Chapter 6

Developmental Assessment

Structure

Development denotes maturation of functions or acquisition of new skills and is intimately related to maturation and myelination of central nervous system.

6.1 IMPORTANCE OF DEVELOPMENTAL ASSESSMENT

Developmental assessment is an essential component of comprehensive evaluation of any child. A thorough knowledge of normal development and acceptable variations is essential to identify early patterns that are pathological and may indicate developmental disability. This would help in instituting early effective intervention strategies.

A thorough developmental assessment becomes especially important in the following situations:

1. Follow-up of high-risk babies.
2. Early diagnosis of vision and hearing impairment.
3. Children with a delay in any field of development, behavioral problems, or sucking and swallowing problems in newborn.
4. During follow-up of children with conditions that may cause brain damage, *e.g.* meningitis, status epilepticus, and metabolic disorders.
5. If the parents have any concerns regarding their child's development; there is a family history of developmental delay or neurological illness; or before adopting a child for excluding developmental disabilities.

Developmental assessment includes a detailed history with emphasis on pregnancy, delivery, neonatal period, and course of development. Special emphasis has to be laid on the following in the child:

- Ascertain the status of hearing, vision, and motor control.
- Note all the milestones and the time of their appearance till date.

In this chapter, we introduce you to the principles and procedures for assessing development of a child. The steps required for developmental assessment are outlined in **Key Box 1**.

Laws of Development

1. *Development is a continuous process from conception to maturity and is commensurate with maturation of neurological function.* For example, at birth, a child is not able to turn

KEY BOX 1

Steps in Assessment of Development

1. Obtain history of development.
2. Identify the tools needed for developmental assessment (depending on the age of the child).
3. Perform developmental assessment including that of vision and hearing.
4. Calculate the developmental quotient (DQ).
5. Interpret, whether the development in a given child is normal or abnormal.
6. If development is abnormal, classify as *developmental delay* or *developmental regression*.
7. If there is a developmental delay, categorize whether it is *global* or *dissociative* **(Fig. 6.1)**.

around, sit, reach for objects voluntarily, laugh, or interact using language. In due course of time, the child acquires all these functions.

2. *Normal development requires an anatomically and functionally normal central nervous system and pathways.* A child with a morphologically abnormal CNS (*e.g.* anencephaly, meningomyelocele) or damaged neurons and pathways (*e.g.* following hypoxic or ischemic insult) is unlikely to have a normal development.

   Abnormal development may result from intrauterine and perinatal insults (perinatal asphyxia, bilirubin encephalopathy, etc.) or any insult to the brain during first 6 years of life (meningitis, CNS hemorrhage, etc.).

3. *Infant development occurs in an orderly and predictable sequence* that is intrinsically determined, *i.e.* from cephalic to caudal (head to toe) and proximal to distal. For example, head control develops before the child learns to sit and stand. A child can do much with his hands before he can walk. Upper extremities become increasingly accurate in reaching, grasping, and transferring (proximal development) before achievement of pincer grasp (distal development).
4. *Even though the sequence of development is predictable and same, the rate of development varies from child to child.* For example, a child has to learn to sit before he/she can stand; but the age of attainment of sitting and standing varies between children.

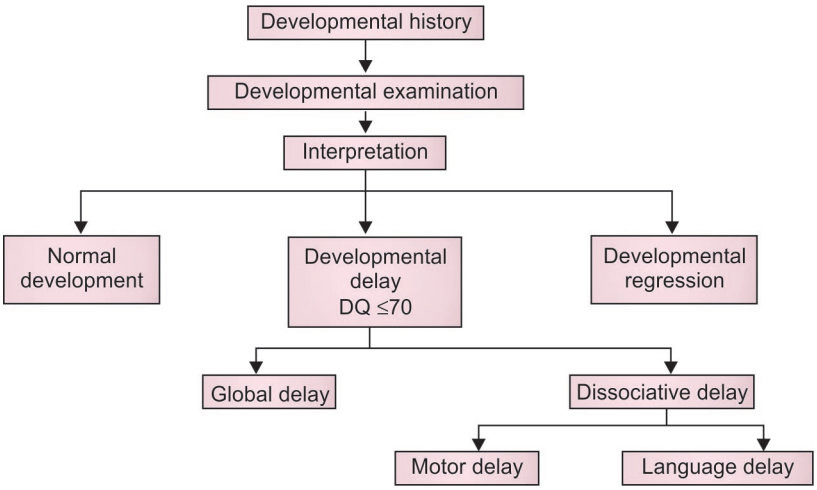

Fig. 6.1 *Process of developmental assessment. Developmental delay (late achievement of certain functions) should be differentiated from developmental regression (loss of already acquired functions).*

5. *Responses to stimuli change from generalized mass activity involving the whole body, as seen in newborn, to discrete voluntary actions that are under cortical control.* This allows the child to move from non-specific and symmetrical responses when attending to a stimulus (*e.g.* vocalization, kicking with both arms and legs) to voluntary, asymmetrical, precise responses towards the stimulus (*e.g.* grasping or use of specific word).
6. *Certain primitive reflexes have to be lost before voluntary functions are acquired.*
   - For example, grasp reflex has to be lost before the infant can learn to reach for objects and grasp them voluntarily.
   - Similarly, asymmetrical tonic neck reflex has to disappear before the infant learns to roll from back to front, bring the hands to midline, or reach for objects.
   - Infant can gain progressive stability in a seated position only after disappearance of Moro reflex as this reflex interferes with head control and sitting equilibrium.

   Persistence of primitive reflexes beyond the age at which they should disappear indicates and predicts abnormal development.

In the following sections, we will briefly review normal development, before proceeding to discussion on how to take a developmental history and conduct a developmental examination.

6.2 NORMAL DEVELOPMENT

Children accomplish maturation of different biological functions (level of development or **milestone**) at an anticipated age, with a margin of a few months on either side. For example, walking on her own is a major motor *milestone* in the life of a child. This is usually achieved at 12–13 months, but can vary from 10 to 15 months in different children.

Development is usually assessed in terms of achieving the milestones in the following domains:

1. Motor Development

Motor development depends on the maturation of muscular, skeletal, and nervous systems. It can be further classified into Gross Motor and Fine Motor domains.

- *Gross motor*—pertains to development of locomotion, general body control, and specific motor skills.
- *Fine motor*—pertains to development of finer body movements and coordination, *i.e.* grasping, fine hand movements, hand-eye coordination.

2. Cognitive Development

Cognition refers to the intellect or mental abilities of a child. This domain pertains to skills required for solving problems and learning new things through logical thinking, memory, and reasoning. In young children, it manifests as the concept of 'cause and effect', 'object permanence' and 'functional use of objects'.

3. Language Development

Development of ability to communicate and it includes comprehension (receptive language) as well as expression of language (expressive language).

4. Personal–Social Development

Child's personal reaction to other persons and his adjustment to domestic life, social groups, and community conventions.

5. Adaptive Development

Adaptive development refers to the ability of a child to use the information and skills acquired in the other domains in day-to-day functioning. As adaptive skills develop, the child's participation in personal care and daily routine increases. Also, his/her ability to adapt to a new environment or situation becomes better.

These major fields of child's development do not really belong to separate compartments. The child always reacts as an integer. Our categorical classification is simply for convenience and to facilitate observations and diagnostic analysis.

Tables 6.1 and 6.2 provide detail of various milestones in all the developmental domains at various ages.

A. Motor Development

1. *Gross Motor Development* (Key Box 2)

As already discussed, development of locomotion occurs in an orderly sequence with the ultimate goal of gaining independent and volitional movements.

0–4 *weeks*

In first few weeks of life, flexed and asymmetrical postures (due to ATNR) predominate. Thus, a newborn baby lies with head turned to one side and limbs predominantly flexed. In prone position also, because of flexed postures, pelvis is high and knees are drawn under the abdomen. Because of poor neck control, there is no lifting of head in 'ventral suspension'; and there is complete head lag, when the baby is pulled to sitting position.

KEY BOX 2

Gross Motor Developmental Milestones

5 months	Head control is complete
6 months	Rolls prone to supine
7 months	Rolls supine to prone, sits without support for a few minutes
8 months	Creeping/commando crawling, sits without support
9–10 months	Crawls, sits up from supine
10–11 months	Pivots, cruises
12 months	Walks with one hand held
13 months	Walks without support
18 months	Runs stiffly, walks backwards
2 years	Walks upstairs with 2 feet per step, runs well, comes downstairs (two feet per step)
2½ years	Jumps on both feet
3 years	Walks upstairs with feet on alternating steps, rides a tricycle
4 years	Comes downstairs (alternating steps), hops/skips on one foot 2–3 times
5 years	Skips with both feet, jumps backwards

Gradually, the extensor muscles gain strength, head control develops, primitive reflexes disappear, and symmetric posture begins to predominate. Therefore, if the same infant is examined at 4 weeks, chin is lifted up momentarily and there is some intermittent partial extension of hips and knees in prone position.

