UNIVERSITATEA DE STAT DE MEDICINĂ ȘI FARMACIE
"NICOLAE TESTEMIȚANU" DIN REPUBLICA MOLDOVA

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
  - **infancy and childhood** are periods of rapid, significant changes. Therefore, **proper nutrition** is very important for the child's growth and development
- **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 vs micro nutrients

- **Macro-nutrients**
  - Protein – structural development (muscle and bone)
  - Carbohydrates – all body functions
  - Fats – cell membrane develop
- **Micro-nutrients**
  - ***Water soluble vitamins*** (assist in energy-release of carbohydrates and red blood cell formation)
  - ***Fat soluble vitamins*** (development & metabolism)
  - ***Minerals***

Water soluble vitamins

- **Thiamin B1**
  - nervous system function, enzymatic energy release of carbohydrates (beef, pork, liver, legumes, breads)
- **Riboflavin B2**
  - Participants in enzymatic energy release of carbs, fat & protein (milk, dairy, dark green vegetables, yogurt)
- **Niacin**
  - Participates in enzymatic energy release of energy nutrients (beef, pork, liver, breads, nuts)
- **Folate**
  - Red blood cell formation, new cell division (eg, seeds)
- **Vitamin B12 (Cobalamin)**
  - Red blood cell formation, nervous system maintainance (animal prod)
- **Pantothenic Acid**
- **Biotin (Vitamin H, CoEnzyme R)**
- **Vitamin B6 (Pyridoxine)**
- **Vitamin C**

Fat soluble vitamins

- **Vitamin A**
  - Essential to vision, fetal development, immune response
  - Found in dairy products, fish liver oils; as B-carotene found in many plants (e.g. carrots, mango)
- **Vitamin D**
  - Bone formation, calcium metabolism and absorption
  - Found in sunlight, egg yolk, dairy products and fish liver oil
- **Vitamin E**
  - Cell membrane construction and maintenance
  - In fats and oils, green leafy vegetables, poultry, fish
- **Vitamin K**
  - Blood clotting, protein synthesis
  - In green leafy vegetables, liver, cabbage

Minerals

Major "Bone" Minerals

Calcium (bones)
Phosphorus (DNA)
Magnesium (bones)
Sodium (nerve impulse)
Chloride (fluid balance)
Potassium (prot. syn)
Sulfur (some a.a.'s)

Trace Minerals

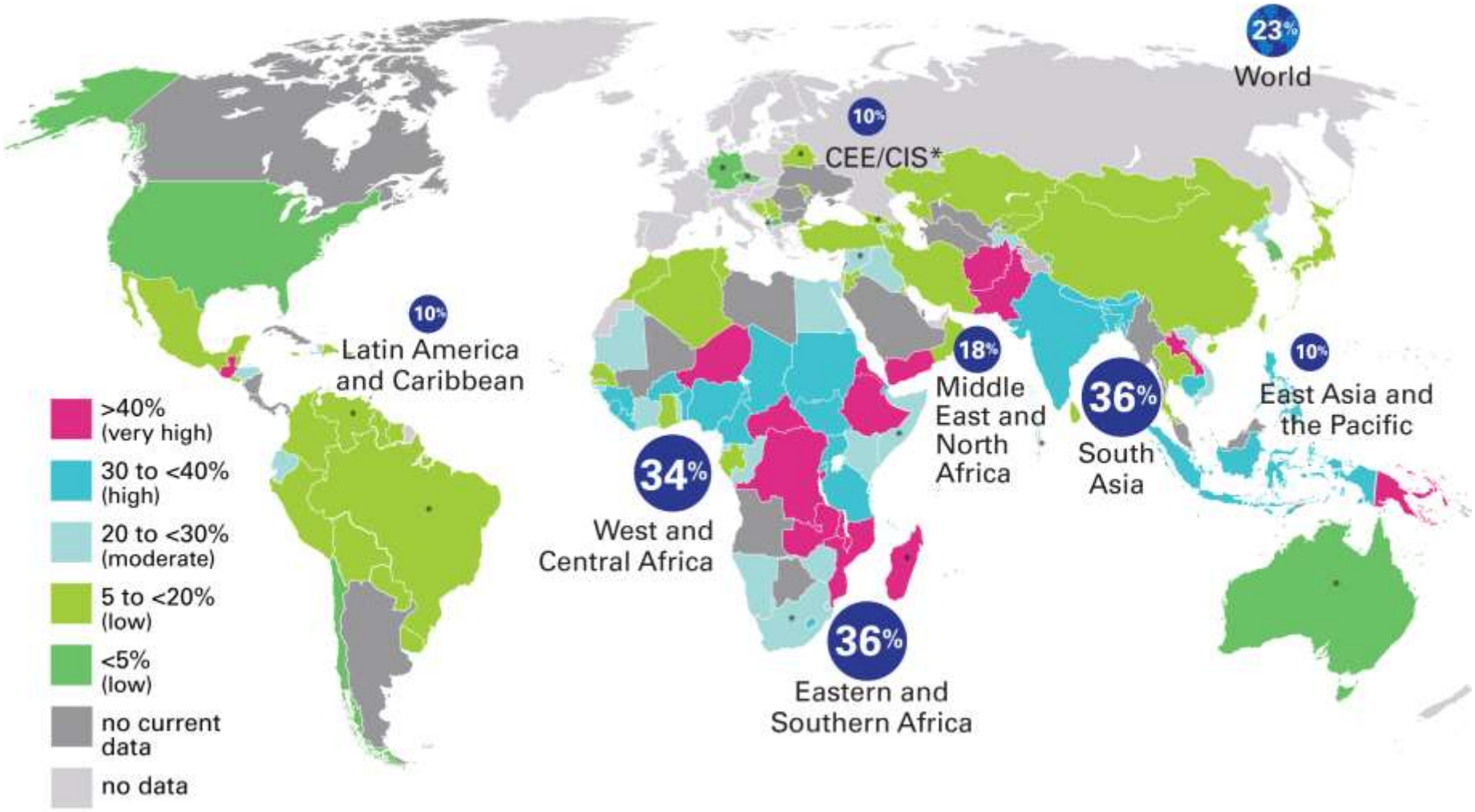
Iodine (thyroid function)
Iron (hemoglobin)
Zinc (enzyme, hormone)
Copper (abs. of iron)
Flouride (bone & teeth)
Chromium (energy rel.)
Molybdenum (enzymes)
Manganese (enzymes)
Selenium (antioxidant)
Cobalt (part of B12)

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.

