
Manganese	Part of many enzymes	Widespread in foods, especially plant foods
Fluoride	Involved in formation of bones and teeth; helps prevent tooth decay	Drinking water (either fluoridated or naturally containing fluoride), fish, and most teas
Chromium	Works closely with insulin to regulate blood sugar (glucose) levels	Unrefined foods, especially liver, brewer's yeast, whole grains, nuts, cheeses
Molybdenum	Part of some enzymes	Legumes; breads and grains; leafy greens; leafy, green vegetables; milk; liver

Other trace nutrients known to be essential in tiny amounts include nickel, silicon, vanadium, and cobalt.

F. WATER, FIBER, ALCOHOL

FUNCTIONS OF WATER

It's common to hear that water is essential for your health. Water makes up a majority of your body weight and is involved in many important functions, including:

- flushing out waste from your body
- regulating body temperature
- helping your brain function

You get most of your water from drinking beverages, but food also contributes a small amount to your daily water intake.

1. It helps create saliva

Water is a main component of saliva. Saliva also includes small amounts of electrolytes, mucus, and enzymes. It's essential for breaking down solid food and keeping your mouth healthy. Your body generally produces enough saliva with regular fluid intake. However, your saliva production may decrease as a result of age or certain medications or therapies.

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2. It regulates your body temperature

Staying hydrated is crucial to maintaining your body temperature. Your body loses water through sweat during physical activity and in hot environments. Your sweat keeps your body cool, but your body temperature will rise if you don't replenish the water you lose. That's because your body loses electrolytes and plasma when it's dehydrated.

3. It protects your tissues, spinal cord, and joints

Water consumption helps lubricate and cushion your joints, spinal cord, and tissues. This will help you enjoy physical activity and lessen discomfort caused by conditions like arthritis.

4. It helps excrete waste through perspiration, urination, and defecation

Your body uses water to sweat, urinate, and have bowel movements. Sweat regulates body temperature when you're exercising or in warm temperatures. You need water to replenish the lost fluid from sweat. You also need enough water in your system to have healthy stool and avoid constipation. Your kidneys are also important for filtering out waste through urination. Adequate water intake helps your kidneys work more efficiently and helps to prevent kidney stones.

5. It helps maximize physical performance

Drinking plenty of water during physical activity is essential. Athletes may perspire up to 6 to 10 percent of body weight during physical activity. Hydration also affects your strength, power, and endurance. You may be more susceptible to the effects of dehydration if you're participating in endurance training or high-intensity sports such as basketball. Negative effects of exercise in the heat without enough water can include serious medical conditions, like decreased blood pressure and hyperthermia. Extreme dehydration can cause seizures and even death.

6. It helps prevent constipation

Eating fiber isn't the only way to prevent constipation. It's also important to maintain your water intake so your bowel movements contain enough water. If you don't consume enough water, magnesium, and fiber, you may be more likely to experience constipation. If you're already constipated, you may find that drinking carbonated water as well as plain water can help ease your symptoms.

7. It aids in digestion

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Contrary to what some believe, experts confirm drinking water before, during, and after a meal will help your body break down the food you eat more easily. This will help you digest food more effectively and get the most out of your meals. Research shows the body adapts to changes in the consistency of food and stomach contents, whether more solid or more liquid.

8. It helps with nutrient absorption

In addition to helping with food breakdown, water also helps dissolve vitamins, minerals, and other nutrients from your food. It then delivers these vitamin components to the rest of your body for use.

9. It helps you lose weight

Studies have linked body fat and weight loss with drinking water in both overweight girls and women. Drinking more water while dieting and exercising may just help you lose extra pounds.

10. It improves blood oxygen circulation

Water carries helpful nutrients and oxygen to your entire body. Reaching your daily water intake will improve your circulation and have a positive impact on your overall health.

11. It helps fight off illness

Drinking enough water can help prevent certain medical conditions. These include:

- constipation
- kidney stones
- exercise-induced asthma
- urinary tract infection
- hypertension

Water also helps you absorb important vitamins, minerals, and nutrients from your food, which will increase your chances of staying healthy.

12. It helps boost energy

Drinking water may activate your metabolism. A boost in metabolism has been associated with a positive impact on energy level. One study found that drinking 500 milliliters of water boosted the metabolic rate by 30 percent in both men and women. These effects appeared to last over an hour.

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13. It aids in cognitive function

Proper hydration is key to staying in tip-top cognitive shape. Research indicates that not drinking enough water can negatively impact your focus, alertness, and short-term memory.

14. It helps improve mood

Not getting enough water can also affect your mood. Dehydration may result in fatigue and confusion as well as anxiety.

15. It helps keep skin bright

Adequate water intake will help keep your skin hydrated and may promote collagen production. However, water intake alone isn't enough to reduce the effects of aging. This process is also connected to your genes and overall sun protection.

16. It prevents overall dehydration

Dehydration is the result of your body not having enough water. And because water is imperative to so many bodily functions, dehydration can be very dangerous.

Severe dehydration can result in a number of severe complications, including:

- swelling in your brain
- kidney failure
- seizures

Make sure you drink enough water to make up for what's lost through sweat, urination, and bowel movements to avoid dehydration.

Sport drinks

Sports drinks contain carbohydrates (sugars and glucose) and electrolytes (sodium) which feed muscles and replace chemicals lost during sweating enabling a person to sustain physical activity for long periods. Sports drinks are really intended for people doing a high level or strenuous physical activity. For most children and even adults, sports drinks aren't required to meet daily activity levels and it's best to consider sports drinks as a 'sometimes' drink rather than an 'every day' drink. The best way for you or your child to keep hydrated is to drink water.

Energy drinks

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In energy drinks, the key ingredient is caffeine that speeds up the central nervous system so your mind tells your body to keep going even though you may not be physically capable. This means that when the effects of the energy drink wear off, so does the person's energy. Energy drinks can contain a much higher dose of caffeine than other drinks kids are consuming and can be quite toxic.

ALCOHOL

Alcoholic drink

An alcoholic drink is a drink that contains ethanol, a type of alcohol produced by fermentation of grains, fruits, or other sources of sugar. The consumption of alcohol plays an important social role in many cultures. Most countries have laws regulating the production, sale, and consumption of alcoholic beverages.

Calories in alcohol

Apart from the negative effects drinking too much alcohol can have on health, alcohol also contains calories (7 kcals per gram) so can contribute to weight gain. Many people are not aware of the calories contained in alcoholic drinks. The calories (and units) can really add up. Have a look at our chart and see how many calories your tipple has. Alcohol may not only stimulate the appetite, but also weakens the resolve not to over-indulge, so any good intentions you might have about eating sensibly may be lost once you've had a few glasses.

Effects of alcohol on sports performance

Alcohol can alter your sports performance because of how it affects the body during exercise. It does this in several ways:

- Alcohol dehydrates you. This is because it is a diuretic, which means it makes your kidneys produce more urine. Therefore drinking too much alcohol can lead to dehydration. Exercising soon after drinking alcohol can make dehydration worse because you also sweat during exercise. Dehydration leads to reduced exercise performance. You need to be well hydrated when you exercise to maintain the flow of blood through your body, which is essential for carrying oxygen and nutrients to your muscles, thus maximising performance.

- Alcohol can interfere with the way your body makes energy. Alcohol is broken down in the liver. When you are breaking down alcohol, all other functions of the liver are secondary, one function involves glucose production, we need glucose for energy. If your liver is not producing enough glucose, your body will become tired as it works to expel the alcohol, making it even more of a struggle to keep up the pace.
- Alcohol slows down the nerves that pass messages around the body, causing a relaxed feeling. This effect can take time to wear off and this can result in your reactions, coordination, accuracy and balance being slower than usual during exercise and competition.

Exercising the day after the night before

- Drinking alcohol the night before exercise could have a negative influence on your performance the following day. It is not possible to perform at your best if you are feeling any of the effects normally associated with a hangover such as dehydration or headache.
- During exercise, your muscles burn glucose for energy. This produces lactic acid. Too much lactic acid leads to muscle fatigue and cramps. If you exercise after drinking your liver will be working harder to get rid of the toxins from the alcohol so it will be slower to clear out the lactic acid thus, increasing the likelihood of cramps. You will also lack strength or power and are more likely to feel tired quicker.
- For these reasons it is advisable to avoid alcohol the night before exercise, especially if it is due to be moderate or intense activity. However, if you do decide to drink, ideally limit the number of drinks and take alcohol with food.
- Drinking directly after exercise is also not advisable if you have not consumed enough water to replace the fluids you lost through sweating.

Effect of alcohol on blood sugar, blood lipids

Regular consumption of even moderate amounts of alcohol (i.e., two to four drinks per day), however, clearly interferes with diabetic blood sugar control and increases the risk of impotence; peripheral neuropathy; and, possibly, retinopathy.

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- While moderate amounts of alcohol may cause blood sugar to rise, excess alcohol can actually decrease your blood sugar level -- sometimes causing it to drop into dangerous levels, especially for people with type 1 diabetes.
- Beer and sweet wine contain carbohydrates and may raise blood sugar.
- Alcohol stimulates your appetite, which can cause you to overeat and may affect your blood sugar control.
- Alcoholic drinks often have a lot of calories, making it more difficult to lose excess weight.
- Alcohol may also affect your judgment or willpower, causing you to make poor food choices.
- Alcohol can interfere with the positive effects of oral diabetes medicines or insulin.
- Alcohol may increase triglyceride levels.
- Alcohol may increase blood pressure.
- Alcohol can cause flushing, nausea, increased heart rate, and slurred speech.

FIBRE

What is fibre?

Dietary fibre is a term that is used for plant-based carbohydrates that, unlike other carbohydrates (such as sugars and starch), are not digested in the small intestine and so reaches the large intestine or colon.