1–6 *months*

- By 8 weeks, head is mostly in the midline and chin is lifted off the couch intermittently (so that the plane of face is at an angle of 45° to the couch) in prone position. In the position of ventral suspension, baby maintains the head in the plane of rest of the body.
- By 12 weeks, there is no more asymmetrical tonic neck reflex attitude in supine position. In prone position, pelvis is flat, legs are fully extended, chin and shoulders are lifted off the couch with weight borne on forearms. Developing head control is seen in ventral suspension as well whereby head is lifted and maintained well beyond the plane of the body.
- By 20 weeks, head control is complete so that there is no head wobble even if the infant is swayed in sitting position.

This evolution in gross motor development (in supine position, in position of ventral suspension, by placing the infant in prone position, by pulling him to sitting position and holding him in standing position) is described in detail in section on developmental assessment.

6 *months–1 year*

Gross motor development proceeds from sitting to standing and achievement of ambulation. Initially, infant moves with abdomen on the ground (creeping/commando crawling; 8 months). Thereafter, he crawls (on hands and knees with abdomen off the ground; 9 months). Though the terms creeping and crawling are used synonymously in English literature, term crawling is used in general sense, when the baby moves with abdomen off the ground. So, we have retained the above terminology.

Later, infant stands and walks (with support, followed by without support).

1–3 *years*

There is further refinement in balance, co-ordination, speed and strength.

Initially when the toddler learns to walk, he walks with a wide based gait with arms abducted and slightly elevated with steps of unequal length and direction.

Movements gradually smoothen, base narrows, arm swing evolves, and adult pattern of walking is achieved by 3 years of age.

3–6 *years*

Milestones evolve in the form of progress in the length of time, number of repetitions, or the distance, each task can be performed successfully.

2. *Fine Motor Development* (Key Box 3)

Fine motor skills are related to the use of upper limbs for exploring the environment. They are necessary for the child to perform self-help tasks, to play, and for progress in cognitive development (via exploration of objects).

In initial few months, upper extremities are used for balance and mobility, *e.g.* rolling, sitting with support, pulling up to stand, and crawling. But as the gross motor development proceeds and infant becomes stable in upright position, hands are available for more purposeful exploration of objects. Thus, in the first year of life, there is a close association between gross and fine motor development that evolves into a similar relationship between fine motor and adaptive/cognitive domain.

In the second year of life, infant learns to use objects as tools for functional play.

0–3 *months*

In first few weeks of life, hands of baby are predominantly closed with a strong grasp reflex. Gradually, grasp reflex becomes weak and disappears by 12 weeks of life. So, in first 3 months of life, infants grasp the objects with eyes, *i.e.* look at objects as if they would like to grasp it and by 12 weeks will hold the object when given in hand.

KEY BOX 3

Fine Motor Developmental Milestones

3 months	Opens hand spontaneously, holds objects when given in hand
4 months	Tries to reach for objects, overshooting
5 months	Reaches objects; bidextrous approach, ulnar palmar grasp, voluntary release (clumsily)
6 months	Unidextrous approach, transfers objects from hand to hand
7 months	Radial palmar grasp
8 months	Finger-thumb scissors grasp
9–10 months	Mature grasp, voluntary release (mature)
10–11 months	Pincer grasp
12 months	Tower of 2 cubes, casting, imitates scribbling
15 months	Tower of 3 cubes, scribbles, releases pellet into bottle
18 months	Tower of 4 cubes, imitates vertical stroke
2 years	Tower of 6 cubes, imitates horizontal stroke and circle, imitates train no chimney, turns door knobs
2½ years	Tower of 8 cubes, imitates train, adds chimney
3 years	Tower of 9–10 cubes, copies circle, imitates bridge
4 years	Copies cross, imitates gate
4½ years	Copies square, triangle, and gate

3–6 *months*

Gradually, hands come together in midline while playing and baby tries to reach for objects clumsily, overshooting the mark (16 weeks). Thereafter, he is able to approach objects voluntarily, initially using the entire palm towards the ulnar side (ulnar palmar grasp) and with a bidextrous approach

towards the objects (using both hands, 5 months) followed by unidextrous approach (6 months).

At the same time, infants learn to release objects voluntarily. Voluntary release is seen as the infant learns to transfer objects from one hand to the other, first using the mouth as an intermediate stage (5 months) and then directly hand to hand (6 months).

6–12 *months*

Grasp matures progressively from *ulnar grasp* (5 months: cube grasped in the palm of hand on the ulnar side) to *radial grasp* (7 months: cube held against the thenar eminence at the base of thumb) to *finger-thumb scissors grasp* (8 months: index finger with the help of ring and little finger presses cube against the base of thumb), and finally to *mature grasp* (9–10 months: cube held between distal volar pads of thumb and fingertips).

At 6 months, if baby is given one cube after the other, he drops the first one but by 7 months, he retains the first cube when second is offered. By 7 months, the child compares the cubes by bringing them together. *Pincer grasp*, *i.e*. picking up a crumble between index finger and thumb, comes at about 10 months. Voluntary release which is awkward at first (with all fingers extended) also becomes more accurate so that by 10 months of age as the infant starts to learn concept of object permanence, he enjoys releasing a cube into a container/dropping things on to the floor. By this time, intrinsic muscle control has developed considerably to allow the isolation of the index finger; and infant uses index finger approach to pry and palpate the objects and poke their fingers into small holes for exploration. By 12 months of age, most infants enjoy putting things into containers and dumping them out repeatedly.

After 1 *year*

As the infant moves into second year of life, mastery of skills of grasp and release achieved in first year of life allows him to use objects as tools and fine motor development becomes more closely associated with adaptive/cognitive development. The infant knows both what he wants to do and how he wants to do that. By 15 months of age, further accuracy of voluntary release enables him to stack 3–4 blocks and release small objects into containers. He starts to adjust objects after grasping to use them properly, *e.g.* picking up a crayon and adjusting it to scribble spontaneously (18 months of age) and adjusting a spoon to use it consistently for eating (20 months of age). Further refinements continue to occur allowing the toddler to draw, explore, problem-solve, create, and perform self-help tasks.

B. Cognitive Development

Cognitive development along with adaptive skills are the foundations of intelligence. Intelligence is defined as the ability to learn or deal with new situations **(Key Box 4)**.

In initial few weeks of life, infant explores the environment visually. Initially, he follows faces and then objects. After gaining better control of arms and hands, he starts batting at and then reaching for objects. At first, objects are brought to the mouth for oral exploration. Later, the infant visually examines an object held in one hand while manipulating it with the other. With maturation of vision, infant can focus on small objects by about 5 months of age.

By 1 year, this ability to focus on small objects combined with newly developed pincer grasp and index finger isolation allows the child to explore the objects by poking and the infant becomes successful in discovering how they work (*e.g*. fingering the clapper of the bell). Mouthing becomes less appealing.

As cognitive abilities continue to progress, infant learns to shift attention between two objects, compare, make choices, discard or combine objects. With maturation of concept of causality and object permanence, infant learns how his actions produce certain effects, how to repeat these actions to get the same effects and later how to vary the action to produce a novel effect. He looks for dropped objects and later for hidden objects. *Thus the*

KEY BOX 4

Adaptive/Cognitive Developmental Milestones

4 weeks	Follows red ring by 45°
6 weeks	Follows up to 90°
8 weeks	Follows moving person
3 months	Hand regard, follows to 180°
4 months	Excited on seeing food, toys; shows pleasure by massive response
5 months	Mouthing, no hand regards
6 months	Looks for dropped toy
7 months	Observes cubes in each hand, finds partially hidden objects
8 months	Reaches for toys out of reach
10 months	Responds to 'No'
11 months	Looks at picture in book, finds toys, under the cup
1 year	Mouthing and drooling stops, puts objects in and out of container
15 months	Turns 2–3 pages at a time
1½ years	Turns 1 page at a time, names one common object
2 years	Points at 4–6 body parts, sorts objects
2½ years	Names 1 color, matches shape/colors
3 years	Names 2 colors, knows gender and age
4 years	Names 5–6 colors, right-left discrimination
5 years	Counts till 10, names 10 colors, identifies coins

child moves on from 'learning to manipulate' to 'manipulate to learn'.

C. Language Development (Key Box 5)

Language refers to the expression of thoughts and ideas. It includes both receptive and expressive languages.

- *Receptive language* is ability to understand what is being said.
- *Expressive language* refers to the ability to make thoughts, ideas known to others through speech, gestures, and facial expressions.

KEY BOX 5

Language Developmental Milestones

4 weeks	Quieting on sound of bell
2–3 months	Turns head to sound, begins vocalization
4 months	Laughs aloud, says *Ah-goo*
6–7 months	Monosyllables
8–9 months	Bisyllables
9–10 months	Imitates sounds, responds to No
10–11 months	First word with meaning
1 year	2–3 words with meaning
1½ years	Vocabulary of 10 words
2 years	Says 2 words sentence, uses 50+ words
3 years	3 words sentences
4 years	4 words sentences, tells stories
5 years	5–8 words sentences, knows telephone number.