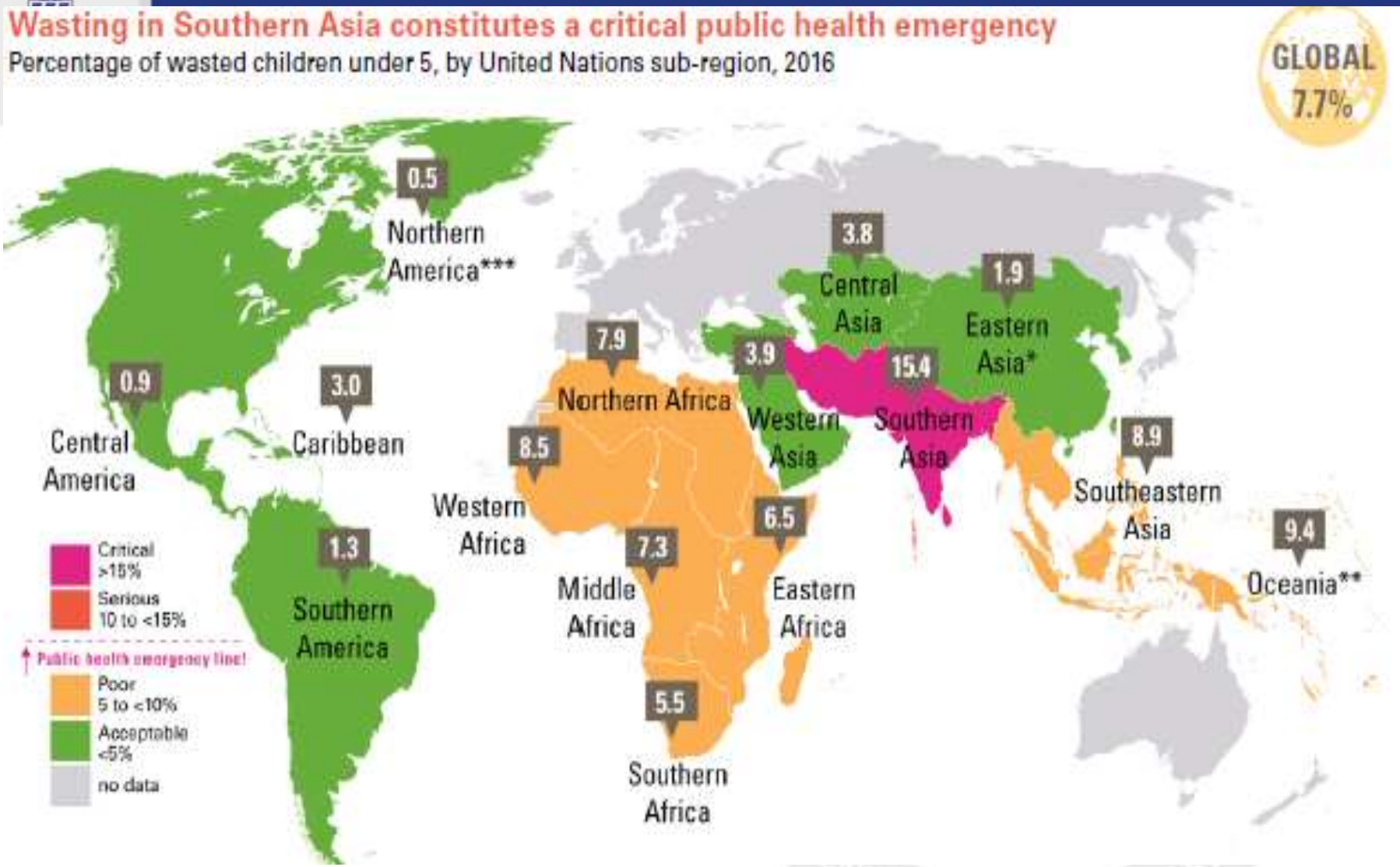
Countries at risk of malnutrition



Source: UNICEF, WHO, World Bank Group joint malnutrition estimates, 2017 edition

Wasting in Southern Asia constitutes a critical public health emergency

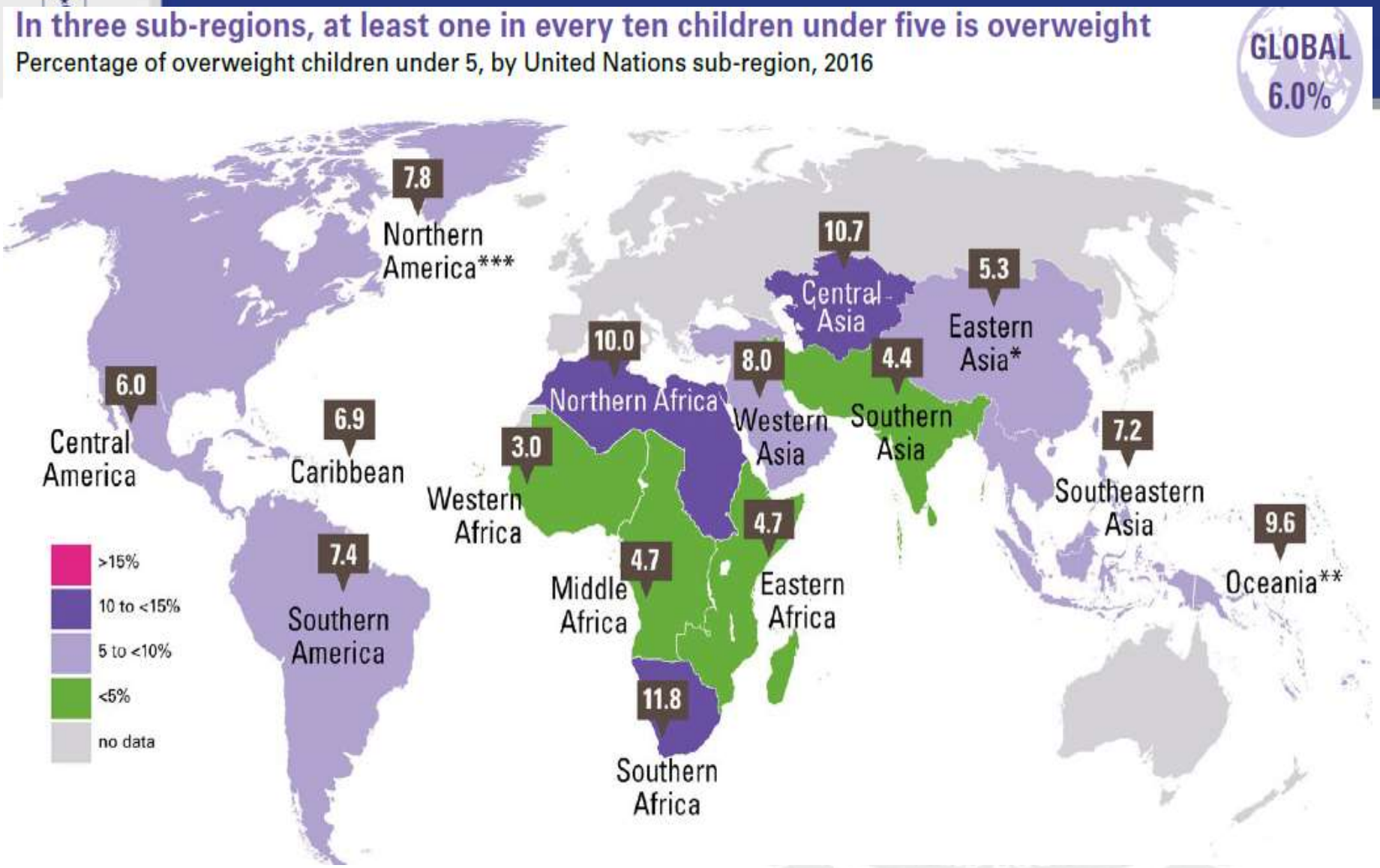
Percentage of wasted children under 5, by United Nations sub-region, 2016



Source: UNICEF, WHO, World Bank Group joint malnutrition estimates, 2017 edition

In three sub-regions, at least one in every ten children under five is overweight

Percentage of overweight children under 5, by United Nations sub-region, 2016



Source: UNICEF, WHO, World Bank Group joint malnutrition estimates, 2017 edition

Geneva Declaration

1924: Declaration of the Rights of the Child (also known as the Declaration of Geneva)

• Adopted after World War I by the League of Nations through the efforts of British child rights pioneer

• Marks the beginning of the international child rights movement and is also the first international affirmation of the right to nutrition.

• Affirms that ***"the child must be given the means needed for its normal development, both materially and spiritually"*** **and states that** ***"the hungry child should be fed."***

Summary: Definition of malnutrition

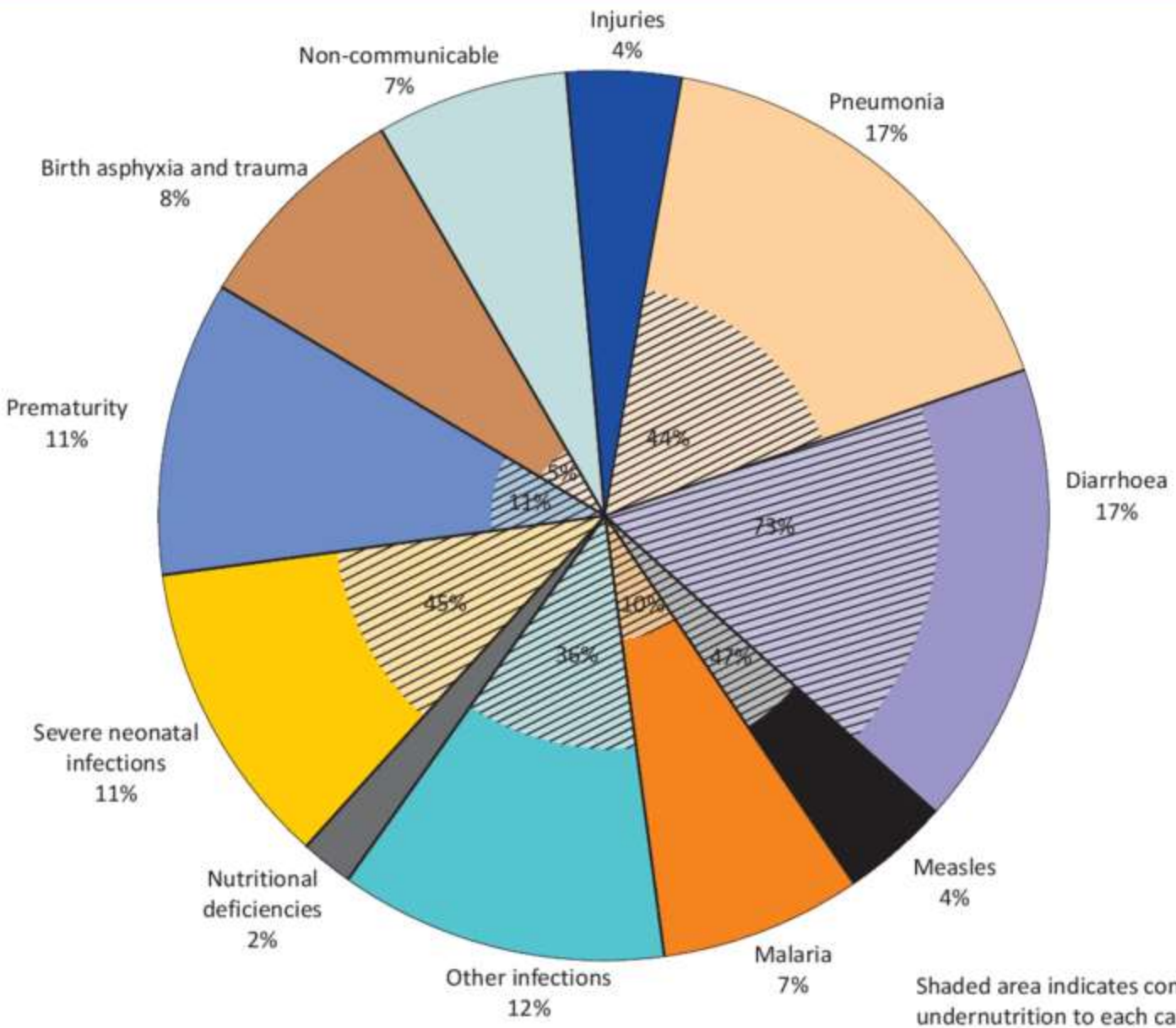
- **Malnutrition** is having the inappropriate level of a micro- or macro- nutrient
- In some cases, malnutrition can be associated with being **grossly overweight**
- In most of the world, malnutrition is defined as a LACK of nutrients

- **Malnutrition contributes to over 50% of deaths in children in the world**

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

Death from malnutrition



MALNUTRITION

UNDERNUTRITION

OBESITY
OVERNUTRITION

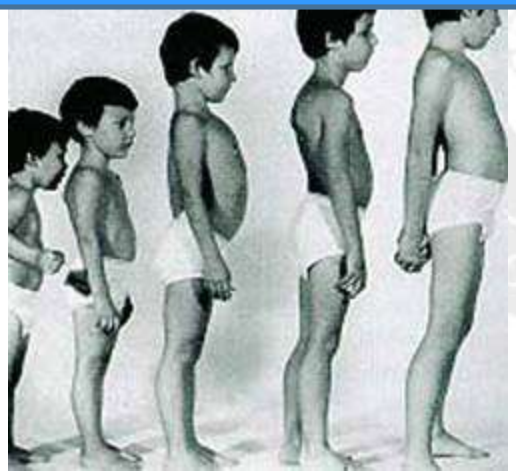
Micronutrient deficiency

DYSTROPHY

HYPOTROPHIA

PARATROPHY
OBESITY

HYPOSTATURE



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
  - Wasting
- **Micro-nutrient deficiency**
  - Iodine
  - Iron
  - Zinc
  - Calcium
  - Vitamin A
  - Vitamin D

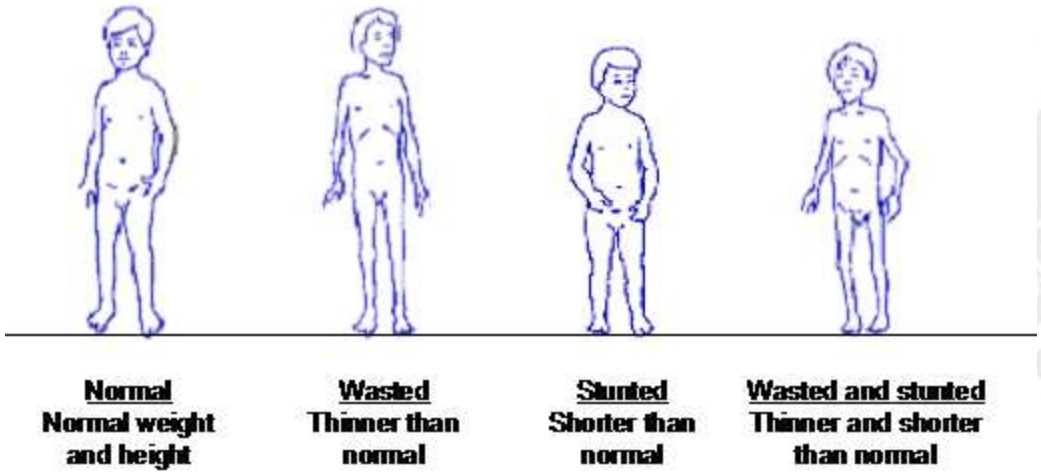
Measurement of Malnutrition

- **UNDERWEIGHT: *Weight for age*** – weight compared to age in a reference population

- **STUNTING: *Height for age*** – height compared to a reference population of the same age.