Soluble and insoluble fibre

You may have heard of the terms ‘soluble fibre’ or ‘insoluble fibre’ – these are words that are sometimes used to describe the types of fibre in our diet. Although scientific organisations argue that these terms are no longer really appropriate, you may see these terms being used, with soluble fibre including pectins and beta glucans (found for example in foods like fruit and oats) and insoluble fibre including cellulose (found for example in wholegrains and nuts). What is important to remember is that fibre-rich foods typically contain both types of fibre.

Fibre rich foods include:

- Wholegrain breakfast cereals, wholewheat pasta, wholegrain bread and oats, barley and rye

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- Fruit such as berries, pears, melon and oranges
- Vegetables such as broccoli, carrots and sweetcorn
- Peas, beans and pulses
- Nuts and seeds
- Potatoes with skin

How does fibre benefit health?

Fibre helps to keep our digestive system healthy and helps to prevent constipation. For example, fibre bulks up stools, makes stools softer and easier to pass and makes waste move through the digestive tract more quickly.

Fibre and bowel cancer

We know that dietary fibre may help to protect against bowel cancer. Although the reasons for this are not fully understood, this may be because fibre increases stool size, dilutes content and moves it faster through the gut so the amount of time waste products stay in contact with the bowel is reduced. Some types of fibre may also help gut bacteria produce helpful chemicals that can have beneficial effects on the bowel (see below).

Fibre and good bacteria

Research has increasingly shown how important the bacteria in our gut may be to our health, and it has been suggested that a fibre rich diet can help increase the good bacteria in the gut. Some fibre types provide a food source for ‘friendly’ gut bacteria helping them to increase and produce substances which are thought to be protective such as short-chain fatty acids.

How much fibre do we need?

The new guidelines recommends that the population's fibre intake should increase to 30g a day for adults (aged 17 years and over). On average, we consume much less than this - about 18g per day. Children also need to increase their intake of fibre. Recommended intakes of fibre are shown below.

<i>Age (years)</i>	<i>Recommended intake of fibre</i>
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2-5	15g per day
5-11	20g per day
11-16	25g per day
17 and over	30g per day

To increase your fibre intake you could:

- Choose a high fibre breakfast cereal e.g. wholegrain cereal like wholewheat biscuit cereal, no added sugar muesli, bran flakes or porridge. Why not add some fresh fruit, dried fruit, seeds and/or nuts.
- Go for wholemeal or seeded wholegrain breads. If your family only typically likes white bread, why not try the versions that combine white and wholemeal flours as a start.
- Choose wholegrains like wholewheat pasta, bulgur wheat or brown rice.
- Go for potatoes with skins e.g. baked potato, wedges or boiled new potatoes – you can eat these hot or use for a salad.
- For snacks try fruit, vegetable sticks, rye crackers, oatcakes, unsalted nuts or seeds.
- Include plenty of vegetables with meals – either as a side dish/salad or added to sauces, stews or curries – this is a good way of getting children to eat more veg.
- Keep a supply of frozen vegetables so you are never without.
- Add pulses like beans, lentils or chickpeas to stews, curries and salads.
- Have some fresh or fruit canned in natural juice for dessert or a snack.

Fibre and Irritable Bowel Syndrome (IBS)

People with IBS are usually well aware that diet can play an important part in controlling symptoms, and are often advised to modify the amount of fibre in their diet. For example, the BDA recommend that if symptoms include constipation then gradually increasing fibre intake may help, particularly wholegrains, oats, fruit, vegetables and linseeds as these may help to soften stools and make them easier to pass. If symptoms include diarrhoea though it may be helpful to try reducing intake of some high fibre food such as wholegrain breakfast cereals and breads.

UNIT-II
NUTRITIONAL MEASURES

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A. Nutrition And energy balance

Energy

Energy is a property of objects which can be transferred to other objects or converted into different forms, but cannot be created or destroyed. Organisms use energy to survive, grow, respond to stimuli, reproduce, and for every type of biological process.

Measuring energy content of food

A calorie is a unit that is used to measure energy. The Calorie you see on a food package is actually a kilocalorie, or 1,000 calories. A Calorie (kcal) is the amount of energy needed to raise the temperature of 1 kilogram of water 1 degree Celsius.

A calorie, like a joule, is a unit of energy. The International System of Units (SI) unit for energy is the *joule*; however, the *calorie* is commonly used for a unit of food energy. A calorie is equal to the amount of energy per unit mass required to raise the temperature of 1 g of water by 1° C. One calorie is the equivalent of 4.18 joules. Food calories, as read off a nutrition label, are actually kilocalories (often denoted as “Calories” with a capital C). There are 1,000 calories in a kilocalorie, or food Calorie.

A calorimeter is a piece of equipment designed to measure the energy released or absorbed during a chemical reaction or phase change. Food calorimetry allows us to determine the number of calories per gram of food. In this activity, a piece of food is burned and the released energy is used to heat a known quantity of water. The temperature change (ΔT) of the water is then used to determine the amount of energy in the food.

C. Weight for height and gender

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WOMEN				MEN			
Height Ft. In.	Frame Size			Height Ft. In.	Frame Size		
	Small	Med.	Large		Small	Med.	Large
4'10"	102-111	109-121	118-131	5'2"	128-134	131-141	138-150
4'11"	103-113	111-123	120-134	5'3"	130-138	133-143	140-153
5'0"	104-115	113-126	122-137	5'4"	132-138	138-148	142-158
5'1"	106-118	115-129	125-140	5'5"	134-148	137-148	144-160
5'2"	108-121	118-132	128-143	5'6"	136-142	139-151	146-164
5'3"	111-124	121-135	131-147	5'7"	138-145	142-154	149-169
5'4"	114-127	124-138	134-151	5'8"	140-148	145-157	152-172
5'5"	117-130	127-141	137-155	5'9"	142-151	150-160	155-170
5'6"	120-133	130-144	140-159	5'10"	144-154	151-163	158-180
5'7"	123-136	133-144	143-163	5'11"	146-157	154-166	161-184
5'8"	126-139	136-150	146-167	6'0"	148-160	157-170	164-186
5'9"	129-142	139-153	149-170	6'1"	152-164	160-174	168-192
5'10"	132-145	142-156	152-173	6'2"	155-168	165-178	172-191
5'11"	135-148	145-159	155-176	6'3"	158-172	167-182	176-202
6'0"	138-151	148-162	158-176	6'4"	162-176	171-187	181-207

D.BMI

The body mass index (BMI) is a measure that uses your height and weight to work out if your weight is healthy. The BMI calculation divides an adult's weight in kilograms by their height in metres squared. For example, A BMI of 25 means 25kg/m².

BMI ranges

For most adults, an ideal BMI is in the 18.5 to 24.9 range.

For children and young people aged 2 to 18, the BMI calculation takes into account age and gender as well as height and weight.

If your BMI is:

- below 18.5 – you're in the underweight range
- between 18.5 and 24.9 – you're in the healthy weight range

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- between 25 and 29.9 – you're in the overweight range
- between 30 and 39.9 – you're in the obese range

Understanding BMI, values for Asians,

Your ethnic group can also affect your risk of some health conditions. For example, adults of Asian origin may have a higher risk of health problems at BMI levels below 25. If all Asian groups are combined, their BMI is 1·3 kg/m² ($\pm 0\cdot 1$) lower in females and 1·4 kg/m² ($\pm 0\cdot 1$) lower in males compared with their European counterparts. If rural Thai are not included, these values are slightly higher at 1·4 kg/m² ($\pm 0\cdot 1$) and 1·6 kg/m² ($\pm 0\cdot 1$) for females and males, respectively.

Health implications, risk for Non communicable disease (NCD)

Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behaviours factors. The main types of NCDs are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes.

- Noncommunicable diseases (NCDs) kill 41 million people each year, equivalent to 71% of all deaths globally.
- Each year, 15 million people die from a NCD between the ages of 30 and 69 years; over 85% of these "premature" deaths occur in low- and middle-income countries.
- Cardiovascular diseases account for most NCD deaths, or 17.9 million people annually, followed by cancers (9.0 million), respiratory diseases (3.9million), and diabetes (1.6 million).
- These 4 groups of diseases account for over 80% of all premature NCD deaths.
- Tobacco use, physical inactivity, the harmful use of alcohol and unhealthy diets all increase the risk of dying from a NCD.
- Detection, screening and treatment of NCDs, as well as palliative care, are key components of the response to NCDs.

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Prevalence of Non communicable disease among Indian population

In India, non-communicable diseases (NCDs) accounted for 40% of all hospital stays and 35% of all outpatient visits in 2004 (1). Also, chronic diseases are estimated to account for 53% of all deaths and 44% of disability-adjusted life-years (DALYs) lost in 2005. As of 2005, India experienced the “highest loss in potentially productive years of life” worldwide. The four leading chronic diseases in India, as measured by their prevalence, are in descending order: cardiovascular diseases (CVDs), diabetes mellitus, chronic obstructive pulmonary disease (COPD) and cancer. All four of these diseases are projected to continue to increase in prevalence in the near future. The projected cumulative loss of national income for India due to non-communicable disease mortality for 2006–2015 is expected to be USD237 billion. By 2030, this productivity loss is expected to double to 17.9 million years lost. In India, there is no regular system for collecting data on non-communicable diseases (NCDs)-which can be said to be of adequate coverage or quality.

E. Actual food intake Vs recommended intake

Food Frequency Questionnaires (FFQ)

Food Frequency Questionnaires (FFQ) are a method for collecting dietary data and use a context-specific food list to estimate the usual diet and understand the relationship between consumption patterns and health outcomes. Data from FFQs are advantageous for measuring consumption of specific foods or specific nutrients consumed by a given population. Because FFQs do not typically weigh foods or quantify using household utensils, they tend to not be as accurate as other quantitative dietary assessment methods (e.g. 24-hour Dietary Recalls and Weighed Food Records).

