Obesity

Endocrine system

Biochemistry Team
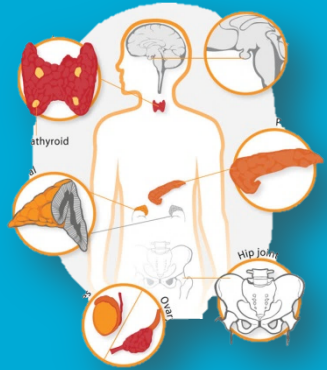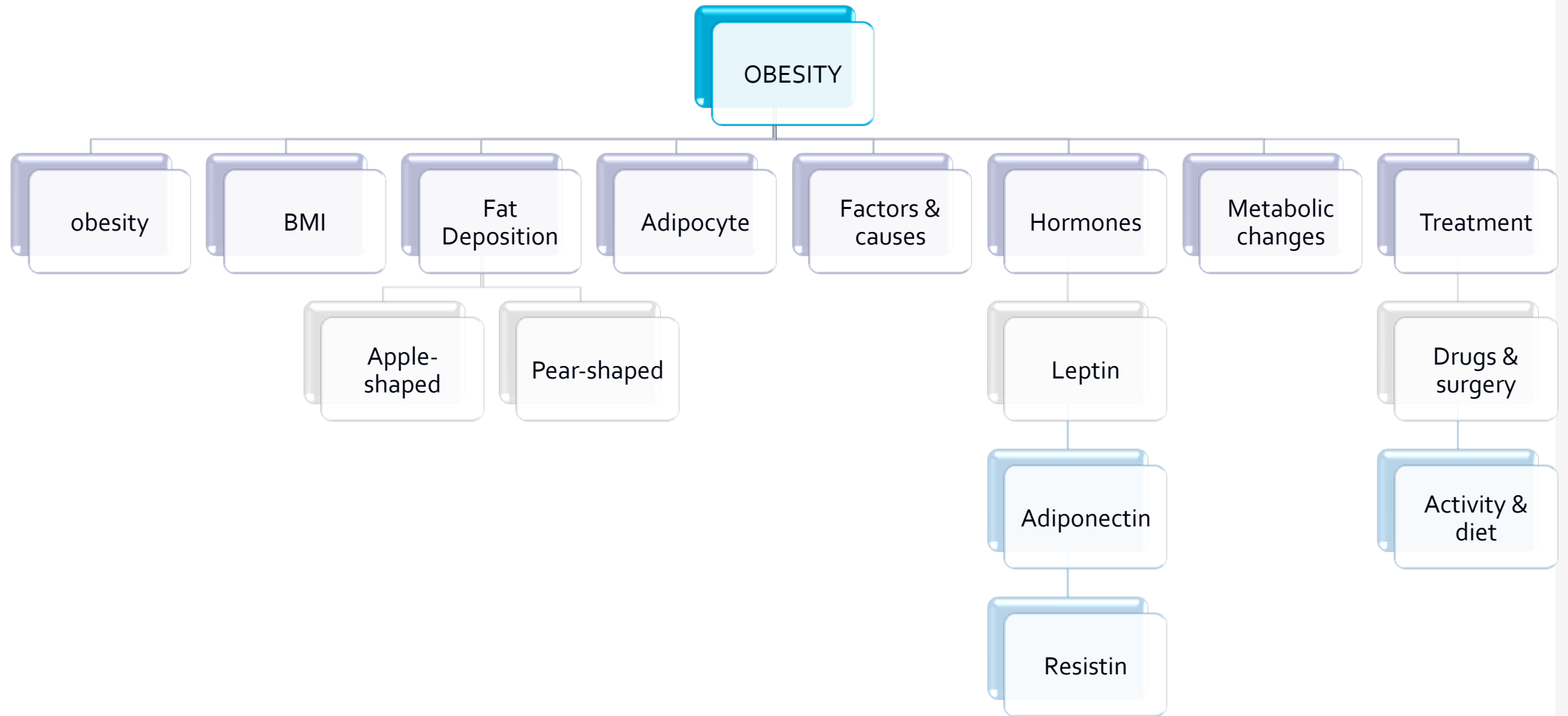
Teams

