PEDIATRICS

1 GROWTH/DEVELOPMENT/PUBERTY

Growth

00:00:21

- Average birth weight of an Indian baby- 2.9kg

Birth Weight

- Doubles at: 5 months
- Triples at: 1 year
- Quadruples at: 2 years

Rate of weight gain

- 1st 3 months: 30g/ day
- 3-6 months: 20g/ day
- 6-9 months: 15g/ day
- 9-12 months: 12g/ day
- 1-3 years: 8g/ day

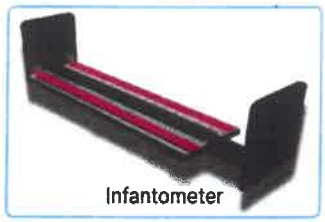
Formula for calculating expected weight of a child

- < 1 year: x+9/2, where x is the age in months
- 2-6 years: 2x+8, where x is the age in years
- 7-12 years: 7x-5/2, where x is the age in years

Length/ Height

PYQ: FMGE 2021

- Length <2 years of age measured by an Infantometer
- **Note:** Infantometer- A horizontal board on which the baby is made to lie down, where one person is made to fix the baby on the board with legs extended and another person can move the plate and read the length
- Height >2 years of age measured using a stadiometer


Infantometer

Precautions

- Remove footwear
- Remove headgear
- Stand erect so that eyes are parallel to the Frankfurt plane
- Occiput, back of the shoulder, buttocks, heel should be touching the vertical wall behind
- Standing length is always 0.7 cm less than the recumbent length (due to gravity)

Usual length or height

- At birth: 50 cms
- At 1 year: 75 cms
- At 2 years: 90 cms
- At 4-4.5 years: 100 cms

Length of a child increases by

- 50% in the 1st year
- 100% in 4-4.5 years (doubles Length)
- Maximum growth takes place in 1st year of life, followed by puberty

Increase in length with age

- 1st 3 months: 3.5 cm/month

- 3-6 months: 2 cm/month
- 6-9 months: 1.5 cm/month
- 9-12 months: 1.2 cm/ month
- 1-3 years: 0.8-1 cm/ month

Formula for calculating expected height of a child

- 6x+77, where x is the age in years

Another parameter that gives idea about the height of the child

- Arm span: Distance between the middle finger of one arm to another when arms are outstretched (perpendicular to the rest of the body)
- < 10 years: 1-2 cms less than the height
- > 10 years: 1-2 cms more than the height

  Normally, difference between the arm span and the height is 3 cms
- At what age is the child's height half of adult height?
  - Average height of an Indian adult: 160-170 cms
  - Half of that - 80-85 cms
  - Age at which the child will be half the adult height: 20-24 months

