IST YEAR MBBS
CVS MODULE

Lecture on Cholesterol

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LEARNING OBJECTIVES

- To understand the structure of Cholesterol
- Biomedical importance of Cholesterol
- Functions of Cholesterol
- Metabolic fate of Cholesterol
- Hypercholesterolemia and its causes
- Hypocholesterolemia

ALCOHOLS

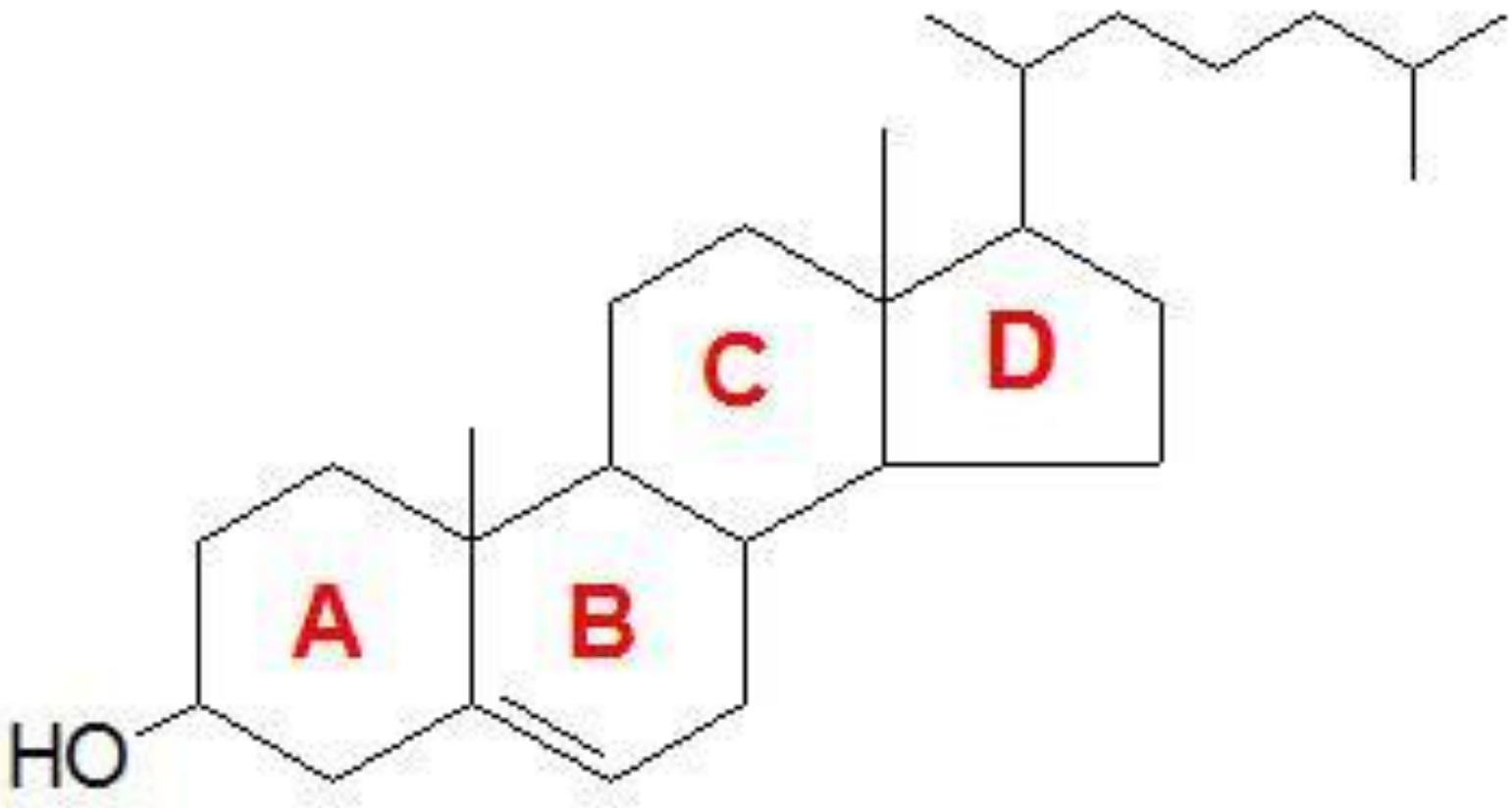
Alcohols contained in the lipid molecule includes glycerol, cholesterol and the higher alcohols, e.g. cetylalcohol, C16H33COOH (usually found in waxes).

