

# Role of Diet in the Primary and Secondary Prevention of Chronic Disease

Chapter 11

Module 11

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# Learning Objectives

- Describe relationships between immunity and nutrition.
- Explain cardiovascular disease and its risk factors.
- Discuss hypertension and its risk factors, including nutrition risk factors.
- Explain the relationships between diet and cancer and diabetes

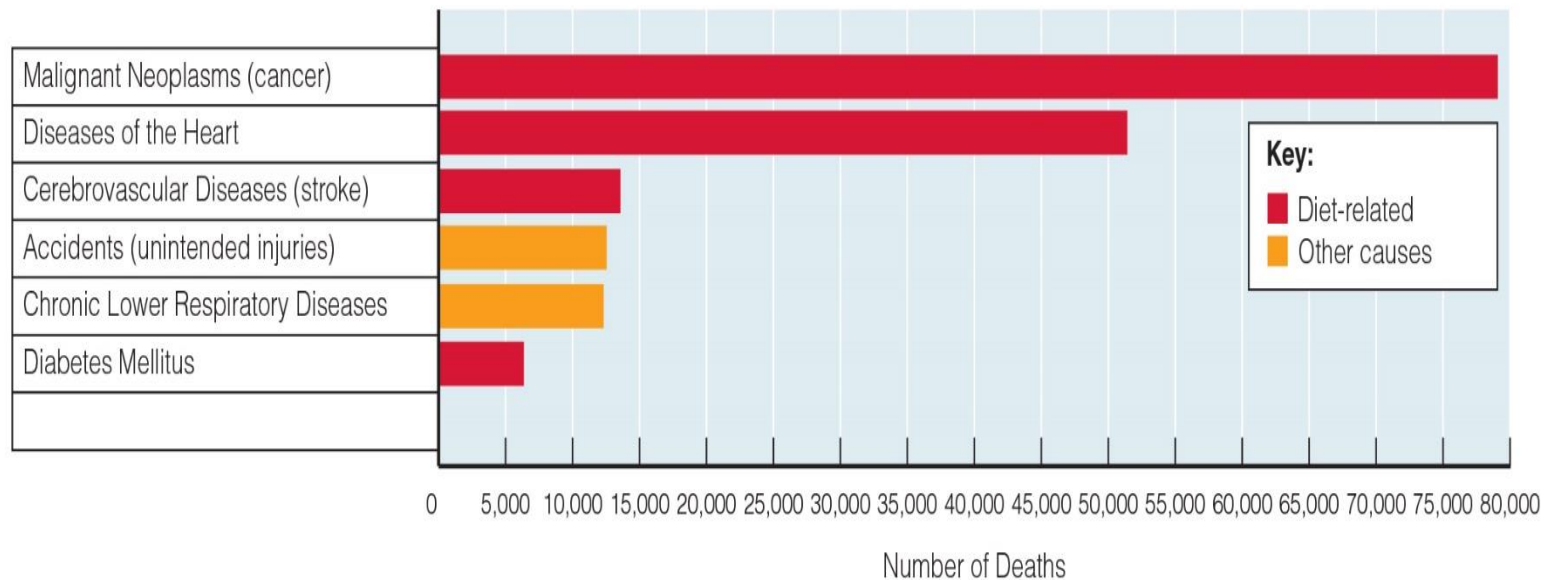
# Introduction

- Two kinds of diseases
  - Infectious:
    - Caused by bacteria, virus, parasite, or other microbe
    - Examples: Tuberculosis, polio, influenza
  - Degenerative:
    - Chronic, irreversible
    - Due to personal lifestyle choices (food, smoking, alcohol, lack of physical activity)
    - Leading causes of death in Canada

# Leading Causes of Death in Canada

Figure 11-1

Leading Causes of Death in Canada, 2017



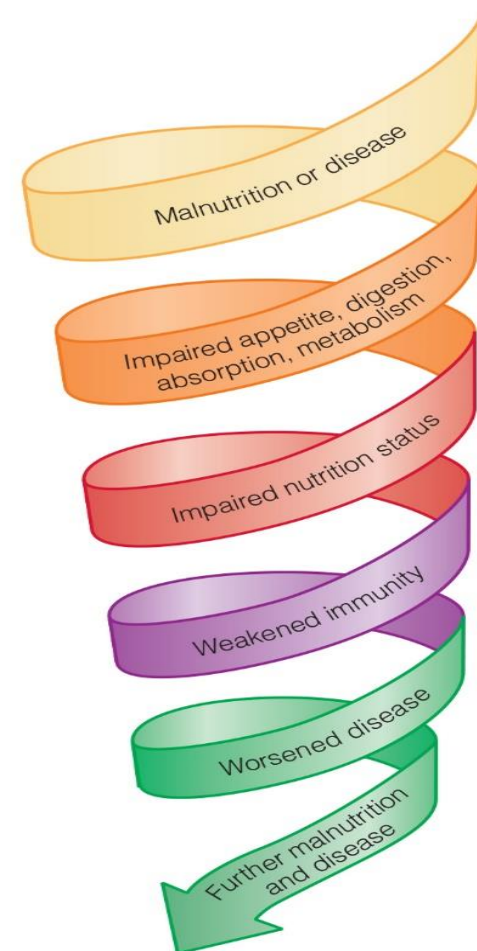
Source: Adapted from <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310039401>.

# Malnutrition and Disease

Figure 11-2

Malnutrition and Disease

- Deficiencies and excesses of nutrients may impair the immune system
- Malnutrition worsens disease, and disease worsens malnutrition



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# Nutrition and Immunity

**Table 11–1**

## **Effects of Protein-Energy Undernutrition (PEU) on the Body's Defence Systems**

System Component	Effects of PEU
Skin	Skin becomes thinner, with less connective tissue to serve as a barrier for protection of underlying tissues; skin sensitivity reaction to antigens is delayed.
Digestive tract membrane and other body linings	Antibody secretions and immune cell numbers are reduced.
Lymph tissues	Immune system organs <sup>a</sup> are reduced in size; cells of immune defence are depleted.
General response	Invader kill time is prolonged; circulating immune cells are reduced; immune response is impaired.

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<sup>a</sup>Thymus gland, lymph nodes, and spleen.