Food Frequency Questionnaires (FFQ) are a type of dietary assessment instrument that attempts to capture an individual's usual food consumption by querying the frequency at which the respondent consumed food items based on a predefined food list.

FFQs are a common method for measuring dietary patterns in large epidemiological studies of diet and health. FFQs are often limited to the food items that are a source of

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nutrients related to the particular dietary exposures under study, for example, fruit and vegetable consumption or foods with high levels of saturated fat. Dietary diversity scores are a type of metric that are often calculated from a simplified FFQ (see the description of Dietary Diversity metrics to learn more). Food consumption modules of Household Consumption and Expenditure Surveys (HCES) that use a food list and an extended recall period can also be considered a type of FFQ.

In general, FFQs rely on a longer recall period in order to capture foods that are not consumed every day but are still part of the individual's typical diet. FFQ recall periods vary greatly, but typically range from 7 to 30 days (although some are as long as one year).

Strengths:

- Better at estimating 'usual diet' due to longer recall period than the 24-hour Dietary Recall or 24-hour Weighed Food Records
- Captures individual-level dietary patterns
- FFQs can be easier and less time-consuming to implement than a 24-hour Dietary Recall, if the food list is relatively short (e.g. <100 items)

Weaknesses:

- FFQs require substantial up-front investment to develop and validate the instrument (food list and quantities) for a given context or country.
- Usual frequency of intake is prone to measurement error, particularly with recall periods longer than seven days (and usual portion size questions are prone to measurement error)
- If the FFQ is too long it can be more time consuming to administer than a standard 24-hour Dietary Recall and cause respondent fatigue
- Like most surveys, to capture seasonal variation data collection must span the entire year or be repeated in multiple seasons

Food records

Food records (also called dietary records or dietary diaries) collect data on dietary intake by subjects' self-record over a specified period. This dietary assessment approach does not rely on individual's memory since respondents are asked to record foods and beverages as they are consumed throughout the reporting day (a "real-time" accounting).

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24 hr diet recall

A 24-hour dietary recall (24HR) is a structured interview intended to capture detailed information about all foods and beverages (consumed by the respondent in the past 24 hours, most commonly, from midnight to midnight the previous day). A key feature of the 24HR is that, when appropriate, the respondent is asked for more detailed information than first reported. For example, a respondent reporting chicken for dinner or a sandwich for lunch would be asked about the preparation method and type of bread. This open-ended response structure is designed to prompt respondents to provide a comprehensive and detailed report of all foods and beverages consumed.

In addition to other detailed descriptors, such as time of day and source of food, portion size of each food and beverage is captured. Food models, pictures, and other visual aids may be used to help respondents judge and report portion size and may improve accuracy.

Dietary recalls typically ask about foods and beverages first, before questions on dietary supplements

Diet history

A dietary history is a structured interview method consisting of questions about habitual intake of foods from the core (e.g. meat and alternatives, cereals, fruit and vegetables, dairy and 'extras') food groups in the last seven days.

Duplicate food collections

Duplicate diets are assessments of dietary intake by retaining a duplicate portion of all food and drinks consumed during the study period. Assessment of dietary intake by duplicate diets is considered the gold standard method of assessing nutrient intakes, in particular minerals, at an individual level.

Source of error in dietary measurement

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Sources of measurement errors in dietary survey methods include: respondent bias, interview bias, respondent memory lapses, incorrect estimation of portion size, flat slope syndrome, coding and computation data, and error during nutrient analysis of food items.

F. Dietary reference values

Dietary reference values (DRVs) is an umbrella term for a set of nutrient reference values that includes the average requirement (AR), the population reference intake (PRI), the adequate intake (AI) and the reference intake range for macronutrients (RI). Dietary Reference Values (DRVs) are important for supporting public health, developing labelling laws and identifying populations at risk of over- or under-consumption. However, the process of developing them is complex, and they should not be viewed as recommendations or goals for individuals

Table 1: Nutritional Requirements at Different Life-Stages

Infants	First 4-6 months of life (period of rapid growth and development) breast milk (or infant formula) contains all the nutrients required. Between 6-12 months - requirements for iron, protein, thiamin, niacin, vitamin B6, vitamin B12, magnesium, zinc, sodium and chloride increase. Department of Health advice recommends exclusive breastfeeding until 6 months of age with weaning introduced at 6 months.
1-3 years	Energy requirements increase (children are active and growing rapidly). Protein requirements increase slightly. Vitamins requirements increase (except vitamin D). Mineral requirements decrease for calcium, phosphorus and iron and increase for the remaining minerals (except for Zinc).
4-6 years	Requirements for energy, protein, all the vitamins and minerals increase except C and D and iron.
7-10 years	Requirements for energy, protein, all vitamins and minerals increase except thiamin, vitamin C and A.

11-14 years	<p>Requirements for energy continue to increase and protein requirements increase by approximately 50%.</p> <p>By the age of 11, the vitamin and mineral requirements for boys and girls start to differ.</p> <p>Boys: increased requirement for all the vitamins and minerals.</p> <p>Girls: no change in the requirement for thiamin, niacin, vitamin B6, but there is an increased requirement for all the minerals. Girls have a much higher iron requirement than boys (once menstruation starts).</p>
15-18 years	<p>Boys: requirements for energy and protein continue to increase as do the requirements for a number of vitamins and minerals (thiamin, riboflavin, niacin, vitamins B6, B12, C and A, magnesium, potassium, zinc, copper, selenium and iodine). Calcium requirements remain high as skeletal development is rapid.</p> <p>Girls: requirements for energy, protein, thiamin, niacin, vitamins B6, B12 and C, phosphorus, magnesium, potassium, copper, selenium and iodine all increase.</p> <p>Boys and girls have the same requirement for vitamin B12, folate, vitamin C, magnesium, sodium, potassium, chloride and copper. Girls have a higher requirement than boys for iron (due to menstrual losses) but a lower requirement for zinc and calcium.</p>
19-50 years	<p>Requirements for energy, calcium and phosphorus are lower for both men and women than adolescents and a reduced requirement in women for magnesium, and in men for iron. The requirements for protein and most of the vitamins and minerals remain virtually unchanged in comparison to adolescents (except for selenium in men which increases slightly).</p>
Pregnancy	<p>Increased requirements for some nutrients. Women intending to become pregnant and for the first 12 weeks of pregnancy are advised to take supplements of folic acid. Additional energy and thiamin are required only during the last three months of pregnancy. Mineral requirements do not increase.</p>
Lactation	<p>Increased requirement for energy, protein, all the vitamins (except B6), calcium, phosphorus, magnesium, zinc, copper and selenium.</p>
50+ years	<p>Energy requirements decrease gradually after the age of 50 in women and age 60 in men as people typically become less active and the basal metabolic rate is</p>

reduced. Protein requirements decrease for men but continue to increase slightly in women. The requirements for vitamins and minerals remain virtually unchanged for both men and women.

After the menopause, women's requirement for iron is reduced to the same level as that for men.

After the age of 65 there is a reduction in energy needs but vitamins and minerals requirements remain unchanged. This means that the nutrient density of the diet is even more important.

Nutritional health

Obesity -Epidemiology - Prevalence of obesity in India -Causes and treatment - Cause of obesity

OBESITY

To most people, the term "obesity" means to be very overweight. Health professionals define "overweight" as an excess amount of body weight that includes muscle, bone, fat, and water. "Obesity" specifically refers to an excess amount of body fat. Some people, such as bodybuilders or other athletes with a lot of muscle, can be overweight without being obese. Obesity is defined as the presence of excess adipose tissue. In normal individuals the percentage of body tissue that is adipose tissue varies by gender (greater in postpubertal females than males) and age (about 12% at birth, increasing to 25% at 5 months, then decreasing to 15% to 18% during puberty).

Obesity is defined as an excessively high amount of body fat or adipose tissue in relation to lean body mass. The amount of body fat (or adiposity) includes concern for both the distribution of fat throughout the body and the size of the adipose tissue deposits. Everyone needs a certain amount of body fat for stored energy, heat insulation, shock absorption, and other functions. As a rule, women have more body fat than men. Most health care providers agree that men with more than 25 percent body fat and women with more than 30 percent body fat are obese.

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Body Mass Index

BMI uses a mathematical formula based on a person's height and weight. BMI equals weight in kilograms divided by height in meters squared ($\text{BMI} = \text{kg}/\text{m}^2$). A BMI of 25 to 29.9 indicates a person is overweight. A person with a BMI of 30 or higher is considered obese. For adults and adolescents, significant obesity in adults has been defined as a body mass index $\geq 30 \text{ kg}/\text{m}^2$ or $\geq 130\%$ ideal body weight for height. Individuals with a BMI of 25 to 29.9 are considered overweight, while individuals with a BMI of 30 or more are considered obese. Like the weight-to-height table, BMI does not show the difference between excess fat and muscle. BMI, however, is closely associated with measures of body fat. It also predicts the development of health problems related to excess weight. For these reasons, BMI is widely used by health care providers.

Causes of Obesity

In scientific terms, obesity occurs when a person consumes more calories than he or she burns. What causes this imbalance between calories in and calories out may differ from one person to another. Genetic, environmental, psychological, and other factors may all play a part.

Genetic factors

Obesity tends to run in families, suggesting a genetic cause. Yet families also share diet and lifestyle habits that may contribute to obesity. Separating these from genetic factors is often difficult. Even so, science shows that heredity is linked to obesity.

Environmental factors

Genes do not destine people to a lifetime of obesity, however. Environment also strongly influences obesity. This includes lifestyle behaviors such as what a person eats and his or her level of physical activity. Although one cannot change the genetic makeup, you can change your eating habits and levels of activity.