The Objectives

- Introduction
- Body Mass Index (BMI)
- Types of fat deposition in the body
- Metabolic changes in obesity
- Adipocytes (fat cells) and weight gain
- Hormones in obesity
  - Leptin, adiponectin, ghrelin, cholecystokinin
- Treatment options

Red = Import- ant

Blue = explain

Green = addition notes

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Obesity

* A disorder of body weight regulatory systems

* Causes accumulation of <u>excess body fat</u> >20% of normal body weight

* Obesity is associated with a high risk of:

- o Diabetes mellitus
- o Hypercholesterolemia
- o High plasma triglycerides
- o Hypertension
- o Heart disease
- o Cancer
- o Gallstones, arthritis, gout
- o Mortality

If a patient's normal weight is **50 Kg**. Then she gained **10 Kg** **(20% of her normal body weight)**, and her weight now is **60 Kg**. Now she's considered obese. Less than 60 she is **overweight** but **not obese**

* <u>Body Mass Index (BMI)</u>

- BMI is an <u>indirect</u> measure of obesity
- Correlates height, weight and amount of body fat in an individual
- High BMI is associated with increased mortality risk

	BMI	GRADE
UNDER WEIGHT	≤ 18.5	
NORMAL	18.5 − 24.9	
OVER WEIGHT	25.0 − 29.9	
OBESE	30.0 − 34.9	I
OBESE	35.0 − 39.9	II
HIGHLY OBESE	≥ 40	III

$$BMI = \frac{Weight\ (Kg)}{(Height\ in\ metres)^2}$$

OR
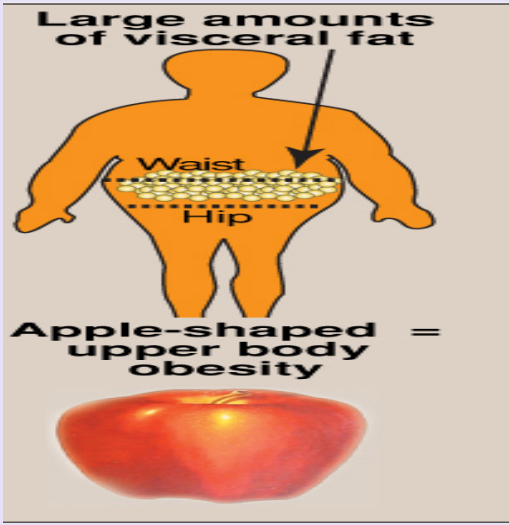
$$BMI = \frac{703 \times Weight\ (lb)}{(Height\ in\ inches)^2}$$
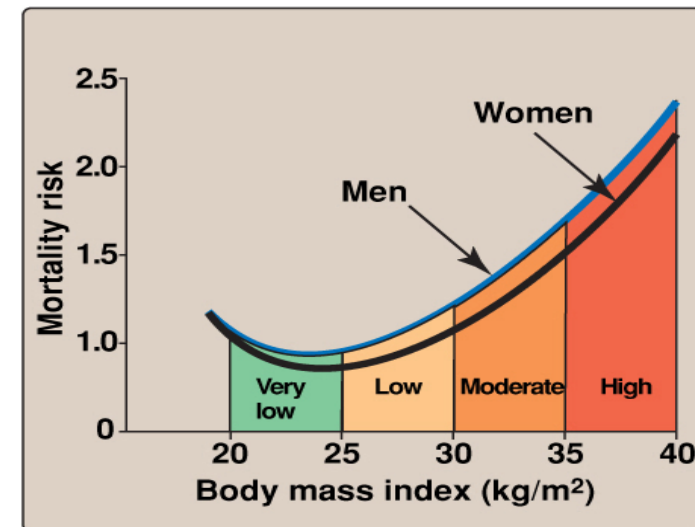
**Anatomic differences in fat deposition**