- **Steroids and Sterols**
- The steroids are often found in association with fat. Most important sterol in human body is cholesterol.

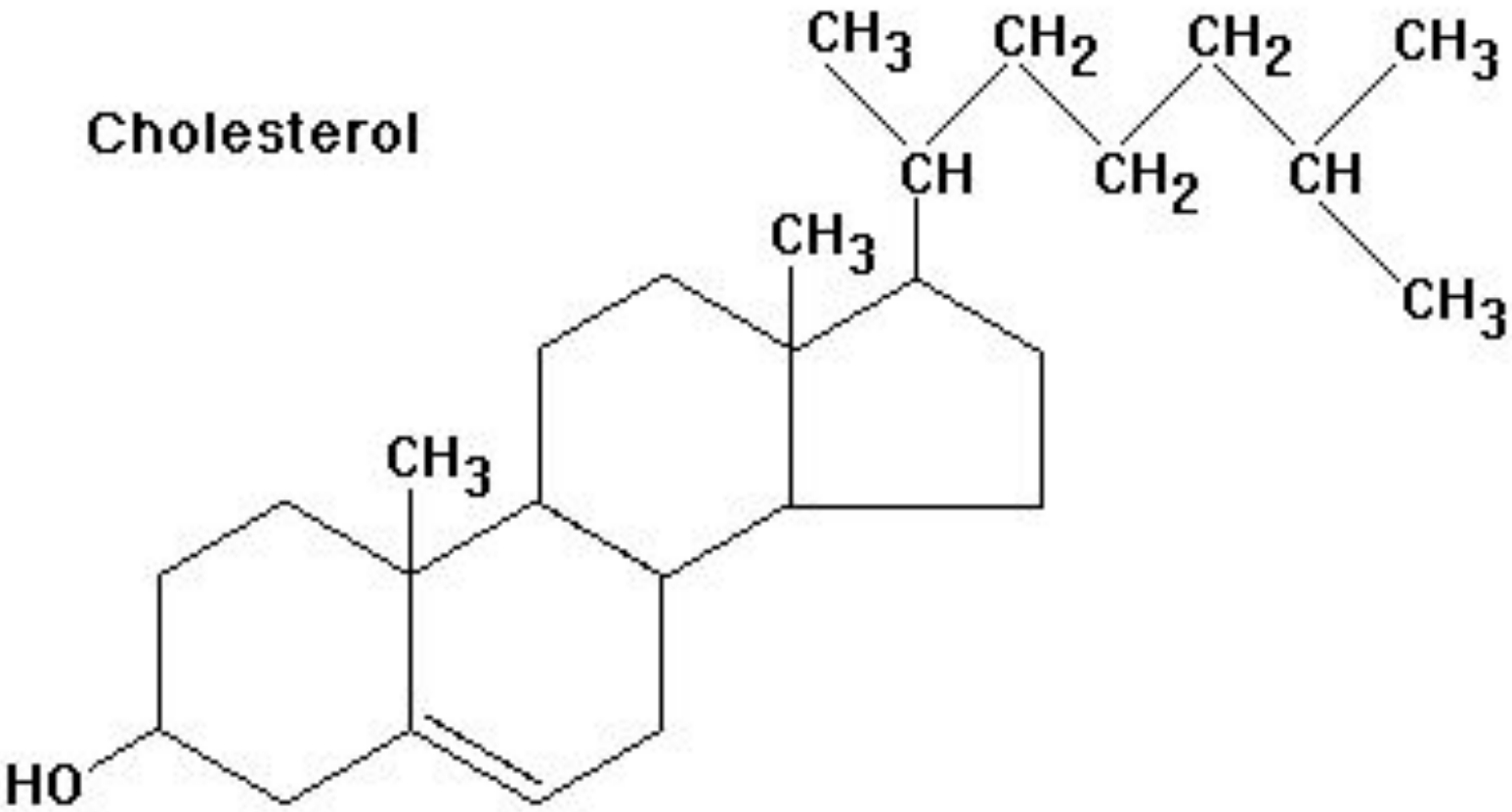
CHOLESTEROL

Structure:

- Cholesterol is the most important sterol in human body. Its molecular formula is C27 H45 OH.
- It possesses “cyclopentanoperhydrophenan-threne nucleus”.
- It has an – OH group at C3.
- It has an unsaturated double bond between C5 and C6.
- It has two – CH3 groups at C10 and C13.
- It has an eight carbon side chain attached to C17.