Psychological factors

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Psychological factors may also influence eating habits. Many people eat in response to negative emotions such as boredom, sadness, or anger. Most overweight people have no more psychological problems than people of average weight. This disorder is even more common in people who are severely obese.

Other causes of obesity

Some illnesses can lead to obesity or a tendency to gain weight. These include hypothyroidism, Cushing's syndrome, depression, and certain neurological problems that can lead to overeating. Also, drugs such as steroids and some antidepressants may cause weight gain.

Consequences of Obesity

Health Risks

Obesity is more than a cosmetic problem and several serious medical conditions have been linked to obesity, including type 2 diabetes, heart disease, high blood pressure, and stroke. Obesity is also linked to higher rates of certain types of cancer. Obese men are more likely than non-obese men to die from cancer of the colon, rectum, or prostate. Obese women are more likely than non-obese women to die from cancer of the gallbladder, breast, uterus, cervix, or ovaries.

Other diseases and health problems linked to obesity include:

- Gallbladder disease and gallstones.
- Liver disease.
- Osteoarthritis, a disease in which the joints deteriorate. This is possibly the result of excess weight on the joints.
- Gout, another disease affecting the joints.
- Pulmonary (breathing) problems, including sleep apnea in which a person can stop breathing for a short time during sleep.
- Reproductive problems in women, including menstrual irregularities and infertility.

Psychological and social effects

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Emotional suffering may be one of the most painful parts of obesity. Many people think that obese individuals are gluttonous, lazy, or both, even though this is not true. As a result, obese people often face prejudice or discrimination in the job market, at school, and in social situations. Feelings of rejection, shame, or depression are common.

Health Effects of Obesity

Persons with obesity are at risk of developing one or more serious medical conditions, which can cause poor health and premature death. Obesity is associated with more than 30 medical conditions, and scientific evidence has established a strong relationship with at least 15 of those conditions. Preliminary data also show the impact of obesity on various other conditions. Weight loss of about 10% of body weight, for persons with overweight or obesity, can improve some obesity-related medical conditions including diabetes and hypertension.

Summary of Health consequences due to Obesity

Overweight and obese individuals (BMI of 25 and above) are at increased risk for physical ailments such as

- High blood pressure (hypertension)
- High blood cholesterol (dyslipidemia)
- Type 2 (non-insulin dependent) diabetes
- Insulin resistance, glucose intolerance
- Hyperinsulinemia
- Coronary heart disease
- Angina pectoris
- Congestive heart failure
- Stroke
- Gallstones
- Cholescystitis and cholelithiasis
- Gout
- Osteoarthritis
- Obstructive sleep apnea and respiratory problems
- Some types of cancer (such as endometrial, breast, prostate, and colon)
- Complications of pregnancy

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- Poor female reproductive health (such as menstrual irregularities, infertility, irregular ovulation)
- Bladder control problems (such as stress incontinence)
- Uric acid nephrolithiasis
- Psychological disorders (such as depression, eating disorders, distorted body image, and low self esteem).

Correction of obesity

Weight Reduction

Health care providers generally agree that people who have a BMI of 30 or more can improve their health through weight loss. This is especially true for people who are severely obese. Preventing additional weight gain is recommended if you have a BMI between 25 and 29.9, unless you have other risk factors. Obesity experts recommend you try to lose weight if you have two or more of the following:

- **Family history of certain chronic diseases.** If you have close relatives who have had heart disease or diabetes, you are more likely to develop these problems if you are obese.
- **Pre-existing medical conditions.** High blood pressure, high cholesterol levels, or high blood sugar levels are all warning signs of some obesity-associated diseases.
- **"Apple" shape.** If your weight is concentrated around your waist, you may have a higher risk of heart disease, diabetes, or cancer than people of the same weight who have a "pear" shape.

Fortunately, a weight loss of 5 to 10 percent can do much to improve health by lowering blood pressure and cholesterol levels. In addition, recent research has shown that a 5- to 7-percent weight loss can prevent type 2 diabetes in people at high risk for the disease.

Treatment for obesity

The method of treatment depends on the level of obesity, overall health condition, and motivation to lose weight. Treatment may include a combination of diet, exercise, behavior modification, and sometimes weight-loss drugs. In some cases of severe obesity, gastrointestinal surgery may be recommended.

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Physical Activity and Obesity

- A decrease in the amount of daily activity related to work, transportation and personal work is believed to contribute to the high percentage of overweight and obesity today.
- Moderate physical activity, progressing to 30 minutes or more on most or preferably all days of the week is recommended for weight loss.
- Physical activity is reported to be a key part of maintaining weight loss.
- Abdominal fat, and in some cases waist circumference can be modestly reduced through physical activity.

Exercise & Weight Loss

- With a typical exercise program, it is common to maintain weight yet lose fat and gain muscle
 - Girth can decrease since muscle is denser than fat.
 - A sheer gain in muscle results in a lower percent of body fat
 - More exercise and improvements in diet may be needed for substantial loss of fat
- Regular body composition tests can assess the effectiveness of a program
 - Absolute weight of fat and lean body weight should be tracked and analyzed
 - Caloric intake/expenditure goals can be adjusted accordingly
- A review of the literature suggests in order to achieve significant fat loss with aerobic activity
 - Exercise or activity must be performed most days of the week.
 - Progress to at least 45 minutes, 60-90 minutes recommended
 - Aerobic exercise should be between 60 to 80% maximum heart rate for progressively longer durations.
 - Lower intensities must be continued for very long durations
- Intense exercise (eg. weight training, HIIT, plyometrics, sprints) can increase metabolic rate for hours after the vigorous workout.
- The combination of anaerobic and aerobic activity results in faster fat loss than anaerobic or aerobic activity alone.
 - Intense anaerobic exercise increases the metabolism hours after exercise
 - Aerobic exercise burns fat during exercise, but has little effect afterwards
- Exercise (particularly weight training) develops muscle

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- Restores muscle that had been lost over the years of a sedentary modern lifestyle.
 - One pound of muscle can burn 30 to 50 Calories a day
 - One pound of fat burns only 3 Calories a day

□

Role of Diet

95% of people who lose weight with diet gain most of the weight back within 3 to 5 years. Often times more fat is gained back due to yo-yo dieting.

1. Most diets restrict your caloric intake so much that your metabolism slows down.
 - Drastically reducing calories can slow your metabolism and hinder the weight loss process
 - Very subtle decreases in calories may result in more permanent weight loss
 - If too few of calories are being consumed, simultaneous adjustments should be made
 - increase calories throughout day by eating 3 balance meals and 2-3 snacks
 - increase anaerobic activity and aerobic activity
2. Dieting may result in depression, which is counter productive to losing weight.
 - Depriving yourself of food can lead to depriving yourself of social events. You may give up eating meals out or eating with friends because you don't want to eat something off your diet. This can lead to depression and possible overeating to compensate for what you're missing.
3. Most diets don't encourage lifestyle changes.
 - Making temporary changes in eating habits or eating prepackaged foods from weight loss programs will facilitate weight loss. However, when you reach your goals or go off the weight loss program, you may be more likely to return to old eating habits and gain the weight back (and possibly more). To have permanent weight loss, you must make permanent changes in food choices and eating habits.
4. With very low calorie diets, weight loss is usually lean body weight.
 - Diets that severely restricts caloric intake, facilitates loss of lean body weight as opposed to fat weight. This can result in a person who isn't overweight, but has a high body fat composition.

Body composition analysis – various technique

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WATER DISPLACEMENT METHOD: UNDER WATER WEIGHING METHODS

Hydrostatic underwater weighing is a form of densitometry (another being air displacement plethysmography), which derives body composition from body density and body volume. The procedure is based on Archimedes' principle, which states that: *The buoyant force which water exerts on an immersed object is equal to the weight of water that the object displaces.*

It is based upon the classic two-component (2-C) model of body composition which assumes that body weight is composed of fat free mass (FFM) with a constant density of 1.10 kg/L, and fat mass (FM) with a constant density of 0.90 kg/L. The density of the whole body, therefore, depends upon the relative size of these two components. As bone and muscle are denser than water, a person with a larger percentage of fat free mass will weigh more in the water, and have a lower percent body fat. Conversely, fat is less dense than water. Therefore, a large amount of fat mass will make the body lighter in the water and have a higher percent body fat.

KINANTHROPOMETRIC DETERMINATION OF THE BODY COMPOSITION (SKINFOLD THICKNESS)

TOTAL body fat. This total body fat can be split into **2** categories...

Storage Fat -- This consists mainly of fat deposited just under the skin or subcutaneous fat. Storage fat for men and women is fairly similar. For the **average** man 12% of bodyweight is storage fat and for the **average** woman 15% of bodyweight is storage fat.

Essential Body Fat -- For the body to function normally and healthily a certain amount of body fat is required. This is called **essential fat**. For women the **average** amount of essential fat is 12% of bodyweight and for men it is 3%. Trying to achieve a body fat percentage that is so low it affects your **essential fat** stores is not good for your health. Some storage fat is also required for good health. It's used to protect internal organs in the chest and abdomen.

BIOELECTRICAL IMPEDANCE ANALYSIS

Bioelectrical impedance analysis (BIA) is a commonly used method for estimating body composition, in particular body fat and muscle mass. In BIA, a weak electric current flows through the body and the voltage is measured in order to calculate impedance

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(resistance) of the body. Most of our body water is stored in our muscle. Therefore, if a person is more muscular there is a high chance that the person will also have more body water, which leads to lower impedance. Since the advent of the first commercially available devices in the mid-1980s the method has become popular owing to its ease of use and portability of the equipment. It is familiar in the consumer market as a simple instrument for estimating body fat. BIA actually determines the electrical impedance, or opposition to the flow of an electric current through body tissues which can then be used to estimate total body water (TBW), which can be used to estimate fat-free body mass and, by difference with body weight, body fat.