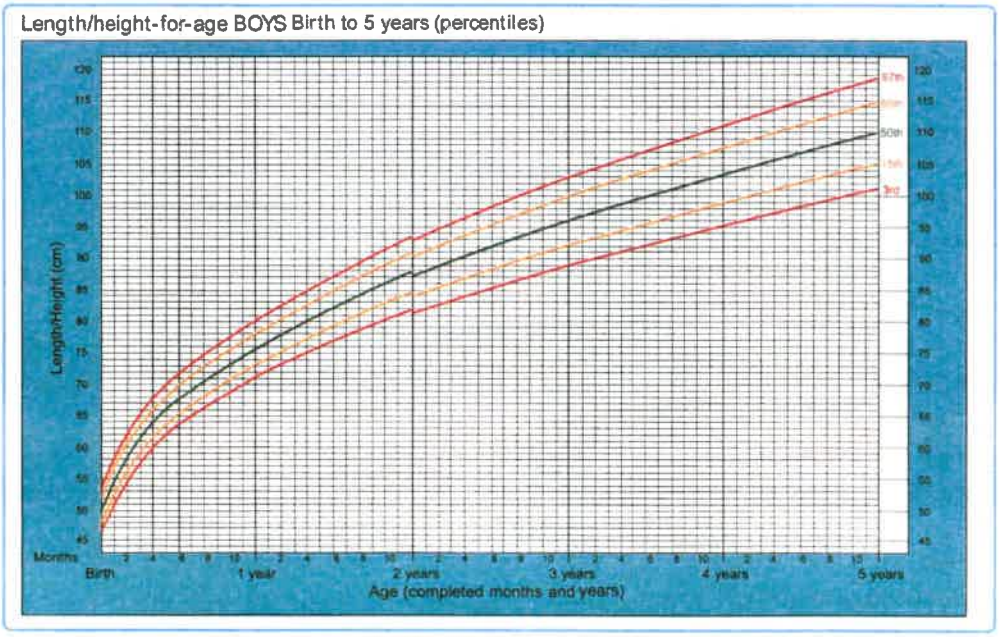
Upper Segment: Lower Segment Ratio

- Upper segment: Part of the body above symphysis pubis
- Lower segment: Part of the body below symphysis pubis

Normally,

- At birth- 1.7-1.9:1
- 3 years- 1.3:1
- 7- 10 years: 1:1

- Interpretation of height of a child:
  - < 5 years: WHO growth charts
  - > 5 years: IAP growth charts



- At 2 years of age is the height of the child is 70cms, corresponding co-ordinates are marked in the growth chart, here it falls below the third percentile, which means that the child has got short stature

WHO Growth Charts

00:09:36

- Based on: MGRS (Multicentre Growth Reference Study)
- Children from 6 countries were studied
  - Brazil
  - Oman
  - Norway
  - Ghana
  - USA
  - India
- Came to use first in 2006
- Used in exclusively breastfed children
- Excluded:
  - Maternal alcohol
  - Smoking

Short Stature

00:11:21

Definition

- If the height of a child is < 3rd percentile or < -2 Z score of expected according to the age and sex of the child

Etiology of Proportionate Short Stature

- Normal variants:
  - Familial short stature
  - Constitutional delay in growth and puberty
- Intra uterine causes:
  - IUGR
  - Infection by TORCH
  - Genetic syndromes: Turner's syndrome, Down's syndrome, Seckel syndrome
- Post natal/ acquired causes:
  - Chronic malnutrition
  - Any chronic systemic illness
  - Celiac disease
  - Maternal deprivation
  - Psychosocial
  - Endocrine: Growth hormone deficiency
- **Note:** Acute malnutrition affects the weight of the child, while Chronic malnutrition affects the height of the child

Case scenario

PYQ: FMGE 2023

A 7-year-old otherwise well child presents with short stature. His weight is appropriate as per his age. His bone age is less than chronological age. The height of his parents is normal. What is the diagnosis?

- Height of parents normal- rules out familial short stature
- Bone age < chronological age- delay in bone maturation- points towards constitutional delay in growth and puberty (CDGP)

X-ray for bone age of:

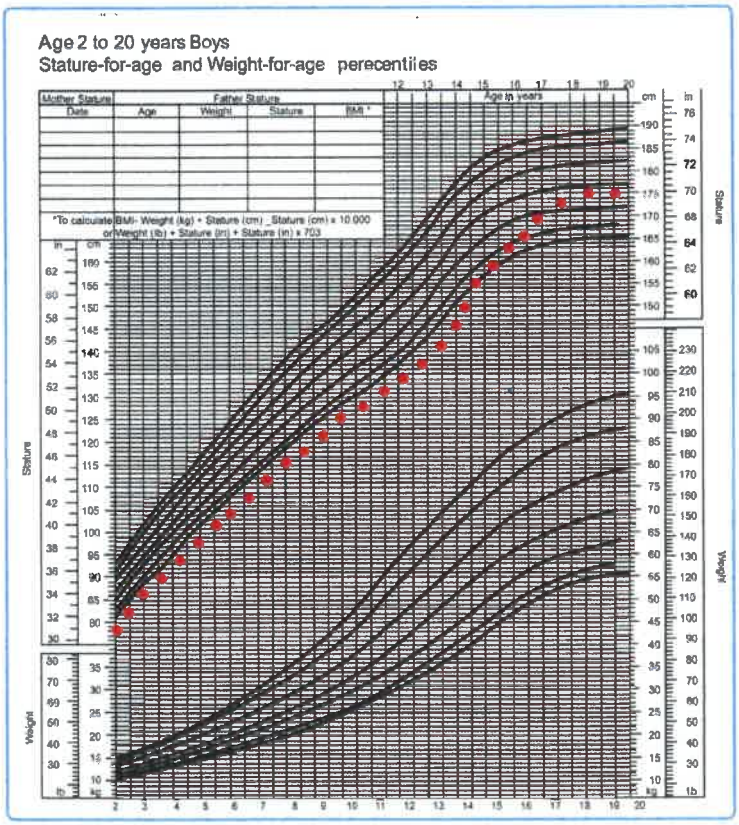
- Children: X-ray left hand and wrist
- Infants: X-ray of knees
- Older children: X-ray of shoulders

