

GROWTH & DEVELOPMENT

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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 at birth, 6 X 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 ∴ age independent
 - Normal 16.5 – 17.5 cm
 - <12.5 cm – malnourished

Z scores = standard deviations from median reference

Weight for Height: Differentiates acute malnutrition from chronic

wt for ht

ht for age

$\geq 80\%$

$\geq 90\%$

Normal

$< 90\%$

Stunted

$< 80\%$

$\geq 90\%$

wasted

$< 90\%$

wasted +
stunted

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

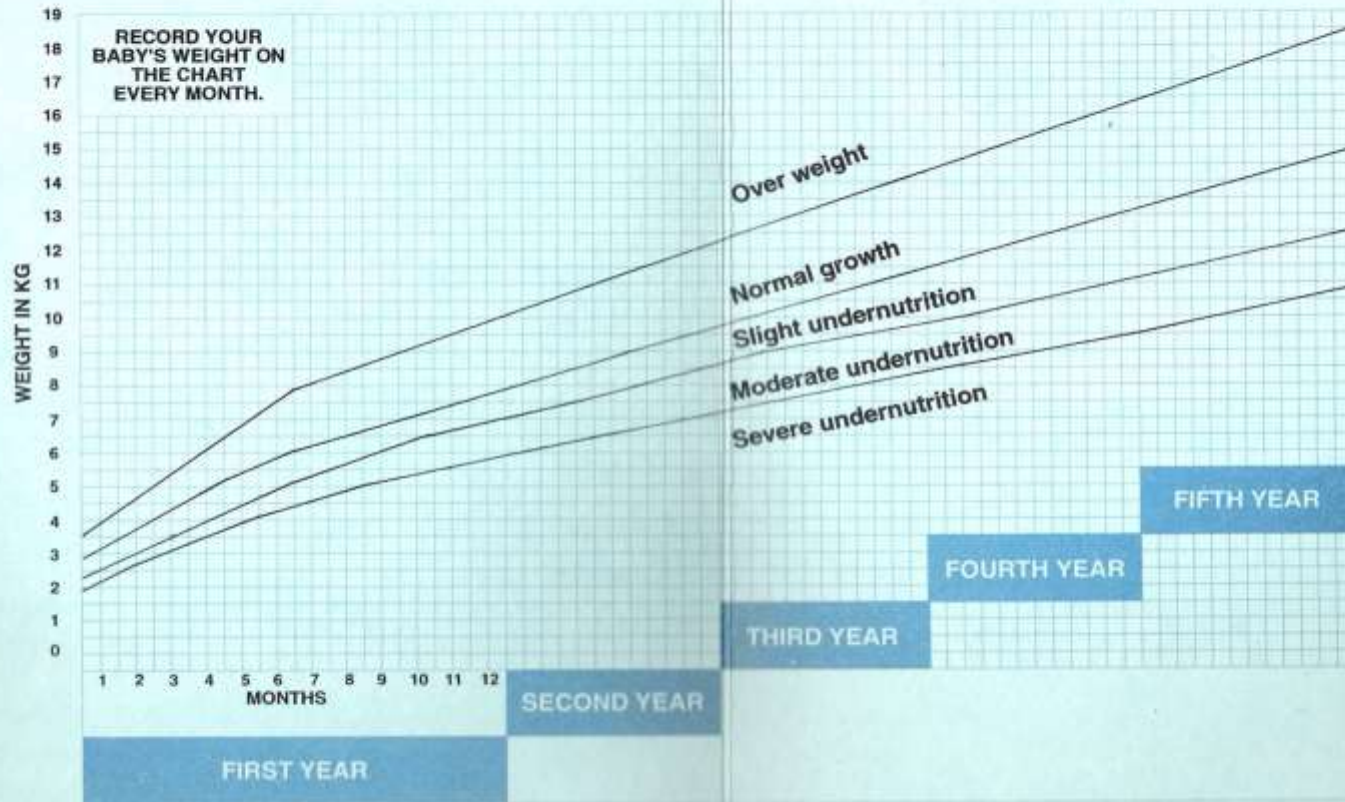
- Depict the permissible limits of normalcy which may be arbitrarily defined
- In a normal distribution, +/- 1 SD includes 68% of the population
- +/- 2 SD includes 95% of the population
- +/- 3 SD includes 99% ,, ,,
- + 1 SD corresponds to 84th centile
- Usually 2 SDs above/below mean form the limits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

YOUR BABY'S WEIGHT CHART FROM BIRTH TO FIVE YEARS

CARE



SPECIAL

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 sunscapular 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. A1 Prone position. Pelvis is not raised and head is lifted off the neck, approximately 18-20 weeks of age.