ULTRASOUND ASSESSMENT OF FAT

Ultrasonography, or ultrasound, is an imaging technique and has been shown to be an alternative, non-invasive and reliable method to estimate visceral adipose tissue (VAT), subcutaneous adipose tissue (SCAT) and liver steatosis (fatty liver).

Ultrasound images are created by computer and digital memory from the transmission and reception of mechanical high-frequency waves applied through a transducer. The ultrasound waves spread through the body, producing an echo where density changes occur. For instance, in the case of human tissue, an echo is created where a signal passes from an adipose tissue region to a muscular tissue region. The echoes return to the transducer, where they are converted back into electrical signals that are amplified to form a digital image displayed on a monitor.

X-RAY ASSESSMENT OF FAT

Dual-energy X-ray absorptiometry (DEXA) is an imaging technique. A DEXA scan requires medical supervision by a radiologist and some consider it to be the new "Gold Standard" in body composition testing. Total body scans using DEXA give accurate and precise measurements of body composition, including bone mineral content (BMC), bone mineral density (BMD), lean tissue mass, fat tissue mass, and fractional contribution of fat. It provides whole body and regional estimates of the three main body components: fat, lean soft tissues and bone mineral mass. Some software can estimate visceral fat from the android/abdominal region (validated only in adults).

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COMPUTED TOMOGRAPHY (CT) ASSESSMENT OF FAT

Computed tomography (CT) is a radiographic method commonly used in medical imaging. In terms of its usefulness in body composition measurement, it produces thin cross-sectional high resolution images that can be processed to differentiate and measure volumes of fat and lean tissue. It provides important quantitative data on the composition of muscle and the distribution of adipose tissue. This is important in examining the relationships among skeletal muscle metabolism, lipid accumulation within muscle and muscle function. The images can also distinguish between different fat compartments e.g. visceral and subcutaneous adipose tissues. CT can also provide objective assessment of hepatic attenuation, which is related to liver fat content. Due to its high spatial and contrast resolution, it has the ability to measure fat and muscle content from one abdominal cross-sectional slice. CT is considered (along with MRI) to be the most accurate methods available to quantify in vivo body composition at tissue-organ level. CT is generally used to calibrate/validate other methods designed to estimate adipose tissue

Food intolerance and allergies -Identifying food allergies, methods to tackle , elimination diets

The body's immune system keeps you healthy by fighting off infections and other dangers to good health. A food allergy reaction occurs when your immune system overreacts to a food or a substance in a food, identifying it as a danger and triggering a protective response.

While allergies tend to run in families, it is impossible to predict whether a child will inherit a parent's food allergy or whether siblings will have a similar condition. Some research does suggest that the younger siblings of a child with a peanut allergy will also be allergic to peanuts.

Symptoms of a food allergy can range from mild to severe. Just because an initial reaction causes few problems doesn't mean that all reactions will be similar; a food that triggered only mild symptoms on one occasion may cause more severe symptoms at another time.

The most severe allergic reaction is anaphylaxis — a life-threatening whole-body allergic reaction that can impair your breathing, cause a dramatic drop in your blood pressure and affect your heart rate. Anaphylaxis can come on within minutes of exposure to the trigger

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food. It can be fatal and must be treated promptly with an injection of epinephrine (adrenaline).

While any food can cause an adverse reaction, eight types of food account for about 90 percent of all reactions:

- Eggs
- Milk
- Peanuts
- Tree nuts
- Fish
- Shellfish
- Wheat
- Soy

Certain seeds, including sesame and mustard seeds (the main ingredient in the condiment mustard), also are common food allergy triggers and considered a major allergen in some countries.

Symptoms of an allergic reaction may involve the skin, the gastrointestinal tract, the cardiovascular system and the respiratory tract. They can surface in one or more of the following ways:

- Vomiting and/or stomach cramps
- Hives
- Shortness of breath
- Wheezing
- Repetitive cough
- Shock or circulatory collapse
- Tight, hoarse throat; trouble swallowing
- Swelling of the tongue, affecting the ability to talk or breathe
- Weak pulse
- Pale or blue coloring of skin
- Dizziness or feeling faint
- Anaphylaxis, a potentially life-threatening reaction that can impair breathing and send the body into shock; reactions may simultaneously affect different parts of the body (for example, a stomachache accompanied by a rash)

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Most food-related symptoms occur within two hours of ingestion; often they start within minutes. In some very rare cases, the reaction may be delayed by four to six hours or even longer. Delayed reactions are most typically seen in children who develop eczema as a symptom of food allergy and in people with a rare allergy to red meat caused by the bite of a lone star tick.

Another type of delayed food allergy reaction stems from food protein-induced enterocolitis syndrome (FPIES), a severe gastrointestinal reaction that generally occurs two to six hours after consuming milk, soy, certain grains and some other solid foods. It mostly occurs in young infants who are being exposed to these foods for the first time or who are being weaned. FPIES often involves repetitive vomiting and can lead to dehydration. In some instances, babies will develop bloody diarrhea. Because the symptoms resemble those of a viral illness or bacterial infection, diagnosis of FPIES may be delayed. FPIES is a medical emergency that should be treated with IV rehydration.

Not everyone who experiences symptoms after eating certain foods has a food allergy or needs to avoid that food entirely; for instance, some people experience an itchy mouth and throat after eating a raw or uncooked fruit or vegetable. This may indicate oral allergy syndrome - a reaction to pollen, not to the food itself. The immune system recognizes the pollen and similar proteins in the food and directs an allergic response to it. The allergen is destroyed by heating the food, which can then be consumed with no problem.

Triggers

Once a food allergy is diagnosed, the most effective treatment is to avoid the food. The foods most associated with food allergy in children are:

- Milk
- Eggs
- Peanuts

Children may outgrow their allergic reactions to milk and to eggs. Peanut and tree nut allergies are likely to persist.

The most common food allergens in adults are:

- Fruit and vegetable pollen (oral allergy syndrome)
- Peanuts and tree nuts
- Fish and shellfish

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People allergic to a specific food may also potentially have a reaction to related foods. A person allergic to one tree nut may be cross-reactive to others. Those allergic to shrimp may react to crab and lobster. Someone allergic to peanuts - which actually are legumes (beans), not nuts - may have problems with tree nuts, such as pecans, walnuts, almonds and cashews; in very rare circumstances they may have problems with other legumes (excluding soy).

Learning about patterns of cross-reactivity and what must be avoided is one of the reasons why people with food allergies should receive care from a board-certified allergist. Determining if you are cross-reactive is not straightforward. Allergy testing to many items in the same “family” may not be specific enough - many times, these tests are positive, given how similar two food items in a “family” may look to the test. If you have tolerated it well in the past, a food that is theoretically cross-reactive may not have to be avoided at all.

Negative tests may be very useful in ruling out an allergy. In the case of positive tests to foods that you have never eaten but that are related to items to which you’ve had an allergic reaction, an oral food challenge is the best way to determine whether the food poses a danger.

Gluten intolerance & Lactose intolerance , symptoms, foods to avoid

Immuno-nutrition and functional foods

Eating disorders

Eating disorders are serious conditions related to persistent eating behaviors that negatively impact your health, your emotions and your ability to function in important areas of life. The most common eating disorders are anorexia nervosa, bulimia nervosa and binge-eating disorder.

Most eating disorders involve focusing too much on your weight, body shape and food, leading to dangerous eating behaviors. These behaviors can significantly impact your body's ability to get appropriate nutrition. Eating disorders can harm the heart, digestive system, bones, and teeth and mouth, and lead to other diseases.

Eating disorders often develop in the teen and young adult years, although they can develop at other ages. With treatment, you can return to healthier eating habits and sometimes reverse serious complications caused by the eating disorder.

Symptoms

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Symptoms vary, depending on the type of eating disorder. Anorexia nervosa, bulimia nervosa and binge-eating disorder are the most common eating disorders. Other eating disorders include rumination disorder and avoidant/restrictive food intake disorder.

Anorexia nervosa

Anorexia (an-o-REK-see-uh) nervosa — often simply called anorexia — is a potentially life-threatening eating disorder characterized by an abnormally low body weight, intense fear of gaining weight, and a distorted perception of weight or shape. People with anorexia use extreme efforts to control their weight and shape, which often significantly interferes with their health and life activities.

When you have anorexia, you excessively limit calories or use other methods to lose weight, such as excessive exercise, using laxatives or diet aids, or vomiting after eating. Efforts to reduce your weight, even when underweight, can cause severe health problems, sometimes to the point of deadly self-starvation.

Bulimia nervosa

Bulimia (boo-LEE-me-uh) nervosa — commonly called bulimia — is a serious, potentially life-threatening eating disorder. When you have bulimia, you have episodes of bingeing and purging that involve feeling a lack of control over your eating. Many people with bulimia also restrict their eating during the day, which often leads to more binge eating and purging.

During these episodes, you typically eat a large amount of food in a short time, and then try to rid yourself of the extra calories in an unhealthy way. Because of guilt, shame and an intense fear of weight gain from overeating, you may force vomiting or you may exercise too much or use other methods, such as laxatives, to get rid of the calories.

If you have bulimia, you're probably preoccupied with your weight and body shape, and may judge yourself severely and harshly for your self-perceived flaws. You may be at a normal weight or even a bit overweight.

Binge-eating disorder

When you have binge-eating disorder, you regularly eat too much food (binge) and feel a lack of control over your eating. You may eat quickly or eat more food than intended, even when you're not hungry, and you may continue eating even long after you're uncomfortably full.

After a binge, you may feel guilty, disgusted or ashamed by your behavior and the amount of food eaten. But you don't try to compensate for this behavior with excessive exercise or

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purgung, as someone with bulimia or anorexia might. Embarrassment can lead to eating alone to hide your bingeing.