PYQ: FMGE 2020

	CDGP	Familial Short Stature
What is it?	Child has short stature during childhood but final height attained is normal	Child has short stature but the height is normal as per his target height (according to the mid parental height)
Puberty	Delayed puberty	Normal
Family history	Family history of delayed puberty	Family history of short stature
Bone age	Bone age < Chronological age	Bone age = Chronological age

Mid parental height:

- For males: Average height of parents + 13/2
- For females: Average height of parents - 13/2



- In the above image, stature/height is plotted
- During childhood, the child's height is running almost parallel to the 3rd percentile line
- But ultimately a catch up growth happens and the final height achieved is normal
- Seen in CDGP

Growth hormone deficiency:

- Type of short stature: Proportionate short stature
- US: LS ratio: Normal
- Bone age: < Chronological age
- Investigations:
  - Growth hormone stimulation test
  - Insulin, Clonidine can be used

- Management: Recombinant growth hormone Inj.
- Side effect: Pseudotumor cerebri

Disproportionate Short Stature

- Short trunk: US:LS ratio- Decreases
- **Mnemonic-** Short Man Climbs High
  - Spondyloepiphyseal dysplasia
  - Mucopolysaccharidosis
  - Caries spine/ Potts' disease
  - Hemivertebrae/ Butterfly vertebra
- Short limbs: US:LS ratio- Increases
  - Rickets
  - Osteogenesis imperfecta
  - Congenital hypothyroidism
  - Achondroplasia

Important Information

Alagille syndrome

- Hemivertebrae/ Butterfly vertebrae
- Conjugated hyperbilirubinemia
- Triangular facies
- Pulmonary stenosis
- Eye abnormalities

Head Circumference

00:21:42

- At birth: 33-35 cm
- Normal rate of increase in HC:
  - 1st 3 months: 2 cm/ month
  - Next 3 months: 1 cm/ month
  - Next 6 months: 0.5 cm/ month
  - Next 2 years: 0.2 cm/ month
- In any given single month if the HC increases at a rate > 2 cm/month- It is abnormal
- Underlying causes such as tumor, hydrocephalus should be ruled out

Microcephaly

00:22:41

PYQ: FMGE 2021

Definition

- HC < -3 Z score of expected according to the age and sex

Etiology of primary microcephaly

- Genetic syndromes:
  - Cri du chat syndrome (5p-)
  - Smith Lemli Opitz syndrome:
    - → Midline defects: Cleft lip, Cleft palate, holoprosencephaly, gonadal abnormalities
    - → Cholesterol metabolism defects, accumulation of 7- dehydrocholesterol
  - Patau syndrome: Trisomy 13
  - Edwar syndrome: Trisomy 18
  - Familial
  - Rubinstein Taybi syndrome - deviated (Z like) thumb
  - Cornelia de syndrome- long eyelashes

Etiology of secondary microcephaly

- Maternal:
  - Alcohol intake
  - Smoking
  - Phenytoin
  - Radiation exposure
  - Metabolic disorder- Phenylketonuria
  - TORCH infections

- Baby:
  - Severe malnutrition
  - Perinatal asphyxia/ HIE
  - Any CNS infection in the first year of life- Meningoencephalitis
- Acquired causes:
  - Rett syndrome- X linked dominant inheritance
  - Angelman syndrome
  - Seckel syndrome

Rett Syndrome 00:26:15

- Inheritance: X linked dominant inheritance
- M/c in: Females
- M/c gene affected: MECP2 gene
- HC at birth: Normal
- C/f:
  - Gradual developmental delay
  - Acquired microcephaly
  - Loss of purposeful hand movements
  - Stereotypic hand wringing movements
- FDA approved drug: Trofinetide