  = represents long term growth retardation

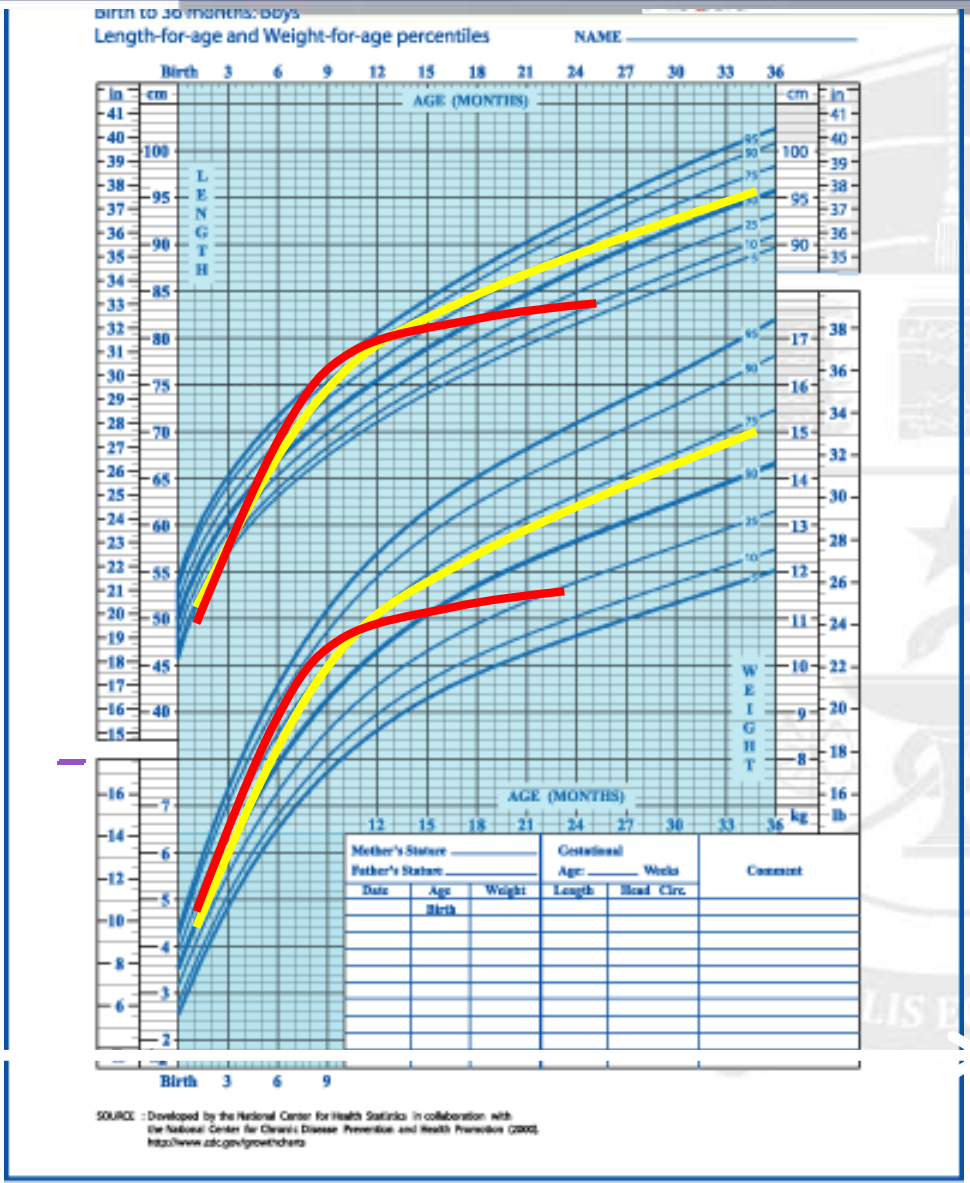
- **WASTING: *Weight for height*** – weight compared to a reference population of the same height



Measurement of Malnutrition

- **Stunting** is the devastating result of poor nutrition in early childhood
  - Children suffering from stunting may never grow to their full height and their brains may never develop to their full cognitive potential
- **Wasting** in children is the life-threatening result of hunger and/or disease
  - Children suffering from wasting have weakened immunity, are susceptible to long term developmental delays, and face an increased risk of death: they require urgent treatment and care to survive

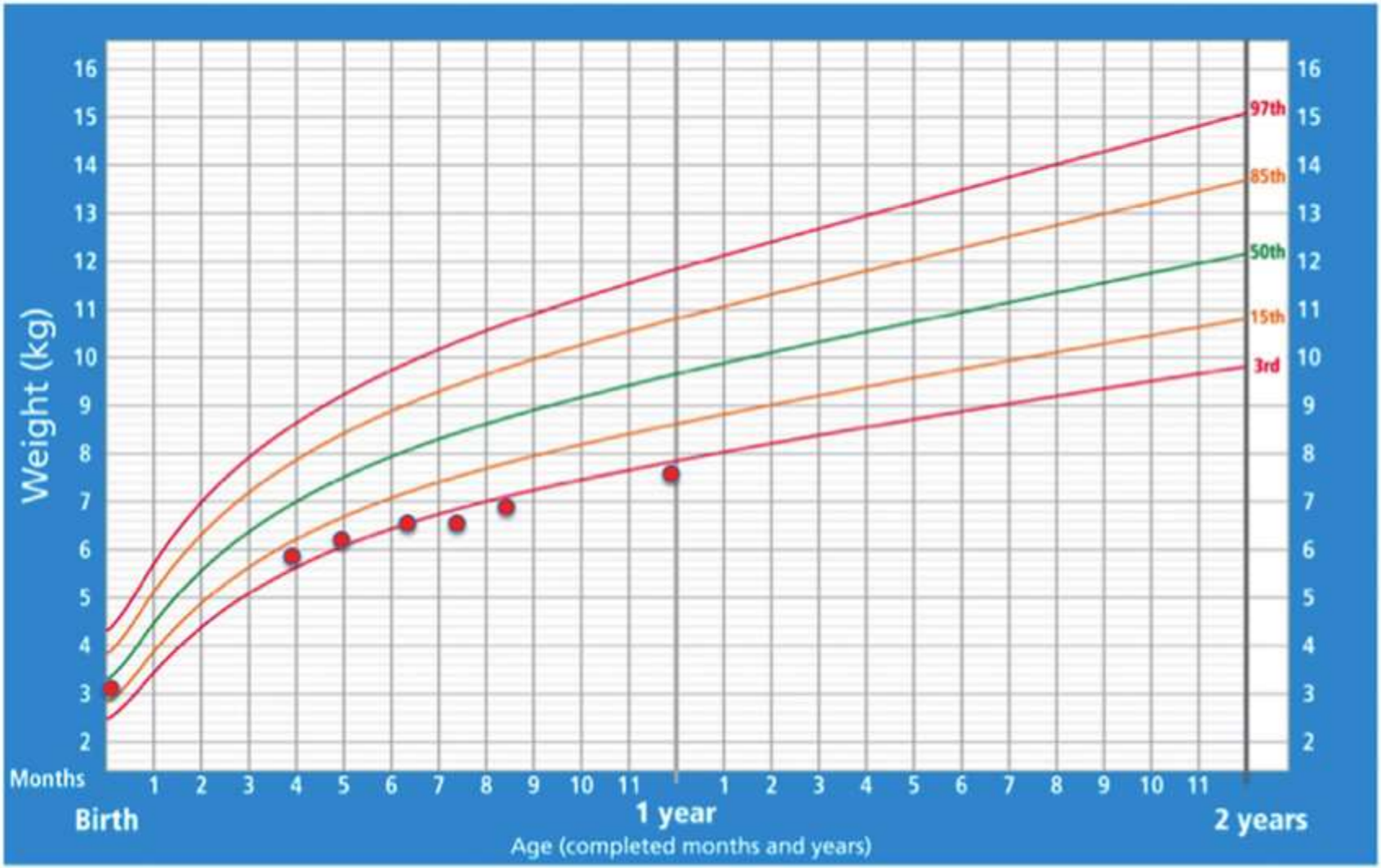
Growth Charts (0-3 years)