A new round of bingeing usually occurs at least once a week. You may be normal weight, overweight or obese.

Rumination disorder

Rumination disorder is repeatedly and persistently regurgitating food after eating, but it's not due to a medical condition or another eating disorder such as anorexia, bulimia or binge-eating disorder. Food is brought back up into the mouth without nausea or gagging, and regurgitation may not be intentional. Sometimes regurgitated food is rechewed and reswallowed or spit out.

The disorder may result in malnutrition if the food is spit out or if the person eats significantly less to prevent the behavior. The occurrence of rumination disorder may be more common in infancy or in people who have an intellectual disability.

Avoidant/restrictive food intake disorder

This disorder is characterized by failing to meet your minimum daily nutrition requirements because you don't have an interest in eating; you avoid food with certain sensory characteristics, such as color, texture, smell or taste; or you're concerned about the consequences of eating, such as fear of choking. Food is not avoided because of fear of gaining weight.

The disorder can result in significant weight loss or failure to gain weight in childhood, as well as nutritional deficiencies that can cause health problems.

Starvation

Starvation is a severe deficiency in caloric energy intake, below the level needed to maintain an organism's life. It is the most extreme form of malnutrition. In humans, prolonged starvation can cause permanent organ damage and eventually, death. The term *inanition* refers to the symptoms and effects of starvation. Starvation may also be used as a means of torture or execution.

According to the World Health Organization, hunger is the single gravest threat to the world's public health. The WHO also states that malnutrition is by far the biggest contributor to child mortality, present in half of all cases. Undernutrition is a contributory factor in the death of 3.1 million children under five every year. Figures on actual starvation are difficult to come

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by, but according to the Food and Agriculture Organization, the less severe condition of undernourishment currently affects about 842 million people, or about one in eight (12.5%) people in the world population.

The bloated stomach represents a form of malnutrition called kwashiorkor. The exact pathogenesis of kwashiorkor is not clear, as initially it was thought to relate to diets high in carbohydrates (e.g. maize) but low in protein. While many patients have low albumin, this is thought to be a consequence of the condition. Possible causes such as aflatoxin poisoning, oxidative stress, immune dysregulation and altered gut microbiota have been suggested. Treatment can help mitigate symptoms such as the pictured weight loss and muscle wasting, however prevention is of utmost importance.

Causes

Starvation is an imbalance between energy intake and energy expenditure. The body expends more energy than it takes in. This imbalance can arise from one or more medical conditions or circumstantial situations, which can include:

Medical reasons

- Anorexia nervosa
- Bulimia nervosa
- Eating disorder, not otherwise specified
- Celiac disease
- Coma
- Major depressive disorder
- Diabetes mellitus
- Digestive disease
- Constant vomiting

Circumstantial causes

- Child, elder or dependent abuse
- Famine – for any reason, such as political strife and war
- Hunger striking
- Excessive fasting
- Poverty

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INFLUENCE ON DIETARY INTAKE AND NUTRITIONAL HEALTH

Dietary habits and influences

Types of diets

Diets used in the treatment of disease are often spoken of by specific names that show a special composition and often indicate the purpose for which the diet is intended.

Regular Diet

The regular diet is composed of all types of foods and is well balanced and capable of maintaining a state of good nutrition. It is intended for convalescing patients who do not require a therapeutic diet.

Modified or Therapeutic Diets

Modified or therapeutic diets are modifications of the regular diet and are designed to meet specific patient needs.

These include

- ◆ method of preparation (e.g., baking, boiling, or broiling),
- ◆ consistency (e.g., ground or chopped),
- ◆ Total calories (e.g., high or low calorie), nutrients (e.g., altering carbohydrate, protein, fat, vitamins, and minerals), and allowing only specific foods (e.g., diabetic diet).

Soft Diet.

The soft diet is soft in texture and consists of liquids and semi-solid foods. It is indicated in certain postoperative cases, for convalescents who cannot tolerate a regular diet, in acute illnesses, and in some gastrointestinal disorders. A soft diet is an intermediate step between a liquid and regular diet and is low in connective tissue and indigestible dietary fiber. Little or no spices are used in its preparation. The Soft diet includes all liquids other than alcohol, and foods.

UNIT-III

NUTRITIONAL CONSIDERATIONS FOR SPECIAL GROUPS

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Nutritional requirements in infancy, childhood and adolescence

The common feature of infancy, childhood and adolescence is that all these age groups are undergoing rapid growth and development. This in turn poses a heavy demand on their nutritional requirements. Small children and infants do not have a well developed body nutrient store, and therefore are more vulnerable to infection. In addition they have a larger surface area compared to their body size. All these factors increase their basal metabolic rate (BMR), resulting in an increased requirement for nutrients.

Adolescent growth spurt

Adolescents also undergo a very rapid growth during their puberty (called the pubertal growth spurt). During the pubertal growth spurt, they increase rapidly both in weight and height. Therefore, they need a nutrient intake that is proportional with their rate of growth. The growth rate is very high right after birth (infancy). Then the growth rate slows down until the age of 12–14 years. At about 15–16 years (the pubertal period) there is a sharp rise in growth rate/velocity. After that, the growth rate slows down again.

Requirements for macronutrients (proteins, carbohydrates and fats) and micronutrients are higher on a per kilogram basis during infancy and childhood than at any other developmental stage. These needs are influenced by the rapid cell division occurring during growth, which requires protein, energy and fat. Increased needs for these nutrients are reflected in daily requirements for these age groups. Increased need for nutrients

Energy: While most adults require 25–30 calories per kg, a 4 kg infant requires more than 100 kilocalories per kg (430 calories/day). Infants of four to six months who weigh 6 kg require roughly 82 kilocalories per kg (490 calories/day). Energy needs remain high through the early formative years. Children of one to three years require approximately 83 kilocalories per kg (990 calories/day). Energy requirements decline thereafter and are based on weight, height, and physical activity.

As an energy source, breastmilk offers significant advantages over manufactured formula milk. Breastfeeding is associated with reduced risk for obesity, a wide range of allergies, hypertension, and type 1 diabetes. It is also linked with improved cognitive development; and with decreased incidence and severity of infections. It is also less costly than formula feeding. The list below outlines the nutrients and other constituents of breastmilk:

- Water = 87–89%
- Vitamins (particularly vitamin A)
- Fat = 3–5%
- Energy = 60–70 kcal/100 ml
- Carbohydrate (lactose) = 6.9–7.2%
- Mineral = 0.2%
- Protein = 0.8–0.9%

Higher intakes of protein and energy for growth are recommended for adolescents. For most micronutrients, recommendations are the same as for adults. Exceptions are made for certain minerals needed for bone growth (e.g. calcium and phosphorus). Evidence is clear that bone calcium accretion increases as a result of exercise rather than from increases in calcium intake. Since weight gain often begins during adolescence and young adulthood, young people must establish healthy eating and lifestyle habits that reduce the risk for chronic disease later in life.

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Water: Infants and children need plenty of water to drink, particularly when ill, or exposed to extreme temperatures. Total water requirements (from beverages and foods) are also higher in infants and children than for adults. Children have a larger body surface area per unit of body weight and a reduced capacity for sweating when compared with adults, and therefore are at greater risk of morbidity and mortality from dehydration. Parents may underestimate these fluid needs, especially if infants and children are experiencing fever, diarrhoea or exposure to very cold or very hot temperatures.

Essential fatty acids: Requirements for fatty acids or fats on a per kilogram basis are higher in infants than adults (see Box 3.4). Some fatty acids play a key role in the central nervous system. However infants and children should not ingest large amounts of foods that contain predominantly fats, so it is important to get the balance right.

Infancy and childhood

Increased requirements of energy, protein, essential fatty acids, calcium and phosphorus.

Adolescence

Increased requirements of energy, protein, calcium, phosphorus and zinc.

Nutritional requirements during adulthood

The nutritional needs in adults of 19–50 years of age differ slightly according to gender. Males require more of vitamins C, K, B1, B2 and B3, and zinc. Females require more iron, compared with males of similar age.

Nutritional requirements during later years

Elderly people are especially vulnerable to nutritional problems due to age related changes in their body (impaired physiological and anatomical capacity). Box 3.5 overleaf sets out some of the problems an older person might experience which could impact on their diet.

Possible nutritional issues in old age

- Problems of procuring and preparing foods

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- Psychosocial problems
- Digestion problems
- Nutrient absorption problems
- Renal changes
- Memory loss (senile dementia), which may include forgetting to eat
- Sensory changes
- Physical problems like weakness, gouty arthritis and painful joints.

Specific nutrient requirements in old age

An elderly person requires less energy than a younger individual due to reductions in muscle mass and physical activity. Some daily requirements for elderly people differ from those of younger adults. For example, in order to reduce the risk for age related bone loss and fracture, the requirement for vitamin D is increased from 200 IU/day to 400 in individuals of 51–70 years of age and to 600 IU/day for those over 70 years of age. Suggested iron intakes reduce however from 18 mg per day in women aged 19–50 to 8 mg/day after age 50, due to better iron conservation and decreased losses in postmenopausal women compared with younger women.

Some elderly people have difficulty getting adequate nutrition because of age or disease related impairments in chewing, swallowing, digesting and absorbing nutrients. Their nutrient status may also be affected by decreased production of chemicals to digest food (digestive enzymes), changes in the cells of the bowel surface and drug–nutrient interactions. Some elderly people demonstrate selenium deficiency, a mineral important for immune function. Impaired immune function affects susceptibility to infections and tumours (malignancies). Vitamin B6 helps to boost selenium levels, so a higher intake for people aged 51–70 is recommended.