# Inflammation & Chronic Diseases

- Immune system response to infection or injury
  - Blood supply to the site increases
  - Vessels become permeable
  - Phagocytes engulf microbes
    - Release oxidative molecules to kill microbes
  - Fights off infection and promotes recovery
- Chronic inflammation- Harmful
  - Obesity, stress, smoking, EtOH, untreated disease, autoimmune disease... lead to risk of chronic disease
  - CVD:
    - Damage increases permeability of blood vessel walls
    - LDL cholesterol becomes trapped in blood vessel walls, are oxidized by free radicals, engulfed by macrophages, becoming part of the plaque
    - Favors the formation of blood clots



# Deficiencies and Toxicities Known to Impair Immunity

## Toxicities Impairing Immunity:

- Iron
- Zinc

## Deficiencies Impairing Immunity:

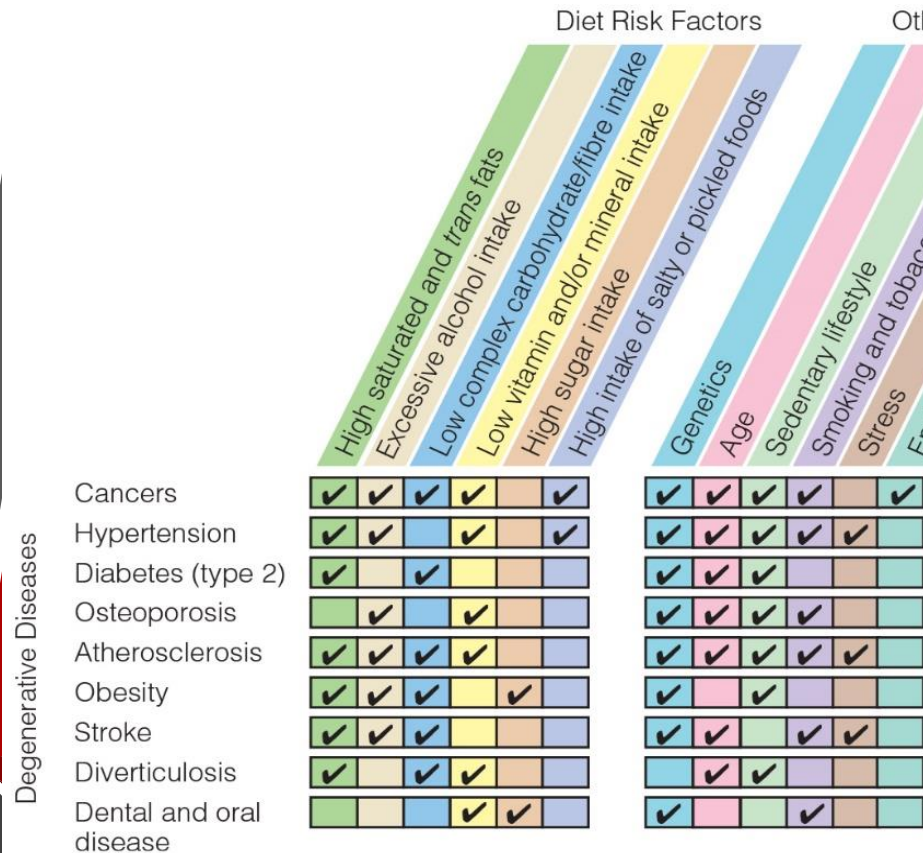
- Energy, Protein
- Vitamins A, D, E, K
  - B vitamins
  - Folate
  - Vitamin C
- Minerals Iron, Zinc, Copper, Magnesium, Selenium



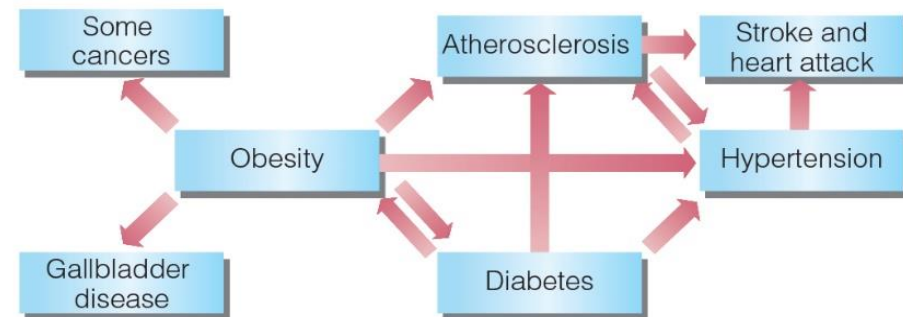
# Diet/Lifestyle Risk Factors for Degenerative Diseases

Figure 11-3

Diet/Lifestyle Risk Factors and Degenerative Diseases



## Interrelationships Among Chronic Diseases



This flowchart shows that many of these conditions are themselves risk factors for other degenerative diseases. For example, a person with diabetes is likely to develop atherosclerosis and hypertension. These two conditions, in turn, worsen each other. Notice how all these degenerative diseases are linked to obesity.

# Lifestyle Choices and Risks of Degenerative Disease

- Conditions in parents, grandparents, or siblings, especially occurring early in life, that may raise a warning flag:
  - Alcoholism
  - Cancer
  - Diabetes
  - Heart and artery diseases
  - Hypertension
  - Liver disease (cirrhosis)
  - Osteoporosis

# Cardiovascular Diseases (CVD)

- At the root of most forms of CVD is **atherosclerosis**: Hardening of the arteries caused by plaques
- High saturated fat diet contributes to the build up of plaque
- Atherosclerosis is also the body's inflammatory response to tissue damage

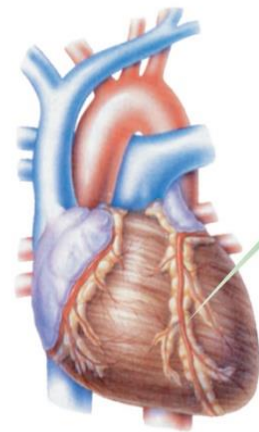
# How Atherosclerosis Develops

- Damage begins with:
  - High LDL cholesterol
  - Hypertension
  - Toxins from cigarette smoking
  - Elevated homocysteine levels in blood
  - Viral or bacterial infections

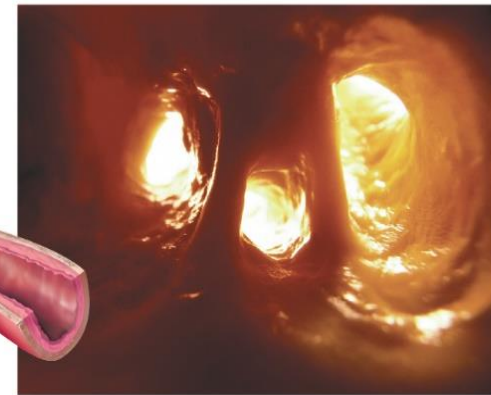
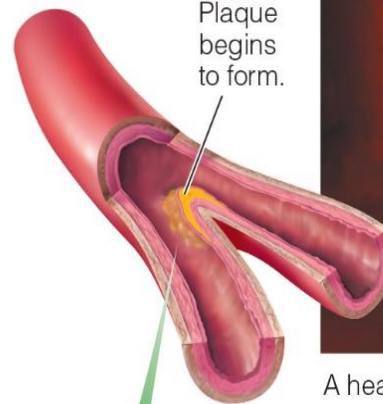
# The Formation of Plaques in Atherosclerosis