Receptive Language

Infant shows receptive language skills at birth. He shows preference for voices.

- At 4 weeks, infant is heedful of sound and quietens on sound of bell and by 12 weeks starts turning head to sound.
- Afterwards, receptive language ability is shown by response to name (7 months), response to 'No' (10 months), and obeying of simple order (Give it to me).
- By 12–15 months, he can point to familiar objects and body parts.

Thereafter, growing receptive ability is shown by ever increasing understanding of words, following simple and then complex instructions, and understanding most of what is being said.

Expressive Language

Initial expressive language consists of musical-like vowel sounds (cooing). At about 3 months, the infant begins vocalizing immediately upon hearing an adult speak and talks a great deal when spoken to; he holds long conversations with his mother by

Table 6.1 Developmental milestones from birth to 6 months

Age	*Supine*	*Pulled to sit*	***Gross motor*** *Held sitting*	*Held standing*	*Prone*	*Ventral suspension*	***Fine motor***	***Adaptive/ cognitive***	***Personal–social***	***Language***
4 weeks	ATNR at rest Arms and legs semiflexed	Complete head lag	Back rounded	Flops at hips and knees, walking reflex	Pelvis high, knees under abdomen	Head held up momentarily, elbows flexed, hips partially extended, knees flexed	Hands predominantly closed, grasp reflex	Regards dangling object in line of vision (3 feet) in midline, follows 45° from midline on either side	Intent regard of mother's face	Quiets on hearing bell
6 weeks	ATNR intermittently	Considerable head lag	Intermittently holds head up	Head sags forward	Pelvis high, knees no longer under abdomen	Head held momentarily in plane of body	Hands often open	When supine, looks at objects in midline, follows it up to 90°	Smiles at mother in response to overtures	
8 weeks	Intermittent ATNR	Less head lag	Head held up but recurrently bobs forward, back less rounded	Holds head up, more than momentarily	Head mostly midline, lifts chin off couch ~ 45°	Head maintained in same plane as body	Hands frequently open, only slight grasp reflex	Fixation, convergence and focusing, follows moving person and dangling toy		Vocalizes when talked to
12 weeks	No more ATNR	Only slight head lag	Head mostly held up but still bobs forward	Partial weight bearing	Pelvis flat, head and shoulder off couch ~ 45–90°, weight borne on forearms	Head held up beyond plane of body	No grasp reflex, hands come together in midline while playing, brings hands to mouth, holds rattle transiently if placed in hand	Hand regard, binocular vision, promptly looks at object in midline, follows dangling toy from side to side ~180°, discriminates between colors	Recognizes mother	Turns head to sound, squeals with pleasure

(Contd).

Table 6.1 Developmental milestones from birth to 6 months *(contd.)*

Age	Gross motor: Supine	Pulled to sit	Held sitting	Held standing	Prone	Fine motor	Adaptive/ cognitive	Personal–social	Language
16 weeks	Head in midline	Only slight head lag in beginning	Head held up but wobbles if swayed		Head and chest off the couch, plane of face ~90° to couch, limb stretched out	Tries to reach but overshoots objects. Plays with rattle, if placed in hand but cannot pick it up, if dropped	Immediately regards dangling objects, excited on seeing food, toys and shows pleasure by massive response	Smiles spontaneously at pleasurable sight/sound	Laughs aloud
20 weeks	Feet to mouth	No head lag	Back straight, no head wobble	Bears most of weight	Weight on forearms, rolls prone to supine	Voluntary grasp with accurate reaching, recovers rattle, if dropped **Cubes**—bidextrous approach	Mouthing no more hand regard	Smiles at mirror image	Razzing *Ah-goo*
24 weeks	Lifts head off the couch when about to be pulled up, rolls supine to prone		Sits supported in high chair (supported sitting)	Bears full weight on legs	Bears weight on hands, chest and upper abdomen off the couch	**Cubes—**unidextrous approach, ulnar palmar grasp, transfers cube from hand to hand, drops one cube when another offered, lifts cup by handle	Looks for dropped toy	Smiles and vocalizes at mirror images, stranger anxiety (beginning), drinks from cup when held to lips Imitates cough, displeasure at removal of toy, feeds self-finger foods Starts enjoying peek-a-boo	Monosyllables—*ma, da, na*

Table 6.2 Developmental milestones from 6 months to 5 years

Age	*Gross motor*	*Fine motor*	*Adaptive/cognitive*	*Personal–social*	*Language*
28 weeks	Spontaneously lifts head off couch. Sitting with support (using own hands for support). Bears weight on one hand	**Cubes–**radial palmar grasp retains first cube when second offered	Explores different aspects of toys. Finds partially hidden objects. Observes cube in each hand	Imitates simple acts, *e.g.* tongue protrusion	Responds to name
32 weeks	Sits momentarily without support. Creeping/ commando crawling	Scissor grasp	Reaches persistently for toys out of reach	Engages in gaze monitoring, *i.e.* child follows adult's glance with own eyes	Imitates sound already in repertoire. Combines syllables – *da-da, ba-ba*
36 weeks	Sits steadily. Leans forwards and recovers balance. Pulls self to stand. Stands holding on to furniture.	**Cubes**– compares 2 cubes by bringing together **Pellet**–pincer grasp		Separation anxiety. Follows finger point	*Dada, mama* inappropriately
40 weeks	Crawling Pulls self to sitting position Cruises around furniture using 2 hands, walks with two hands held	Index finger approach **Cubes**–releases cubes	Responds to no	Waves bye-bye. Plays pat-a-cake. Pulls clothes to attract attention. Repeats performance laughed at	Responds to simple words. Uses *mama, dada* appropriately
48 weeks	Pivots while sitting. Cruises around furniture using one hand. Walks with one hand-held. Stands alone for a few seconds	Throws objects. Stirs with spoon	Releases toy to examiner. Finds toy under cup. Looks at picture in book. Gives toys to adult, for repeat demonstration	Cooperates with dressing	Imitates sound of dog, cow. Shakes head for no One word with meaning other than *mama, dada*
1 year	Stands well. Independent 2–3 steps	Casting **Pencil**–imitates scribbling **Cubes**–tower of 2 cubes	Mouthing and drooling stopped. Puts objects in and out of container	Proto imperative pointing	Speaks 2–3 words with meaning. Follows one step command with gesture
15 months	Gets into standing position without support. Stoops to pick up toys. Kneels without support. Creeps upstairs. Climbs on furniture	**Pencil–**spontaneous scribbling **Cubes–**builds 3 cubes tower **Pellet–**releases pellet into bottle	**Simple formboard–**inserts round block **Book–**turns pages 2–3 at a time **Body parts**–points to one	**Feeding**–manages cup well Uses spoon with spilling **Sphincter control**– indicates wet pants protodeclarative pointing starts (pointing at objects to express interest) Shows empathy, hugs adult in reciprocation	Speaks 3–5 words with meaning, follows one step command without gesture, *e.g.* getting objects from another room, Jargoning
18 months	Walks pulling toys Walks backward Runs stiffly Walks upstairs	**Pencil**–imitates vertical stroke **Cubes**–tower of 4 cubes	**Formboard**–inserts circle after it has been turned (usually with trial and error)	**Feeding**–manages spoon well without rotation **Dressing**–takes off socks/unzips	Understands mine Uses 10–25 words

(Contd.)

