GROWTH & DEVELOPMENT

Dr. R. Padmavathi
Asst. Professor
Govt. College of Nursing
Guntur
GROWTH & DEVELOPMENT

An essential feature of children which distinguishes them from adults

Growth: Net increase in size or mass of tissues. Due to
- increase in number of cells (2X 10^10 at birth, 6 X 10^10 in adults)
- increase in size of cells
- increase in ground substance

Development: Maturation of function
- Acquisition of skills
- Due to myelination of neurons
Characteristics of G&D:

• Continuous & orderly process, but rate may not be uniform
• Specific periods when growth accelerates, decelerates or is steady
• Generalised mass activity gives way to specific responses
• G&D proceeds in a cephalocaudal direction
• Different tissues grow at different rates
FACTORS AFFECTING G & D:

**Genetic**
- parental phenotype & familial patterns
- Race
- Sex
- Genetic disorders
  - chromosomal
  - gene defects

**Environmental**

**Intrauterine factors**
- Maternal nutrition
- anemia
- PET, HT
- Tobacco
- alcohol
- drugs
- infections

**Postnatal**
- nutrition
- Infections
- trauma
- emotional factors
- cultural practices
- Hormonal influences
  - Growth hormone
  - insulin
  - thyroid
  - sex hormones
ASSESSMENT OF PHYSICAL GROWTH:
Growth Parameters:

**Weight**: child weighed nude on lever/electronic scale
- Spring balance less accurate

**Length**: For <2 yrs
- Child supine on rigid table/infantometer
- Legs straightened
- Feet at right angles
- Foot board brought upto child's heels

**Height**:  
- Child stands upright against wall/stadiometer
- Heels, buttocks, back in contact with vertical surface
- Head held in Frankfurt’s plane - line joining floor of external auditory meatus to floor of orbit is horizontal
- Head piece firmly over vertex

**Crown Rump length**: Length from vertex to ischial tuberosity

**Sitting Height**: 
ASSESSMENT OF PHYSICAL GROWTH:

Growth Parameters:

• **Head Circumference**: Maximum circumference from occipital protuberance to forehead

• **Chest Circumference**: Measured at level of nipples midway between inspiration & expiration in recumbent position.

• **Body Proportions**:
  • US:LS ratio  1.7:1 at birth
  •  1.3 at 3 yrs
  •  1:1 at 6-7 yrs

• **Mid Arm Circumference**:
  • Relatively constant between 1-5 yrs  \( \therefore \) age independent
  • Normal 1605 –17.5 cm
  •  <12.5 cm – malnourished

**Z scores** = standard deviations from median reference
Weight for Height: Differentiates acute malnutrition from chronic

<table>
<thead>
<tr>
<th>wt for ht</th>
<th>ht for age</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;= 80%</td>
<td>&gt;= 90%</td>
<td>Normal</td>
</tr>
<tr>
<td>&lt; 90%</td>
<td>&lt; 90%</td>
<td>Stunted</td>
</tr>
<tr>
<td>&lt; 80%</td>
<td>&gt;= 90%</td>
<td>wasted</td>
</tr>
<tr>
<td></td>
<td>&lt; 90%</td>
<td>wasted + stunted</td>
</tr>
</tbody>
</table>
GROWTH TABLES & CHARTS

• Derived from cross sectional/longitudinal studies in large populations
• Growth parameters may be represented in tabular/graphic form
• Growth varies between individuals
• Like all biologic measurements, growth parameters follow a 'normal' distribution in the population
Percentiles: If 100 individuals are arranged according to weight/height, then 50th percentile is one who has equal number above & below

- Child is placed in relation to comparable population

Standard Deviation: > 2 or 3 SDs above/below mean maybe taken as abnormal

- Depict the permissible limits of normalcy which may be arbitrarily defined
- In a normal distribution, +/- 1 SD includes 68% of the population
- +/- 2 SD includes 95% of the population
- +/- 3 SD includes 99% ,, ,,
- + 1 SD corresponds to 84th centile
- Usually 2 SDs above/below mean form the limits of normalcy
GROWTH STANDARDS:

• Country specific growth standards usually taken from children of high socioeconomic strata of society Eg: ICMR/ Agarwal et al 1992

• International standards – NCHS (USA)
All babies are different especially in rate of the growth. So if your baby's weight curve does not follow the weight curve on the chart there is no cause for alarm. As long as his weight increase is satisfactory, he is perfectly healthy.