Upper Body Obesity	Lower Body Obesity
Android, "apple-shaped," or upper body obesity "mainly present in males"	Gynoid, "pear-shaped," or lower body obesity "mainly present in females"
Excess body fat deposited in the central abdominal area	Fat deposited around the hips or gluteal region
Associated with risk of hypertension, insulin resistance, diabetes, dyslipidemia, and coronary heart disease	Associated risks are lower

Abdominal fat	Gluteal Fat
Smaller cells	Larger cells
More responsive to hormones	Less responsive
Release substances via portal vein to the liver	Release substances to circulation with no effect on the liver

Adipocytes

- ✓ Triacylglycerols are deposited in adipocytes (fat cells)
- ✓ The cells increase in size, expand and divide "and this is the cause of obesity"
- ✓ Fat cells, once gained, are never lost "there life-span is about 10 years"
- ✓ In obesity adipocytes increase in number and size
- ✓ Reduction in weight causes adipocytes to reduce in size

That's why gaining weight is easy after losing weight. Because the number of adipocytes doesn't change, there is only reduction in size.
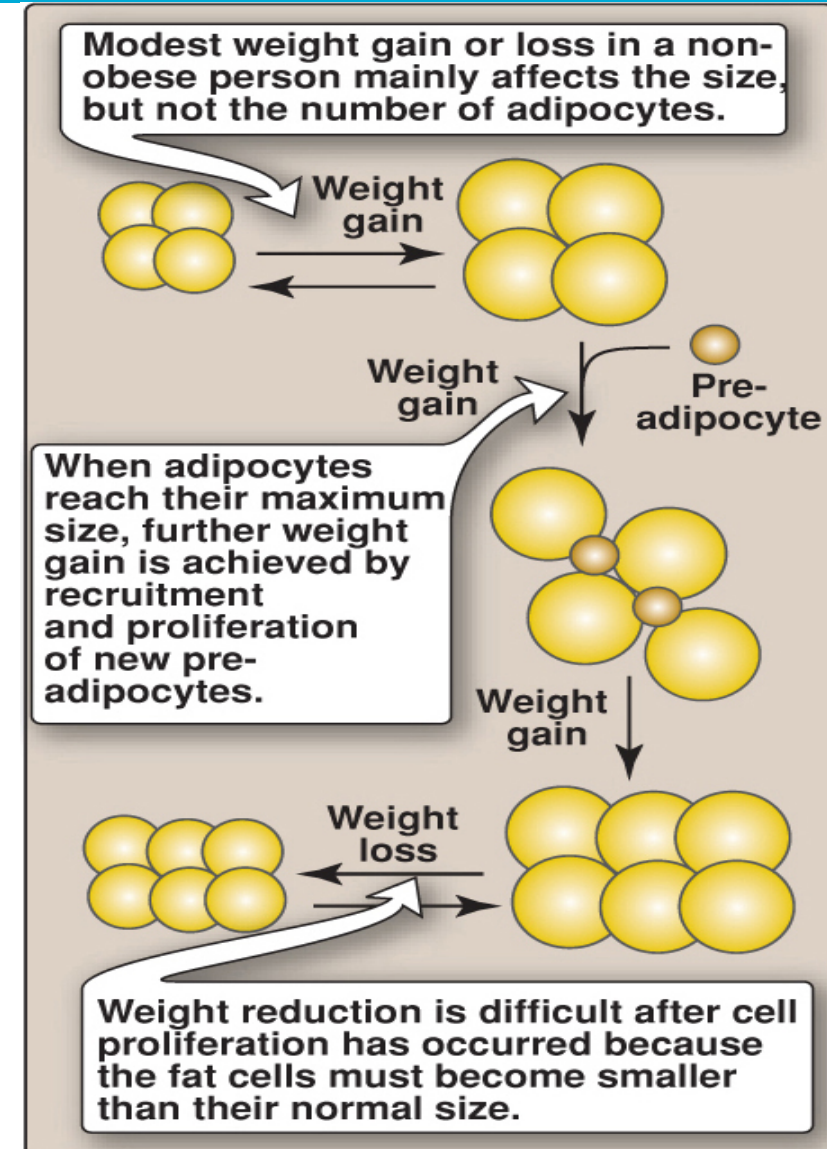
Factors & Causes contributing to obesity