Table 6.2 Developmental milestones from 6 months to 5 years *(contd.)*

Age	*Gross motor*	*Fine motor*	*Cognitive*	*Personal–social*	*Language*
	one hand-held Creeps downstairs Seats self on chair Throws ball without falling		**Book**–turns pages singly **Picture cards**–points to 1–2 objects Names one common object **Body parts**–points to 2–3, points to self and familiar people when named	**Play**–domestic mimicry **Sphincter control–**dry by day with an occasional accident Begins to show shame when does something wrong	
24 months	Runs well, walks upstairs and downstairs holding rail both feet on each step. Kicks ball without falling Throws overhead	**Pencil**–imitates horizontal and circular stroke **Cubes**–tower of 6 cubes, imitates train of cubes without adding chimney Turns door knobs Unscrews lids	**Formboard**–places square (20 months) Completes at 2 years **Picture cards–**points to 5, names 3 **Body parts**–points to 4–6 objects, Matches objects to pictures, Shows use of familiar object	**Feeding**–sucks through a straw **Dressing**–pulls off pants, takes off clothes without button **Play**–parallel play **Sphincter control**–dry at night, if lifted out in evening	Begins to understand her/him/mine Follows 2 step command Says 2 word sentences Refers to self with name Uses 50+ words
30 months	Jumps on both feet Walks on tiptoes when asked	**Cubes**–tower of 8 cubes, imitates train and adds chimney Strings large beads awkwardly	**Formboard**–replaces all 3 shapes after it has been rotated (no trial and error) **Picture cards**–points to seven and names 5 pictures. Points to small details in pictures **Colors**–names 1, matches shapes and colors **Digit span**–repeats 2, one of three trials	**Dressing**–pulls pants up with assistance **Sphincter control**–attends to toilet need without help except for washing Washes hands Brushes teeth with assistance	Starts using pronouns, Echolalia and jargoning disappear, Follows two prepositions, Understands actions words: playing . . . coming . . .
3 years	Synchronous gait Stands on one foot for 3 seconds Walks upstairs alternating feet Pedals tricycle Catches ball with stiff arm	**Pencil**–copies circle, **Cubes**–tower of 9–10 cubes, imitates bridge **Scissors**–cuts with scissors awkwardly Strings small beads well	**Goodenough test**–draws 2–3 parts person **Incomplete man**–adds 1–2 parts **Body parts**–Points to body parts based on function, **Picture cards**–names 8–10 pictures, **Colors**–names 2 colors **Digit span**–repeats 3, one of three trials Understands long/short, big/small, more/less Knows gender and age	**Dressing**–dresses, undresses fully, if helped with buttons **Play**–joins in play Begins to take turns Starts to share Imaginative play Pours liquid from one container to other, tries to help with household tasks	Three-word sentences, Uses pronouns correctly, Uses plurals
4 years	Balances on one foot for 4–8 seconds Goes downstairs alternating feet Hops on one foot 2–3 times	**Pencil**–copies cross **Cubes**–imitates gate **Scissors**–cuts circle	**Goodenough test**–draws a 4–6 part person **Incomplete man**–adds 3 parts **Colors**–names 5–6 **Digit span**–repeats 3 Three of three trials	**Feeding**–uses fork Dressing–buttons **Play**–group play, has a preferred friend **Sphincter control**–goes to toilet alone	4-word sentences, Understands adjectives: long, thin, Follows 3-step command,

(Contd.)

Table 6.2 Developmental milestones from 6 months to 5 years *(contd.)*

Age	*Gross motor*	*Fine motor*	*Cognitive*	*Personal–social*	*Language*
	Catches bounced ball (4.5 years)		**Number concept**–till 4 Reads several common signs/store names on the road Right-left discrimination	Washes after bowel movement Brushes teeth alone	Tells stories, Labels happiness, sadness, fear and anger in self, 100% intelligibility
5 years	Skips Running broad jump (2–3 feet) Jumps backward	**Pencil**–copies square (4.5 years) and triangle **Cubes**–copies gate (4.5 years)	**Goodenough test**–draws 8–10 parts person **Incomplete man**–adds 6–7 parts **Colors**–names 10 colors **Digit span**–repeats 4, two of three trials **Number concept**–till 10 Rote counting till 10 Identifies coins Names letters/numerals out of order Compares 2 weight	Independent dressing Bathes independently Has group of friends	5–8-word sentence Knows telephone number Responds to "why" questions Retells story with clear beginning, middle and end

12–16 weeks (to and fro vocalization). By 16 weeks, he laughs aloud, squeals with pleasure and begins to say *ng, Ah-goo*. By 20 weeks, he enjoys razzing (*i.e.* blowing between partially closed lips) and imitates coughing and tongue protrusion. This is followed by monosyllables (*ba/da/ga*; 6–7 months) and bisyllables (8–9 months). By this time, he vocalizes with many high and low pitched tones and vocalizes cough to attract attention. At 9–10 months, he starts imitating sounds.

First meaningful word, *i.e.* use of mono-/bisyllables with a specific meaning for the child (*e.g.* saying mama only for referring to mother is a meaningful word which otherwise is a bisyllable), is spoken by 10–11 months.

After 1 year of age

By 12–13 months, he is saying 2–3 words with meaning and starts pointing at objects to communicate a request. Jargoning, speaking in an unintelligible language of his own, with modulations and phrasing, but only an occasional intelligible word, starts between 15 and 18 months.

There is an exponential gain in language 18 months onwards. An 18-month-old toddler boasts of a vocabulary of 10 different words. He repeats things said to him 21 months onwards and begins to join words other than in imitation by 21–24 months. Jargoning usually disappears. He starts using pronouns in order of mine, me, you and I in that order, though he is much more prone to call himself by his name rather than using I. He talks incessantly.

A 3-year-old is constantly asking questions, many of which seem meaningless and answers to these he already knows.

Questioning is at its peak at 4 years. Why and how frequently appear in questions and now he tells tall stories.

At 5, speech is much more mature. Language is now essentially complete in structure and form. He uses all types of sentences including complex sentences with hypothetical and conditional clauses.

Clarity of speech

Assessment of clarity of speech is also an important component of language assessment. While assessing speech clarity, it should be assessed whether the child is speaking as distinctly as expected of his age. Ability to pronounce words improves with age so that

by 2 years of age, at least 50% of the speech is understandable to a stranger. At 3 years of age, 75% is understandable and by 4 to 5 years of age, speech is completely understandable to strangers. Lisping should disappear at 4 years of age. Slight stuttering may be present at 2–3 years of age, but if it is severe and persistent, referral to speech therapist is warranted.

D. Personal–Social Development (Key Box 6)

0–3 months

- A 4-week-old infant fixates on a face that bends over into his line of vision. This brief intent regard is the chief token of his social interest at this age. Infants soothe down when picked in lap and if snugly and warmly wrapped.
- By 6 weeks, infant begins to smile and 2 weeks later vocalizes in response to social overtures.
- By 3 months, infant shows considerable interest in the surroundings, engages in to and fro vocalization, watches movement of people in the room and may refuse to be left alone. He starts recognizing his mother and other familiar attendants and turns head to sound.

KEY BOX 6

Personal–Social Developmental Milestones

4 weeks	Fixates on a face for brief
6 weeks	Starts smiling at mother
3 months	Recognizes mother, takes considerable interest in surroundings
5–6 months	Smiles/vocalizes at mirror image
6–7 months	Enjoys Peak-a-boo, responds to name
7–8 months	Imitates simple acts, gaze monitoring
8–9 months	Stranger anxiety
10 months	Waves bye-bye, plays pat-a-cake
11 months	Cooperates with dressing
1 year	Helps to dress
15 months	Uses spoon with spilling
1½ years	Takes off socks, dry by day
2 years	Sucks through a straw, pulls off pants, dry at night
2½ years	Washes hands, brushes teeth
3 years	Dress, undresses fully, if helped with buttons
4 years	Uses fork, goes to toilet alone
5 years	Independent dressing and bathing

6 months–1 year

At 6 months, he smiles and then vocalizes at his mirror image. While lying down, he stretches his arms out on seeing that his mother is going to lift him up. He shows displeasure at removal of toy, starts imitating simple actions such as tongue protrusion and coughing and even tries to establish contact by coughing. A month later, he starts enjoying peek-a-boo, responds to his name, and starts differentiating unfamiliar and familiar people (*stranger anxiety*). Between 10 and 12 months, he responds to words, *e.g.* 'Where is Papa' and repeats performances laughed at.

By 1 year, he helps to dress, begins to anticipate movement in nursery rhymes, starts showing interest in books, takes vocal and other means to elicit attention, and displays considerable perceptiveness of emotions of others.

Joint attention (process whereby an infant and caregiver share an experience) is the quintessential social milestone that develops towards the end of the first year after birth. The earliest demonstration of joint attention occurs around 8 months of age, when an infant follows a caregiver's gaze and looks in the same direction. By 10 months, he starts imitating pat-a-cake and bye bye.

After 1 year

Between 12 and 14 months, children begin to point to request something (*proto-imperative pointing*), and they usually integrate this pointing with eye contact directed between the object of interest and the caregiver, sometimes accompanied by a verbal utterance. This is

followed by *proto-declarative pointing* by 16 months of age, characterized by the child pointing at something merely to indicate interest, usually accompanied by eye contact directed between the object and the caregiver. By 18 months, he brings objects or toys to his caregivers to show them or to share the experience.

Play skills

Play skills also follow a specific developmental course.

- By 18 months, child engages in *simple pretend play*, *e.g.* pretending to talk on a toy phone, pretending mother in domestic duties, *e.g.* dusting, cleaning, wiping (*domestic mimicry*).
- Two-year-old engages in *parallel play* (plays next to another child, but not with him, frequently looking at and imitating his actions) as he has not yet mastered the skill of cooperation.
- After his second birthday, the child begins to play with others of his own age. As a thumb rule, a child can play effectively only in groups of children in the same number as his age in years. Thus, a 2-year-old can play well only with one other child.
- By 30 months, the child uses *complex pretend play*, such as using generic items to represent other objects. A block may be used as a table in one scenario and a phone in another. By age of 3 years, a child is able to initiate a cooperative play with one or two peers, taking turns and having joint goals.
- 4-year-olds are able to play effectively with up to three other kids, become interested in tricking others, and concerned about being tricked themselves.
- By age 5, children have learned many adult social skills, their imaginative play is increasingly more complex, and they love to dress up and act out their fantasies.

