NUTRITION

(Lecture 2)

OBJECTIVES

1. To describe the nitrogen balance.
2. To describe the factors affecting the protein quantity.
3. To describe nutritional facts on glucose, glycaemic index, lipids and vitamins.
4. To describe the importance of dietary fiber
5. To describe the nutritional recommendations.
6. To describe protein energy malnutrition:
   - A. Marasmus.
   - B. Kwashiorkor.
   - C. Marasmic-Kwashiorkor

CONTENTS

1. Nitrogen balance.
2. Factors affecting the protein quantity.
3. Nutritional facts on glucose, glycaemic index, lipids and vitamins.
4. Importance of dietary fiber
5. Nutritional recommendations.
6. Protein energy malnutrition:
    - A. Marasmus.
    - B. Kwashiorkor.
    - C. Marasmic-Kwashiorkor

NITROGEN BALANCE

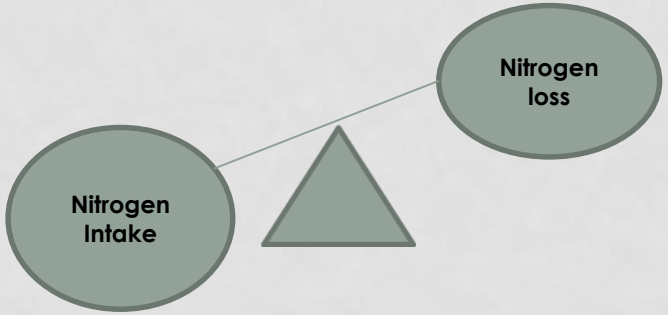
A healthy adult is typically in nitrogen balance

Positive nitrogen balance
(conditions with increased tissue growth occurs, for example, in childhood, pregnancy, or during recovery from an emaciating illness)

Negative nitrogen balance
(Inadequate dietary protein, lack of an essential amino acid, or during conditions, such as trauma, burns, illness, or surgery)

Nitrogen Intake = Nitrogen Loss

Nitrogen Intake > Nitrogen Loss



Nitrogen Intake < Nitrogen Loss

NITROGEN BALANCE

- An adult in a state of equilibrium requires dietary protein to replace the essential AAs and AA nitrogen lost during metabolic turnover.
- Pregnancy, lactation, tissue repair after injury, recovery from illness, increased physical activity all require more dietary protein.
- For most situations, a diet in which 12% of the energy is supplied as protein is adequate in humans.

- The RDA for protein is estimated at 0.8-1.0 g/kg of body weight for adults.
- Athletes: 1g/kg is recommended.
- Pregnant or lactating women require additional protein up to 30 g/day.
- Children: 2 g/kg/day to support their growth .

PROTEIN QUANTITY REQUIRED IS AFFECTED BY 3 MAJOR FACTORS:

1. Protein quality:

Is measured by comparing the proportions of essential AAs in food with proportions required for good nutrition. The closer proportions are, the higher the protein quality.

Egg and milk proteins are high quality proteins.

PLANT PROTEINS ARE RELATIVELY DEFICIENT IN CERTAIN ESSENTIAL AAS

Corn:

deficient in: Tryp., Lys.

Wheat:

deficient in: Lys.

Beans:

deficient in: Meth. Cys.

Complementary proteins:

In a mixed diet, deficiency of an AA in one protein is made up by it's abundance in another: the protein of wheat and beans combined provide a satisfactory AA intake.

2. Energy intake:

Energy derived from CHO and fat affects protein requirements as it spares the use of protein as an energy source.

3. Physical activity:

It increases nitrogen retention from dietary protein.

GLUCOSE

- It does not have to be provided as such in diet, since other dietary CHO are converted to glucose either during digestion (ex. Starch), or in the liver (ex. fructose and galactose). Glucose is also formed from non-CHO source via gluconeogenesis.
- The minimal daily CHO intake is 100g is recommended to prevent ketosis and loss of muscle protein.
- A balanced diet should contain more CHO than this in the form of polysaccharide in order to reduce the amount of fat that would be otherwise required for energy.

GLYCEMIC INDEX

It describes the percentage increase in blood glucose concentration 2 hours following ingestion of 50g CHO, to 50g anhydrous glucose.

CHO with high glycemic index (70-100)

Bread, Potatoes, Glucose

CHO with low glycemic index (55 and less)

Legumes, Whole grain cereals

LIPIDS

- Although lipids frequently provide a significant proportion of dietary requirement for energy, this is not an essential function.
- A part from increasing the palatability of food and producing a feeling of satiety, dietary lipid has also two essential functions:
    1. Act as dietary vehicle for fat soluble vitamins.
    2. Supply essential poly unsaturated FAs.
- The principal function of essential FAs is to serve as precursor of leukotrines, lipoxins, prostaglandins and thromboxans

- **Consumption of *saturated fats* is strongly associated with high levels of total cholesterol and LDL-C.**

- ***Monounsaturated fatty acids*** **lower both total cholesterol and LDL-C, with an increase in HDL-C (protective effect).**

- ***ω-6 polyunsaturated fatty acids*** **lowers plasma LDL, but HDL, which protect against coronary heart disease, are also lowered.**
- ***ω-3 polyunsaturated fatty acids*** **Suppress cardiac arrhythmias, reduce serum triacylglycerols and decrease the tendency for thrombosis, and reduce the risk of cardiovascular disease.**

ADIPOSE TISSUE

- Most of excess energy stored as fat (TG) in adipocytes.
- Adipose tissue contain roughly 85% fat & 15% water.
- 1 kg of adipose tissue contain 850g TG
- 850g x 9 kcal/g = 7650 kcal ~ (*7500 kcal*)

VITAMINS

Water soluble vitamins:

There is little storage of these vitamins which needs to be continuously supplied in diet. Some storage of folic acid and vitamin B12 occurs in the liver. Depletion may take several months for vitamin C and several years for Vitamin B12.