Figure 11-4

## The Formation of Plaques in Atherosclerosis

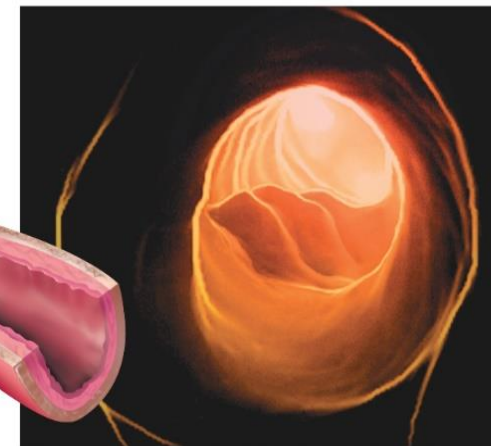
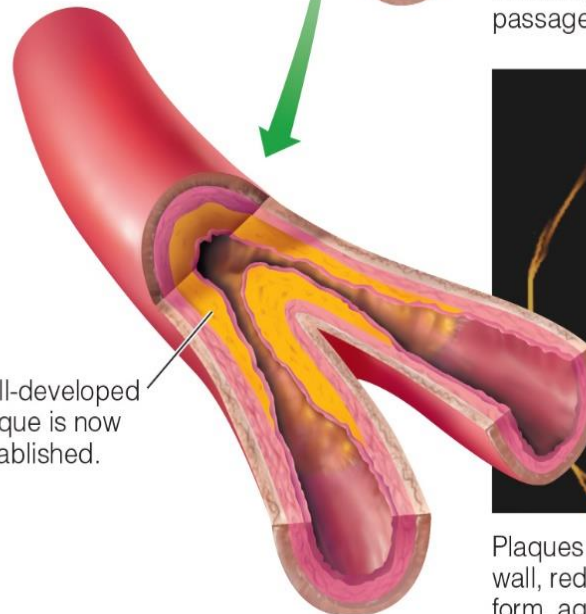


These coronary arteries bring nourishment to the heart muscle. If one of these arteries becomes blocked by plaque, the part of the heart muscle that it feeds will die.



A healthy artery provides an open passage for the flow of blood.

Jean-Claude Revy/ISM/Phototake



Plaques form along the artery's inner wall, reducing blood flow. Clots can form, aggravating the problem.

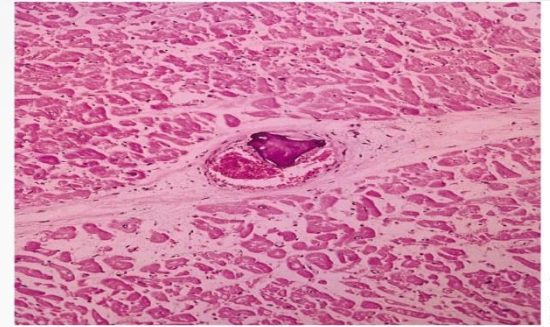
Zephyr/Science Source



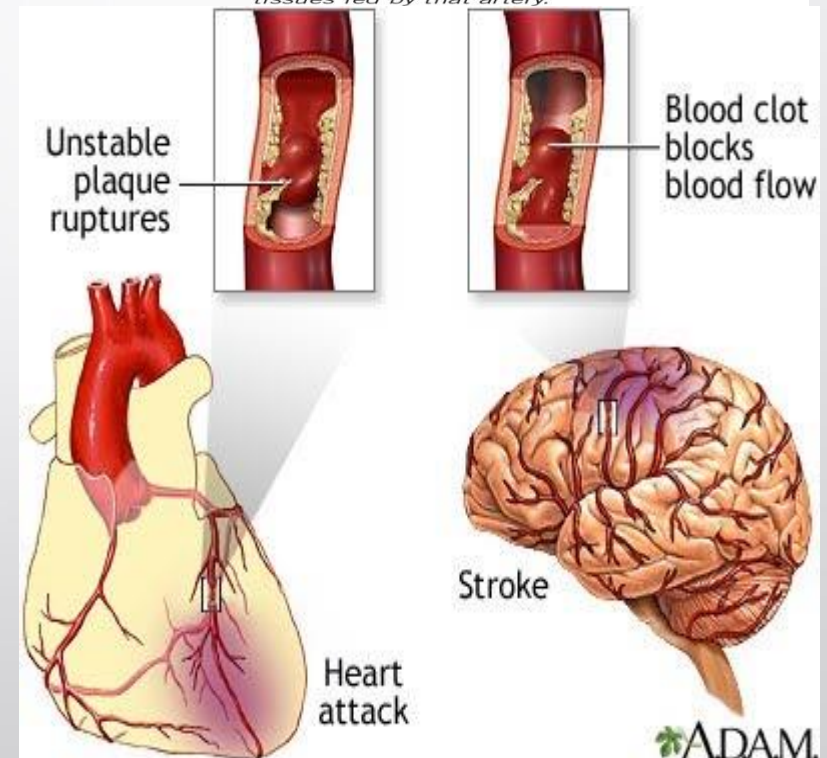
# Atherosclerosis

## Blood clots

- Thrombus:
  - Stationary clot
- Thrombosis:
  - Large clot that closes off a blood vessel
- Embolus:
  - A clot that breaks loose
- Embolism:
  - A clot that becomes stuck
- **Stroke:** clot in brain
- **Heart attack:** clot in heart



A blood clot in an artery, such as this fatal heart embolism, blocks the blood flow to tissues fed by that artery.