E. Adaptive Development

Adaptive development includes self care skills (such as feeding, dressing, drinking independently, bathing and toilet training); assuming responsibility for oneself (putting away toys, avoiding dangers) and adapting to different environments or situations on a daily basis. This entails appropriate utilization of usual skills acquired in cognitive, communication, socio-personal and fine motor domains. Thus evaluation of adaptive domain, entails assessment of these skills in the child's daily repertoire.

6.3 HISTORY OF DEVELOPMENT

A. Timing of Developmental Assessment

Developmental surveillance, i.e. observing emergence of abilities in a child over a period of time, should be part of every well child visit (*e.g.* during routine immunization). During these visits, the pediatrician should monitor the development of child and be watchful for *Developmental Red Flags*. 'Developmental Red Flags' in each of the developmental domains are listed in **Table 6.3**. If any of these Red Flags is discovered, a thorough developmental screening is warranted and child should be referred for detailed evaluation **(Fig. 6.2)**.

American Academy of Pediatrics recommends general developmental screening at 9, 18, and 30 (or 24) months; autism specific screening at 18 and 24 months; using standardized tools.

Rashtriya Bal Swasthya Karyakaram, launched by Government of India in 2013, aims at screening for developmental delay including disabilities in children between 0–18 years. Screening tools cum reference cards and pictorial job aids have been developed for developmental screening under the program. Indian Academy of Pediatrics (IAP) emphasizes the need for continuous developmental surveillance but there are no formal recommendations for developmental screening. For autism, IAP recommends, children should be screened by standardised autism screening tools the Modified Checklist for Autism in Toddlers M-CHAT, Social Communication Questionnaire, Trivandrum Autism Behaviour Checklist) at 18 and 24 months of age.

Table 6.3 Red flag signs suggestive of developmental delay

Age	*Red flag*
Motor development	
1–2 months	Early rolling
3 months	Persistent fisting
4 months	Lack of steady head control while sitting
9 months	Inability to sit
18 months	Inability to walk independently
Prior to 18 months	Hand dominance
Any age	Scissoring, frog-leg posture, W sitting, bunny hopping
Adaptive/cognitive development	
2 months	Lack of fixation
4 months	Lack of visual tracking
6 months	Failure to turn to sound or voice
Language development	
6 months	Failure to turn to sound or voice
9 months	Lack of babbling consonant sounds
18 months	Does not use single words such as *mama*, *papa*, *dada*
24 months	Lack of words and two-word meaningful sentences; inability to follow simple commands
36 months	Failure to speak in three-word sentences
Personal–social development	
6 months	Lack of smiles or other joyful expressions
9 months	Lack of reciprocal (back-and-forth sharing of) vocalizations, smiles, or other facial expressions
12 months	Failure to respond to name when called, absence of babbling, lack of reciprocal gestures (showing, reaching, waving)
15 months	Lack of proto-imperative pointing (point to desired objects)
18 months	Lack of proto-declarative pointing (point to show interest) or showing gestures
24 months	Lack of simple pretend play
Any age	Loss of previously acquired babbling, speech, or social skills

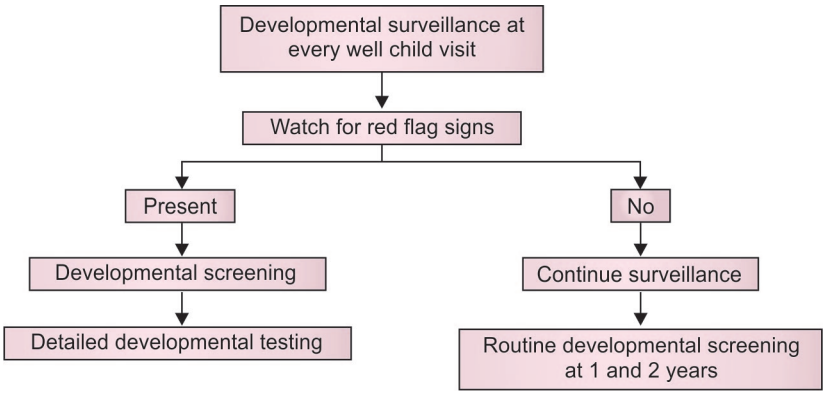

Fig. 6.2 *Plan of developmental surveillance.*

B. Developmental History

History is a vital part of the developmental diagnosis. It must include not only history regarding achievement of milestones (developmental history), but also all factors which may affect development, whether prenatal/perinatal/postnatal, especially in cases with abnormal development and these factors should be mentioned under appropriate headings. It is important to note that for assessment of language and social developmental domains, it is essential to take a detailed history as these domains are difficult to assess by observation alone in a clinician's office.

i. *History of Milestones*

1. Take a detailed history regarding achievement of milestones in all the domains, *i.e.* motor (*gross/fine*), adaptive and cognitive, language, and personal social, as described previously.
2. Questions should be simple and precise. Explain to the mother the exact meaning of what you are asking.
3. It is easiest to start with gross motor milestones as parents tend to remember them easily.
4. Choice of questions to be asked depends on child's age and your rough estimate of his mental age.

***For example, in an average appearing 15-month-old child, asks the following questions*:**

Motor: Can the child walk unsupported? Does the child try to feed himself with a spoon?
Adaptive and cognitive: Does he scribble spontaneously? Does he watch pictures in a picture book?
Language: Can the child say 2–3 words with meaning?
Personal–social: Does the child indicate desire by pointing at objects?

If the child has acquired these functions, the development can be considered as normal. State as follows: *The development of this 15-month-old child matches the chronological age, in all 4 spheres of development.*

5. If the child has not acquired these functions, ask for a function that the child would have achieved by an earlier age. For example, if the child is not walking unsupported till now, ask whether he can walk with support. If yes, what kind of support is required, *i.e.* walking supported with one hand held or both hands held? If the child can walk with one hand held, his developmental age in gross motor domain corresponds to the chronological age of a child between 9 and 12 months. Record this as follows: *The development of this 15-month-old child in the gross motor domain corresponds to a chronological age of between 9 and 12 months.* Similarly, try to find the developmental age in each domain of development separately.
6. *Assess the rate of development* This is a vital piece of information to be obtained from history. It will tell you whether the child (*i*) has been a slow starter, or (*ii*) had an illness and is now catching up; or (*iii*) had normal development followed by regression of development as in degenerative disorders of CNS.
7. History given by the mother is usually reliable. In case of doubt, one can check one milestone against the other. For example, vocalization begins 1 or 2 weeks after babies begin to smile. You can also check the mother's version against your own observation.

ii. *History of Risk Factors Responsible for Developmental Delay* **(Key Box 7)**

If developmental delay is expected, it is important to find the etiology for the same.

1. Inquire about *genetic, prenatal and perinatal factors* that may affect development, *e.g.* maternal age and diseases, smoking, drug intake, irradiation, birth asphyxia, bilirubin encephalopathy, infection, prematurity and present the relevant information in the antenatal, birth and postnatal history.
2. History must include *environmental factors* which may have a bearing on development. Overprotection, rejection, neglect, or abuse may all adversely affect development. Any relevant information should be presented in the family history.

KEY BOX 7

Identify the Following Risk Factors in Developmental History

1. Prenatal maternal factors
   a. Acute or chronic illness (*e.g.* human immunodeficiency virus infection)
   b. Use of drugs or alcohol
   c. Toxemia, previous miscarriage or stillbirth
2. Perinatal factors
   a. Obstetrical complications
   b. Prematurity, low birth weight
   c. Multiple gestation
3. Neonatal factors
   a. Neurologic events (seizures or intraventricular hemorrhage)
   b. Sepsis or meningitis
   c. Severe hyperbilirubinemia
   d. Hypoxia due to respiratory compromise
4. Postnatal factors
   a. Seizures
   b. Sepsis or meningitis
   c. Recurrent otitis media
   d. Poor feeding, poor growth
   e. Exposure to lead or other toxins
5. Factors in the family history
   a. Developmental delay
   b. Deafness, blindness
   c. Chromosomal abnormalities
6. Factors in the social history
   a. History of abuse or neglect
   b. Limited social or financial support
   c. Teenage parent
   d. Single parent
   e. Mentally retarded parent
   f. Stressful life events (*e.g.* divorce, death or unemployment of parent)

3. Ask *history of relevant illness, e.g.* malnutrition, meningitis, encephalitis that may affect development and mention the same in past history.
4. *Prematurity* History of prematurity is very important because, if baby is born premature, allowance must be made for prematurity till 2 years of age. For example, if a baby is born 2 months premature and is assessed at 4 months of age, he must be compared with an average 2-month-old baby and not with a 4-month-old.

6.4 DEVELOPMENTAL EXAMINATION

From the history, you can roughly assess the developmental age.