Nutritional interventions should first emphasise healthy foods, with supplements playing a secondary role. Although modest supplementary doses of micronutrients can both prevent deficiency and support immune functions, very high dose supplementation (example, high dose zinc) may have the opposite effect and result in immune-suppression. Therefore, elderly people also need special attention with regard to nutritional care.

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Energy requirements for sedentary, physically active adults

Elderly

Dietary supplements required for elderly

Eating right and staying fit are important no matter what your age. As we get older our bodies have different needs, so certain nutrients become especially important for good health.

Calcium and Vitamin D

Older adults need more calcium and vitamin D to help maintain bone health. To meet these needs, select calcium-rich foods and beverages and aim for three servings of low-fat or fat-free dairy products each day. Other sources of calcium include fortified cereals and fruit juices, dark green leafy vegetables, canned fish with soft bones, and fortified plant-based beverages. Good sources of vitamin D include fatty fish, such as salmon, eggs and fortified foods and beverages. If you take a calcium supplement or multivitamin, choose one that contains vitamin D.

Vitamin B12

Some adults older than 50 may not be able to absorb enough vitamin B12. Fortified cereal, lean meat and some fish and seafood are sources of vitamin B12. Ask your doctor or a registered dietitian nutritionist if you need a vitamin B12 supplement.

Dietary Fiber

Eat fiber-rich foods to stay regular. Dietary fiber also may help lower your risk for heart disease and reduce your risk for Type 2 diabetes. Eat whole-grain breads and cereals, and more beans and peas — along with fruits and vegetables which also provide dietary fiber.

Potassium

Consuming adequate potassium, along with limiting sodium (salt) intake, may lower your risk of high blood pressure. Fruits, vegetables, beans and low-fat or fat-free dairy products are good sources of potassium. Also, select and prepare foods with little or no added salt. Add flavor to food with herbs and spices.

Know Your Fats

Most of the fats you eat should be polyunsaturated and monounsaturated fats, which are primarily found in nuts, seeds, avocados, vegetable oils and fish. Choose foods that are low in saturated fat and trans fat to help reduce your risk of heart disease.

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Dietary guidelines for Diabetes,

Basic Diabetes Management Guidelines

1. Eat a Balanced Diet

You should eat a variety of foods to meet your nutritional requirements. Your dietitian will work with you to ensure you eat a suitable amount and types of food from each of the food groups.

2. Moderate Your Sugar Intake

Sugar and sugar products contain carbohydrates, which can affect your blood sugar level. They are therefore among the foods to avoid with diabetes when possible, or take very occasionally and in small amounts only.

- Replace sweetened drinks (e.g. soft drinks, sweetened packaged drinks and fruit juice) with unsweetened drinks (e.g. water, plain tea and unsweetened soy milk)
- Have fresh fruits instead of fruit juice and canned fruits soaked in syrup
- Choose a piece of fresh fruit for dessert instead
- Avoid eating snacks that are high in sugar content such as jellies, ice cream, chocolates and cake
- Artificial sweeteners like aspartame or saccharin can be used as a substitute for regular sugar

3. Moderate Your Consumption of Rice and Other Starch

Pasta, noodles and starchy vegetables (e.g. potatoes, carrots, corn and yam) contain carbohydrates, which will affect blood sugar levels.

- Spread these foods evenly throughout the day to manage your blood sugar level
- Select foods rich in fibre, such as brown rice and wholemeal or wholegrain bread, to prevent the rapid rise of glucose in your blood

Every individual has different nutritional requirements; your dietitian will advise you on the appropriate portion sizes.

4. Fruits for Diabetics

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It is recommended to have two servings of fruits per day to provide you with adequate vitamins, minerals, antioxidants and fibre. As fruit also contains carbohydrate in the form of sugars, your blood sugar levels will be affected if you consume too much.

- Spread your fruits evenly throughout the day
- Choose fresh fruits instead of fruit juice or canned fruits soaked in syrup
- Limit the amount of dried fruits you eat, as they have a higher sugar content than fresh fruits

5. Limit Fat Intake

Type 2 diabetics should not consume excessive amounts of fat or oils, as this decreases the effectiveness of insulin action.

- Use less oil when cooking and remove all visible fat before eating
- Instead of deep-frying food, select healthier cooking methods such as steaming, boiling and grilling. Limit deep-fried foods to one or two times a week
- Choose lean meat or poultry without skin
- Choose fat-free or lower-fat food products such as low-fat milk and fat-free yoghurt
- Go for healthier cooking oils with polyunsaturated fat (e.g. corn, soybean) or monounsaturated fat (e.g. olive, canola)

6. Moderate Your Alcohol Intake

Alcohol is only allowed if blood sugar is well-controlled. Avoid alcohol if you have a high blood triglyceride level, kidney disease or heart disease. A standard alcoholic drink contains 10 grams of alcohol, which translates to 100 millilitres of wine or two-thirds of a can (220 millilitres) of regular beer.

- Drink alcohol in moderation, i.e. not more than one standard drink per day
- Use sugar-free sodas or water to mix your drinks and cocktails

Dietary guidelines for hypertension.

- Add a serving of vegetables at lunch and at dinner.
- Add a serving of fruit to your meals or as a snack. Canned and dried fruits are easy to use, but check that they don't have added sugar.

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- Use only half your typical serving of butter, margarine, or salad dressing, and use low-fat or fat-free condiments.
- Drink low-fat or skim dairy products any time you would normally use full-fat or cream.
- Limit meat to 6 ounces a day. Make some meals vegetarian.
- Add more vegetables and dry beans to your diet.
- Instead of snacking on chips or sweets, eat unsalted pretzels or nuts, raisins, low-fat and fat-free yogurt, frozen yogurt, unsalted plain popcorn with no butter, and raw vegetables.
- Read food labels to choose products that are lower in sodium.

Dietary guidelines for Cardiovascular disease.

To maintain a healthy weight, diet should include a variety of foods, increased intake of fruits and vegetables, whole grains, olive oil, and nuts. Moderate intake of fish, poultry, and red wine is recommended. Consumption of foods high in sodium and sugar should be minimized.

1. Control your portion size

How much you eat is just as important as what you eat. Overloading your plate, taking seconds and eating until you feel stuffed can lead to eating more calories than you should. Portions served in restaurants are often more than anyone needs.

Use a small plate or bowl to help control your portions. Eat larger portions of low-calorie, nutrient-rich foods, such as fruits and vegetables, and smaller portions of high-calorie, high-sodium foods, such as refined, processed or fast foods. This strategy can shape up your diet as well as your heart and waistline.

Keep track of the number of servings you eat. The recommended number of servings per food group may vary depending on the specific diet or guidelines you're following. A serving size is a specific amount of food, defined by common measurements such as cups, ounces or pieces. For example, one serving of pasta is about 1/3 to 1/2 cup, or about the size of a hockey puck. A serving of meat, fish or chicken is about 2 to 3 ounces, or about the size

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and thickness of a deck of cards. Judging serving size is a learned skill. You may need to use measuring cups and spoons or a scale until you're comfortable with your judgment.

2. Eat more vegetables and fruits

Vegetables and fruits are good sources of vitamins and minerals. Vegetables and fruits are also low in calories and rich in dietary fiber. Vegetables and fruits, like other plants or plant-based foods, contain substances that may help prevent cardiovascular disease. Eating more fruits and vegetables may help you cut back on higher calorie foods, such as meat, cheese and snack foods. Featuring vegetables and fruits in your diet can be easy. Keep vegetables washed and cut in your refrigerator for quick snacks. Keep fruit in a bowl in your kitchen so that you'll remember to eat it. Choose recipes that have vegetables or fruits as the main ingredients, such as vegetable stir-fry or fresh fruit mixed into salads.

Fruits and vegetables to choose

- Fresh or frozen vegetables and fruits
- Low-sodium canned vegetables
- Canned fruit packed in juice or water

Fruits and vegetables to limit

- Coconut
- Vegetables with creamy sauces
- Fried or breaded vegetables
- Canned fruit packed in heavy syrup
- Frozen fruit with sugar added

3. Select whole grains

Whole grains are good sources of fiber and other nutrients that play a role in regulating blood pressure and heart health. You can increase the amount of whole grains in a heart-healthy diet by making simple substitutions for refined grain products. Or be adventuresome and try a new whole grain, such as whole-grain farro, quinoa or barley.

Grain products to choose

- Whole-wheat flour
- Whole-grain bread, preferably 100% whole-wheat bread or 100% whole-grain bread
- High-fiber cereal with 5 g or more fiber in a serving
- Whole grains such as brown rice, barley and buckwheat (kasha)
- Whole-grain pasta
- Oatmeal (steel-cut or regular)

Grain products to limit or avoid

- White, refined flour
- White bread
- Muffins
- Frozen waffles
- Corn bread
- Doughnuts
- Biscuits
- Quick breads
- Cakes
- Pies
- Egg noodles
- Buttered popcorn

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- High-fat snack crackers

4. Limit unhealthy fats

Limiting how much saturated and trans fats you eat is an important step to reduce your blood cholesterol and lower your risk of coronary artery disease. A high blood cholesterol level can lead to a buildup of plaques in your arteries, called atherosclerosis, which can increase your risk of heart attack and stroke.

Guidelines for how much fat to include in a heart-healthy diet:

Type of fat	Recommendation
Saturated fat	No more than 5 to 6% of your total daily calories, or no more than 11 to 13g of saturated fat if you follow a 2,000-calorie-a-day diet
Trans fat	Avoid

You can reduce the amount of saturated fat in your diet by trimming fat off your meat or choosing lean meats with less than 10 percent fat. You can also add less butter, margarine and shortening when cooking and serving. You can also use low-fat substitutions when possible for a heart-healthy diet.

