Dietary Balances; Regulation of Feeding; Obesity and Starvation; Vitamins and Minerals

Energy Intake and Output Are Balanced Under Steady-State Conditions

- The intake of the large nutrients provide energy that the body uses to perform it's function or store for later.
- The energy intake & the energy expenditure must be balance to the body weight & composition stability.
- The excess energy usually is stored as a fat.
- The insufficient energy intake lead to loss of body mass and the body can not meet it's metabolic needs.

Energy available in foods

- The available energy in each gram of the Macronutrients is:

Macronutrients	Calories
Carbohydrate	4
Fat	9
Protein	4

- The absorption percentages of Macronutrients from the GI tract:

Macronutrients	Absorption percentages
Carbohydrate	98%
Fat	95%
Protein	92%

Dietary Balance

- The body degrades 20 to 30 gram of it’s proteins every day to produce some of it’s chemicals.
- So, the average requirement for protein is 30 to 50 gram daily, to replace the destroyed proteins.
- Large amount in the diet of the partial proteins, which have inadequate amount of some essential amino acids, can not be used to replace the destroyed proteins.
- Usually the animal proteins are more complete than the vegetable & grain proteins.

Protein Sparers

- The body usually uses Carbohydrates and Fats to produce energy, and too little of energy is derived from proteins.
- Conversely, in starvation when the Carbohydrates and Fats are depleted, the body starts to use the stored proteins to produce energy.
- In this case, the average requirement for protein increases to several hundred grams per day.

Methods for Determining Metabolic Utilization of Carbohydrates, Fats, and Proteins

- **"Respiratory Quotient":** The Ratio of CO_2 Production to O_2 Utilization.
- Can Be Used to Estimate Fat and Carbohydrate Utilization.
- Carbs metabolized with 1 O_2 → Formed 1 Co_2
- Fats metabolized with 100 O_2 → Formed 70 Co_2
- Protein metabolized with 100 O_2 → Formed 80 Co_2

Macronutrients	Respiratory Quotient
Carbohydrate	1
Fats	0.70
Protein	0.80

The reasons for the changes in the Respiratory Quotient between the Macronutrients

- The Respiratory Quotient for carbohydrates is higher than the Respiratory Quotient for fats & protein.
- The portion of the oxygen metabolized with fats and protein is required to combine with the extra hydrogen atoms present in their molecules. For that, less Co_2 is formed in relation to the O_2 used.

Nitrogen Excretion to Assess Protein Metabolism

- Nitrogen Excretion Can Be Used to Assess Protein Metabolism.
- The average protein contains 16% of nitrogen.
- During the breakdown of protein in the body, 90% of nitrogen is excreted in the urine and 10% of nitrogen is excreted in the feces.
- Estimating the ratio of protein breakdown in the body by measuring the rate of nitrogen in the urine and adding 10% for the nitrogen in the feces and multiplying by 6.25.

Regulation of Food Intake and Energy Storage

- 27% of ingested energy reach used in the functional system of the cells.
- The rest of energy intake converted to heat, which if generated of muscle activity, organs and tissues activity, and protein metabolism.
- The extra energy intake is stored as fat.
- The deficiency of energy intake causes loss of body mass until the energy intake equals the energy expenditure or death occurs.

Neural Centers Regulate Food Intake

- Some neuronal centers of the Hypothalamus

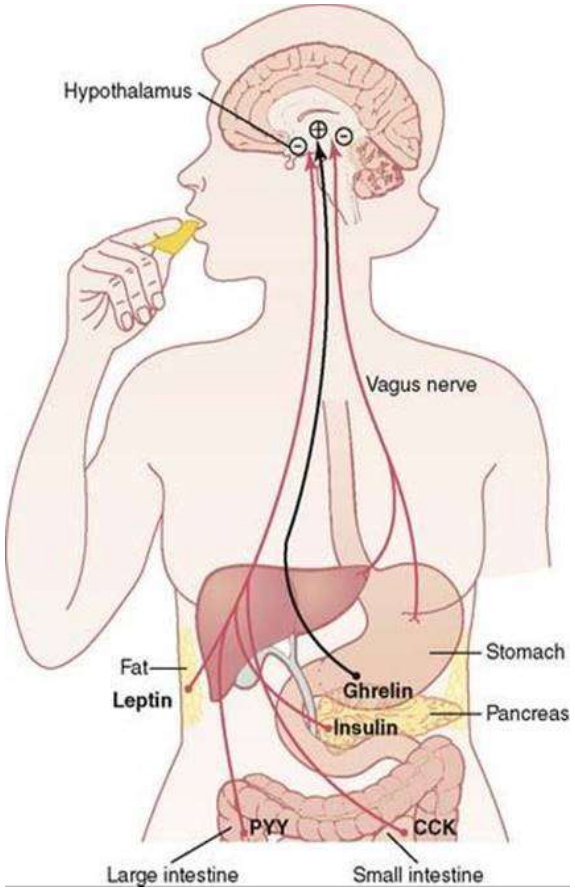
Contains Hunger and Satiety Control.