A
B
C
D
HO

Cholesterol



PROPERTIES:

- The name cholesterol is derived from the Greek word meaning “solid bile”. It occurs as a white or faintly yellow, almost odourless, pearly leaflets or granules. It is insoluble in water, sparingly soluble in alcohol and soluble in ether, chloroform, hot alcohol, ethylacetate and vegetable oils.

Cholesterol is found in :

- Egg yolk
- Meat
- Liver
- Brain

Source:

Exogenous:

Dietary cholesterol, approximately 0.3 gm/ day. Diet rich in cholesterol are butter, cream, milk, egg yolk, meat, etc. A hen's egg weighing 2 oz gives 250 mg cholesterol.

Endogenous:

Synthesized in the body from acetyl CoA, approximately 1.0 gm/day.

Occurrence:

It is widely present in body tissues. Cholesterol is found in largest amounts in normal human adults brain and nervous tissue 2%, in the liver about 0.3%, skin 0.3% and intestinal mucosa 0.2% certain endocrine glands viz. adrenal cortex contain some 10% or more, corpus luteum is also rich in cholesterol.

- **Forms of Cholesterol:**
- Cholesterol occurs both in free form and in ester form, in which it is esterified with fatty acids at – OH group at C3 position.

- Free cholesterol is equally distributed between plasma and red blood cells, but the latter do not contain esters. In brain and nervous tissue, free form predominates.

BIOMEDICAL IMPORTANCE

- Cholesterol is present in tissues and plasma either as FREE CHOLESTEROL or as CHOLESTERYL ESTER,the storage form.
- Both forms are transported in plasma as lipoproteins
- Free cholesterol is removed from the tissues by plasma HDL-----tansported to liver------eliminated either unchanged or converted to Bile acids or major constituent of gallstones

FUNCTIONS

- Cholesterol is an essential structural component of
- Membranes
- Outer layer of plasma lipoproteins.
- Cholesterol is synthesized in many tissues from acetyl coA

- It is the precursor of :
- Corticosteroids
- Sex hormones (androgens,estrogen,progesterone)
- Bile acids
- Vitamin D
- Major constituent of gallstones
- Factor for atherosclerosis of vital arteries,causing
- Cerebrovascular
- Coronary
- Peripheral vascular diseases.

FATE OF CHOLESTEROL

- Cholesterol is used by cells to decrease fluidity of cell membrane
- Used in steroid hormone biosynthesis
- Used in Vit A D E K biosynthesis
- Cholesterol can also be exported from liver as bile acids, cholesteryl esters, or biliary cholesterol
  - Cholesteryl esters are transported to other other tissues to use cholesterol

METABOLIC FATE OF CHOLESTEROL

Cholesterol is converted into following compounds as shown below.
Cholesterol is mainly excreted in the form of bile salts in stool.