Example:
Suppose a child is 1-year-old but he has achieved only those milestones, which he should have attained at the age of 6 months; then his development age will be taken as 6 months.

To confirm the developmental age, one needs to perform developmental examination.

A. Prerequisites for Developmental Examination

- The child should be in a happy and playful mood.
- The playtime of the child should coincide with the time of assessment.
- Child should not be hungry, thirsty, sleepy, or wet.
- Keep irrelevant toys and objects out of the room in which you are assessing the child.
- Mother should be present. But she should not disturb or help the child during assessment.
- Watch the child as closely as possible, during free play.
- Establish rapport with the child otherwise he may not cooperate during examination.
- Perform developmental examination before doing the physical check-up as the child may cry during the later.
- Carry out the tests as quickly as possible, otherwise the child may loose interest and not cooperate.

B. Test for Hearing and Vision

Test for hearing and vision, before you begin with the proper developmental assessment. A visual or auditory handicap may affect the development as well as interpretation of developmental assessment.

An otherwise normal but deaf child is likely to be slow in development in the spheres of language acquisition and social domain.

Similarly, a child with a visual handicap may be delayed in adaptive and personal social domains.

1. Hearing Assessment

First of all, ask the parents whether the child responds to sound. The response could be an ocular movement (blink), a motor activity (startle), or behavioral change (crying or quietening).

It is important to note that deaf babies can gurgle, coo, vocalize, and say syllables (*dadada, bababa*), but language development does not progress further. More importantly, children who are hearing impaired, but not deaf; babble, laugh, startle to sound and show some, though delayed, language development. Thus, *normal early language development does not exclude hearing impairment and observation alone can miss hearing impaired children*. So, refer the child for detailed hearing evaluation on slightest suspicion of hearing impairment.

Hearing can be assessed by:

a. Observing the response to sound (in young infants 0–3 months);
b. By assessing sound localization (3–9 months); and
c. Later by assessing response to name, by asking the child to point at familiar objects and by giving him simple instructions to follow.

- In *first 3 months*, infants respond to sound by quieting (if crying), crying (if quiet), startle reflex, or blink. At 3 months, baby turns head to the side from which the sound is heard. Observe response to sound of crumpling a paper at ½ meter distance from the child's ear. A bell can also be used.
- *Between 4 and 6 months*, infants (*i*) turn head to sound (sound localization); (*ii*) imitate sound in their own speech repertoire; (*iii*) reciprocally vocalize with adults; (*iv*) notice toys that make sound; and (*v*) pay attention to music.

Sound localization is assessed by using a noisemaker, *e.g.* a small bell. Sound is produced behind the child to avoid giving visual stimulus and at a distance of about 18 inches from ear. Initially, the baby is able to localize sound only horizontally, but from 5 to 6 months, babies turn head not only to the side, but also look down, if the sound is made below the ears. At 6 months, he would turn head to the side, and then upwards, if the sound is made above the ear.

- *Between 7 months and 1 year*, infant turns head directly towards the sound and responds to his name. By the end of first year, his ability to localize sound is as good as that of an adult.
- *After 1 year of age*, hearing can also be assessed by assessing response of the child to various commands given by the examiner, provided that the examiner takes care not to give gestural/visual cues. For example, point to a picture of a cat and ask: What is it? *Cover your mouth while speaking, to avoid lip reading*.

For other details of hearing assessment, *see Chapter* 13. Clinical pointers to presence of a hearing defect are outlined in **Key Box 8**.

KEY BOX 8

Pointers to Hearing Problem

1. Does not respond to sound or voice.
2. Does not begin to speak by 2 years of age.
3. Does not follow simple instructions.
4. Does not respond in the classroom.
5. Abnormal facial features.
6. History of birth asphyxia, or neonatal seizures neonatal jaundice.
7. Had meningitis/encephalitis.

2. Vision Assessment

Defect of vision should be suspected, if mother or examiner notices absence of visual fixation or presence of nystagmus.

- Visual fixation can be tested in infants as young as 4 weeks by using a dangling object that does not produce sound (*e.g.* red ring on a string). A 4-week-old infant regards the dangling object when it is brought into his line of vision (at a distance of ~ 8–10 inches

to 3 feet from eyes) in midline and follows it less than 90°.

- A 6-week-old infant fixates on objects held in midline and follows it as it moves from midline to side and side to midline (90°).
- A 12-week-old infant promptly looks at objects in midline and follows it from one side to other (180°).
- A formal objective measurement of visual acuity can be done by 2.5 to 3 years of age by using picture charts.
- Objective measurement of refraction can be done at any age using a retinoscope by ophthalmologist.

It is important to note that hand regard (seen in normal infants between 12 and 24 weeks of age) is a developmental phenomenon and is not related to vision.

Snellen chart can only be used after 3 years of life. Details of vision testing at different ages are summarized in *Chapter* 12. Clinical pointers to presence of a visual defect are outlined in **Key Box 9**.

C. Tools for Developmental Assessment

The most important tools for developmental assessment are your special senses; that listen to the history, vocalization and language of the child, and that elicit various reflexes and developmental milestones. You will need the following tools for developmental assessment of children till 5 years of age **(Fig. 6.3)**:

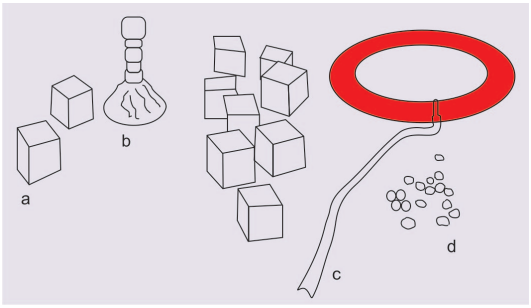

Fig. 6.3 *Tools needed for development assessment: (a) cubes, (b) small bell, (c) red ring, and (d) pellets made of cardboard, wool or paper (8 mm size).*

- A red ring
- A small bell
- Pellets made of cardboard, wool or paper (8 mm size)
- 10 cubes of 1 inch each
- A pen and paper
- A picture book of common objects (scrap-book)
- Cards with circle, cross, square, triangle drawn on them
- Simple form board
- Colored and uncolored geometric forms
- Goddard's form board (for children > 3 years of age)

KEY BOX 9

Pointers to Visual Handicap

1. Does not turn head to a light source or any object.
2. Mother complains of squint or that the pupils may look grey.
3. Slow in using hands or moving around.
4. Eyes are red, swollen and watering.
5. Eyes look dull, wrinkled.
6. Difficulty in seeing at night.
7. Child is slow in school, difficulty in reading.

General Tips for Developmental Examination

1. Perform developmental assessment prior to the physical examination.
2. Observe the child closely, throughout examination.
3. Look out for an abnormal movement (tremor, chorea, convulsion, etc.), or spasticity (tightening of body).
4. Note down what all the child babbles (for speech and language functions).
5. Record the child's interest, concentration and alertness.
6. Observe not only whether the child performs a certain task, but also see the rapidity with which the task is performed.
7. Undress the child last.
8. Do not stick to a rigid order of examination.

6.5 PROCESS OF ASSESSMENT

A. Between 1 and 3 Months

1. Observe the baby in the mother's lap; observe for any obvious abnormality such as fisting, tightness of body, etc.
2. Notice, if the child watches the mother, smiles or produces sound. The child starts smiling at the mother from 6 to 8 weeks onwards in response to visual/verbal contact.
3. Note the shape and size of the head. Palpate sutures and anterior fontanel. Different shapes of head are described in **Chapter 7** on general physical examination.
4. Assess resistance to passive movement for tone. Loose limbs indicate *hypotonia* while stiff limbs indicate *hypertonia*.
5. Place the child supine on the surface and observe the posture:
   - *Up to* 8–10 *weeks:* Generally, flexed posture with symmetrical writhing. Arm extends on the same side, to which the head is turned (asymmetric tonic neck reflex) **(Fig. 6.4)**.
   - 12 *weeks:* No more appearance of asymmetric tonic neck reflex.
6. Observe the hands:
   - 4 *weeks:* Closed hands, presence of grasp reflex.
   - 8 *weeks:* Opens hands frequently, slight grasp reflex.
   - 12 *weeks:* Hands loosely open, may hold a rattle for a minute, if placed in hand. No grasp reflex.
7. Pull the child from supine position. Observe head lag and back:
   - 4 *weeks:* Complete head lag, back completely rounded **(Fig. 6.5a)**.
   - 8 *weeks:* Able to hold up head momentarily, less rounding of back **(Fig. 6.5b)**.
   - 12 *weeks:* Head held up most of the time.