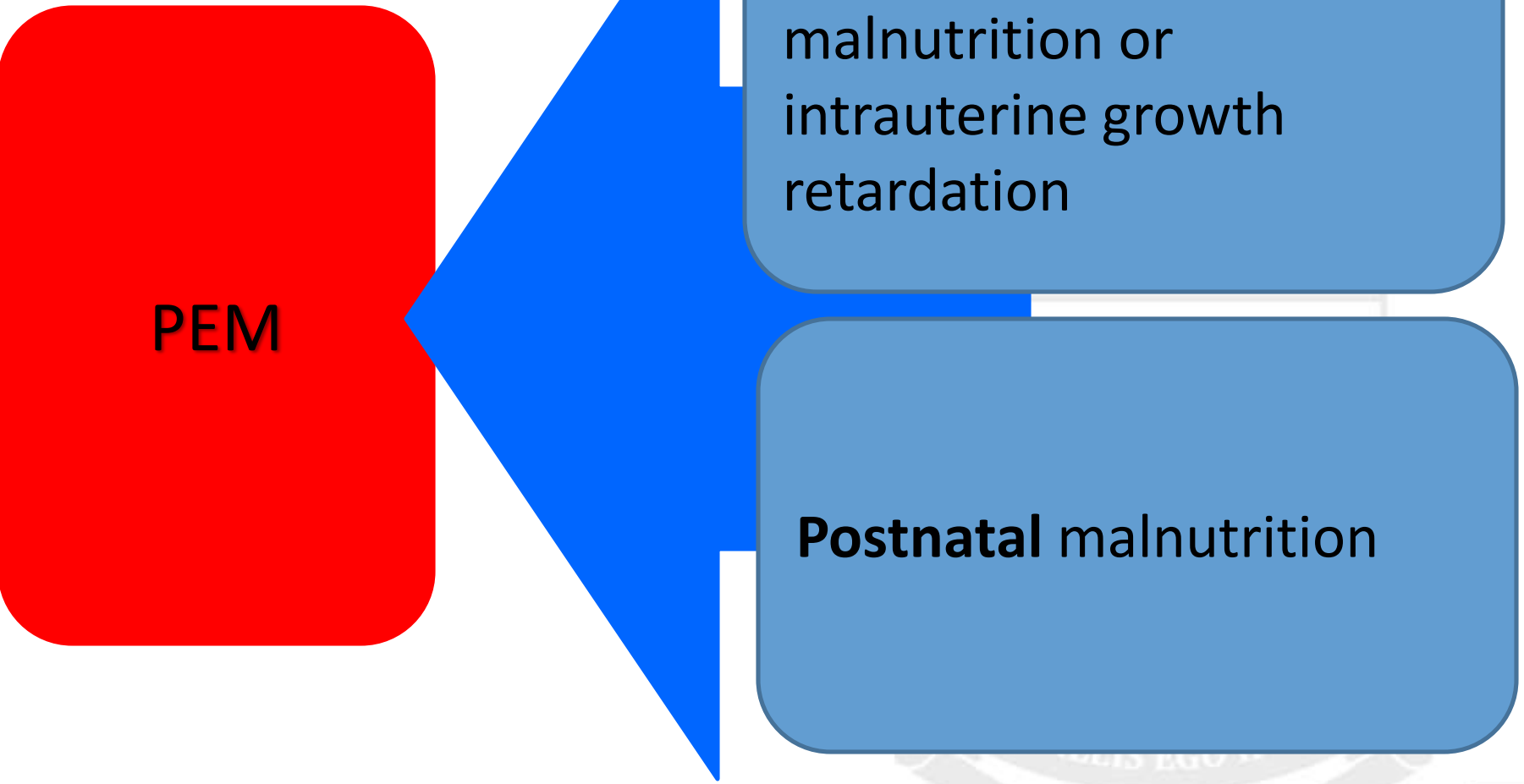
Weight-for-age BOYS

Birth to 2 years (percentiles)

World Health Organization



PEM etiology



Prenatal factors

- 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

Maternal health and nutrition

- Approximate weight gain during pregnancy is 9-11 kg
- Good nutrition in pregnancy is required to:
  - maintain maternal health,
  - fulfill needs of growing fetus,
  - provide strength and vitality required during labor;
  - for successful lactation.
- The fetus extracts iron from the mother, even if she suffers from anemia, so iron rich foods and iron suppliers are required

Postnatal factors

PEM

Primary (non organic)
Insufficiency of food, Inadequate or unbalanced diet

Secondary (organic)
Problems with digestion or absorption, chronic illnesses

Primary (non organic) malnutrition

- Low intake (parents are not giving their child enough food)
  - they can't afford to (poverty, unemployed);
  - they don't want to (child abuse or neglect);
  - they don't know (they are too young or uneducated).

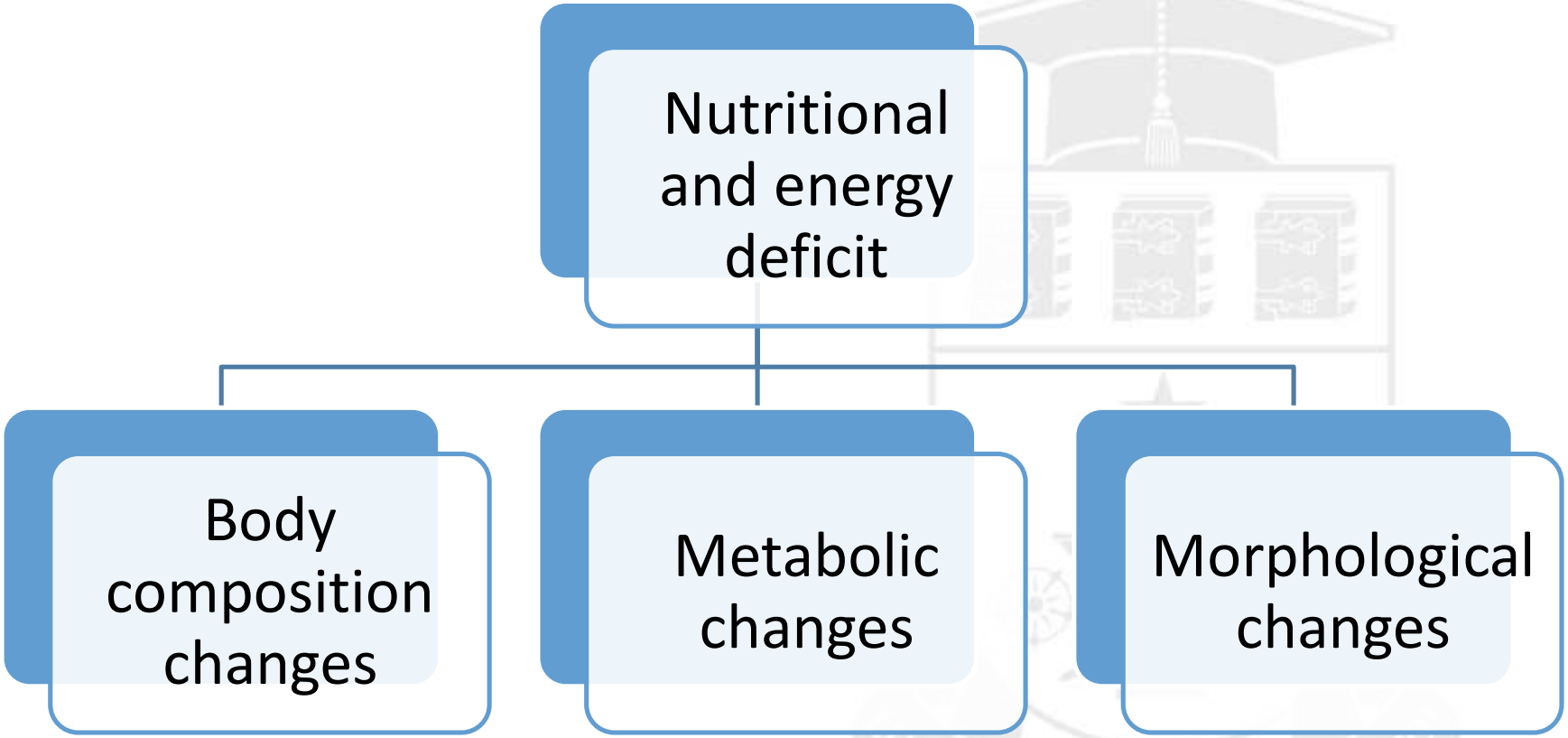
Child health and nutrition

- Babies should be exclusively breastfed for the first six months of life to achieve optimum growth and development
- After six months, adequate and safe complementary foods should be introduced while continuing breastfeeding
  - foods should be introduced in small quantity and gradually increase it with growing age of the child
  - a variety of foods including soft cooked food like potatoes, cereals, meat, poultry, fish or eggs etc
- Infants can be given mashed and semi-solid foods beginning at 6 months daily 2-3 times gradually increasing to 3-4 times daily after 9 months.
- Most children can eat the same types of foods as consumed by the rest of the family after 1 year of age

Defective digestion or absorption

- **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.)

Pathophysiological changes



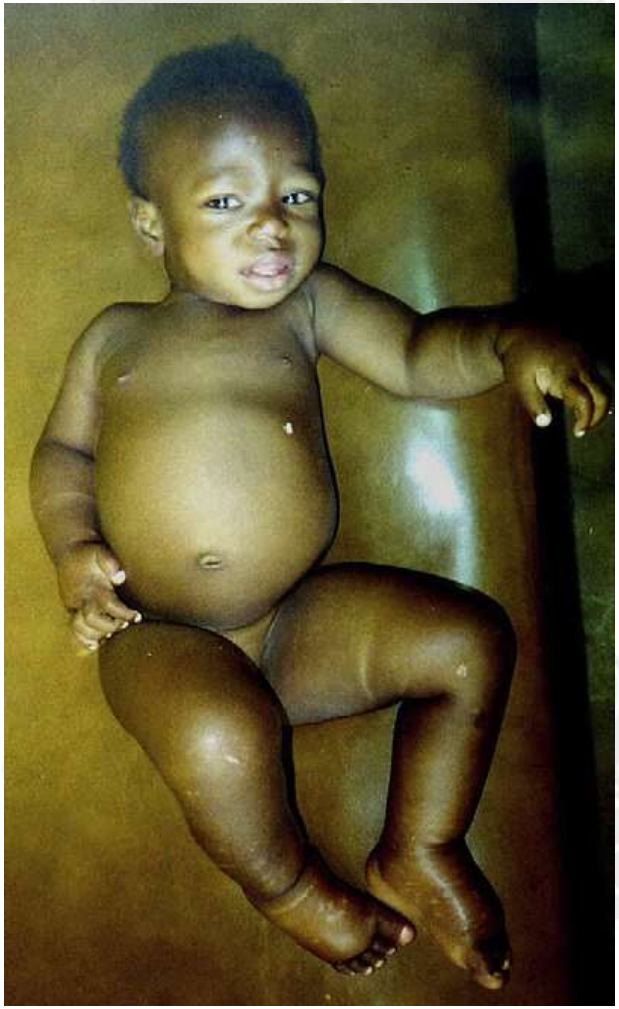
Criteria	M I deg.	M II deg.	M III deg
PI (W%) NI Weight deficit	PI = 0,90-0,76 NI = 0,90-0,81 < 25%	PI = 0,75-0,6 NI = 0,80-0,71 25% - 40%	PI = 0,6 NI < 0,7 >40%
Height	Normal	Normal	Decreased
Weight curve	Stationary	Descendent In steps	Descendent continuously
Adipose tissue	Diminished on abdomen, chest	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

Criteria	M I deg.	M II deg.	M III deg.
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: - ↓ oxygen consumption; - ↓ basal metabolism - tendency to hypothermia; - CV insufficiency	Homeostasis total ly disturbed. Hypothermia, bradycardia, tendency to collapse
Reversibility	Reversible	Reversible	Hardly reversible