# Risk Factors for CVD

- Hypertension
  - Worsens CVD
  - Accelerates plaque formation
- Diabetes
  - Independent risk factor for CVD
- Obesity and physical inactivity
  - Central obesity and physical inactivity elevate LDL cholesterol, lower HDL cholesterol
- Smoking
  - Directly damages heart with toxins and increases blood pressure
  - Makes blood clots likely to develop
- Atherogenic diet
  - Diet high in saturated fat, trans fat, and cholesterol

# Metabolic Syndrome: Characteristic cluster of CVD risk factors

## Features of metabolic syndrome:

- Central obesity
- Elevated blood pressure
- Elevated fasting blood glucose or insulin resistance
- Abnormal blood lipids: low HDL & high triglycerides (TG)
  - People with elevated TG should limit simple sugars and highly refined starchy foods, which can cause TG to rise



# True or False

Up to 80% of premature heart disease and stroke can be prevented through your life habits, such as eating a healthy diet and being physically active

# Lifestyle Changes to Reduce CVD Risk

- Lifestyle changes
  - Increase physical activity
  - Lose weight, if needed
  - Reduce exposure to tobacco smoke
- Dietary changes
  - Increase V/F, whole grains fibre
    - Soluble fibre, phytochemicals
  - Enjoy more plant proteins and fish
  - Healthy liquid fats, less SFA
  - Enjoy more fresh, whole, lightly processed foods



# Diet to Reduce CVD Risk

- Alcohol
  - Older adults who drink 1 to 2 drinks a day reported to raise HDL cholesterol concentrations and reduce the risk of blood clots, thereby reducing the likelihood of heart attack
  - Cannot reverse the effects of other risk factors such as poor diet or physical inactivity

# Hypertension

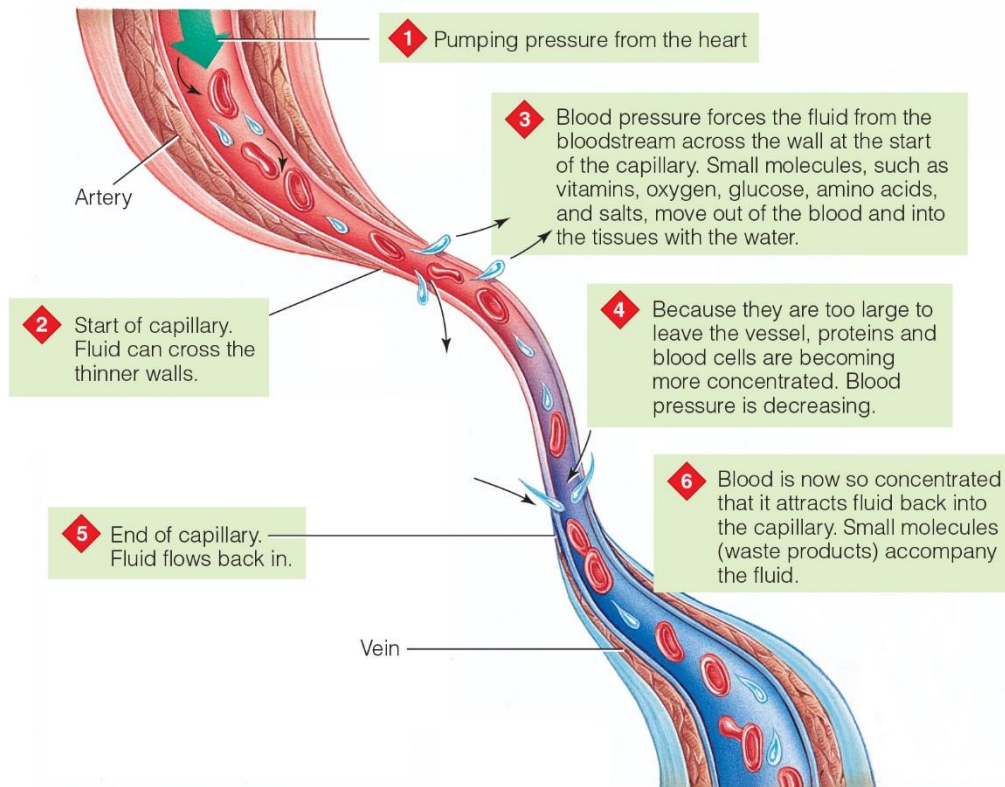
- 1 in 4 Canadians have HTN
- Physiological factors affecting blood pressure
  - Cardiac output
    - Contractions in heart muscle, pumping blood
  - Peripheral resistance
    - Diameters of arterioles
  - Nervous system
  - Hormones
    - Kidneys



Figure 11-8

## The Blood Pressure

Three major factors contribute to the pressure inside an artery. First, the heart pushes blood into the artery. Second, the small-diameter arteries and capillaries at the other end resist the blood's flow (peripheral resistance). Third, the volume of fluid in the circulatory system, which depends on the number of dissolved particles in that fluid, adds pressure.



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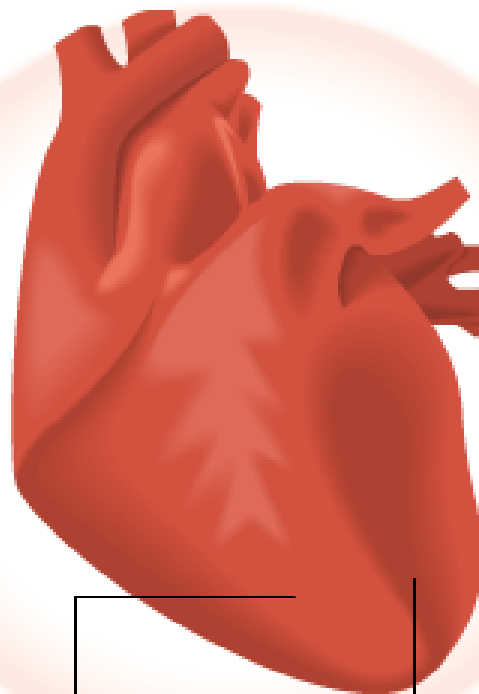
**NORMAL** ✓

→ **120** *mm hg*

**80** *mm hg*

**SYSTOLIC**

Measures the blood's pressure as the **heart ventricles contract**.  
"120" is regarded as right in the middle of the range of normal blood pressures