Fig. A2 Prone position. Pelvis is not raised and head is lifted off the neck, approximately 18-20 weeks of age.



Fig. A3 Prone position. Chest is maintained off the neck and body weight is supported on forearms during 18-20 weeks of age.



Fig. A4 Traction response. Infant is being pulled down upon by lifting position by holding a forearm. There is complete head lift in a 18-20 week baby.



Fig. A7 Tracheostomy. Head is normally maintained in a plane of the body around 41.



Fig. A8 Tracheostomy. Head is normal too at 47 weeks.



Fig. A9 Tracheostomy. Head is normal too at 47 weeks.



Fig. A10 Post and high at 4 months around 4 months.



Fig.6.10 Infant follows dangling ring by 10W at 12 weeks



Fig.6.11 Sits with support of her hands around 4-5 months

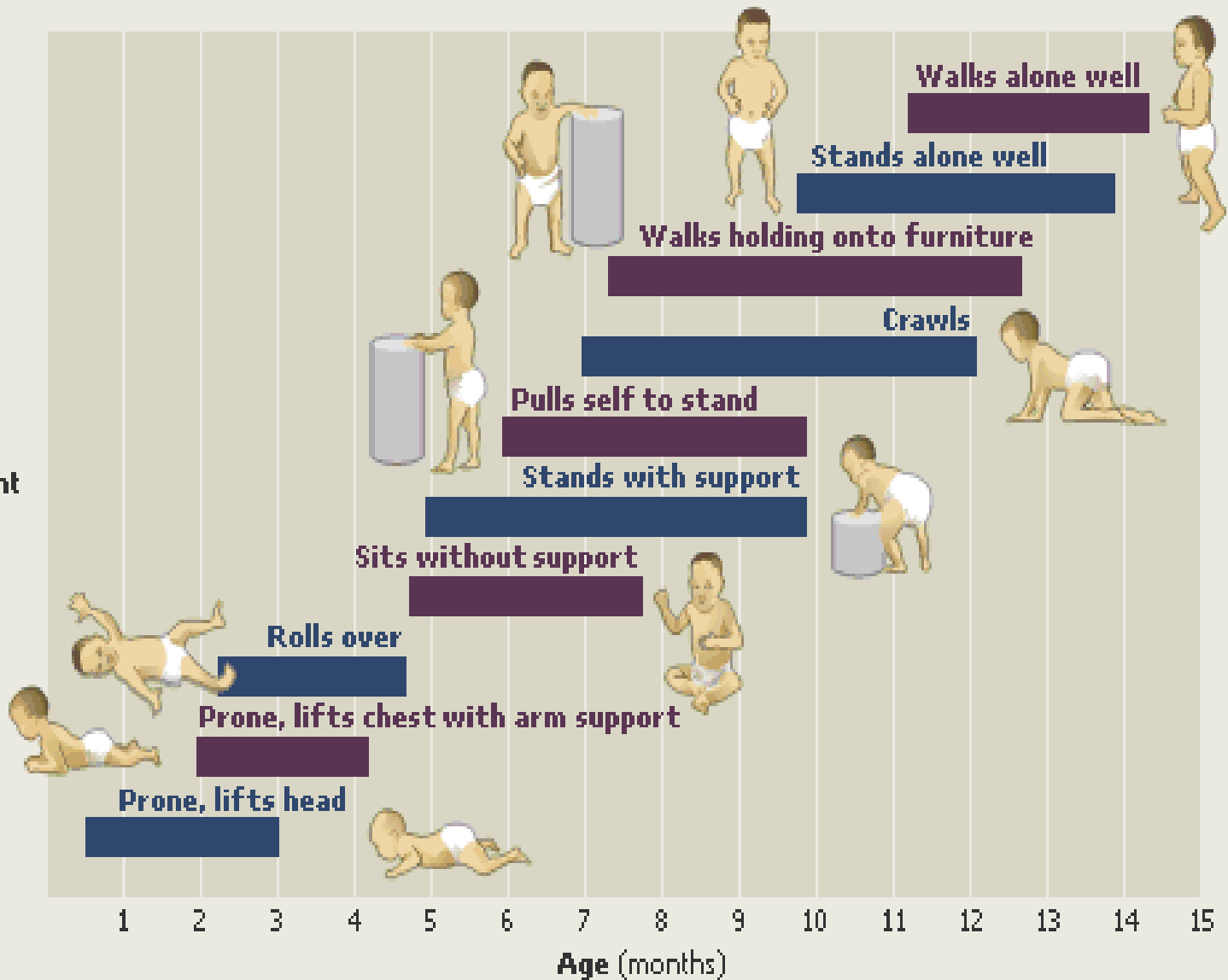


Fig.6.14 Holds feet and tries to put them in the mouth at 10-11 weeks



ig.6.2 Head is momentarily lifted up on ventral suspension in a 4-weeks old infant.