Severe malnutrition

Marasmus
(low energy)

Kwashiorkor
(low protein)



Marasmus vs Kwashiorkor

	Marasmus	Kwashiorkor
Usual Age	0-2 years	1-3 years
Edema	None	lower legs, face or generalized
Wasting	Gross loss of SubQ fat	sometimes hidden
Muscle Wasting	obvious	sometimes hidden
Growth retardation	obvious	sometimes hidden
Mental Changes	apathetic, quiet	irritable, also apathetic
Appetite	good	poor
Diarrhea	often	often
Skin Changes	seldom	flaky-paint dermatoses
Hair Changes	seldom	sparse
Moon face	seldom	often
Hepatic enlargement	seldom	always

Main Features of Protein Energy Malnutrition

	Marasmus	Kwashiorkor
Serum albumin	N or low	low
Urea/creatinine	N or low	low
Hydroxyproline	low	low
Essential AA	normal	low
Anemia	uncommon	common
Liver biopsy	Normal or atrophic	fatty chang

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)

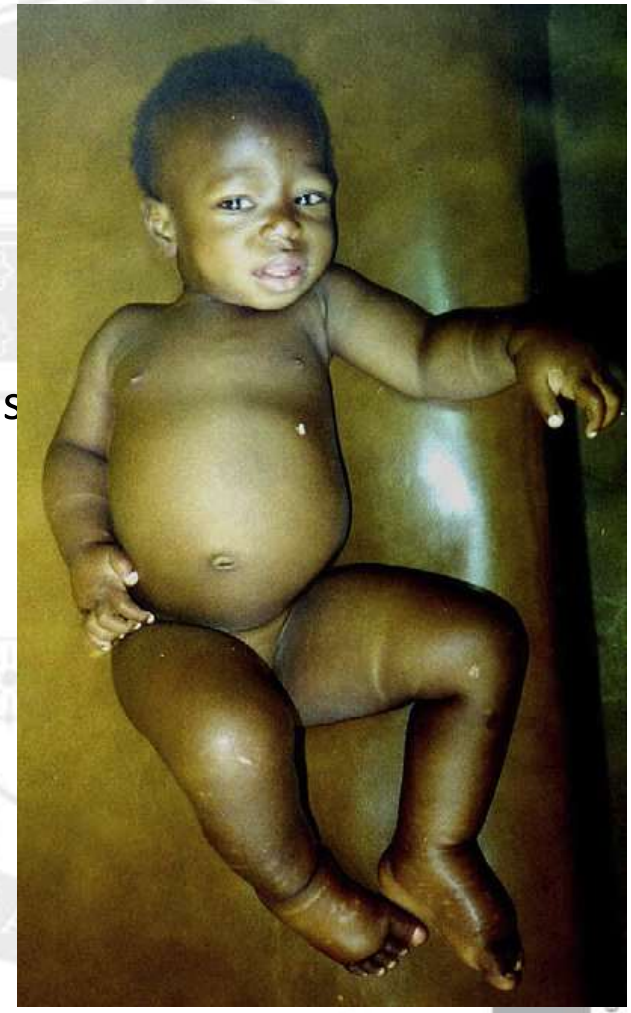
Marasmus – mechanism

- Energy intake is insufficient for body's requirements – body must draw on own stores
- Liver glycogen exhausted in a few hours – skeletal muscle protein used via gluconeogenesis to maintain adequate plasma glucose
- When near starvation is prolonged, fatty acids are incompletely oxidized to ketone bodies, which can be used by brain and other organs for energy
- High cortisol and growth hormone levels

➔ **Mechanism is same as anorexia**

Kwashiorkor (low protein)

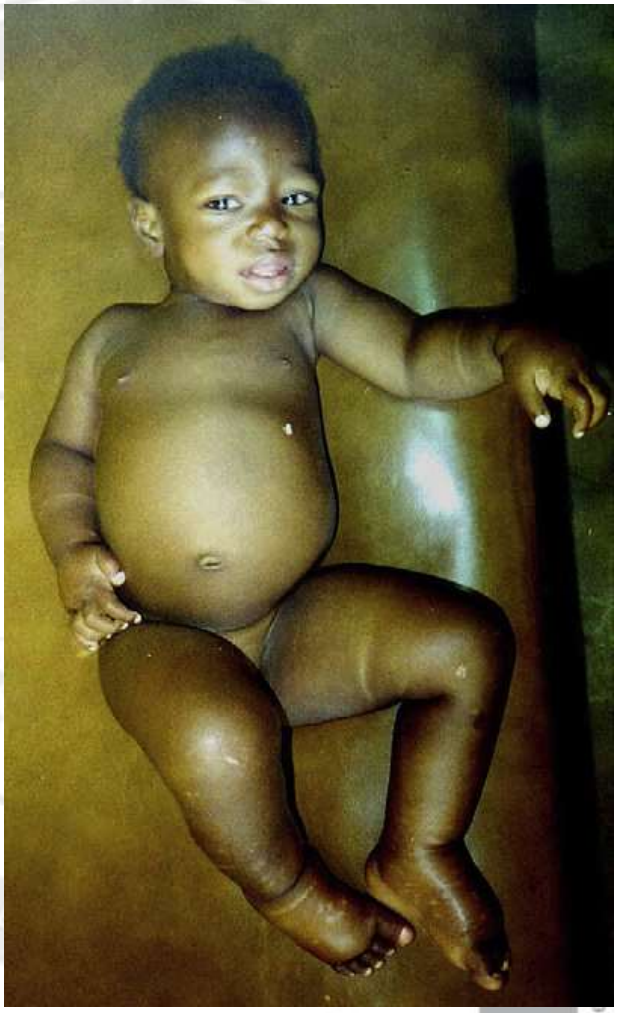
- **Decreased muscle mass** (failure to gain weight and of linear growth)
- **Swollen belly** (edema and lipid build-up around the liver)
- **Changes in skin pigment (pellagra);** may lose pigment where the skin has peeled away (desquamated) and the skin may darken where it has been irritated or traumatized
- **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**

Kwashiorkor – mechanisms

- Occurs in reaction to emergency situations (famine)
- Kwashiorkor more likely in areas where cassava, yam, plantain, rice and maize are staples, not wheat
- Increased carbohydrate intake with decreased protein intake eventually leads to edema (water) and fatty liver



Severe Malnutrition: Consequences

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 mothers

Summary: Severe malnutrition

- Severe malnutrition is defined as > 3 SD away from median reference standards;
- 66M children under the age of 5 are severely malnourished (64M of these in developing countries);
- Key types of severe malnutrition are kwashiorkor (low protein) and marasmus (low calories);
- Severe malnutrition results in severe deficits for children

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 the devastating result of poor nutrition in early childhood
- Stunting is good cumulative measure of “well-being” for populations of children (because not affected by weight recovery)

Stunting: 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)

➔In 1833, British children were as tall as children today from India and Guatemala

➔All immigrant populations have same height after 3 generations in US

Stunting: 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 (breast fed infants often protected)

Stunting: Consequences

- Children suffering from stunting may never grow to their full height and their brains may never develop to their full cognitive potential
- Cross-sectional associations – Low height for age associated with:
  - 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

Summary: Mild/moderate maln.

- Stunting refers to growth retardation (>2 S.D.) secondary to malnutrition;
- Almost 40% (223M) of children <5 in the developing world are stunted;
- Children are most at risk for stunting in the first 2-3 years of life;
- Stunting is associated with poor mental development and altered behavior.

IMCI/WHO criteria for acute malnutrition in children

THEN CHECK FOR ACUTE MALNUTRITION

CHECK FOR ACUTE MALNUTRITION
LOOK AND FEEL:

Look for signs of acute malnutrition
- Look for oedema of both feet
- Determine WFH/L*___ z-score.
- Measure MUAC**____ mm in a child 6 months or older

If WFH/L less than -3 z-scores or MUAC less than 115 mm, then:

- Check for any medical complication present:
  - Any general danger signs
  - Any severe classification
  - Pneumonia with chest indrawing
- If no medical complications present:
  - Child is 6 months or older, offer RUTF*** to eat. Is the child:
    Not able to finish RUTF portion?
    Able to finish RUTRF portion?
  - Child is less than 6 months, assess breastfeeding:
    Does the child have a breastfeeding problem?

CLASSIFY NUTRITIONAL STATUS

• Oedema of both feet OR • WFH/L less than -3 z-scores or MUAC less than 115 mm AND any one of the following: ○ Medical complication present or ○ Not able to finish RUTF or ○ Breastfeeding problem	***Pink :*** **COMPLICATED SEVERE ACUTE MALNUTRITION**	➢ ***Give first dose appropriate antibiotic*** ➢ ***Treat the child to prevent low blood sugar*** ➢ ***Keep the child warm*** ➢ ***Refer URGENTLY to a hospital***
• WFH/L less than -3 z-score **OR** • MUAC less than 115 mm **AND** • Able to finish RUTF	***Yellow:*** **UNCOMPLICATED SEVERE ACUTE MALNUTRITION**	➢ Give oral antibiotics for 5 days ➢ Give ready-to-use therapeutic food for a child aged 6 months or more ➢ Counsel the mother on how to feed the child ➢ Assess for possible TB infection ➢ Advise mother when to return immediately ➢ Follow up in 7 days
• WFH/L between -3 and -2 z-scores **OR** • MUAC 115 up to 125 mm	***Yellow:*** **MODERATE ACUTE MALNUTRITION**	➢ Assess the child's feeding and counsel the mother on the feeding recommendations ➢ If feeding problem, follow up in 7 days ➢ Assess for possible TB infection ➢ Advise mother when to return immediately ➢ Follow up in 30 days
• WFH/L -2 z-scores or more **OR** • MUAC 125 mm or more	***Green :*** **NO ACUTE MALNUTRITION**	➢ If child is less than 2 years old, assess the child's feeding and counsel the mother on feeding according to the feeding recommendations ➢ If feeding problem, follow up in 7 days.