Macrocephaly 00:27:56

HC > +2 SD

- Increased thickness of cranial bones:
  - Rickets
  - Osteogenesis imperfecta
  - Chronic hemolytic anemia- thalassemia
- Subdural Effusion or empyema (usually a sequelae of meningitis)
- Megalencephaly: Condition where the size of the brain increases due to accumulation of storage/abnormal substance
- Hydrancephaly: Condition where cerebral hemispheres are absent and are replaced by fluid filled sac Transillumination + Midbrain and brain stem are intact
- Hydrocephalus: Condition where there is enlargement of ventricles either due to increased production or impaired drainage of CSF

Etiology of Megalencephaly

- Benign familial megalencephaly
- Amino acid disorders:
  - Glutaric aciduria
- Lysosomal storage disorders:
  - Mucopolysaccharidosis
- Weavers syndrome
- Achondroplasia
- Neuro degenerative diseases:
  - Alexander disease- deposition of GFAP, Rosenthal fibers
  - Caravan disease- deficiency of asparto acylase- leads to deposition of N asparto acetic acid (NAA) in the brain
- Soto syndrome
- Neurofibromatosis
- Galactosemia

Etiology of Hydrocephalus

Communicating	Non-Communicating
• Choroid plexus papilloma • Achondroplasia • Meningeal malignancy/ metastasis • Post hemorrhagic	• Mass lesion • Arnold Chiari syndrome: Herniation of cerebral tonsils into the foramen magnum • Dandy Walker malformation: Dilatation of the fourth ventricle • Hematomas • Infections: mumps, neurocysticercosis, TB • Vein of Galen malformation • Aqueductal stenosis

Vein of Galen malformation

- An arteriovenous malformation involving the precursor vein of Galen
- Onset- 11-13 weeks of gestation
- Median prosencephalic vein
- Cranial bruit + on auscultation

Treatment of hydrocephalus

- VP shunt (ventrico-peritoneal shunt)
- Medical management: Mannitol, 3% saline/ hypertonic saline, acetazolamide, glycerol

Craniosynostosis

00:36:16

- Abnormal head shape due to premature fusion of one or more cranial sutures
- Anteroposteriorly- oblong head- dolichocephaly (m.c) - premature fusion of sagittal suture
- Trigonocephaly- premature fusion of metopic suture
- Oxycephaly or turricephaly- tower like head due to fusion of multiple sutures n the base of skull

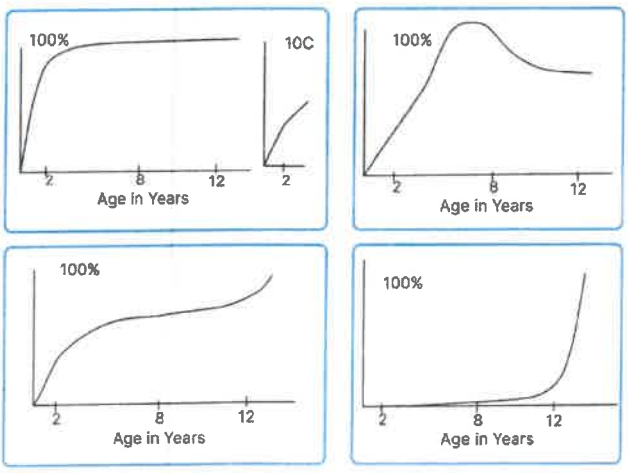
Syndromes associated with Craniosynostosis

- Crouzon syndrome: Prominent eyes, mid facial hypoplasia, bulging eyes, small mandible
- Pfeiffer syndrome: Clover leaf shape of the skull
- Carpenter syndrome
- Apert syndrome: Syndactyly - Mitten hands and toes

Patterns of Growth

00:38:40

- In the above graph, maximum growth takes place in the first 2 years after which the growth is stagnant- signifies brain growth
- In the above graph, maximum growth is taking place between 4 to 9 years- signifies lymphoid growth- there is physiologic lymphoid hyperplasia between 4-9 years
- In the above graph, a sigmoid curve is seen, an accelerated growth phase from birth to 2 years followed by slowing of growth after which the rate of growth picks up again- signifies somatic growth showing two periods of accelerated growth, i.e. infancy and puberty
- In the above graph, the rate of growth is minimal in the first 10 years after which rate of growth picks up- signifies gonadal growth