**Stages
of
motor
development**



- **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 → defecates asfter each feed
- 7 mths - no relation to feeds
- Toilet trainable by 18mths - 2 yrs

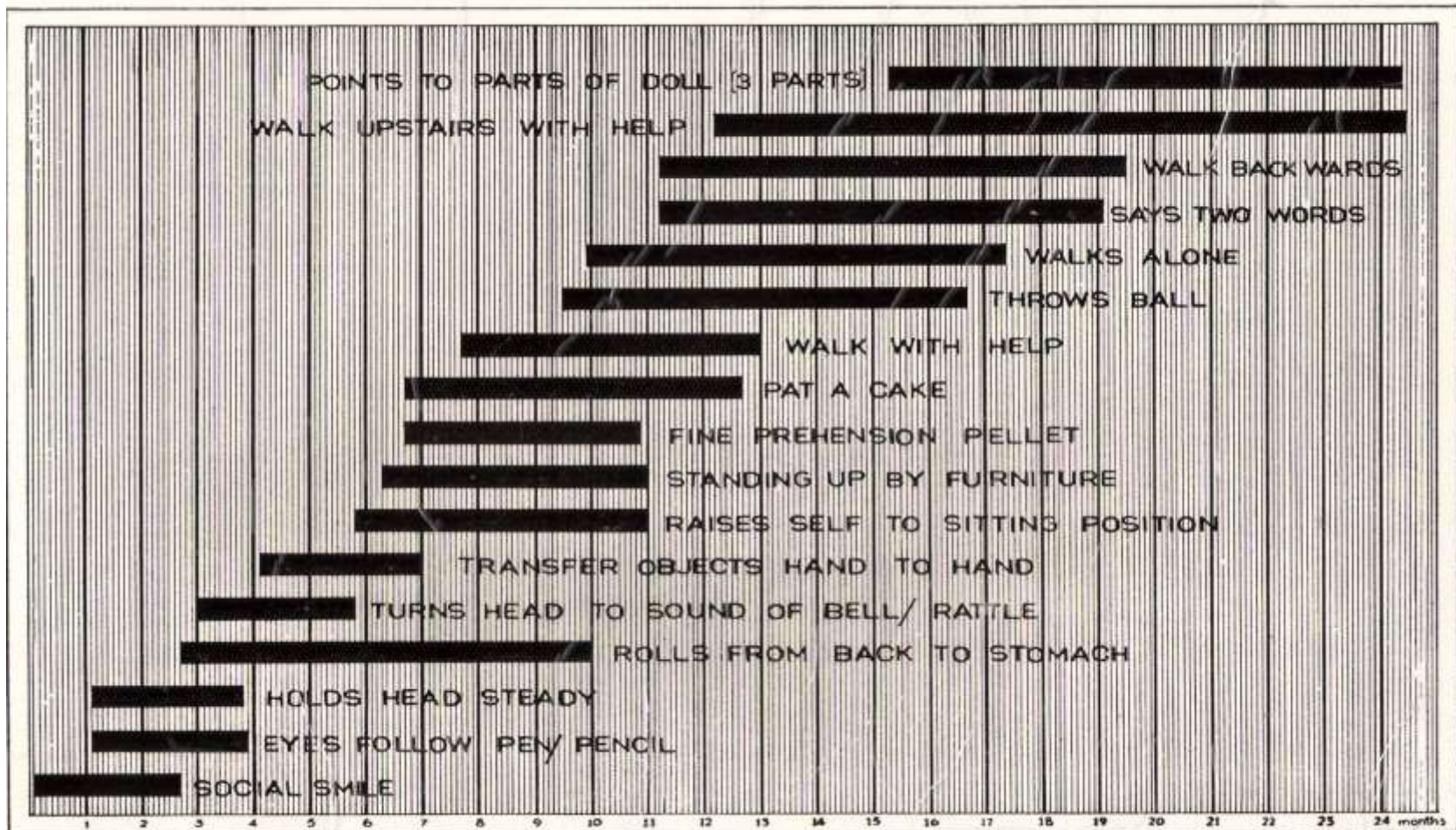
Developmental Delay

- 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)



Based on BSID Baroda norms

M.K.C. Nair, Babu George, Elsie Philip. Indian Pediatr 1991, 28: 869-72.

CHILD DEVELOPMENT CENTER PROJECT, S.A.T. HOSPITAL, TRIVANDRUM