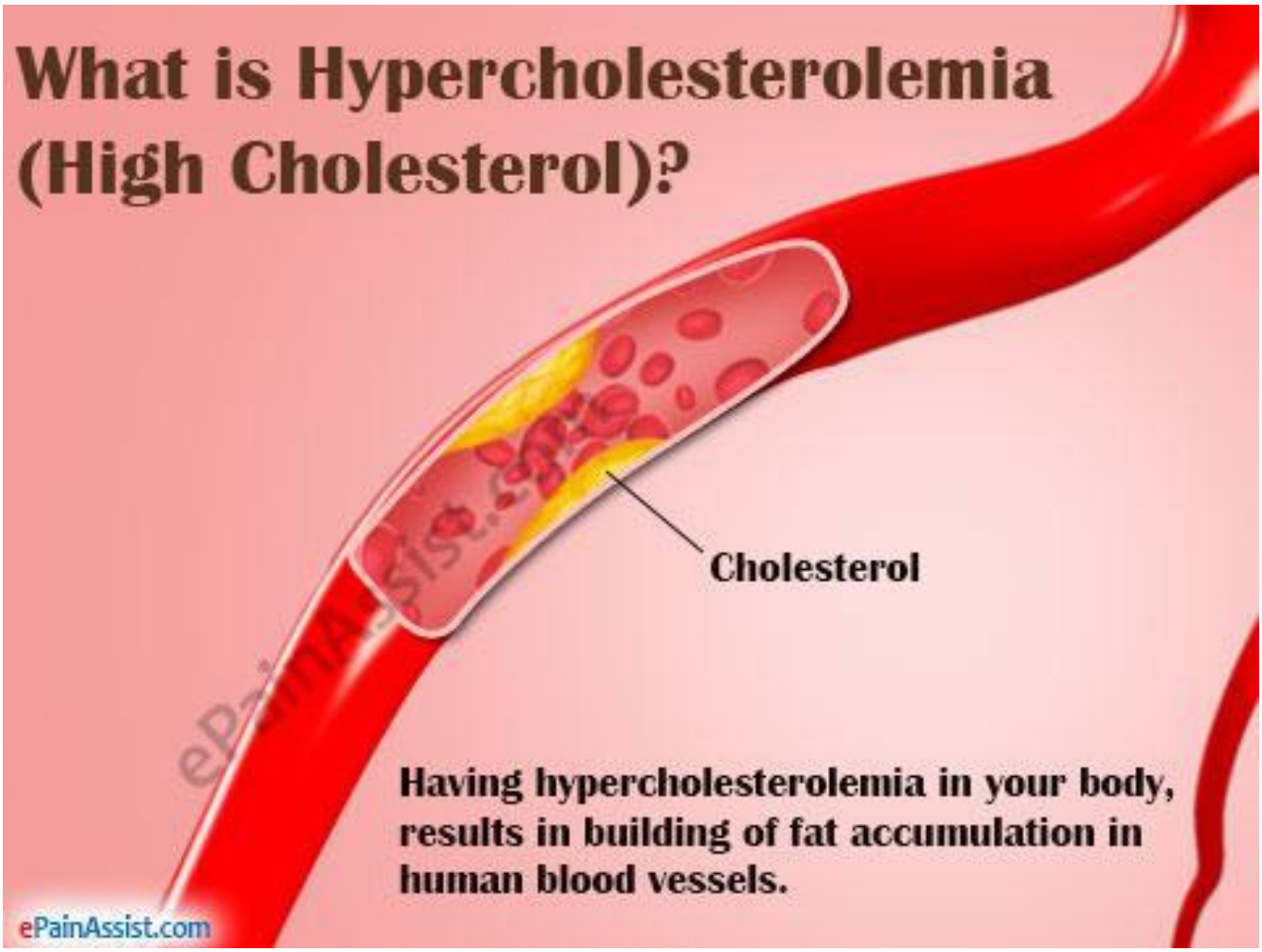
Acetyl CoA → Cholesterol →
- Steroid hormone (Testosterone, estrogens progesterone, glucocorticoids mineralocorticcoids)
- Vitamin D_3
- Bile acids (salts)

Increased plasma cholesterol results in the accumulation of cholesterol under the tunica intima of the arteries causing atherosclerosis. The progression of the disease process leads to narrowing of the blood vessels. Dietary intake of polyunsaturated fatty acid (PUFA) helps in transport and metabolism of cholesterol and prevents atherosclerosis

LIPID PROFILE

	DESIRABLE	BORDERLINE	HIGH RISK
Cholesterol	<200 mg/dl	200-239 mg/dl	240 mg/dl
Triglycerides	<150 mg/dl	150-199 mg/dl	200-499 mg/dl
HDL cholesterol	60 mg/dl	35-45 mg/dl	<35 mg/dl
LDL cholesterol	60-130 mg/dl	130-159 mg/dl	160-189 mg/dl
Cholesterol/ HDL ratio	4.0	5.0	6.0

CLINICAL SIGNIFICANCE


What is Hypercholesterolemia (High Cholesterol)?
Cholesterol
Having hypercholesterolemia in your body, results in building of fat accumulation in human blood vessels.
ePainAssist.com