Regular monthly check-up of your baby is very important. It will give you all vital information regarding immunisation, common illnesses and proper bringing up of your baby.
New WHO Growth Charts (2006)

- Study in 6 countries: developed & developing, 8500 children, Upto 5 years
- Wt for age, Ht for age, wt for ht, BMI, head circumference, mid arm, triceps, subscapular skin fold + 6 key motor milestones
- Only on breast fed babies with no environmental constraints to growth
- Cross sectional + longitudinal data
- Lower weight for length, z scores, triceps and subscapular skin folds in breast fed
- Prescriptive rather than descriptive
- Detects both undernutrition & obesity
MNEMONICS:

Weight:
- Average birth weight 3 kg → lose 10% body weight → regain BW by 10 days → gain at 25-30 gm/day for 1st 3 mths → 400 gm/month till end of 1st year
  - Roughly, BW doubles by 5 mths
  - trebles by 1 year
  - 4 times by 2 yrs
  - 6 times at 5 yrs
  - 10 times at 10 yrs
- Or, gains 2 kg/yr between 3-7 yrs
- 3 kg/yr after that till pubertal spurt
Height:

- 50 cm at birth
- 60 cm at 3 mths
- 75 cm at 1 yr
- 100 cm at 4 yrs
- gain 5 cm/yr till 10 yrs
Head Circumference:
• Birth - 35 cm
• 3 mths - 40 cm
• 12 mths - 45 cm
• 24 mths - 48 cm
• 12 yrs - 52 cm

Chest Circumference:
• 3 cm less than head circumference at birth, equal at 1 yr
• After that, exceeds head circumference
VELOCITY OF GROWTH:

- **Serial measurements** of growth parameters over a period of time. Derived from longitudinal studies.
- One time measurement does not indicate the rate of growth.
- An abnormal percentile may only present once the factors retarding growth are profound or persist for a long time.
- Plotting growth over a period of time provides a good epidemiologic tool for **early detection** of malnutrition, infections & growth disorders eg: Road to Health Charts.
ERUPTION OF TEETH:

Primary Teeth
- Lower central incisors  5-8 mths
- Upper central incisors – a month later
- Lateral incisors – within next 3 months
- 1st Molars – 12-15 mths
- Canine - 18-21 mths
- 2nd Molars – 21 – 24 mths

Permanent teeth:
- 1st molar – 6 yrs
- Central & lateral incisors – 6-8 yrs
- Canines & premolars – 9-12 yrs
- 2nd molar - 12 yrs
- 3rd molar – 18 yrs or later
BONE AGE:

- An indicator of physiological development
- Distinct from chronological age
- More advanced in girls - by 1 yr in early childhood; 2 yrs in mid childhood
- Assessed by number, shape & size of ossification centers and density size & shape of ends of bones

- Which bones to Xray?
  - Newborn – Xray of foot & knee
  - Infant 3-9 mths – shoulder
  - 1-13 yrs – wrist & hands
  - 12-14 yrs – elbow & hip
BEHAVIORAL DEVELOPMENT:

- As age advances, child acquires better coordination of motor activity and reacts to environment willfully.
- Development is a continuous process and different levels of development (milestones) are achieved at an anticipated age (+/- few months).
- Early primitive reflexes are lost.
- 4 areas of development:
  - Gross motor
  - Fine motor (adaptive)
  - Social
  - Language
GROSS MOTOR: Involves control of child over his body. Tested in:
Ventral Suspension: Baby held in prone position and lifted off the bed.
  Newborn – head flops down
  • 4-12 wks – brings head to plane of body and then above plane of body
Supine:
  • Child placed supine and gently pulled up by the arms
  • Newborn – head lag
  • By 16-20 wks – head in plane of body or ahead with back straight
Prone:
  • Newborn – can turn head to 1 side
  • 1 mth – lifts chin momentarily
  • 3 mths – lifts head and upper chest
  • 6 mths – liftd head & chest
  • 5-8 mths – rolls over, first back to side and front
  • 8 mths – crawls
Sitting:
• 5 mths – sits with support
• 8 mths – sits steadily with back straight, without support
• 10 mths – pulls from supine to sitting position
Standing:
• 4 mths-Bears weight on legs
• 9 mths – early stepping movements, pulls to standing with help of furniture
• 10 mths – cruising
• 13 –15 mths – walks unsupported
• 15 mths – walks sideways/backwards
Climbing stairs –
• 2 yrs – climbs stairs – 2 feet per step
• 3 yrs – climbs up stairs – one foot per step
• 4 yrs – climbs down one foot per step
Key Gross motor milestones:
• 3 mths – neck holding
• 5 mths – sitting with support
• 8 mths – sitting without support
• 9 mths – standing with support
• 10 months – cruising
• 12 mths – standing without support
• 14 mths – walking without support
• 18 mths – running
• 24 mths – walking upstairs
Clinical Assessment