Fat soluble vitamins:

The liver which serves as the major store of vitamins A,D and K. Adipose tissue is a major storage of vitamin. E. Fat soluble vitamins are not excreted in urine, and if taken in excess are toxic (especially A &D).

- **Non-availability of vitamins (whether due to dietary or other reasons, ex. Malabsorption) results in:**

"*Characteristic deficiency syndromes*"

DIETARY FIBER

- Dietary fiber consists of all plant cell wall components that cannot be digested by enzymes such as cellulose, hemicellulose, lignin, gums, pectins and pentosans.
- High fiber diet aids water retention during passage of food along the gut producing softer faeces.
- A high fiber diet is associated with reduced incidence of diverticulosis, cancer of colon, diabetes mellitus and cardiovascular disease.

DIETARY FIBER

- **The more insoluble fibers:**

Such as cellulose and lignin found in wheat bran are beneficial to colonic function.

- **The more soluble fibers:**

Found in legumes and fruit ex. gums and pectins lowers blood cholesterol possibly by binding bile acids and dietary cholesterol, and also slow gastric emptying, and they delay and attenuate the post prandial rise in blood glucose with consequent reduction in insulin secretion.

DIETARY FIBER

(BENEFITS)

1. Slow gastric emptying.
2. Increased satiety.
3. Decreased absorption of dietary fat and cholesterol
4. Increased faecal excretion of cholesterol
5. Decreased post-prandial blood glucose level.

- **All nutritional requirements must be met to prevent deficiency diseases and ill health.**

- **Ignorance or poor economic conditions are almost always underlying the cause of failure to satisfy nutritional requirements.**

- ***On the other hand,*** **certain common diseases are associated with excess intake of nutrients.**

- **Obesity generally reflects excess energy intake and is often associated with the development of T2D.**

- **Atherosclerosis and CHD are associated with diets high in total fat and saturated fat.**

NUTRITIONAL RECOMMENDATIONS

1. Overweight and obesity should be avoided. The DEI should be monitored to maintain an optimal weight and prevent over weight and obesity.

2. The consumption of fat should be reduced to less than 30% of the total DEI. The consumed dietary fat should be mostly in the form of poly unsaturated and mono unsaturated fat and less in the form of saturated fat. Cholesterol consumption should be reduced.

NUTRITIONAL RECOMMENDATIONS

3. Carbohydrate consumption should be in mostly in the form of complex CHO and naturally occurring sugars and less as refined and processed sugar.

4. Salt consumption should be reduced to less than 6 g/day.

5. Consumption of dietary fiber ,fruits and vegetables should be encouraged.

PROTEIN ENERGY MALNUTRITION (PEM)

- It is the commonest nutritional disorder in many parts of the world. As many as 1 billion people suffers various diseases of PEM.
- PEM encompasses a range of disorders of starvation and malnutrition that involve deficiencies of other nutrients such as vitamins and minerals in addition to protein.
- In severe form, it occurs in growing children usually under 5 years of age in developing areas of Asia, Africa and South America.

TWO EXTREME FORMS OF PEM ARE RECOGNIZED:

A. Marasmus:

- Due to severe and prolonged restriction not only of proteins but of all food.
- There is generalized wasting due to deficiency of both energy and protein. Massive loss of muscle and fat occurs.
- It usually occurs in *children younger than 1 year of age* when breast milk is supplemented with watery gruels of native cereals that are usually deficient in protein and calories.

MARASMUS: CLINICAL PRESENTATION

- Severe wasting
- Loss of muscle mass
- Loss of subcutaneous fat mass
- Anemia
- Retarded growth
- Loose and wrinkled skin
- Brittle hair

B. Kwashiorkor:

- An essential feature is protein deficiency with relatively adequate energy intake.
- Kwashiorkor tends to occur mainly in older infants and young children (6 months to 3 years).
- Results from a diet with inadequate protein but reasonably normal caloric intake, often exacerbated by superimposed infection.

Kwashiorkor:

- It is characterized by oedema which may mask muscle loss.
- The energy intake may be adequate, however, there is deficiency in both the quantity and quality of protein.
- The hallmarks of kwashiorkor are hypoalbuminaemia, oedema and fatty liver.

Comparison between Kwashiorkor and Marasmus

Parameter	*Kwashiorkor*	*Marasmus*
Deficiency	Protein deficiency	Protein and calorie deficiency
Age	6 – 36 months	Less than 12 months
Hypoalbuminaemia	Present (May be severe)	Mild
Oedema	Present	Absent
Fatty liver	Present	Absent
Subcutaneous fat	Preserved	Diminished
Rib cage	Not prominent	Very prominent
Muscle wasting	Absent or mild	May be very severe
Dietary needs	Protein	CHO, Protein and Fat

A Third Intermediate form of PEM:

C. Marasmic-Kwashiorkor:

- **Intermediate between typical marasmus and typical Kwashiorkor.**