Fig. 6.4 *Asymmetric tonic neck reflex.*

Fig. 6.5a *Pull from supine. Complete head lag, back completely rounded at 4 weeks.*

Fig. 6.5b *Pull from supine. Able to hold up head momentarily at 8 weeks; back is less rounded.*

8. Hold the child in standing position:
   - Child should have some flexion at hips and knees and able to place sole on the surface **(Fig. 6.6)**.
   - In a hypotonic child, the arms and legs hang loosely; while in a spastic child, the two legs may cross each other in a scissoring position.
9. Hold the child in ventral suspension as shown in **Fig. 6.7** by placing the child prone in air with hand under the abdomen. Watch for position of limbs and head control:
   - 0–2 *weeks:* Curled up on ventral suspension. Note flexion of elbows, knees with some extension at hips **(Fig. 6.7a)**.
   - 4 *weeks:* The child holds up the head momentarily. There is some flexion at the knees and hip. Back is rounded **(Fig. 6.7b)**.
   - 6 *weeks:* Head held momentarily in plane of body.
   - 8 *weeks:* Maintains head in the same plane as rest of the body **(Fig. 6.7c)**.
   - 12 *weeks:* The child holds the head up and above the plane of the body for considerable period of time.

Fig. 6.6 *Child less than 12-week-old is able to place sole on surface while held in stand position. No weight bearing.*

Fig. 6.7a *Ventral suspension at 0–2 weeks. Child curled up; flexion of elbows and knees with some extension at hips.*

Fig. 6.7b *Ventral suspension at 4 weeks. Child holds up the head momentarily. There is some flexion at the knees and hip. Back is rounded.*

Fig. 6.7c *Ventral suspension at 8 weeks. Head is maintained in the same plane as rest of the body.*

10. Keep the child prone on an even surface. Observe the posture; specially chin, pelvis, and thighs **(Fig. 6.8)**:
    - 0–2 *weeks:* The pelvis is high and the knees are drawn under the abdomen. Back is rounded, head remains on one side **(Fig. 6.8a)**.

- 6 *weeks:* Knees are not under abdomen. Hips extended. Chin raised from the couch intermittently.
- 8 *weeks:* Head mostly in midline. Lifts chin off the couch up to 45°C **(Fig. 6.8b)**.
- 12 *weeks:* Child can lift the chin as well as the shoulders off the surface or couch, up to 90°, bearing weight on the forearms. Pelvis is flat on the surface **(Fig. 6.8c)**.

Fig. 6.8a *Prone at 0–2 weeks: The pelvis is high and the knees are drawn under the abdomen. Back is rounded, head remains on one side.*

Fig. 6.8b *Prone at 8 weeks: Knees are not under abdomen. Hips extended. Chin raised from the couch. Keeps head in midline.*

Fig. 6.8c *Prone at 12 weeks: Child can lift the chin as well as the shoulders off the surface or couch, up to 90°, bearing weight on the forearms. Pelvis is flat on the surface.*

B. Between 4 and 6 Months

1. *Observe the child:* Note facial expressions, vocalization, altertness, and interest in surroundings. Check vision and hearing.
2. Place a rattle in the hand of the child. Observe, how he plays with it? At 4 months, the child plays with rattle placed in hand for long period; but cannot pick it up, if he drops it. At 5 months, he recovers the rattle, if dropped; and at 6 months, he looks for the dropped rattle.
3. Place a 1 inch cube in front of the child. Observe whether he gets it (5 months) and if yes, whether he transfers it from one hand to the other (6 months).
4. Watch for hand regard (normal between 3 and 5 months of age). It should disappear by 5 months of age.
5. Place the child in prone position and observe:
   - 4–5 *months:* Can lift the head and chest off the surface, bearing weight on forearms **(Fig. 6.9)**.
   - 5–6 *months:* Can lift the head and chest off the surface with weight bearing only on hands, may roll from prone to supine.
6. Place the child supine and observe: The child lifts the head off the surface when about to be pulled up (6 months).
7. Pull the child to sitting position. Look for head lag:
   - If head lag is present, the development is less than 5 months. There may be a slight head lag at beginning of 4 months.

Fig. 6.9 *Prone: A 4–5 months old child can lift the head and chest off the surface, bearing weight on forearms.*

- If there is no head lag, watch for the amount of support required for sitting:
  - 4 *months:* Sits with both hands held **(Fig. 6.10a)**.
  - 5 *months:* Sits supported in a high chair or mother's lap.
  - 6 *months:* Sits with his own hands on surface for support **(Fig. 6.10b)**.

Fig. 6.10a *Pull the child to sitting position. Sits with both hands held at 4 months.*

Fig. 6.10b *Pull the child to sitting position. Sits with hands on surface for support.*

8. Hold the child in standing position. By 5–6 months, the child is able to bear most of the weight on legs.
9. *Show a mirror:* Smiles at mirror image by 6 months.
10. Observe the speech
    - 4 *months:* Laughs aloud.
    - 5 *months:* Speaks *Ah-goo*.

C. Between 6 and 12 Months

1. Observe the child's interest, alertness, and quality of vocalization/language as he sits or moves around. Does he differentiate between family and strangers? Also, notice interaction with mother, *e.g.* in peek-a-boo and pat-a-cake games.
2. *Offer a cube* With the child sitting in the mother's lap, place a cube on the table in front of the child. Observe, how the child approaches the cube and also observe what the child does with it:
   - 6 *months:* Approaches cube with fingers and holds cube with the palm on the ulnar side **(Fig. 6.11a)**. *Unidextrous approach*.
   - 7 *months:* Radial *palmar grasp* of cube.
   - 8 *months: Scissor grasp* (using all 4 fingers against the thumb).
   - 9–12 *months:* Approaches cube by index finger and holds cube steady with index finger and thumb **(Fig. 6.11b)**. This is *mature grasp*.
3. As soon as the child takes one cube, offer the second cube:
   - 5 *months:* Drops first cube when second is offered.

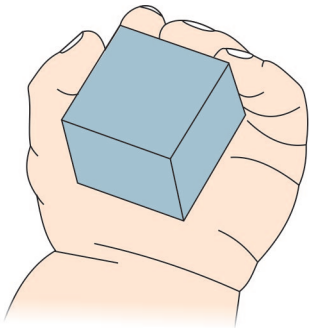

Fig. 6.11a *6 months: Approaches cube with fingers and holds cube with the palm.*

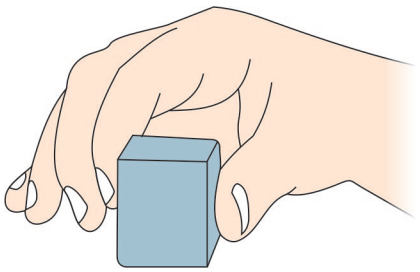

Fig. 6.11b *9–12 months: Holds cube steady with index finger and thumb.*

- 6 *months:* Retains the first cube in hand, and takes the second cube also. Transfers from one hand to another.
- 9 *months:* Compares two cubes by bringing them together.

4. Offer a pellet. Watch the approach and the grasp:
   - 7–9 *months:* Approaches with all the fingers/hand (rakes). Not able to pick it up.
   - 9–12 *months:* Able to pick up the pellet between tip of thumb and forefinger **(Fig. 6.12)**.
5. Place the child in the sitting posture and observe:
   - 7 *months:* Can sit unsupported, momentarily.
   - 8 *months:* Can sit steadily on floor without support.
   - 10 *months:* Sits steadily without risk of imbalancing. Can pivot around to pick a toy from back/side.
6. Place in the prone position and observe for creeping (9–10 months).

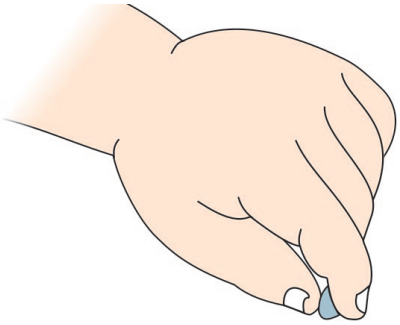

Fig. 6.12 *9–12 months: Able to pick up the pellet between tip of thumb and forefinger.*

7. Pull to the stand position, offer support of a table and observe. If the child can stand holding on to furniture and whether he can pull himself to standing position. Also watch, if he can walk around holding on to furniture.
   - 9–10 *months:* Stands holding on to furniture, pulls to stand **(Fig. 6.13a)**.
   - 10–11 *months:* Can walk around holding onto the furniture **(Figs 6.13b and 6.13c)**.
   - 12–13 *months:* Stands independently, takes a few independent steps.

D. Between 1 and 2 Years

1. If child comes walking into the room, watch his gait and assess its maturity. Observe his interest in toys or pictures hanging in the

Fig. 6.13a *8 months: Stands holding on to objects, with both hands.*

Fig. 6.13b *10–11 months: Can walk around holding on to the furniture, with one hand.*

Fig. 6.13c *11–12 months: Walks with one hand held.*

room. Does he point at things to ask for them or show something interesting to parents?

2. *Offer 10 cubes:* Show him how to build a tower and then let him do the same. This process is known as **imitating**. See how many cubes he can utilize in building a tower **(Fig. 6.14)**.
   - 15 *months:* Tower of 2 cubes.
   - 18 *months:* Tower of 3–4 cubes.
   - 2 *years:* Tower of 6–7 cubes.