Dentition

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PYQ: NEET PG 2021

- Primary dentition- Milk teeth
- Secondary dentition- Permanent teeth

	Primary	Secondary
Begins at	6-7 months of life	6 years
1st tooth	Lower central incisor	1st molar
Last tooth	2nd molar	3rd molar
Completes by	2.5-3 years	12 years except 3rd molars
Dental formula	I C P M 2 1 0 2 = 5 × 4= 20	I C P M 2 1 2 3 = 8 × 4= 32

- Period of mixed dentition: 6 to 12 years

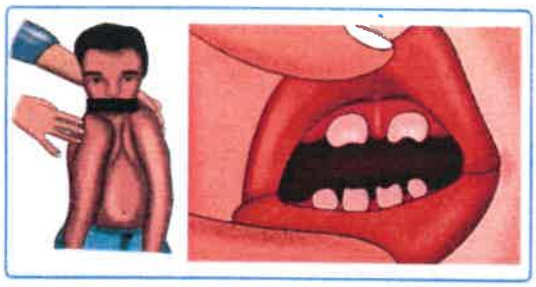
Delayed dentition

Definition

- When no teeth erupts by 13 months of age

Etiology

- Familial
- Rickets
- Idiopathic
- Endocrine:
  - Hypopituitarism
  - Hypothyroidism
  - Hypoparathyroidism
- Down's syndrome
- Cleidocranial dysostosis:
  - Complete or partial absence of clavicles
  - Autosomal dominant inheritance
  - Large anterior fontanelle
  - Supernumerary teeth



PYQ: FMGE 2020

Notching of incisors- Hutchinson's teeth

- Hutchinson's triad:
  - Hutchinson's teeth
  - SNHL
  - Interstitial keratitis
- Late manifestation of congenital syphilis
- Others features include:
  - Saddle nose
  - Mulberry molars
  - Running nose
  - Clutton's joints

Development

00:46:19

PYQ: INICET 2022, 2023

Major Gross Motor Milestones

- Neck holding:
  - Partial: 3 months
  - Complete: 5 months

- Rolls Over: 5-6 months
- Sitting:
  - With support (Tripod position): 6 months
  - Without support: 8 months
- Pivoting, Cruising: 10-11 months
- Standing:
  - With support: 9 months
  - Without support: 12 months
- Walking without support: 13 months
- Creeps upstairs: 15 months
- Upstairs and downstairs: 2 years
- Upstairs with alternate feet and downstairs with two feet per step: 3 years
- Alternate feet up and down: 4 years

Important Information

- In the image on the upper left corner, a child is looking at his hands intently suggestive of hand regard -3 months
- In the image on the upper right corner, the child is seen lifting his head above the rest of the body suggestive of having partial neck control- 3 to 4 months
- The image on the lower left corner depicts pincer grasp, where the child is holding mall objects using thumb and the index finger while taking support from other fingers- 9 months
- In the image to the lower right corner, a child is seen riding a tricycle- 3 years

Major Fine Motor Milestones

PYQ: NEET PG 2021

PYQ: FMGE 2023

- Hand regard: 3 months
- Reaches out for objects: 4 months
- Bidextrous grasp: 5 months
- Unidextrous/ Palmar grasp: 6 months
- Transfers objects: 7 months - compare objects
- Pincer grasp:
  - Immature: 9 months
  - Mature: 12 months
- Casting (drops everything down): 13 months

Tower of Cubes: Number of cubes put on top of each other = Age × 3

- 2 years: Tower of 6 cubes
- 3 years: Tower of 9-10 cubes
- Train without chimney: 2 years
- Train with chimney: 2.5 years
- Bridge: 3 years
- Gate: 4 years
- Steps: 5-6 years

At 2 years:

- Copies a straight line
- Turns door knob
- Unscrews a lid

At 3 years:

- Copies a circle
- Handedness gets established
- Dress and undress by self - Except buttons

At 4 years:

- Copies a rectangle or a cross
- Buttons and unbuttons

At 5 years:

- Copies a triangle/ a tilted cross
- Ties shoe laces