Fig A.2: Prone position, chest is maintained off the couch and body, weight is supported on forearms during 18-20 weeks of age.
Fig. 6.18 Infant lying down, not yet able to sit at 12 weeks.

Fig. 6.19 Baby with support of the body lying down, 4-5 months.

Fig. 6.20 Baby holding feet and hands, not yet able to sit, at 16-20 weeks.

Fig. 6.21 Baby is momentarily lifted up on ventral suspension in a 4-week-old infant.
• FINE MOTOR OR ADAPTIVE MILESTONES: Includes eye coordination, hand eye coordination, hand mouth coordination and manipulation with hands
• Tested with red ring, pen torch, red cubes (2.5 cm), pellet, cup with handle, spoon, book with thick pages, red pencil/crayon, paper, wooden blocks, doll, mirror
• **Eye coordination:**
  • 4 wks – regards torch/red ring kept at 20 cm in front
  • 6 wks – follows object from side to side – unsteadily
  • 2-3 mths – follows with steady movements of eyes
  • Binocular vision by 3-6 mths
Hand eye coordination:
• 4 mths – tries to grasp red ring dangling in front but may overshoot
• 5 mths – reaches out & grasps object with ulnar side
• 6 mths – radial grasp, transfers objects from hand to hand
• 10 mths – pincer grasp

Hand-mouth coordination:
1 yr – tries to feed with spoon but may spill
• 15 mths – feeds with spoon
• 18 mths – feeds self from cup

Hand skills: Book:
• 13 mths – turn 2-3 pages at a time
• 24 mths – turns 1 page at a time

Scribbling:
• 12-24 mths – scribbles
• 2 yrs – copies vertical line
• 2 ½ yrs – copies horizontal line
• 3 yrs – circle
• 4 yrs – cross, rectangle
• 5 yrs – copies cross, triangle
PERSONAL & SOCIAL DEVELOPMENT:

• 1 mth - regards face of mother/caretaker
• 2 mth - social smile
• 3 mths - recognises mother/caretaker
• 6 mths - enjoys mirror
• 7-8 mths - separation anxiety
• 9 mths - waves bye-bye
LANGUAGE DEVELOPMENT:
• 1 mth - turns head towards sound
• 3-5 mths - vowel sounds, gurgles
• 6 mths - monosyllables
• 9 mths - bisyllables
• 10 mths - understands spoken speech
• 12 mths - speaks 2 words with meaning
• 18 mths - 20 words
• 24 mths - joins 2-3 words in a short sentence
• 3 yrs - 250 words

BOWEL & BLADDER CONTROL:
• Early months - gastrocolic reflex $\rightarrow$ defecates after each feed
• 7 mths - no relation to feeds
• Toilet trainable by 18mths - 2 yrs
Developmental Delay

• 3 Step diagnosis
  – Clinical
  – Screening tools
  – Psychometric scales
DEVELOPMENTAL SCREENING:

- Denver Development Screening Test: Most widely used
  - 4 scales
  - 125 items
- Baroda Development Screening Test: Adapted from Bayley scales for Indian children
- Trivandrum Development Screening Test
TRIVANDRUM DEVELOPMENTAL SCREENING CHART (TDSC)

POINTS TO PARTS OF DOLL [3 PARTS]
WALK UPSTAIRS WITH HELP
WALK BACKWARDS
SAYS TWO WORDS
WALKS ALONE
THROWS BALL
WALK WITH HELP
PAT A CAKE
FINE PREHENSION PELLET
STANDING UP BY FURNITURE
RAISES SELF TO SITTING POSITION
TRANSFER OBJECTS HAND TO HAND
-turns head to sound of bell/rattle
-rolls from back to stomach
-Holds head steady
-EYES FOLLOW PEN/ PENCIL
SOCIAL SMILE

Based on BSID Baroda norms
CHILD DEVELOPMENT CENTER PROJECT, S.A.T. HOSPITAL, TRIVANDRUM