Hypercholesterolemia

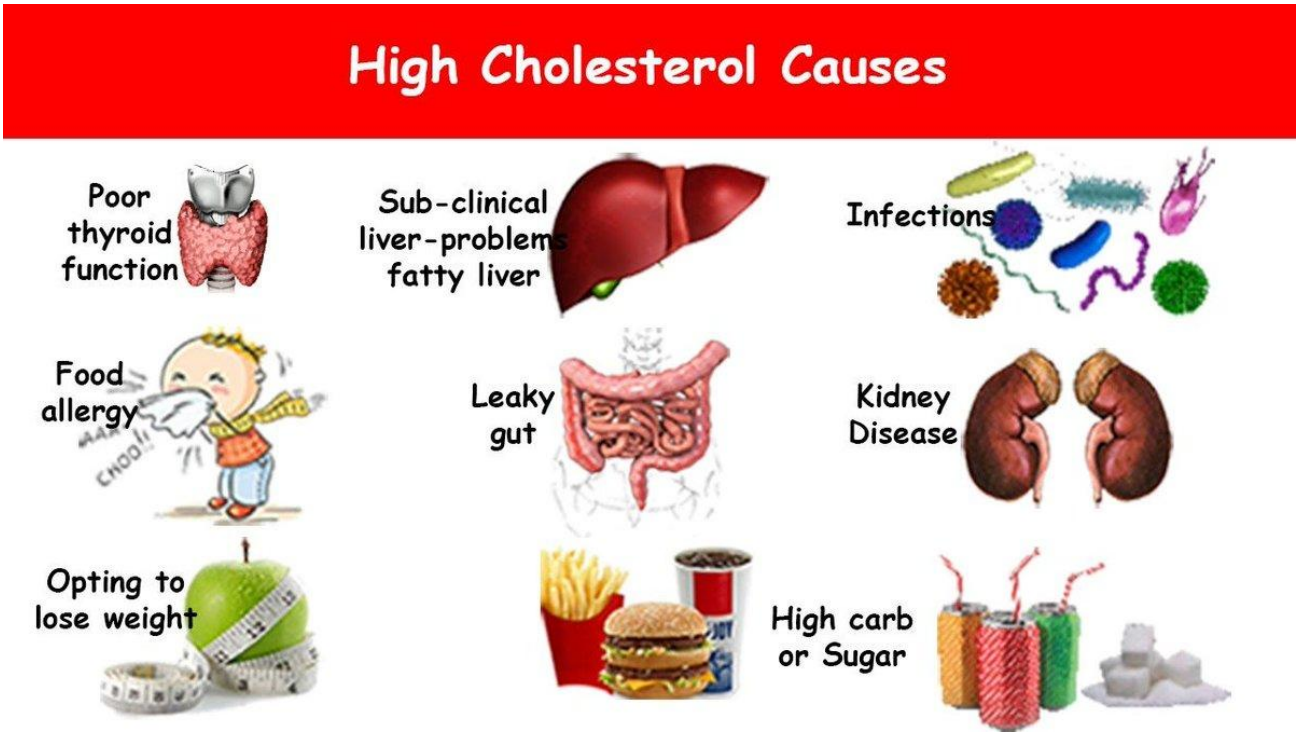
abnormal cholesterol levels (hypercholesterolemia) — that is, higher concentrations of LDL and lower concentrations of functional HDL — are strongly associated with cardiovascular disease because these promote atheroma development in arteries (atherosclerosis). This disease process leads to myocardial infarction (heart attack), stroke, and peripheral vascular disease.

Elevated levels of the lipoprotein fractions, LDL, IDL and VLDL are regarded as atherogenic

