

# Child's Physical Development

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## **Growth definition**

- Is a dynamic process defined as an increase in the physical size of the body as a whole or any of its parts associated with increase in cell number and/or cell size
- Reflects changes in absolute size, mass, body composition
- Growth in children is usually steady and predictable, and good references are available for assessment and comparison
- Growth is a key component of nutritional status and indicator of health
- Growth can be measured objectively by using various anthropometric measurements and is universally part of any pediatric care
- **Quantitative growth**
  - changes in the mass of body tissues (muscle, fat, and bone)
- **Qualitative growth**
  - specify maturation of the function
  - it is related to the maturation and myelination of the nervous system – acquisition of a variety of skills
  - differences in maturation and body composition between boys and girls

## **Growth patterns**

- **Cephalocaudal pattern** (head down to toes)
- **Proximodistal pattern** (center of the body to peripheral)
- **General to Specific** (children at first are able hold the big things by using both arms, in the next part able to hold things in a single hand, then only able to pick small objects)
- Although infancy and adolescence are characterized by rapid growth, **growth occurs in spurts**, with rapid growth followed by slower growth

## **Factors influencing child's growth**

- Genetic factors (Growth potential)
  - gender
  - race and nationality
- Prenatal factors
  - maternal malnutrition
  - maternal infection
  - maternal substance abuse
  - maternal illness
  - maternal hormones
  - miscellaneous
- Postnatal factor
  - hormonal influence
    - ✓ After birth the somatotropin has the main role in growth
    - ✓ Growth hormone from hypophysis influence anabolic processes and growth regulation
    - ✓ Thyroid hormones have an influence in the first year of life with (T3, T4,)
    - ✓ Parathyroid hormones – on skeletal mineralization
  - birth order of the child
  - child's nutrition
  - childhood illness
  - physical environment
  - psychological environment
  - cultural influence

- socio-economic status
- climate and season
- play and exercise

#### **Methods of growth assessment**

- **Somatometry** – measurement of weight, height, head and chest circumference
- **Somatoscopy** – visual observation of physical features of different parts of the body (shape of the chest, spinal column, muscle development, fat development, skin elasticity)
- **Dynamometry** – spirometry, muscle's stretch
- All the parameters are compared with standard/references values according to age and gender of the child

#### **Somatometry (anthropometric measurements)**

- are inexpensive, noninvasive, and fast
- reflect both short- and long-term nutrition status
- the accuracy of measurements is an essential component of the assessment
- are objective, but growth must be interpreted in the context of clinical assessment

#### **Main parameters of growth**

- Linear growth (Length/Height)
- Weight and body mass index
- Weight/Height
- Head and chest circumference; HC/CC ratio
- Mid arm circumference
- Body proportions (arm span and upper-to-lower segment ratio)
- Growth velocity
- Growth patterns
- Dentition
- Bone Age

#### **Physical characteristics of newborn**

- In medical contexts, newborn or neonate refers to an infant in the first 28 days after birth; the term applies to premature infants, postmature infants, and full term infants
- Full term newborn characteristics
  - A normal duration of pregnancy between 37-42 weeks of gestation
  - The average birth weight is 3.5 kg, the normal range is 2.5-4.5 kg
  - Newborns often lose around 230 g (6-8%) in the first 4-5 days after birth but regain it by about 10 to 12 days of age
  - In the first month, the typical newborn gains about 20 g a day, or about 110-230g a week.
  - The average length of full-term babies at birth is 51 cm, the normal range is 46-56 cm
  - In the first month, babies typically grow 4 cm to 5 cm

#### **Infant & child's growth – weight**

- 1-3 month – weight gain is 25-30 g/day
- 3-12 month – 400-1000 g/mo (average 800 g/mo)

#### **Milestones**

- 6 month – infant double birth weight
- 12 month – triple birth weight
- 2 years – four times
- 3 years – five times
- 5 years – six times
- 7 years – seven times
- 10 years – ten times

#### **Rules for body weight measurement**

- Child up to 6 months is placed on the special children's scale in the supine position.
- Baby older than 6-7 months may be measured on the same scale in a sitting position
- Child after a year in the measurement of body weight to be in a standing position

## **Formulas for calculating the ideal weight and height for healthy infants and children**

- Ideal weight of infant 0-6 months

$$Wi = BW + 800 n, (n - mo)$$

- Ideal weight of infant 6-12 months

$$Wi = BW + 800 \times 6 + 400 (n - 6), (n - mo)$$

- Ideal weight of infant 6-12 months

$$Wi = 10.5 \text{ kg} + 2 (n - 1), (n - yrs)$$

## **Height measurement in children**

- In children under 2 years, length is measured lying horizontally, using the mother to assist.
  - the legs need to be held straight and infants often dislike being held still
- In children over 2 years of age, the standing height is measured