**WFH/L is Weight-for-Height or Weight-for-Length determined by using the WHO growth standards charts.*
*** MUAC is Mid-Upper Arm Circumference measured using MUAC tape in all children 6 months or older.*
****RUTF is Ready-to-Use Therapeutic Food for conducting the appetite test and feeding children with severe acute malnutrition.*

Specific Nutritional Deficiencies

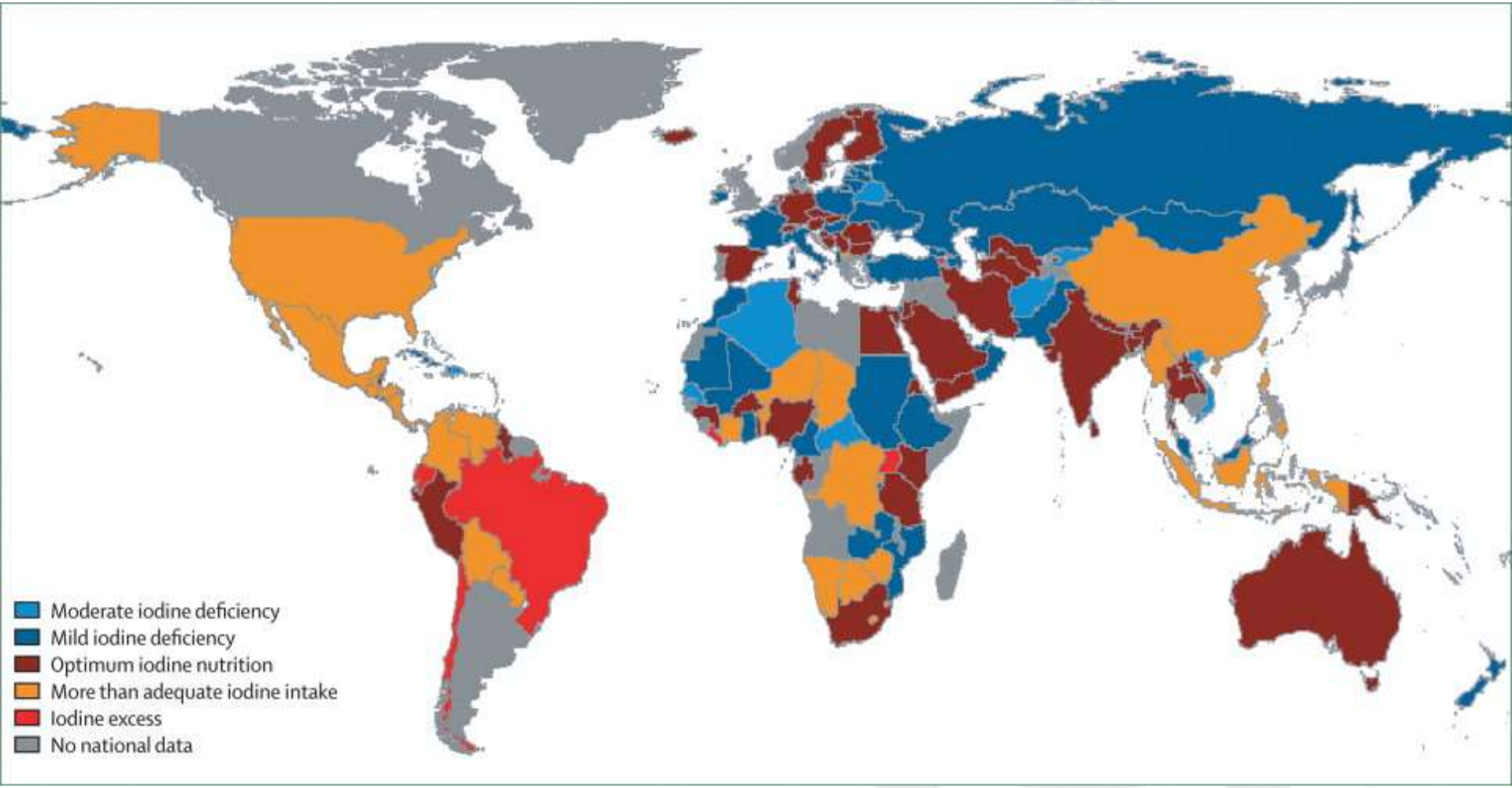
- Iodine Deficiency
- Iron Deficiency
- Zinc Deficiency
- Calcium Deficiency
- Vitamin A Deficiency
- Vitamin D Deficiency

Iodine deficiency – thyroid

"Simple goiter is the easiest of all known diseases to prevent . . .
It may be excluded from the list of human diseases as soon as society determines to make the effort"

David Marine 1923

Iodine Deficiency Disorders



Causes of Iodine Deficiency

- Mountainous areas at risk (soils leached by high rainfall, melting snow, flooding)

- Culturally induced behavioral change
  - Tasmanian Aboriginals migrated every season until European invasion, became sedentary and had incidence of thyroid problems

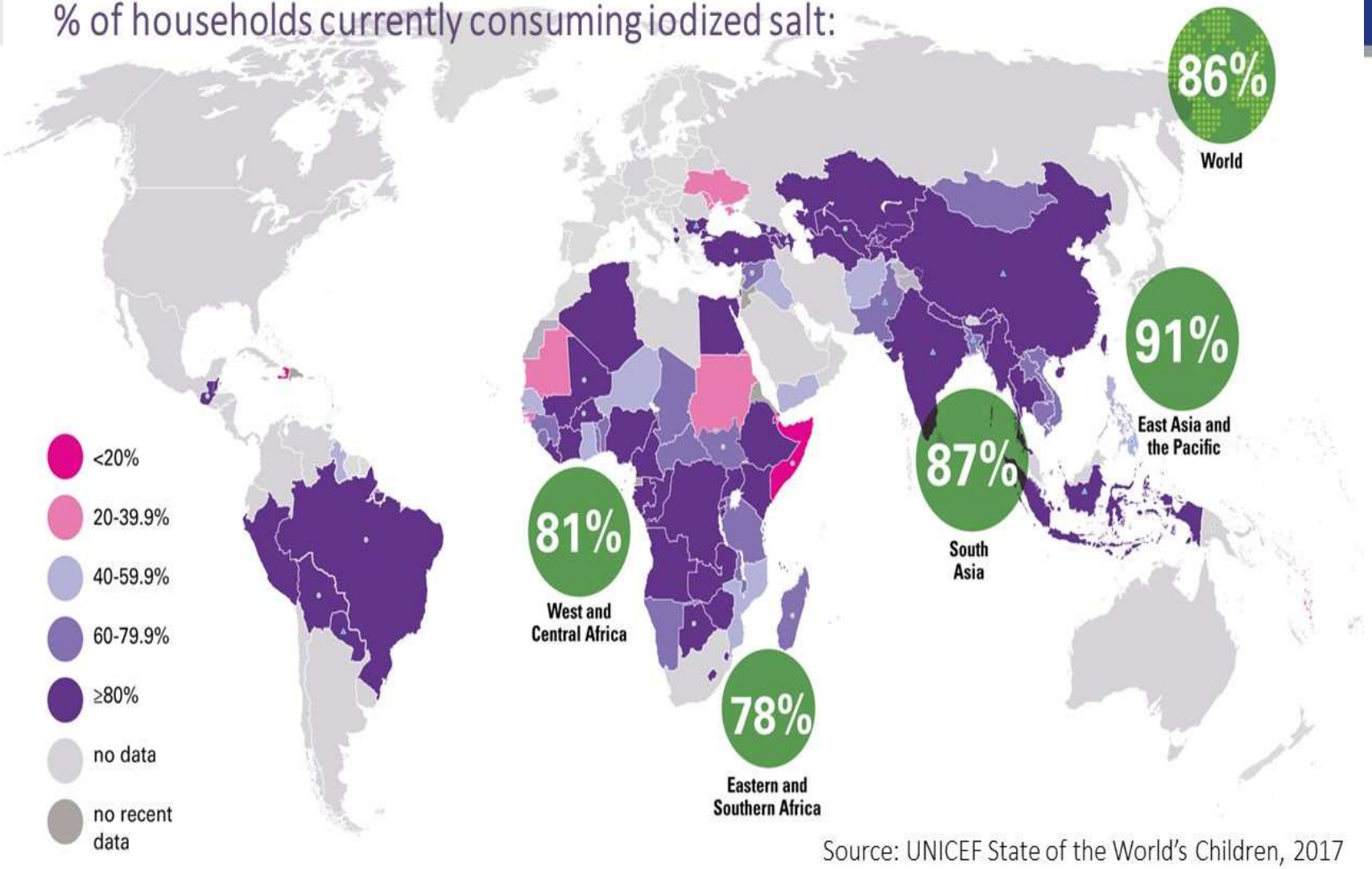
Iodine Deficiency: Severe

- 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

Iodine Deficiency: Moderate

- Studies comparing 2 Villages
  - Consistent results: meta-analysis showed 13.5 IQ point difference between groups
- Intervention Studies
  - Prenatal supplementation (esp. 1st trimester): clear impact – prevents cretenism, and affects mental development in children
  - Childhood supplementation: many small studies, but positive impact

Global experience with salt iodization:
% of households currently consuming iodized salt:

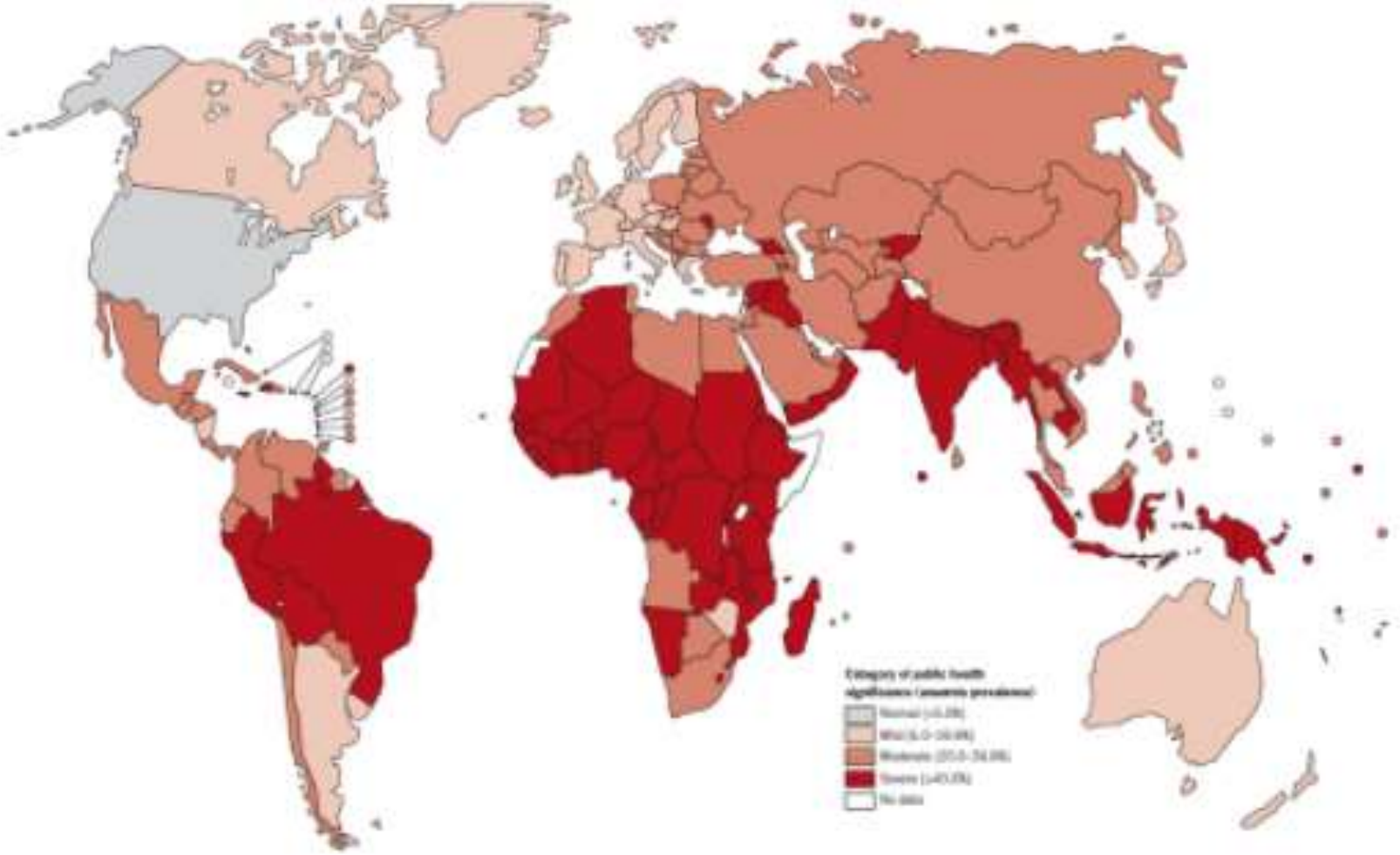


Source: UNICEF State of the World's Children, 2017

Iron Deficiency

- Iron deficiency is the most common nutritional deficiency worldwide
- 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)

Anemia as a public health problem by country: Preschool-age children



(Source: Worldwide Prevalence of Anemia 1993-2005, WHO 2008)

Risk factors for Iron deficiency

- a diet lacking animal products
- Pregnancy
- prematurity, low birthweight, early umbilical cord clamping
- rapid growth
- cow's milk feeding (intestinal microhemorrhages)
- reduced intestinal absorption of iron due to high phytate and phosphate intake (cola beverages)
- menstruation
- parasitic infections

Iron Deficiency Consequences

- 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
- Very severe anemia (Hb <5 g/mL) is associated with increased mortality

TABLE 5. Hemoglobin (Hb) and hematocrit (Hct) cut-off values used to define anemia in people living at sea level

Age or Group	Hb below (g/mL)	Htc below (%)
Children 6 to 60 months	11	33
Children 5-11 years	11.5	34
Children 12-13 years	12	36
Non-pregnant women	12	36
Pregnant women	11	33
Men	13	39

Adapted from: Preventing Iron Deficiency in Women and Children. Technical Consensus on Key Issues. A UNICEF/UNU/WHO/MI Technical Workshop. October 1998.

- Clinical examination is not a reliable method for diagnosing isolated iron deficiency or milder forms of anemia
- If laboratory tests are available, the diagnosis of anemia can be documented with hemoglobin (Hb) or hematocrit determinations

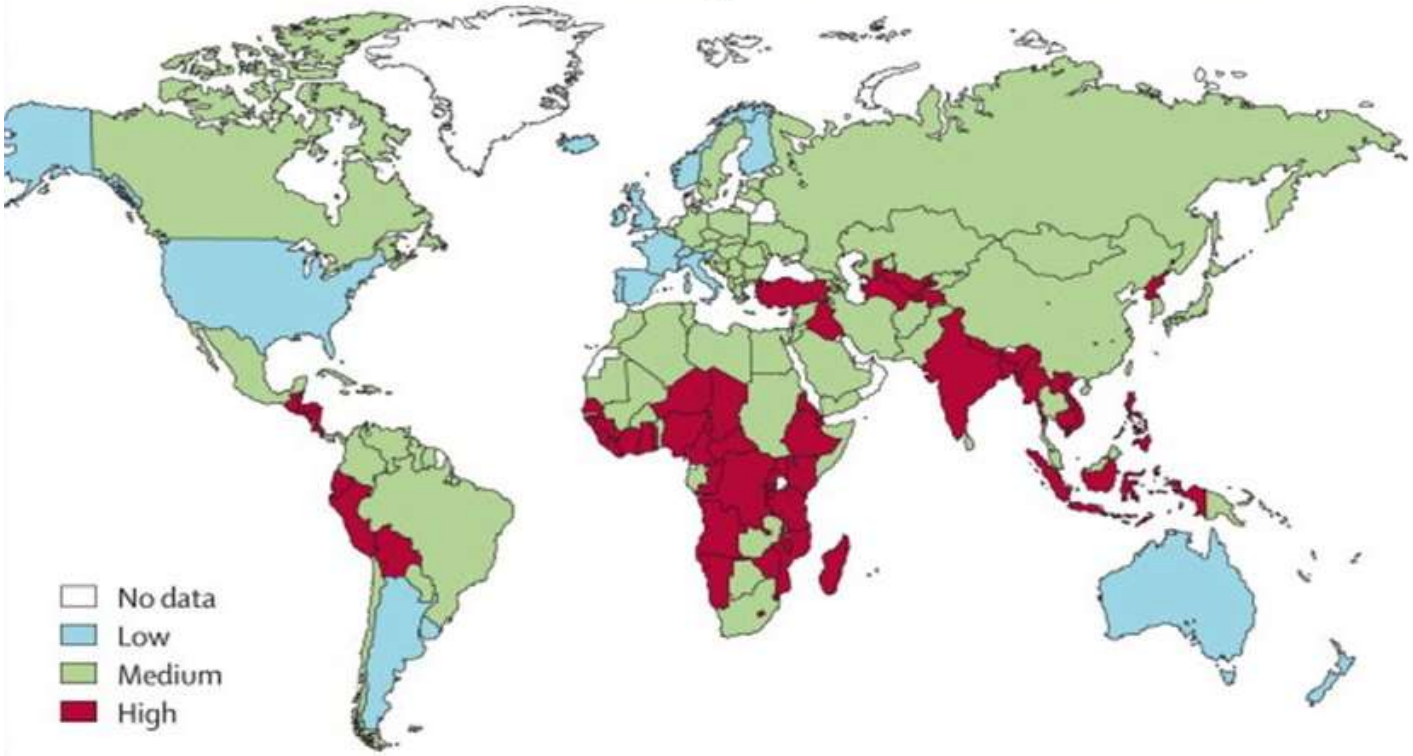
Iron supplementation

- Due to the high bioavailability (about 50%) of lactoferrin-linked iron in human milk, **exclusive breastfeeding during the first 6 months guarantees an appropriate iron pool in healthy term infants**
- **Preterm infants need early iron supplementation**, because their iron pools at birth are insufficient
- With the introduction of solids at 6 months of age, begin appropriate supplementary feeding including foods with highly bioavailable heme iron
- Treatment of iron deficiency anemia
  - Preterm infants: 2-4 mg elemental iron/kg/day PO divided BID or may be given once a day
  - Children: 3-6 mg elemental iron/kg/day PO divided BID - TID

Zinc deficiency

- The exact prevalence of zinc deficiency worldwide is not known, but is estimated to be similar to that of ID, which makes it an underrecognized public health problem
- Zinc is essential for mammalian cell life, function, growth, differentiation, and replication
- Zinc plays a central role in protecting health and immune function of individuals
  - constituent of more than 200 enzymes and transcription proteins that modulate cell differentiation, nucleic acid synthesis, and the metabolism of proteins, lipids, and carbohydrates

Countries at Risk of Zinc Deficiency in Children



Black et al. 2008. The Lancet Maternal and Child Undernutrition Series

Clinical manifestations of zinc deficiency

- Decreased growth velocity
- Skin lesions, glossitis
- Alopecia
- Nail dystrophy
- Delayed sexual development, erectile dysfunction
- Behavioral abnormalities, depressed mood
- Photophobia and impaired ocular adaptation to darkness
- Delayed wound, burn, and ulcer healing
- Impaired or loss of taste
- Low birth weight and prematurity