Right  
ventricle

Left  
ventricle

mm hg = MILLIMETRES OF  
MERCURY DISPLAYED BY  
THE BLOOD PRESSURE GAUGE

**HIGH** ✗

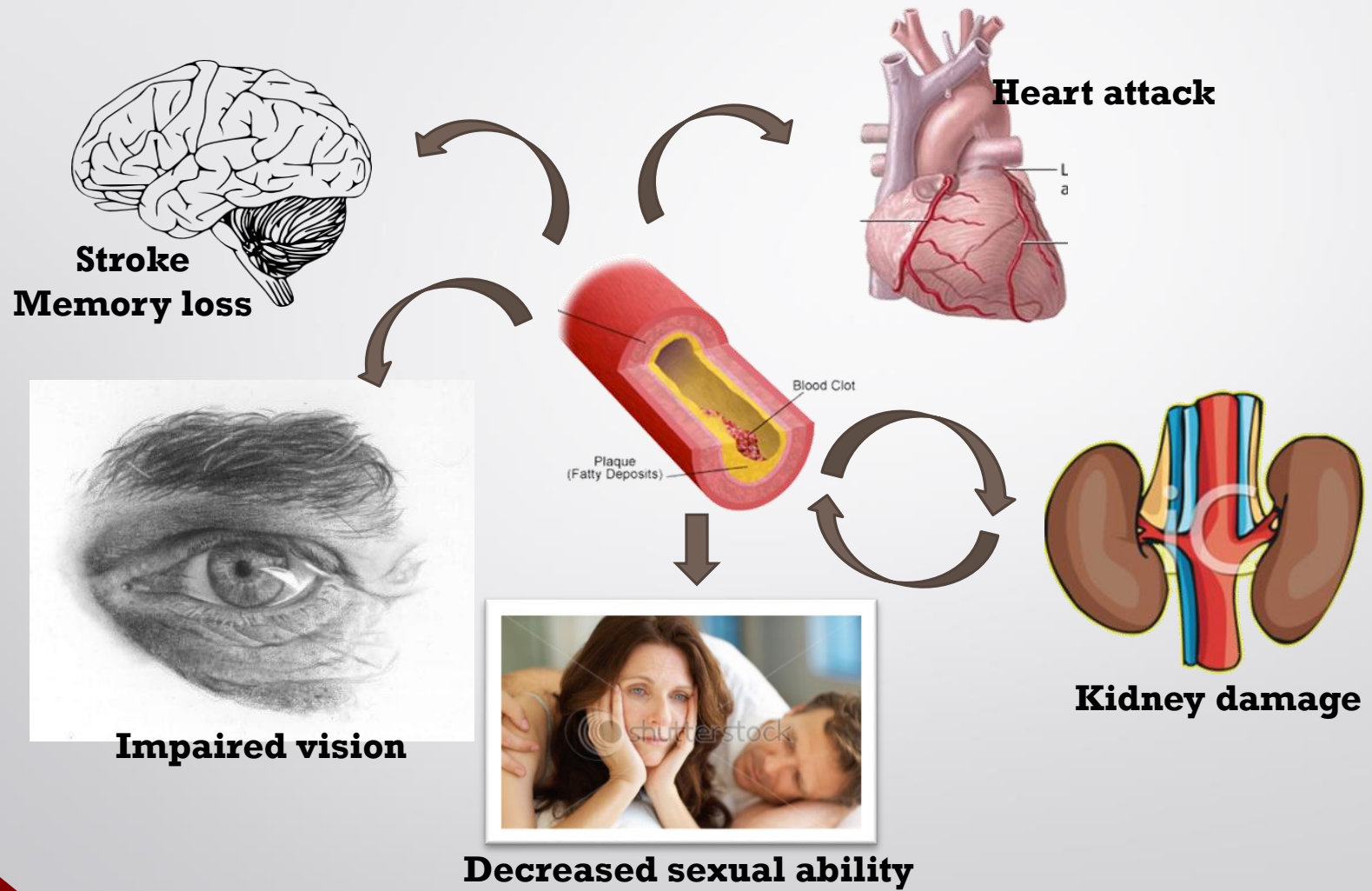
→ **140** *mm hg*

**90** *mm hg*

**DIASTOLIC**

Measures the blood's pressure as the **heart ventricles relax**.  
"90" is regarded as high and if left untreated could lead to illness

# How Does High Blood Pressure Affect the Body?





# HTN Risk Factors

## Modifiable

- Current cigarette smoking, secondhand smoke
- Excess Weight
- Physical inactivity
- Unhealthy diet
- Stress

## Relatively Fixed:

- Family history/ genetics
- Ethnicity
- Increased age
- Male sex
- ~ Psychosocial stress

## Diseases that increase risk:

- Heart disease - dyslipidemia
- Diabetes, insulin resistance
- Kidney disease
- Sleep apnea
- Obesity



# Hypertension Risk Factors and Treatment

- Treatment
  - DASH diet
  - ↓ Sodium intake
  - Physical activity
  - Weight control
  - Stress management
  - Medications



# Dietary Approaches to Stop Hypertension

- DASH diet
  - Rich in vegetables and fruits
  - Provides ~30% of its calories from fat  
(nuts, fish, whole grains, low-fat dairy products)
  - Emphasizes vegetarian protein sources, less sugar
  - Restricts Na together with an increase in Potassium
  - Nutrient dense

# DASH Diet vs. Normal American Diet

- DASH diet provides more:

- Fibre
- Potassium
- Magnesium
- Calcium

} Lower blood pressure

- And less:

- Red meat
- Sweet foods and beverages

- And helps:

- Lower blood pressure
- Prevents/reduces hypertension when combined with a low sodium diet

- Lowers cholesterol and LDL cholesterol, cancer risk...



