

# CLINICAL NUTRITION

Obtaining adequate nutrition is a fundamental requirement for survival of every individual and species.

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In recent decades, economic success has been rewarded by plentiful nutrition unknown to previous generations, which has led to a pandemic of obesity and its serious consequences for health.

# CLINICAL NUTRITION

- Yet in many parts of the world, famine and under nutrition still represent a huge burden.

# Physiology of nutrition

Nutrients in the diet can be classified:

- \*Macronutrients

- \*Micronutrients (e.g. vitamins and minerals).

# ENERGY BALANCE

The laws of thermodynamics dictate that  
energy balance= energy expenditure.

# ENERGY BALANCE

Energy intake is determined by the 'macronutrient' content of food.

- Carbohydrate (16kJ/g)
- Fat (37 kJ/g)
- Protein (17 kJ/g)
- Alcohol (29 kJ/g)

## Daily Recommendations for macronutrients

Total fat 30%

Total carbohydrates 75%

Protein 15%

# Micronutrients

- Inorganic nutrients
- Vitamins are organic substances with key roles in certain metabolic pathways.
- 1. Calcium & phosphorus
- 2. Iron
- 3. Iodine
- 4. Zinc
- 5. Selenium
- 6. Fluoride
- 7. Sodium, potassium & magnesium



# Micronutrients

Other essential inorganic nutrients:

- Chloride
- Cobalt
- Sulphur
- Manganese
- Chromium

# Responses to under-nutrition

- Reproductive function is suppressed
- BMR is reduced
- Profound psychological effects (lethargy)

These adjustments can 'defend' body weight within certain limits. Fuels are liberated from stores initially in glycogen (in liver and muscle). Then in triglyceride (lipolysis in adipose tissue, with excess FFA supply to the liver leading to ketosis) and finally in protein (proteolysis in muscle).

## Responses to over-nutrition

- BMR is increased, and extra energy is consumed in the work carrying increased fat stores, so that body weight is again 'defended' within certain limits
- Excess energy is invested in fatty acids and stored as triglycerides; these are deposited principally in adipose tissue but they may also accumulate in liver (NASH) and skeletal muscle.

## Nutrition in pregnancy and lactation

- Energy requirements: increased in both mother and fetus, but can be met through reduced maternal energy expenditure
- Micronutrient requirements: adaptive mechanisms ensure increased uptake of minerals in pregnancy, but extra increments of some are required during lactation (e.g. Some vitamins)

# Clinical assessment of nutritional status

Energy balance is reflected in body composition, which is assessed by:

- Anthropometric measurements
- Dual energy X-ray absorptiometry (DEXA) scanning.
- Biochemical tests for micronutrients.

# Anthropometric measurements

Body mass index (BMI) is useful for categorizing under and over-nutrition. It is the weight in kilograms divided by the height in meters squared.

BMI does not discriminate between fat mass and lean body mass and can be increased by muscle mass (e.g. in athletes).

For optimal health, the BMI should be 18.5-24.9 kg/m<sup>2</sup>

Waist circumference

Hip circumference

Waist:hip ratios

Skinfold measurements (to calculate body fat content)

Mid-arm circumference (to calculate relative loss of muscle and s/c fat).

# PRESENTING PROBLEMS OF ALTERED ENERGY BALANCE

## **OBESITY**

Pandemic

Disastrous consequence for human health.

BMI > 30 kg/m<sup>2</sup>

# Complications of obesity

## **Metabolic syndrome**

Type 2 diabetes

Hypertension

Hyperlipidemia

Liver fat accumulation (NASH)

**Restricted ventilation** (sleep apnoea, respiratory failure)

**Mechanical effects of weight** (urinary incontinence, OA, varicose veins)



# Complications of obesity

**Increased peripheral steroid interconversion in adipose tissue** (Hormone-dependent cancers, PCOS)

**Others:**

- Psychological morbidity
- Socioeconomic disadvantage
- Gallstones
- Colorectal cancer
- Skin infections

Obesity at age 40 years can reduce life expectancy by up to 7 years for non-smokers and by 13 years for smokers. CHD is the major cause of death but cancer rates are also increased in the overweight, esp. colorectal cancers in males and cancer of the GB, biliary tract, breast, endometrium and cervix in females.

# OBESITY: Clinical assessment

- Quantify the problem
- Exclude an underlying cause
- Identify complication
- Reach a management plan

A waist circumference of >102 cm in men or >88 cm in women indicates that the risk of metabolic and CV complications of obesity is high.

# Quantifying obesity with BMI

## >30.0 obese

30.0-34.9	Class I	Moderate
35.0-39.9	Class II	Severe
>40.0	Class III	Very severe

# Potentially reversible causes of weight gain

- Hypothyroidism
- Cushing's syndrome
- Insulinoma
- Hypothalamic tumours
- Drug treatments
  1. Tricyclic antidepressants
  2. Sulphonylureas
  3. Oestrogen-containing contraceptive pill
  4. Corticosteroids
  5. Sodium valproate
  6. Beta blockers.

# Under-nutrition

There remain regions of the world, particularly rural Africa, where under-nutrition due to famine is endemic.

# Under-nutrition: Classification (by BMI)

- |    |                        |                               |
|----|------------------------|-------------------------------|
| •  | >20                    | Adequate nutrition            |
| •  | 18.5-20                | Marginal                      |
| •  | <b><u>&lt;18.5</u></b> | <b><u>Under-nutrition</u></b> |
| 1. | 17-18.4                | Mild                          |
| 2. | 16-17                  | Moderate                      |
| 3. | <16                    | Severe                        |

# Under-nutrition: Causes in adults

## Decreased energy intake

- **Famine**
- **Persistent regurgitation or vomiting**
- **Anorexia, including anorexia nervosa**
- **Malabsorption (e.g. small intestinal disease)**
- **Maldigestion (e.g. pancreatic exocrine insufficiency)**

# Under-nutrition: Causes in adults

## **Increased energy expenditure**

- Increased BMR (thyrotoxicosis, trauma, fever, cancer)
- Excessive physical activity (e.g. marathon runners)
- Energy loss (e.g. glycosuria in diabetes)
- Impaired energy storage (e.g. Addison's disease, pheochromocytoma)



# Severe under-nutrition: Clinical features

1. Weight loss
  2. Thirst, craving for food, weakness and feeling cold
  3. Nocturia, amenorrhea or impotence
  4. Lax, pale, dry skin with loss of turgor
  5. Cold and cyanosed extremities
  6. Hair-thinning or loss
  7. Muscle wasting
  8. Loss of subcutaneous fat
  9. Hypothermia, bradycardia, hypotension and small heart
  10. Edema
  11. Distended abdomen with diarrhea
  12. Diminished tendon jerks
  13. Apathy, loss of initiative, depression introversion
  14. Susceptibility to infection
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# KWASHIORKOR



# KWASHIORKOR



# MARASMUS



# Marasmus



# Infection associated with starvation

- Gastroenteritis and Gram-negative septicemia
- Respiratory infections, esp. bronchopneumonia
- Certain viral infections (measles, herpes simplex)
- Tuberculosis
- Streptococcal & staphylococcal skin infections
- Helminthic infestations

# Under-nutrition: Sequelae

- Leads to vitamin deficiencies, esp. of thiamin, folate and vitamin C
- Diarrhoea can lead to depletion of sodium, potassium and magnesium.
- High mortality rate in famine situation is often due to outbreaks of infection e.g. typhus or cholera.
- In advanced starvation, patients become completely inactive and assume a flexed fetal position.
- In the last stage of starvation, death comes quietly and often quite suddenly.

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