Pediatric chronic nutritional disorders

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Terminology

- Nutrition: individual's intake of calories and nutrients to meet requirements for energy, growth, development, and learning
- Growth: children's height (length) and weight achievements, and the relationship between them
- Undernutrition and malnutrition: requirements are not met, usually due to environmental factors or developmental disabilities
- Macro-nutrients
  - Protein (amino acids)
  - Energy (carbohydrates)
  - Fat (fatty acids)
- Micro-nutrients
  - Water soluble vitamins (assist in energy-release of carbohydrates and red blood cell formation)
  - Fat soluble vitamins (development & metabolism)
  - Minerals

Nutritional requirements

- In order to live and function, humans need macro- and micro- nutrients;
- Macro-nutrients are fat, protein and carbohydrates;
- Micro-nutrients are water-soluble vitamins, fat-soluble vitamins, and minerals (bone and trace); the most critical micro-nutrients are iron, iodine, zinc, vitamin A and vitamin D.

What is malnutrition?

World Health Organization definition:

The term is used to refer to a number of diseases, each with a **specific cause related to one or more nutrients (for example, protein, iodine or iron)** and each characterized by cellular imbalance between the **supply of nutrients and energy on the one hand, and the body's demand for them to ensure growth**, maintenance, and specific functions, on the other.

- Malnutrition is having the inappropriate level of a micro- or macro- nutrient;
- In some cases (i.e. the US), malnutrition can be associated with being grossly overweight;
- In most of the world, malnutrition is defined as a LACK of nutrients;
- Malnutrition contributes to over 50% of deaths in children in the world.
- However, the term '**malnutrition**' is frequently used to denote either the lack of adequate nutrition or inadequate supply/amount of calories, as the synonym of 'undernutrition'!!!
- "**dystrophy**" is usually used to mean children's chronic disorders of nutrition. It corresponds to the term "malnutrition"
- **Failure to thrive** is a term typically used to describe infants and young children whose weight is persistently below the third percentile for age on an appropriate standardized growth chart, or less than 80% of ideal weight for age

Four Forms of Nutritional Disorders

- **Undernutrition:**
  - pathological state resulting from the consumption of an inadequate quantity of food over an extended period of time
- **Specific Deficiency**
  - absolute or relative lack of an individual nutrient
- **Overnutrition:**

- consumption of an excessive quantity of food for an extended period of time
- **Imbalance:**
  - disproportionate intake among essential nutrients

Types of malnutrition

- Severe Protein-Energy Malnutrition (>3 S.D.)
  - Kwashiorkor (low protein)
  - Marasmus (low calories)
- Mild/moderate undernutrition (>2 S.D.)
  - Stunting
  - Underweight
  - Wasting
- Micro-nutrient deficiency
  - Iodine
  - Iron
  - Vitamin A
  - Vitamin D

Measurement of Malnutrition

- STUNTING: Height for age – height compared to a reference population of the same age.
  = represents long term growth retardation
- UNDERWEIGHT: Weight for age – weight compared to age in a reference population
- WASTING: Weight for height – weight compared to a reference population of the same height.

WHO data

- Malnutrition is by far the biggest contributor to child mortality:
  - 49% of the 10.4 million deaths occurring in children younger than 5 years in developing countries are associated with PEM
  - 6 million children die of hunger every year
- Even mild degrees of malnutrition double the risk of mortality for infectious disease mortality

Etiology

- Prenatal or congential malnutrition or intrauterine growth retardation
  - A defective nutrition of pregnant women
  - Acute and chronic diseases of pregnant women
  - In utero toxin exposure (professional factors, unfavorable environmental factors of, bad habits – smoking, alcohol and\or drugs abuse)
  - Intra-uterine infections of fetus (TORCH)
  - Chromosomal aberrations of fetus
  - Prematurity
- Postnatal malnutrition
  - **Primary (non organic):** insufficiency of food, inadequate or unbalanced diet
  - **Secondary (organic):** Problems with digestion or absorption, chronic illnesses
    - ✓ Malabsorption (infections; celiac disease; chronic diarrhea (allergies, immune deficiencies, chronic diseases)
    - ✓ Genetic metabolism disorders (galactosemia, leycinosis, fructosemia, fenilketonuria, etc.),
    - ✓ GIT malformations (pylorostenosis, etc.)
    - ✓ Syndrome of "short bowel" after extensive intestinal resections
    - ✓ Chronic diseases (CF, chronic renal failure, chronic heart or lung diseases, endocrine diseases, etc.)

Malnutrition Clasification

Criteria	M I deg.	M II deg.	M IIIdeg
PI NI Weight deficit	PI = 0,90-0,76 NI = 0,90-0,81 < 25%	PI = 0,75-0,6 NI = 0,80-0,71 25% - 40%	PI = 0,6 NI < 0,7 >40%
Height	Normal	Normal	Decreased
Weight curve	Stationary	Descendent In steps	Descendent continuously
Adipose tissue	Diminished on abdomen, chest	Absent on chest, abdomen; reduced on limbs	Absent on trunk, limbs, face (old man face)
Abdominal skin fold	< 1,5 cm	0,5 cm	< 0,5 cm
Teguments	Normal colored	Pale	Trophic disorders: wrinkled, grey skin buttocks redness, bed sores
Aspect	Weak suckling	Very weak suckling (the ribs are seen)	Triangle face, sharp chin, thin lips, wrinkled forehead, abdomen distension, sometimes edemas
Motor and neuropsychical activity	Normal	Muscular hypotonia	Apathic, hypo-reactive baby
Digestive tolerance	Normal or slight decreased; normal appetite	Decreased, bad appetite	Compromised, "hunger" or infectious diarrhea appears
Resistance to infections	Slight decreased	Decreased	Falled
Metabolic activities	Normal or slight increased oxygen consumption	Hunger metabolism: - ↓ O_2 consumption; - ↓ basal metabolism - tendency to hypothermia; - CV insufficiency	Homeostasis totally disturbed. Hypothermia, bradycardia, tendency to collapse
Reversibility	Reversible	Reversible	Hardly reversible