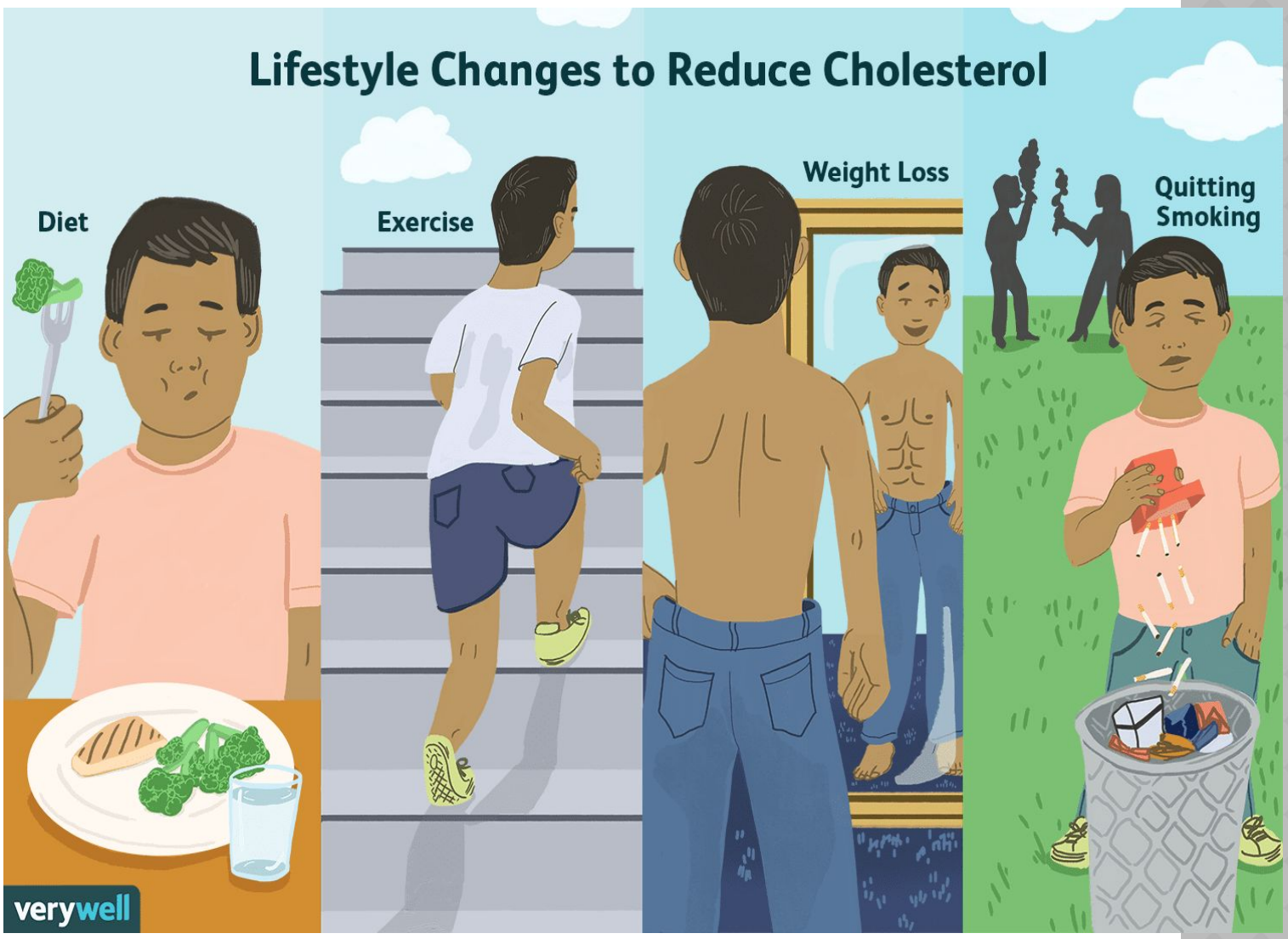
CAUSES OF HYPERCHOLESTEROLEMIA

- Family history
- Obesity
- Diet high in saturated and trans fatty acids
- Low fibre in diet
- Physical inactivity
- Stress
- Pregnancy
- Cigarette smoking
- Alcohol use
- Diabetes
- Kidney failure
- Liver disease
- Polycystic ovarian syndrome
- Underactive thyroid

CAUSES OF HYPERCHOLESTEROLEMIA



Elevated cholesterol levels are treated with a strict diet consisting of low saturated fat, fat-free, low cholesterol foods,often followed by one of various hypolipidemic agents, such as statins,


Lifestyle Changes to Reduce Cholesterol
Diet
Exercise
Weight Loss
Quitting Smoking
verywell

Hypocholesterolemia

Abnormally low levels of cholesterol are termed hypocholesterolemia. Research into the causes of this state is relatively limited, but some studies suggest a link with depression, cancer, and cerebral hemorrhage. In general, the low cholesterol levels seem to be a consequence, rather than a cause, of an underlying illness.

CHOLESTEROL TESTING

- A blood sample after 12-hour fasting is taken to determine a lipoprotein profile. This measures total cholesterol, LDL (bad) cholesterol, HDL (good) cholesterol, and triglycerides

- It is recommended to test cholesterol at least every five years if a person has total cholesterol of 5.2 mmol/L or more (200+ mg/dL), o

- Cholesterol should be tested yearly or every six months :
- if a man over age 45 or a woman over age 50 has HDL (good) cholesterol less than 1 mmol/L (40 mg/dL)
- or there are other risk factors for heart disease and stroke.

THE END