## Complications of Diabetes Mellitus

High blood sugar

Conversion to sugar alcohols

Vision loss

Glycoproteins

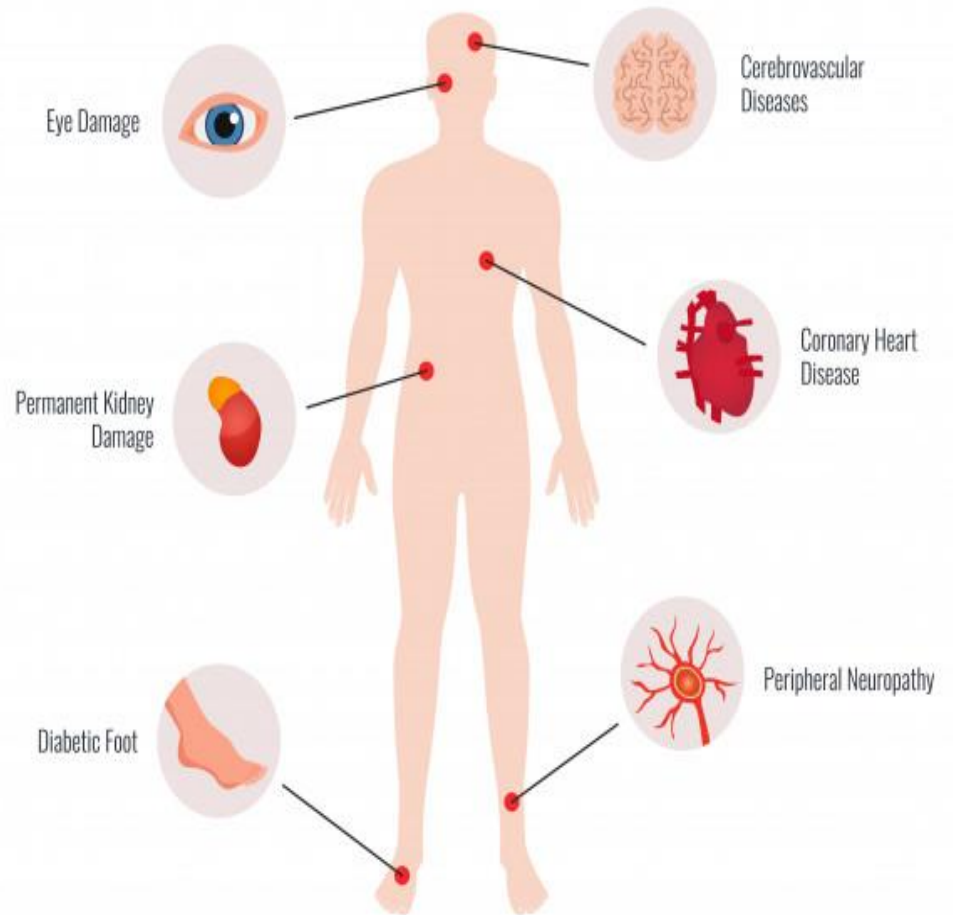
Nerve function

Loss of circulation

Infections

Microvascular damage

Kidney...

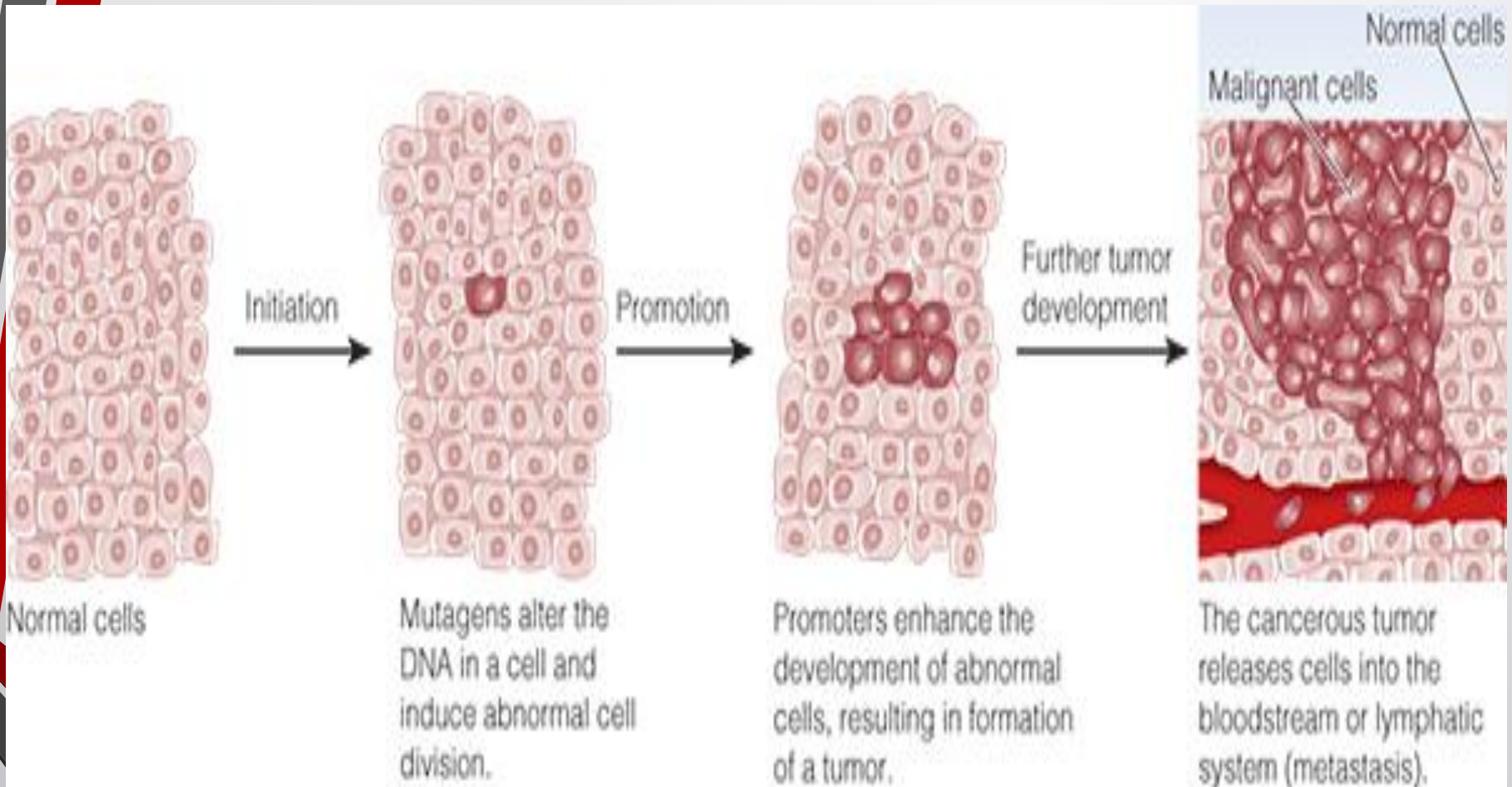


# How Does Cancer Develop?

Leading cause of death in Canada

- Cancer arises in the genes
  - DNA is damaged by a carcinogen
    - Cellular repair or self-destruction
  - Cell loses ability to self-destruct
    - Replicates uncontrollably
  - Mass of abnormal tissue
    - Benign – non-cancerous
    - Malignant – cancerous
- Cancer prevention at level of tumour formation

# Cancer Development:



2 in 5 Canadians will develop cancer in their lifetime



# Environmental Factors and Cancer

- Known environmental causes of cancer
  - Radiation and sun
  - Water and air pollution
  - Smoking
- Obesity and physical inactivity are risk factors
- Hormones: estrogen
  - Breast cancer risk after menopause
  - Excess fat



# Tobacco, Alcohol and Cancer

- Excessive alcohol intake is associated with higher cancer risks
  - Head, neck, GI and liver
- Smoking-a significant risk factor of cancer
  - Risk of lung cancer increases up to 23% in smokers
- Alcohol + tobacco → strongly correlates with cancers of the head & neck





# Nutrition and Cancer

- 20% - 50% of cancers are influenced by diet

Foods or their components may:

- Cause cancer
- Promote cancer
- Protect against cancer

# Factors Associated with Cancers at Specific Sites

**Table 11–8**

## Factors Associated with Cancers at Specific Sites

	Convincing or Probable <i>Increased Risk</i>	Convincing or Probable <i>Decreased Risk</i>
Breast cancer (premenopausal)	Alcohol	Breastfeeding, body fatness
Breast cancer (postmenopausal)	Alcohol, body/abdominal fatness	Breastfeeding, physical activity
Colorectal cancer	Red and processed meat, body/abdominal fatness, alcohol	Foods containing dietary fibre, physical activity, garlic, diets high in calcium
Mouth and throat cancer	Alcohol	Fruits, nonstarchy vegetables
Esophagus cancer	Body, fatness, maté,* and alcohol	Fruits, nonstarchy vegetables
Liver cancer	Mould aflatoxin, alcohol	
Lung cancer	Beta-carotene supplements (in smokers), arsenic in drinking water	Fruits
Pancreatic cancer	Body/abdominal fatness	Foods containing folate
Prostate cancer	Diets high in calcium	Foods containing lycopene, foods containing selenium
Stomach cancer	Salt, salted and salty foods	Fruits, nonstarchy vegetables, foods in the allium family (e.g., onion and garlic)

Source: This material has been adapted from the 2017 WCRF/AICR Report “Diet, Nutrition, Physical Activity and the Prevention of Cancer: A Global Perspective.” <https://www.wcrf.org/dietandcancer>. Please visit <https://www.wcrf.org/> and <http://www.aicr.org/>.

\*A herbal beverage in parts of South America that, while it is very hot, is drunk through a metal straw.

# Cancer Prevention

## 4 in 10 cases can be prevented

- Diets low in saturated trans fats, rich in fruits and vegetables
- Reduce/quit smoking
- Physical activity
- Limit alcohol consumption
- Limit sun exposure
- Vaccination
- Regular check ups
- Environmental changes



# Mental Health VS Mental Illness

- Mental Health is defined as “a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community.”
- Mental Illness is “characterized by alterations in thinking, mood, or behavior associated with significant distress and impaired functioning.”
- Risk factors: Genetics, brain chemistry, environmental stressors (poverty, unsafe housing, family conflict/ violence, neglect/ poor nutrition), lack of coping



# Foods for brain health

## Fermentable Products



Whole grains  
Fruits and veggies  
Lean proteins, fish  
Healthy fats  
Vit D, B vitamins..  
Regular meals and snacks..  
Caution with EtOH



RESEARCH ARTICLE

Open Access



# A randomised controlled trial of dietary improvement for adults with major depression (the 'SMILES' trial)

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## Abstract

**Background:** The possible therapeutic impact of dietary changes on existing mental illness is largely unknown. Using a randomised controlled trial design, we aimed to investigate the efficacy of a dietary improvement program for the treatment of major depressive episodes.

**Methods:** 'SMILES' was a 12-week, parallel-group, single blind, randomised controlled trial of an adjunctive dietary intervention in the treatment of moderate to severe depression. The intervention consisted of seven individual nutritional consulting sessions delivered by a clinical dietician. The control condition comprised a social support protocol to the same visit schedule and length. Depression symptomatology was the primary endpoint, assessed using the Montgomery-Åsberg Depression Rating Scale (MADRS) at 12 weeks. Secondary outcomes included remission and change of symptoms, mood and anxiety. Analyses utilised a likelihood-based mixed-effects model repeated measures (MMRM) approach. The robustness of estimates was investigated through sensitivity analyses.

**Results:** We assessed 166 individuals for eligibility, of whom 67 were enrolled (diet intervention,  $n = 33$ ; control,  $n = 34$ ). Of these, 55 were utilising some form of therapy: 21 were using psychotherapy and pharmacotherapy combined; 9 were using exclusively psychotherapy; and 25 were using only pharmacotherapy. There were 31 in the diet support group and 25 in the social support control group who had complete data at 12 weeks. The dietary support group demonstrated significantly greater improvement between baseline and 12 weeks on the MADRS than the social support control group,  $t(60.7) = 4.38$ ,  $p < 0.001$ , Cohen's  $d = -1.16$ . Remission, defined as a MADRS score  $< 10$ , was achieved for 32.3% ( $n = 10$ ) and 8.0% ( $n = 2$ ) of the intervention and control groups, respectively ( $\chi^2(1) = 4.84$ ,  $p = 0.028$ ); number needed to treat (NNT) based on remission scores was 4.1 (95% CI of NNT 2.3–27.8). A sensitivity analysis, testing departures from the missing at random (MAR) assumption for dropouts, indicated that the impact of the intervention was robust to violations of MAR assumptions.

**Conclusions:** These results indicate that dietary improvement may provide an efficacious and accessible treatment strategy for the management of this highly prevalent mental disorder, the benefits of which could extend to the management of common co-morbidities.

**Trial registration:** Australia and New Zealand Clinical Trials Register (ANZCTR): ACTRN12612000251820. Registered on 29 February 2012.