* CAUSES OF WEIGHT GAIN :-

*Energy imbalance : calories consumed not equal to calories used

*Over a long period of time

*Due to a combination of several factors
- o Individual behavior
- o Social interaction
- o Environmental factors
- o Genetics

*More in and less out = weight gain

*More out and less in = weight loss

*Hypothalamus : A control center for hunger and satiety

*Endocrine disorder
- o Hormonal imbalance

* FACTORS CONTRIBUTING TO OBESITY :-

➢ Genetic: familial tendency

➢ Environmental and behavioral
- o Sex: women more susceptible
- o Activity: lack of physical activity
- o Psychogenic: emotional deprivation/depression
- o Alcohol: problem drinking
- o Smoking

➢ Drugs: e.g. antipsychotic drugs

*Appetite is influenced by : 1- Neural signals 2- circulating hormones 3-metabolites

*These signals cause the release of hypothalamic peptides and activate neural signals

*Adipocytes also function as endocrine cells

*They release many regulatory molecules:
- o Leptin, adiponectin, resistin => may cause insulin resistance observed in obesity

Leptin

- A protein hormone produced by adipocytes.
- Functions:
- ✓ Required to keep the body weight under control.
- ✓ Signals the brain about fat store level (sensor for the amount of body fat).
- ✓ Regulates the amount of body fat by: Controlling appetite and energy expenditure.
- Leptin secretion:
- ✓ Suppressed in starvation (depletion of fat stores).
- ✓ Enhanced in well-fed state (expansion of fat stores).
- Leptin causes overweight mice to lose weight and maintain weight loss.
- "OB gene" is the gene coded for leptin and if it is absent it will cause weight gain.

Leptin Resistance :

- Leptin increases metabolic rate and decreases appetite in humans.
- Plasma leptin level in obese humans is usually normal for their fat mass.
- Resistance to leptin has been found in obese humans.
- The receptor for leptin in the hypothalamus is produced by *db* gene
- Mutation in the *db* gene causes leptin resistance in mice
- Leptin resistance may have some role in human obesity
  - Dieting decreases leptin levels
  - Reducing metabolism, stimulating appetite

Adiponectin & others..

- A protein hormone secreted by adipocytes and affect Glucose by cAMP
- Promotes uptake and oxidation of fatty acids and glucose by muscle and liver.
- Blocks the synthesis of fatty acids and gluconeogenesis by hepatocytes.
- Increases insulin sensitivity / glucose tolerance.
- Adiponectin levels are inversely correlated with body fat levels and directly with HDL levels.
- Low levels are seen in metabolic syndrome and diabetes mellitus.
- Obese => low adiponectin
- Dieter => high adiponectin

Ghrelin:
- A peptide hormone secreted by stomach
- Stimulates appetite
- Secretion increases just before meals and drops after meals
- Increases food intake
- Decreases energy expenditure and fat catabolism
- Levels in dieters are *higher* after weight loss
- The body steps up ghrelin production in response to weight loss
- The higher the weight loss, the higher the ghrelin levels

- **Cholecystokinin**: Peptides released from the gut after a meal Sends satiety signals to the brain
- **Insulin**: Promotes metabolism

Metabolic Changes in Obesity

Metabolic Changes in Obesity :
Adipocytes send signals that cause abnormal metabolic changes such as:
- Dyslipidemias: High triglycerides and LDL + low HDL level.
- Glucose intolerance: Because of insulin resistance, there is build-up of glucose.
- Insulin resistance
High level of TAG induce inflammation that triggers release of specific Adibokines.