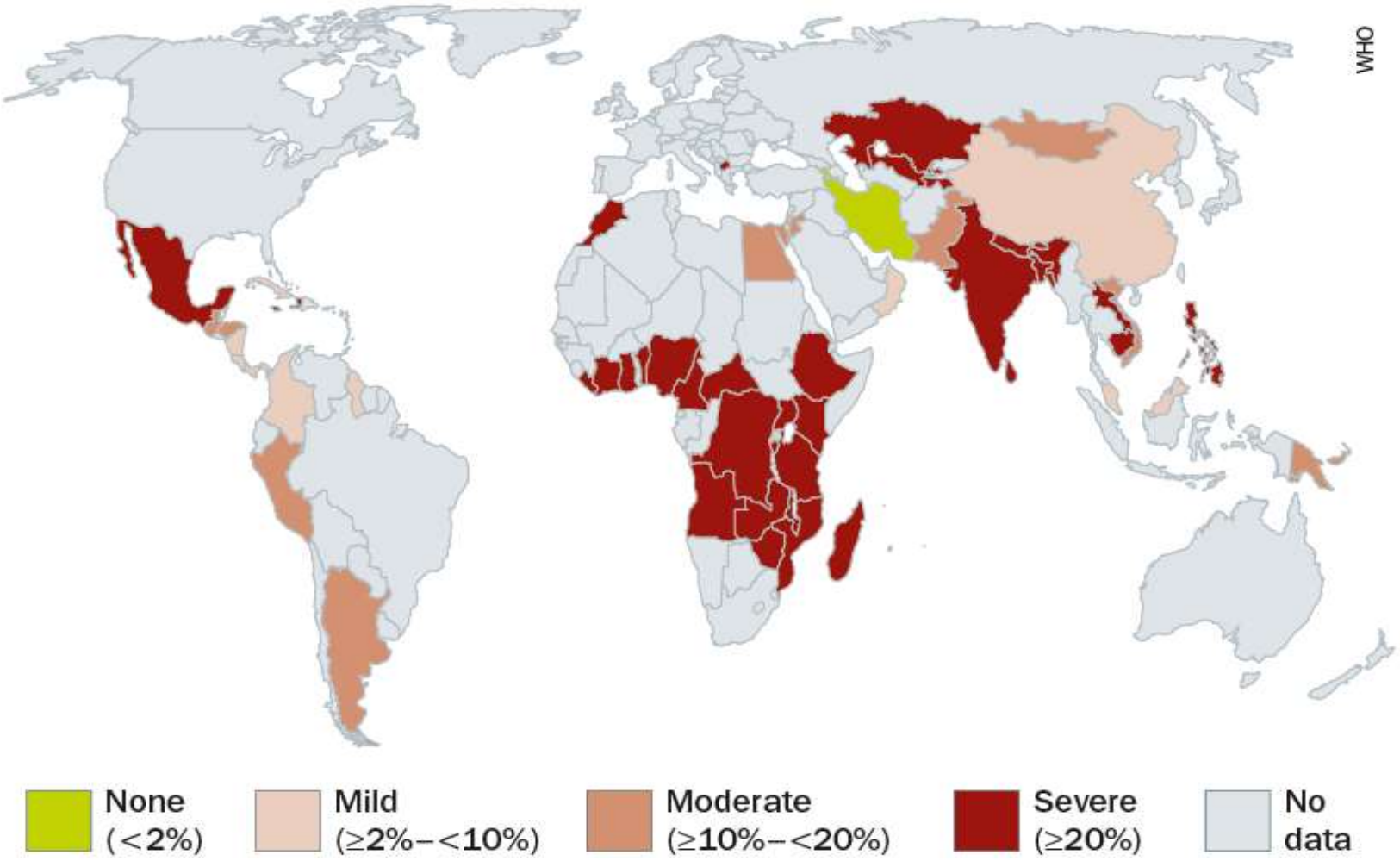
Zinc daily recommended intake

- Promotion of excl**usive breastfeeding for the first 6 months prevents zinc deficiency** in infants.
- Fruits and other vegetables are not good sources of zinc, because **zinc in vegetable proteins is poorly bioavailable**, in contrast to zinc associated with animal proteins
- **Zinc daily recommended intake**
  - Infants: 5 mg/day
  - Young children: 10 mg/day
- In the **management of diarrhea**, WHO now recommends supplementation with zinc in combination with oral rehydration solution
  - children under 6 months 10 mg /day,
  - children above 6 months 20 mg/day for 10-14 days

Vitamin A Deficiency

- **Vitamin A is important because it is essential to vision, fetal development, immune response**
- **250 million** children of pre-school age lack sufficient Vitamin A in their diet.
- **350,000** become blind each year, and half of them die within a year of becoming blind….
- is the most common preventable cause of childhood blindness in the world.

Figure 1. Global extent of vitamin A deficiency as defined by prevalence of serum reinol <0.70 µmol/l in preschool children[3]



3 World Health Organization (WHO). Global prevalence of vitamin A deficiency in populations at risk 1995–2005. WHO Global Database on Vitamin A deficiency. Gen Switzerland: WHO; 2009. Available at: http://whqlibdoc.who.int/publications/2009/9789241598019_eng.pdf

Vitamin A Deficiency

- Associated with blindness and increased severity of infections such as measles and diarrhoeal disease
- The clinical features of VAD involving the ocular system are known as xerophthalmia
  - night blindness
  - conjunctival xerosis
  - keratomalacia

- Conjunctival xerosis may progress to ulceration or in the most advanced form to keratomalacia, its typical presentation being necrosis of the cornea.

TABLE 4. Vitamin A treatment and prevention schedule

Age	Treatment*	Preventive Dosage
<6 months (<6 kg)	50,000 IU	50,000 IU every 4-6 months
6-12 months (6-8 kg)	100,000 IU	100,000 IU every 4-6 months
>1 year (> 8kg)	200,000 IU	200,000 IU every 4-6 months
Women	200,000 IU**	200,000 IU ≤ 8 weeks after delivery

Vitamin D Deficiency: Rickets

Nutritional disorders in chronic diseases

- Common examples of chronic disease in children that influence the growth include:
  - cystic fibrosis
  - chronic kidney disease
  - chronic liver disease
  - congenital heart disease
  - inflammatory bowel disease
  - multiple food allergies

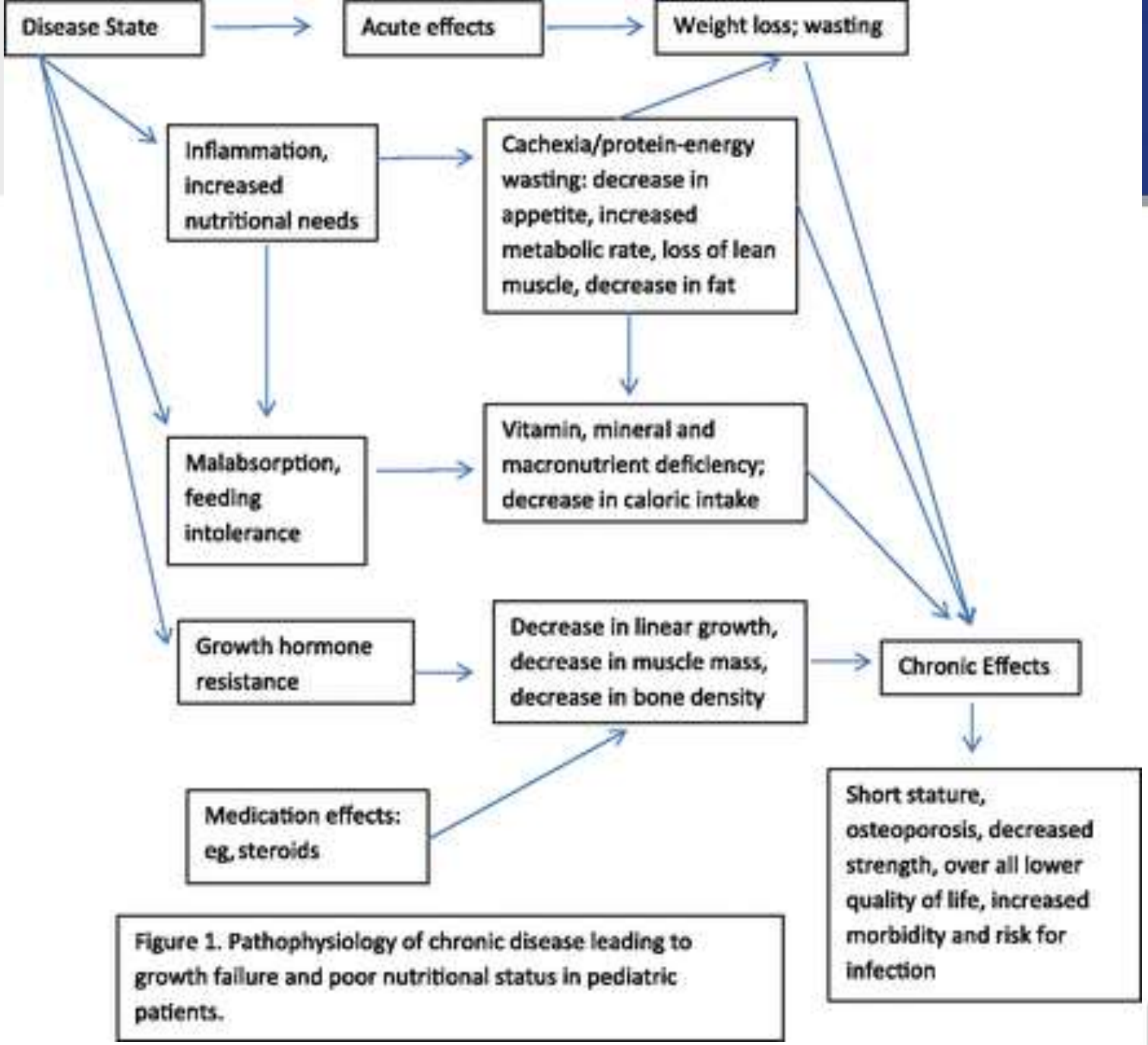


Figure 1. Pathophysiology of chronic disease leading to growth failure and poor nutritional status in pediatric patients.

A. Sevilla. Pediatrics in Review, 2017

Nutritional Disorders

Obesity: body wt more than 97th over wt or

Wt more than 120 % of expected

There are now nearly 41 million overweight children globally, an increase of 11 million since 2000.

Source: UNICEF, WHO, World Bank Group joint malnutrition estimates, 2017 edition

Obesity

- Appears most frequently in the 1st year, 5-6 years & adolescence

Etiology:

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

Obesity

Obesity: clinical picture

1. Fine facial features on a heavy-looking taller child
2. Larger upper arms & thighs
3. Genu valgum common
4. Relatively small hands & fingers tapering
5. Adiposity in mammary regions
6. Pendulous abdomen w/ striae
7. In boys, external genitalia appear small though actually average in size
8. In girls, external genitalia normal & menarche not delayed
9. Psychologic disturbances common
10. 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

Types of Eating Disorders

- Anorexia Nervosa
- Bulimia Nervosa
- Binge Eating Disorder*
- Avoidant/Restrictive Food Intake Disorder*
- Pica
- Rumination
- Other Specified Eating Disorder

Anorexia Nervosa

A. **Restriction of energy intake** relative to requirements, leading to a significantly low body weight in the context of age, sex, developmental trajectory, and physical health.
B. **Intense fear of gaining weight** or of becoming fat, or persistent behavior that interferes with weight gain, even though at a significantly low weight.
C. Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on selfevaluation, or persistent lack of recognition of the seriousness of the current low body weight.

Nature of Anorexia

- This is a psychiatric disorder with high medical morbidity, psychological co-morbidity, and the highest mortality rate of all psychological conditions.
- It is defined by disruptions and pathology in behavior, cognition, and emotion. This leads to starvation which alters body composition and functioning.
- Hospitalizations for eating disorders has increased most sharply for children younger than 12

Avoidant/Restrictive Food Intake Disorder

- is a common eating disorder experienced by young children
- Children with this disorder experience a disturbance in their eating which can include a lack of interest in food or a sensory aversion to certain foods
  - For example, a child might be averse to swallowing or the texture of foods they once enjoyed
  - They might also fear getting stomach aches or vomiting if they became sick because of a certain food.
- These aversions and restrictions can lead to weight loss and nutritional deficiency among young children

Pica

- **Pica** is a type of condition where a child might eat non-food or non-nutritional substances persistently
- To be diagnosed with pica, the behavior must fall outside of the child's expected developmental level (i.e. an infant who chews on objects would not qualify)
- These substances often include dirt, soap, chalk, sand, ice, and hair.