An easy way to add healthy fat (and fiber) to your diet is ground flaxseed. Flaxseeds are small brown seeds that are high in fiber and omega-3 fatty acids. Some studies have found that flaxseeds may help lower cholesterol in some people, but more research is needed. You can grind the seeds in a coffee grinder or food processor and stir a teaspoon of them into yogurt, applesauce or hot cereal.

Fats to choose	Fats to limit
<ul style="list-style-type: none">• Olive oil• Canola oil• Vegetable and nut oils• Margarine, trans fat free• Cholesterol-lowering margarine, such as Benecol, Promise Activ or Smart Balance• Nuts, seeds• Avocados	<ul style="list-style-type: none">• Butter• Lard• Bacon fat• Gravy• Cream sauce• Nondairy creamers• Hydrogenated margarine and shortening• Cocoa butter, found in chocolate• Coconut, palm, cottonseed and palm-kernel oils

5. Choose low-fat protein sources

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Lean meat, poultry and fish, low-fat dairy products, and eggs are some of your best sources of protein. But be careful to choose lower fat options, such as skim milk rather than whole milk and skinless chicken breasts rather than fried chicken patties.

Fish is another good alternative to high-fat meats. And certain types of fish are rich in omega-3 fatty acids, which can lower blood fats called triglycerides. You'll find the highest amounts of omega-3 fatty acids in cold-water fish, such as salmon, mackerel and herring. Other sources are flaxseed, walnuts, soybeans and canola oil.

Legumes — beans, peas and lentils — also are good sources of protein and contain less fat and no cholesterol, making them good substitutes for meat. Substituting plant protein for animal protein — for example, a soy or bean burger for a hamburger — will reduce your fat and cholesterol intake and increase your fiber intake.

Proteins to choose

- Low-fat dairy products, such as skim or low-fat (1%) milk, yogurt and cheese
- Eggs
- Fish, especially fatty, cold-water fish, such as salmon
- Skinless poultry
- Legumes
- Soybeans and soy products, such as soy burgers and tofu
- Lean ground meats

Proteins to limit or avoid

- Full-fat milk and other dairy products
- Organ meats, such as liver
- Fatty and marbled meats
- Spareribs
- Hot dogs and sausages
- Bacon
- Fried or breaded meats

6. Reduce the sodium in your food

Eating a lot of sodium can contribute to high blood pressure, a risk factor for cardiovascular disease. Reducing sodium is an important part of a heart-healthy diet. The American Heart Association recommends that:

- Healthy adults have no more than 2,300 milligrams (mg) of sodium a day (about a teaspoon of salt)
- Most adults ideally have no more than 1,500 mg of sodium a day

Although reducing the amount of salt you add to food at the table or while cooking is a good first step, much of the salt you eat comes from canned or processed foods, such as soups, baked goods and frozen dinners. Eating fresh foods and making your own soups and stews can reduce the amount of salt you eat.

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If you like the convenience of canned soups and prepared meals, look for ones with reduced sodium. Be wary of foods that claim to be lower in sodium because they are seasoned with sea salt instead of regular table salt — sea salt has the same nutritional value as regular salt.

Another way to reduce the amount of salt you eat is to choose your condiments carefully. Many condiments are available in reduced-sodium versions, and salt substitutes can add flavor to your food with less sodium.

Low-salt items to choose

- Herbs and spices
- Salt-free seasoning blends
- Reduced-salt canned soups or prepared meals
- Reduced-salt versions of condiments, such as reduced-salt soy sauce and reduced-salt ketchup

High-salt items to limit or avoid

- Table salt
- Canned soups and prepared foods, such as frozen dinners
- Tomato juice
- Condiments such as ketchup, mayonnaise and soy sauce
- Restaurant meals

7. Plan ahead: Create daily menus

You know what foods to feature in your heart-healthy diet and which ones to limit. Now it's time to put your plans into action. Create daily menus using the six strategies listed above. When selecting foods for each meal and snack, emphasize vegetables, fruits and whole grains. Choose lean protein sources and healthy fats, and limit salty foods. Watch your portion sizes and add variety to your menu choices.

8. Allow yourself an occasional treat

Allow yourself an indulgence every now and then. A candy bar or handful of potato chips won't derail your heart-healthy diet. But don't let it turn into an excuse for giving up on your healthy-eating plan. If overindulgence is the exception, rather than the rule, you'll balance things out over the long term. What's important is that you eat healthy foods most of the time.

Nutrition during pregnancy and lactation

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An unborn child needs a healthy and well-nourished mother to grow properly. Therefore, a mother needs to gain weight during pregnancy to help nourish her growing baby. Women who do not gain enough weight often have babies that weigh too little (**low birth weight**). A baby weighing less than 2.5 kg has an increased chance of both physical and mental health problems. It may also suffer more from infection and malnutrition compared with babies of normal weight.

Increased requirements: energy, protein, essential fatty acids, vitamin A, vitamin C, B vitamins (B1, B2, B3, B5, B6, B12, folate), calcium, phosphorus, iron, zinc, copper and iodine. Women should gain at least 11 kg during pregnancy (Figure 3.1). If the mother gains less than this, the baby's chances of survival and health declines. If a mother is overweight, she still needs to gain for her baby's health. She should not try to lose weight while she is pregnant.



Gaining weight during pregnancy.

Gaining weight in pregnancy

A pregnant mother should gain weight smoothly and steadily. If weight gain occurs suddenly, she should see a health professional.

- During the first three months, she should expect to gain a total of 1–2 kg.
- During the last six months, she needs to gain about 0.5 kg each week.
- If she has already gained 11 kg after six–seven months, she should continue to gain moderately until delivery.

The baby puts most of its weight during the last few months.

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Eating during pregnancy

Women's nutrition during pregnancy and lactation should focus on the three micronutrients (vitamin A, iron and iodine) and extra energy intake/reduction of energy expenditure. Therefore the following are essential nutrition actions related to maternal nutrition:

- A pregnant or breastfeeding woman needs extra foods, especially those that are good sources of iron.
- Pregnant women need at least one additional meal (200 Kcal) per day during the pregnancy.
- A pregnant woman needs to cut down her energy expenditure. She should reduce her involvement in strenuous household tasks that lead to higher energy expenditure.
- Pregnant women should eat iodised salt in their diet.
- Pregnant women should take vitamin A rich foods (such as papaya, mango, tomato, carrot, and green leafy vegetable) and animal foods (such as fish and liver).
- In the malarious areas, pregnant women should sleep under an insecticide-treated bed net.
- Pregnant women during the third trimester of pregnancy should be de-wormed using mebendazole or albendazole (you will learn about the doses for this in Study Session 7 of this Module).
- Pregnant women need a well balanced diet containing mixture of foods. This should include as far as possible food from the different food groups (animal products, fruits, vegetables, cereals and legumes).

Remember, there is no need for high-priced foods! A pregnant or lactating woman can get extra foods by eating a little more of ordinary meals. She should increase the amount of nourishment at one or two meals, not every meal.

Preventing anaemia in pregnancy

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Some women feel weak and tired when pregnant. They may be anaemic, which in turn means that they may have difficulty in pregnancy and childbirth. Common problems linked to the mother's anaemia include:

- Babies will be born without three to six months iron supply
- Breastmilk may have insufficient iron.

A pregnant or breastfeeding mother should have enough iron to keep herself and her baby healthy. She should eat plenty of iron-rich foods every day such as dried beans, legumes, dark green leafy vegetables, liver, kidney and heart. A pregnant mother should go for her first antenatal care visit at the latest by the fourth month of her pregnancy. At the clinic, check her urine for excess sugar and proteins, and her blood for malaria (if she is showing signs of infection).

You diagnose anaemia in the following way:

Examine the lower eyelids, the inside of the lips and the palms which should be bright pink; if there is anaemia, all of these will be pale whitish.

- Give the mother iron tablets or tablets with iron and folate to build strong blood
- Remind the mother to take the tablets after a main meal. She should not take iron tablets with tea, coffee or milk
- If the iron tablets upset the mother or cause side effects, she should not stop taking iron, but eat more leafy vegetables.

Pregnant women with special needs

Some pregnant women in your community will be particularly vulnerable. As a Health Extension Practitioner it is important that you identify the women who may need extra help and support. Box 3.2 gives examples of women who may need special help from you and outlines the kinds of service you can provide for them.

Box 3.2 Identifying and helping pregnant women who need special help

Pregnant women who might need special help include:

- Women from poor families, or who are unemployed
- Women who are widows/separated, and have no support

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- Mothers who have given birth to many babies over a short time
- Women who are ill from diseases like Tuberculosis (TB)
- Women who look thin and depressed
- Mothers whose previous babies were small and malnourished
- Teenagers
- Women with a history of their baby or babies dying in their first year of life
- Mothers overburdened with work
- Mothers who are very worried, particularly first time pregnancies.

Nutrition during lactation (breastfeeding)

If all babies are to be healthy and grow well, they must be fed breastmilk. When a baby sucks at the nipple, this causes the milk to come into the breast and continue to flow. Breastmilk is food produced by the mother's body especially for the baby, and it contains all the nutrients (nourishment) a healthy baby needs.

A lactating woman needs at least two extra meals (550 Kcal) of whatever is available at home. In addition a dose of vitamin A (200,000IU) should be given once between delivery and six weeks after delivery. This will enable the baby to get an adequate supply of vitamin A for the first six months. During the first six months the best way of feeding the baby is for the mother to breastfeed exclusively.

Increased nutrients required during lactation

Increased requirements: vitamins A, C, E, all B vitamins, and sodium (applies only to individuals under age 18).

In addition to extra meals and one high dose of vitamin A, a breastfeeding woman also needs:

- Iodised salt in her diet
- At least one litre of water per day
- Vitamin A rich foods (such as papaya, mango, tomato, carrot and green leafy vegetables) and animal foods (such as fish and liver).

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