- The lateral nuclei of the hypothalamus serve

as a hunger center.

- The ventromedial nuclei of the hypothalamus

serve as the satiety center.



- Also, the Hypothalamus nuclei influence some hormones from the thyroid, adrenal glands & pancreatic to regulate the metabolism & energy balance.

Factors That Regulate Quantity of Food Intake

1/ Short-Term Regulation of Food Intake:

- Gastrointestinal Filling Inhibits Feeding: when the GI tract (ex. Stomach) stretches, signals are transmitted to inhibit the feeding center to reducing the desire for food.
- GI Hormonal Factors Inhibit Feeding:
- Insulin, peptide (PYY), and cholecystokinin (CCK) are hormones that inhibit some neurons and stimulate other neurons, to reduce the food intake.
- GI Hormonal Factors Increase Feeding:
- Ghrelin, a hormone secreted from the stomach, activates some neurons to increase food intake.

Factors That Regulate Quantity of Food Intake

2/ Long-Term Regulation of Food Intake:

- Many studies found that the decrease in blood concentrations of Glucose, Amino Acids, or Lipids causes hunger.
- Other studies on animals found that, exposing to cold increases feeding, and exposing to heat decrease the intake. Because of the interaction between the temperature-regulating system and the food intake–regulating system.
- For more, when the energy stores of the body fall below normal, the feeding centers of the hypothalamus increases hunger, Conversely, when the energy stores are abundant, the person develops a state of satiety.

Obesity

- Obesity: is the excess of body fat.
- The body mass index (BMI): is the marker for body fat content.
- (BMI) = Weight (Kg) ÷ Height (m^2)
- Overweight: BMI between **25** & 29.9 Kg/m^2
- Obese: BMI greater than 30 Kg/m^2

The major causes of obesity:

1. Abnormal feeding behavior (The greater energy intake than energy expenditure). Because of environmental, social, and psychological factor such as (stress, illness)
2. Decreased physical activity.
3. Childhood overnutrition.
4. Neurogenic Abnormalities.
5. Genetic Factors.

Obesity Treatment

1. Decreasing energy input below energy expenditure by 2 ways:

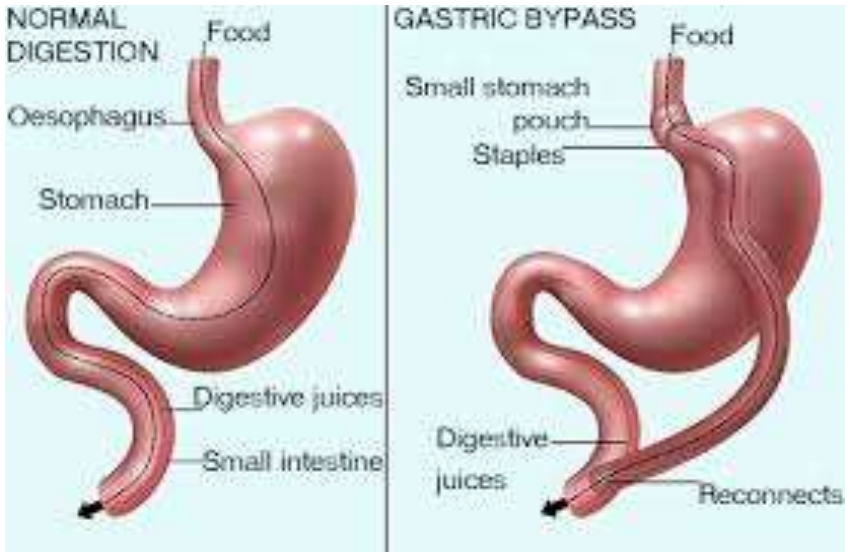
- Reducing energy intake → appropriate diet.
- Increasing energy expenditure → Increasing physical activity.

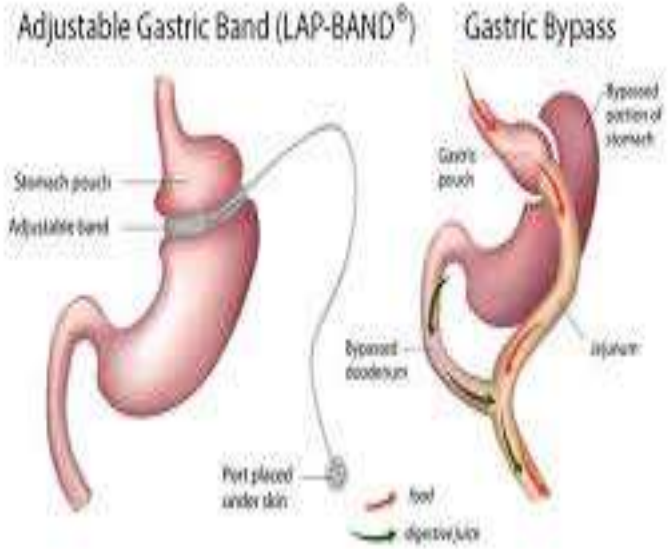
2. Drugs:

The drugs	**How it is work?**	**Disadvantages**
Decreasing the degree of hunger	Inhibit the feeding centers in the brain.	• overexcite the sympathetic nervous system • raise the blood pressure • A body adapts soon to the drug
Altering lipid metabolism	Make a portion of the ingested fat to be lost in the feces.	• Cause bad side effects on the GI tract. • loss of fat-soluble vitamins in the feces.

3. Surgical procedures. Ex: gastric bypass surgery and gastric banding surgery.

- It's long term effects are still uncertain.





Inanition, Anorexia, and Cachexia

- **Inanition:**

The extreme weight loss caused by inadequate availability of food, or pathophysiological conditions that decrease the desire for food.

- **Anorexia:**

Reduction in food intake caused by diminished appetite. Ex: Cancer or Several inflammations

- **Cachexia:**

Increased energy expenditure because of metabolic disorder, leading to weight loss. Ex: Cancer or Several inflammations.

Starvation

Definition: Depletion of Food Stores in the Body Tissues.

- First: During the first few hours of starvation:

the tissues usually use Carbs for energy, but the quantity of Carbs stored in the body is few hundred grams. So, the Carbs can supply the energy for body functions for half a day.

- Second, After the first few hours of starvation:

Because fat is the source of energy, the stored fat depletion continue until most of the stored body fat are gone.

- Third: The 3 phases of protein depletion:

- First, rapid depletion, then slowed depletion, and finally, rapid depletion again shortly before death. death happened when the proteins of the body have been depleted to half their normal level.

Vitamins

- Definition: an organic compound needed in small quantities for normal metabolism that cannot be made in the cells of the body.
- Daily Requirements: depending on some factors such as: body size, age, gender, and pregnancy.
- Storage of Vitamins: some stored vitamins sufficient for long period as year (B_{12}) months (vitamin A & D), other stored for vitamins sufficient for short period as days (Vitamin Bs except B_{12}) weeks (Vitamin C).

Vitamin A:

- Occur in the vegetable as provitamin changes in the liver into Vitamin A.
- Deficiency Causes (Night Blindness) and Abnormal Epithelial Cell Growth.

Thiamine (B_1):

- Needed for the final metabolism of carbohydrates and many amino acids.
- Deficiency causes (beriberi), effect Nervous Systems health, cardiovascular symptoms.

Niacin:

- Function in the body as coenzyme.
- Deficiency causes (Pellagra), muscle weakness, effect Nervous Systems health, effect skin health.

Riboflavin (B_2):

- Combines in the body with phosphoric acid to form two coenzymes
- Deficiency causes coma, burning sensations of the skin and eyes, mental depression.

Vitamin B12:

- Promote growth and red blood cell formation.
- deficiency causes pernicious anemia.

Folic Acid:

- Require for the formation of DNA & promote growth.
- deficiency causes macrocytic anemia.

Vitamin (B6):

- Function as a coenzyme. Play many roles in protein metabolism.
- deficiency causes decreased rate of growth, development of fatty liver, anemia.

Pantothenic Acid:

- Function as a coenzyme in the body.
- Deficiency is rare.

Vitamin C:

- Important for collagen formation, growth, strength of teeth, bone & cartilage.
- Deficiency causes: weakness collagen fibers, Scurvy & effect bone growth.

Vitamin D:

- Increases calcium absorption & control calcium deposition in the bone.

Vitamin E:

- Prevents oxidation of unsaturated fats.
- Deficiency causes :Crohn's disease.

Vitamin K:

- Is made by bacteria of the colon.
- Important for blood clotting.

Mineral Metabolism

Magnesium:

- Important for carbohydrate metabolism
- decreasing magnesium causes increased irritability of the nervous system.

Calcium:

- Excess quantities of calcium causes mental depressant.
- Low level of Calcium resulting in Tetany.

Phosphorus:

- The major anion of intracellular fluid.
- Important for the functions of adenosine triphosphate & diphosphate.

Iron:

- Formation of hemoglobin
- Important for transportation of Oxygen to the tissues.

The trace elements:

Iodine:

Important for the formation of thyroid hormone.

Zinc:

- Part of many enzyme
- Important for some reactions related to carbon dioxide metabolism.
- Important for the digestion of proteins.

Fluorine:

- Protect against caries during teeth formation.

References

Hall, J. E. (2011). *Guyton and hall textbook of medical physiology* (12th ed.). W B Saunders.


Thank
you