Weight loss:
- ✓ Decreases risk factors
- ✓ Leads to:
    - Lower blood pressure
    - Decreased serum triacylglycerols
    - Lower blood glucose levels
    - Increase in HDL levels
    - Decreased mortality
    - Beneficial changes in BMR
    - Decreased energy requirement
- ✓ Slow weight loss is more stable
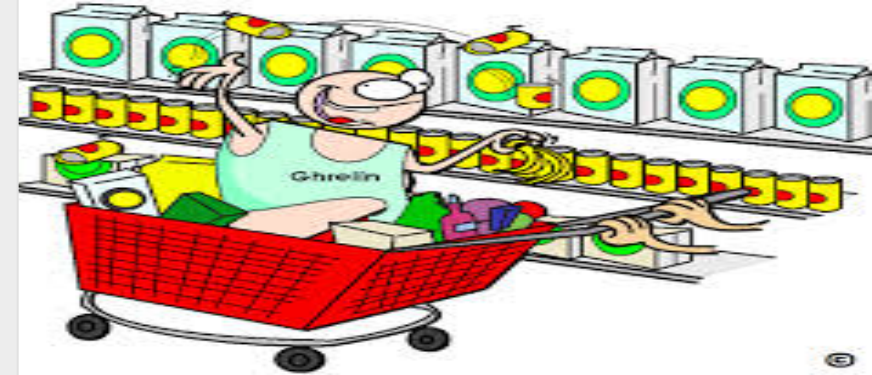
Treatment options

Physical activity
- Combined with healthy diet decreases obesity
- Reduces risk of heart disease and diabetes
- Dieting
- Use of calorie-restricted diet

Drugs
- **A- Orlistat**
- A pancreatic and gastric lipase inhibitor
- Decreases the breakdown of dietary fat
- **B- Sibutramine**
- An appetite suppressant
- Inhibits the reuptake of both serotonin and norepinephrine

Surgery
- Surgical procedures reduce food consumption in patients with BMI >40
- Used when other treatment options fail

Summary

✓ A disorder of body weight regulatory systems, which causes accumulation of excess body fat.
✓ Obesity is associated with a high risk of several chronic diseases, such as: DM, HTN.
✓ BMI is an indirect measure of obesity.
✓ Health risks depend on the pattern of fat deposition.
✓ Fat cells, once gained, are never lost.
✓ Factors contributing to obesity: Genetic factors, environmental factors and drugs.
✓ Causes of weight gain: energy imbalance and due to combination of several factors, such as: social interactions.
✓ Appetite is influenced by: Afferent neural signals, circulating hormones, and metabolites
✓ Leptin increases metabolic rate and decreases appetite in humans.
✓ Adiponectin levels are inversely correlated with body fat percentage and parallels with the HDL level.

YouTube

http://m.youtube.com/watch?v=TyUuoEUjD-s

Q1: Which one of the following is not secreted by adipocytes?

A. Leptin

B. Adiponectin

C. C. Ghrelin

Q2: One of the following acts as appetite stimulating hormone:

A. CCK

B. Insulin

C. Ghrelin

Q3: Regarding leptin which of the following is not true?

A. Regulate the amount of body fat

B. When depleted, the result is losing weight

C. Acts on hypothalamus

Q4: A 40-year-old woman, 155 cm tall and weighing 85.5 kg, seeks your advice on how to loss weught. Her waist imeasured 104 cm and her hips 99 cm. A physical examination and blood laboratory data were all withn the normal range. Her only child, who is 14 years old, her sister, and both of her parents are overweight. The patient recalls being obese thoughout her chidhood and aldolescence. Over the past 15 years she had been on seven different diets for periods of 2 weeks to 3 months, losing from 2-7 kg. On discontinuation of each diet, she regained weight, returning to 84-86 kg. Which of the following best describes this patient?

A. She is classified as overweight.

B. She shows an "apple" pattern of fat distribution.

C. She has approximately the same number of fat cells as a normal-weight individual, but each adipocyte is larger.

D. She would be expected to show lower than normal levels of circulating leptin.

E. She would be expected to show lower than normal levels of circulating triacylglycerol .

If you find any mistake, please contact us =)
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