**Keywords:** Depression, Major depressive disorder, Diet, Nutrition, Randomised controlled trial, Dietetics

# Self-Care+ Support, Treatment

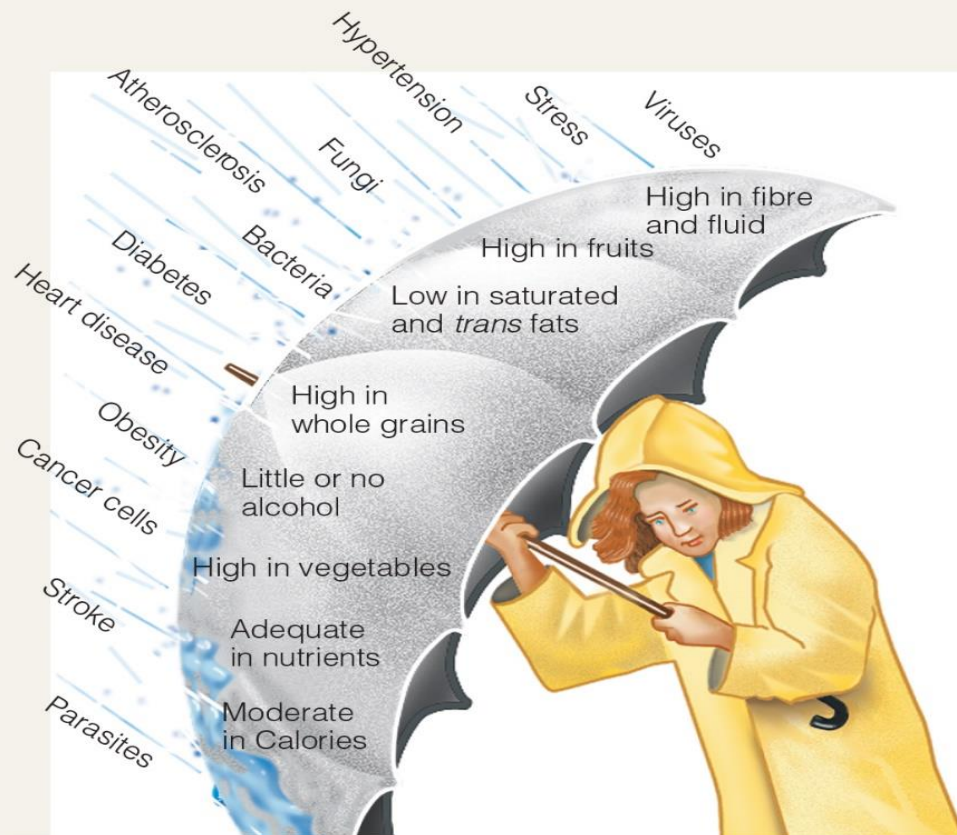


# Proper Nutrition Shields Against Diseases

**Figure 11–11**

## **Proper Nutrition Shields against Diseases**

A well-chosen diet can protect your health.



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# Individual Treatment

Disease	Screening tools
Atherosclerosis	blood cholesterol, lipid profile
Hypertension	blood pressure
T <sub>2</sub> DM	blood glucose, urinalysis - glucose
Cancer	mammogram, pap, prostate test, colonoscopy, fecal occult blood, etc...
Osteoporosis	bone densitometry
Mental health, dementia	Behavior questionnaires, ...

# Individual Disease Treatment

Disease	Treatment
Atherosclerosis	Balanced diet, wt, activity, meds..
Hypertension	DASH diet, decrease salt, anti-HTN drugs, activity..
T2 Diabetes	Balanced eating, Wt mgmt, activity, fibre, meds...
Cancer	Nutritional status/diet, chemo/radiation/surgery, food safety..
Osteoporosis	Calcium, vitamin D, K, balanced eating, activity, drugs...
Mental health, dementia	Balanced diet, healthy fats, probiotics, activity, treatment (therapy, meds, sleep...)

Canada's  
food guide

# Eat well. Live well.

Eat a variety of healthy foods each day

Have plenty  
of vegetables  
and fruits

Eat protein  
foods

Make water  
your drink  
of choice



Choose  
whole grain  
foods

Discover your food guide at

**Canada.ca/FoodGuide**

# **Eat sustainably.. Human and planet health...**

**“According the 2019 EAT-Lancet commission on healthy diets from sustainable food systems, a global shift toward more plant-based foods including legumes (beans, peas, lentils, peanuts), whole grains, vegetables, fruits and nuts, and less animal-based foods, especially red meat and processed meat, will help feed the world's growing population a nutritious and sustainable diet.”**

<https://www.eatright.org/health/lifestyle/culture-and-traditions/sustainable-eating#:~:text=According%20the%202019%20EAT%2DLancet,meat%2C%20will%20help%20feed%20the>

# How to eat sustainably:



Eating  
Local



Cooking at  
Home



Eating  
Meatless  
Meals



Minimizing  
Food  
Packaging



Reducing  
Food  
Waste



# FOOD WASTE IN CANADA

THE FACTS



**40%**

of food produced  
in Canada is  
wasted each year.



Food waste costs Canada's  
economy more than

**\$31 BILLION**

each year.

The average Canadian wastes  
approximately

**183 KG**

of solid food per year.

As a country, that's

**6 MILLION TONNES.**

Equivalent to the weight of

**1 MILLION**

full-grown male  
elephants.



The average Canadian  
household spends

**\$1,456**

on food that is wasted every year.



Organics wasted in a  
landfill produce methane  
gas which is

**25 TIMES**

times more  
damaging  
to the  
environment  
than carbon  
dioxide.



*Source: Recycling  
Council of Ontario*

## **Case Study: Diets for Disease Prevention**

Ellen is a 59-year-old woman with multiple medical problems, including chronic back pain, HTN, CHD. She is 1.65 m tall and weighs 130 kg. She takes medications for high blood pressure and hypercholesterolemia, both of which are currently under control. Her sleep quality is poor. She also takes pain medications every day and has difficulty walking, although she occasionally attends a water exercise class at the local sports center. She states that she has been overweight most of her life and confesses that foods, especially sweet foods, are a comfort to her when she experiences physical or emotional pain. She works part-time & lives with her husband. A recent visit to her doctor reveals a weight gain of 8 kg over the past 6 months and an increase in her fasting blood glucose level into the “pre-diabetes” range. She has no family history of diabetes. Her doctor has recommended she make lifestyle changes to prevent diabetes.

### **Diet history:**

Coffee: 2-3 cups, Two or three cans of root beer /d, 1 glass of red wine/day

Eats 2 meals that usually include meat or chicken (she dislikes fish) and vegetables, such as corn and potatoes. She enjoys milk, but only drinks it occasionally (2-3 cups/ wk). Skips breakfast. Snacks on several types of desserts between meals, often in front of TV or standing in the kitchen.

- **What are Ellen’s challenges/barriers?**
- **Evaluate Ellen’s weight and associated risk.**
- **What risk factors does she have for chronic diseases based on current diet?**
- **What risk factors does she have for chronic diseases based on current lifestyle?**
- **What can she do to decrease her risk factors for each chronic disease?**



## **Case Study: Fatigue**

Samuel is a 63-year-old single man who works full time in a food processing plant. He has a history of esophageal cancer, which was treated successfully with anticancer drugs and surgery four years ago. His weight had been stable at 135 pounds until six months ago. Since then, he has experienced an involuntary weight loss of 10 pounds (BMI =18). He complains of a poor appetite and being overly weak, tired, and irritable. He also complains of cracks at the corners of his mouth and a chronic sore throat, which concerns him, given his cancer history. Smokes less now (5 - 10 cigs/d).

**Usual diet** is fairly consistent. He states that he rarely eats breakfast because he starts work at 6 a.m. He eats two deli meat sandwiches, “usually pastrami or salami,” and a soda at 10 a.m., and he may eat a candy bar in the afternoon when he gets off work. He often prepares and eats a frozen dinner or pizza at home in the evening and routinely drinks “about four or five beers” before going to bed. Occasionally, he cooks roast and mashed potatoes for dinner and may have cereal with milk for a snack before bed. He rarely eats vegetables or fruits.

- **Considering Samuel’s alcohol consumption, which B vitamin may he be deficient in? Symptoms?**
- **What other nutrients are you concerned about?**
- **What are his risk factors for cancer?**
- **What is your assessment of his weight?**
- **What suggestions do you have for his diet?**



Quiz 11 Due Dec. 2

Questions?