## **Child's length in the first year of life**

- 0-3 mo – 3 cm per month
- 3-6 mo – 2,5 cm per month
- 6-9 mo – 2 cm per month
- 9-12 mo – 1,5 cm per month

## **Child's height in older children**

- Ideal height after 1 year = 75 cm + 5 cm x n (n – number of years)

## **Infant & child's length milestones**

- 3 month – 60 cm
- 9 month – 70 cm
- 12 month – 75 cm
- Second year – 12 cm increase
- Third year – 9 cm increase
- Fourth year – 7 cm increase (double the birth length)
- Fifth year – 6 cm increase
- Afterwards – till onset of puberty – 5 cm/year

## **Head circumference**

- Head circumference is measured over the most prominent part on the back of the head (occiput) and just above the eyebrows (supraorbital ridges)
- Head circumference is generally measured in infants and children until age three years

$$\begin{aligned} &\text{Normal range of the head circumference (5}^{\text{th}} - 95^{\text{th}} \text{ percentile)} = \\ &= \left[ \frac{\text{length(cm)}}{2} + 9.5 \right] \pm 2.5. \end{aligned}$$

## **Infant & child's HC milestones**

- It is related to brain growth and development of intracranial volume
- Newborn HC – 34-36 cm (average 35 cm)

## **HC milestones**

- 3 month – 40 cm
- 6 month – 43 cm
- 12 month – 45 cm
- 2 years – 48 cm
- 7 years – 50 cm
- 12 years – 52 cm (similar to adults)
- If HC increase >1 cm in 2 weeks during first 3 month – hydrocephalus should be suspected

## **Chest circumference**

- The tape should be located in the back at an angle of the shoulder blades, and in front – at the lower edge of the areola
- Circumference of the chest in infants measures in lying position, in older children – standing

## **Infant & child's CC milestones**

- Newborn CC – 32-34 cm (2-3 cm less than HC)

- 6-12 month – HC and CC become equal
- After first year of age CC is greater than HC by 2.5 cm
- 5 years – CC is 5 cm larger than HC

#### **Calculation of chest circumference**

- 0-6 months:  $CC = 45 - 2 (6 - n)$
- 6-12 months:  $CC = 45 + 0,5 (n - 6)$ ; n - the child's age in months
- 1-10 years:  $CC = 63 - 1.5 (10 - n)$
- 10 years and older:  $CC = 63 + 3 (n - 10)$ ; n - the child's age in years

#### **Growth Charts for Infants and Children**

- Child growth is monitored to:
  - Assess adequacy of nutrition
  - Identify weight status and potential for obesity
  - Screen for disease related to abnormal growth
- Growth charts are the standard tool for interpreting growth
- Growth Parameters
  - Weight-for-age
  - Length-for-age
  - Weight-for-length
  - Head circumference-for-age
- No BMI percentile are used for children younger than 2 years
- **Centile levels**
  - 0-3 – Very low development
  - 3-10 – Low development
  - 10-25 – Decreased development
  - 25-75 – Average development
  - 75-90 – Increased development
  - 90-97 – High development
  - 97-100 – Very high development

#### **Somatoscopy**

##### **Muscle system development**

- First degree – low development
  - decreased elasticity
  - plate thorax, scapula is moved on thoracic surface
  - abdomen has low muscular tone
- Second degree – well development
  - medium elasticity
  - cylindrical thorax
  - abdomen muscle with good tonus
- Third degree – excellent development

##### **Examination of subcutaneous tissue**

- Skin fold in following regions
- Thorax – vertical at the level of medioclavicular line, at the level of third rib
- Abdomen – vertical 5 cm to the left from umbilicus
- On shoulder – on the triceps muscle and the line between acromion and olecranon
- Under the scapula – at inferior angle of scapula

##### **4 degrees of development**

- Ist degree – skin fold has 5 mm
- IInd degree – 5-9 mm
- IIIrd degree – 10-15mm

- IVth degree – 15 mm

#### **Skin assessment**

- Color
- Elasticity and turgor
- Humidity
- Temperature
- Hypo- or hyper-trichosis
- Mucousa layer of oral cavity and conjunctiva
- Characterized after inspection and all pathological changes noted

#### **Biological growth (age)**

- Bone maturation (ossification points on x-ray examination of left hand )
- Teeth eruption (temporary and permanent dentition)
- Appreciation of development of sexual stage and degree of sexual maturity (development of secondary sexual signs)