Main Features of Protein-Energy malnutrition

- **Kwashiorkor (low protein)**
  - **Decreased muscle mass** (failure to gain weight and of linear growth)
  - **Swollen belly** (edema and lipid build-up around the liver)

- **Changes in skin pigment (pellagra);** may lose pigment where the skin has peeled away (desquamated) and the skin may darken where it has been irritated or traumatized
- **Hair lightens** and thins, or becomes reddish and brittle.
- **Increased infections** and increased severity of normally mild infection, diarrhea
- **Apathy**, lethargy, irritability
- **Death does not occur from actual starvation but from secondary infection**

• **Marasmus (low energy)**
- Deficit in calories – "marasmus" comes from Greek origin of word "to waste"
- Gross weight loss
- Hyper-alert and ravenously hungry
- Children have no subcutaneous fat or muscle
- Eventually starve to death (immediate cause often is pneumonia)

Consequences of Severe Malnutrition

• Mental development
- Lower IQ levels
- Poorer school performance

• Behaviors of recovered severely malnourished children
- shy, isolated, withdrawn
- decreased attention span
- immature, emotionally unstable
- fewer peer relationships/reduced social skills
- played less/stayed nearer to mother

Stunting – Height for Age

• Height for age reflects pre- and post- natal linear growth
• "Stunting" refers to shortness that is not genetic, but due to poor health or nutrition
• Most standard definition < 2 S.D.
• Stunting is good cumulative measure of "well-being" for populations of children (because not affected by weight recovery)

Causes

• Poor nutrition plays major role
• Role of environment: improvements in average height shown by populations over last century (impact of genetic influence subsumed by level of socio-economic development)

Timing

• Age of onset varies, but usually in first 2-3 years of life
• First few months, infants in developing countries grow just as quickly as children in reference populations
- Growth retardation starts from 2-6 month of life (often associated with weaning)
- Infants at risk during this time because of high nutritional requirements and high rates of infections

Consequences

- Reduced cognitive development
- Poor motor skills
- Poor neuro-sensory integration
- Quiet, reserved, withdrawn, timid, passive
- Difficulty making decisions
- Decreased involvement with environment, toys, tasks
- Less able to deal with stressor such as hunger or parasites

Specific Nutritional Deficiencies

• Iodine Deficiency

- Causes: mountainous areas at risk (soils leached by high rainfall, melting snow, flooding), ulturally induced behavioral change
- Goiter: most commonly recognized consequence (enlarged thyroid) occurs when thyroid gland is unable to meet the metabolic demands of the body through sufficient hormone production – thyroid compensates by enlarging (works in short term)
- Cretenism: proximal pyramidal signs, intellectual impairment, primitive reflexes – only occurs with severe fetal iodine deficiency

• Iron Deficiency
  - Iron is critical for body: carries oxygen to tissues from lungs, transports electrons within cells, integral part of important enzyme reactions
  - Anemia is caused most commonly by iron deficiency (anemia is found in 40-60% of women and children in developing countries)
  - Iron deficiency results in:
    ✓ Decreased work capacity and work productivity
    ✓ Permanently impaired development
    ✓ Psychomotor development of anemic children will be reduced by 5-10 IQ points
    ✓ Increased morbidity and mortality from infections
    ✓ Decreased growth
• Vitamin A
  - Vitamin A is important because it is essential to vision, fetal development, immune response
  - Vitamin A deficiency is associated with blindness and increased severity of infections such as measles and diarrhoeal disease
• Vitamin D

Obesity

Obesity: body wt more than 97th over wt or Wt more than 120 % of expected

• In infant and children of normal weight, increase in adipocytes size account for most of increase in adipose mass during the first year of life. Obese children have larger fat cell size than normal weight controls children and may have increase in number of adipocytes.

Etiology:

• Excessive intake of food compared with utilization
• Genetic constitution
• Psychic disturbance
• Endocrine & metabolic disturbances rare
• Insufficient exercise or lack of activity

Clinical picture

• Fine facial features on a heavy-looking taller child
• Larger upper arms & thighs
• Genu valgum common
• Relatively small hands & fingers tapering
• Adiposity in mammary regions
• Pendulous abdomen w/ striae
• In boys, external genitalia appear small though actually average in size
• In girls, external genitalia normal & menarche not delayed
• Psychologic disturbances common
• Bone age advanced

Complications of obesity

A- Cardiovascular complications: like hypertension , increase in serum cholesterol level
B- Hyperinsulinemia
C- Cholelithiasis
D- Blount disease or slipped capital femoral epiphysis E- Abnormal pulmonary function tests

F- Pseudotumour cerebri
G- Sleep apnea
H- Psychological trauma

Treatment of Obesity

A. 1st principle: decrease energy intake
    1. Initial med exam to R/O pathological causes
    2. 3-day food recall to itemize child's diet
    3. Plan the right diet
        a. Avoid all sweets, fried foods & fats
        b. Limit milk intake to not >2 glasses/day
        c. For 10-14 yrs, limit to 1,100-1300 cal diet for several months
    4. Child must be properly motivated & family involvement essential
B. 2nd principle: increase energy output
    1. Obtain an activity history
    2. Increase physical activity
    3. Involve in hobbies to prevent boredom