   Warning signs The child should not take the cube to his mouth after the age of 15 months. Similarly, he should not be throwing cubes on the floor, one after another, after 18 months.
3. *Train and chimney:* Demonstrate, how to make a train of 9 cubes and place the 10th one on top of the first one (chimney). Ask him to do the same. A 2-year-old child can make the train, but fails to put the chimney **(Fig. 6.15)**.

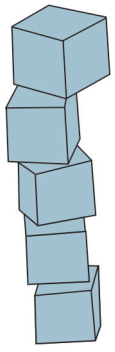

Fig. 6.14 *Tower of cubes.*

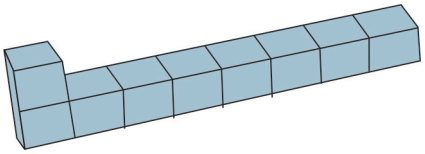

Fig. 6.15 *Train with a chimney.*

4. *Picture identification and naming:* Show picture cards or book, and ask to identify them in the following format "where is the cat"? At a later age, you may ask "what is that"? This is known as *picture naming* and more difficult **(Fig. 6.16)**.
   - 18 *months:* Identifies 1 object and names 1 object.
   - 2 *years:* Identifies 5 objects; can name 3 objects.
5. *Give a picture book:* See, how many pages of a book, he can turn at one time.
   - 15 *months:* Turns 2–3 pages at a time.
   - 18 *months:* Turns 1 page at a time.
6. *Offer pen and paper and notice any spontaneous scribbling.* Ask to *imitate* (by showing how to do it by drawing in his/her sight) the drawing of a vertical stroke (|), horizontal stroke (—), and a circle. Interpret as follows:
   - 12 *months:* Imitates scribbling.
   - 15 *months:* Scribbles haphazardly.

Fig. 6.16 *Common pictures for identification.*

- 18 *months:* Imitates vertical stroke.
- *2 years:* Can imitate horizontal stroke and a circle.

7. *Offer Simple form board:* First, offer only the round block **(Fig. 6.17)**.

- If the child puts the round block in the correct slot without error, rotate the form board by 180°, take out the inserted block and ask the child to do it again. The child can do this by 15 months.
- If a child can put in the round block, offer all 3 blocks. If the child puts all 3 correctly then ask to do it again, after you have rotated the Form board. If the child can correctly put in the blocks 2–3 times, he/she is at least 2 years of age.

E. Between 2 and 5 Years

1. *Notice the gait.* At the end of the session, see how he climbs stairs, jumps/hops/skips. Can he throw a ball overhead? Undressing/buttoning-unbuttoning can be observed before the physical examination.
2. *Offer 10 cubes*
   - Usually a child in this age group spontaneously begins to build a tower. Notice how many cubes he utilizes in making the tower.
   - Ask the child to imitate/copy (depending on expected maturity level) a train, bridge, gate and steps, one by one **(Figs 6.18 to 6.20)**. (Note: **Imitation** means building the model while the child is watching and then asking him to build the same; while **Copying** means building the model out of sight of child, shielding with a paper, and then showing him the final model and asking him to build the same.)
     - 2½ *years:* Tower of eight cubes; imitates train with chimney.
     - 3 *years:* Tower of 9–10 cubes, imitates bridge.
     - 3½ *years:* Copies bridge.
     - 4 *years:* Imitates gate.
     - 5 *years:* Copies gate.
     - 6 *years:* May copy steps.

     While the child is handling cubes, observe minutely for any abnormal hand movements or disability.
3. *Give a pencil and paper:* Ask to imitate vertical and horizontal stroke, circle, cross,

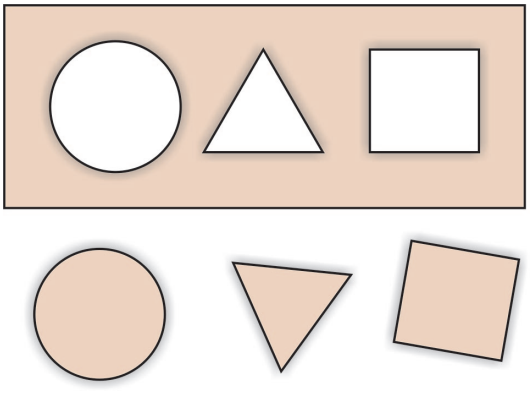

Fig. 6.17 *Simple form board.*

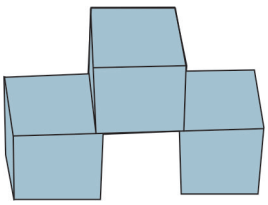

Fig. 6.18 *Bridge of cubes.*

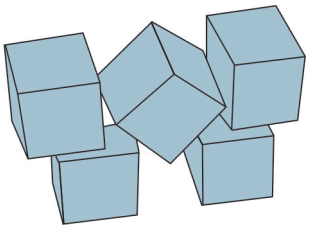

Fig. 6.19 *Gate of cubes.*

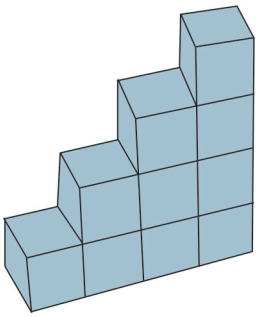

Fig. 6.20 *Steps of cubes.*

square, triangle, and diamond, in that order. If the child is able to imitate a task, ask to copy the same.
- 2 *years:* Imitates horizontal/circular stroke.
- 3 *years:* Copies circle and horizontal stroke. Imitates cross.
- 4 *years:* Copies cross.
- 4½ *years:* Copies square.
- 5 *years:* Copies triangle.
- 6 *years:* Copies diamond.

4. *Show the picture cards* and ask to *identify* or *name* the objects
   - 2½ *years:* Identifies seven objects; names up to 5.
   - 3 *years:* Names 8–10 objects.
5. Offer simple form board and observe the ability of the child to insert the blocks and the accuracy with which he does that.
6. If the child is successful with simple form board, he should be tried with the colored geometric forms followed by uncolored geometric forms. In each case, he is asked where the shapes fit, being given different forms one after the other. He is not told about his mistakes and is given another chance with those he has placed incorrectly.
7. After developmental age (DA) of 3½ years, time his performance in Goddard Form board, the score being based on the best of 3 trials.
8. *Goodenough draw-a-man test:* After DA of 3 years, ask the child to draw a man as completely as he knows. Child is given 1 point for each of the body parts added. For each 4 points, 1 year is added to the basal age which is 3 years. The test has 51 items, details of which can be found in textbooks. This test can be used for developmental assessment *between 3 and 10 years of age.*
9. *Gessel 'Incomplete Man' test:* In this test, picture of a man which is halfway complete is given to the child. The picture consists of a small circle for a head and below it a larger incomplete circle representing the trunk with one stick arm and one stick leg protruding. The head has one ear, half hair, a mouth and a nose but is missing eyes, one ear, half hair, one arm and one leg and various connecting elements. Child is asked to complete the man. Depending on how many and in what way the child adds the parts, DA is deciphered.
10. *Digit repetition:* Child is asked to repeat digits, *e.g.* six, five, seven. Initially he is given 2 digits. If he can repeat them, ask him to repeat three and then four digits followed by five. In each case, he is given 3 trials with different numbers.
11. Ask the child to identify colors in pictures.

F. Perform Relevant Physical Examination

Key Box 10 provides a list of risk factors that you need to look for. If present, they place the child at a higher risk of having abnormal

KEY BOX 10

Identifiable Risk Factors for Developmental Delay on Physical Examination

1. Abnormal growth (*e.g.* height or weight less than 3rd percentile or head circumference less than–3 SD or >2 SD).
2. Major congenital anomalies (*e.g.* spina bifida or midline defects).
3. Minor congenital anomalies (*e.g.* hypertelorism, hirsutism, or micrognathia).
4. Neurocutaneous skin lesions (*e.g.* neurofibromatosis or *cafe au lait* spots).
5. Abnormal optical findings (*e.g.* esotropia, exotropia, cataracts, or poor visual tracking).
6. Abnormal findings in ears (*e.g.* unusual shape or placement or recurrent acute or serous otitis media).
7. Visceral abnormalities (*e.g.* hepatosplenomegaly).
8. Skeletal abnormalities (*e.g.* brittle bones or dwarfism).
9. Neurologic abnormalities (*e.g.* lack of alertness, abnormal reflexes, hypertonia or hypotonia, or asymmetric findings).

KEY BOX 11

Warning Signs of Delay in Development

1. Shrill/high pitched cry
2. Excessive sleepiness/irritability
3. Frog-legged positioning/opisthotonus
4. Tremors/convulsions
5. Small/large head size for age
6. Poor eye following/poor response to sound
7. Asymmetrical/increased/absent/persistent neonatal reflexes
8. Hypotonia/hypertonia/dystonia
9. Delayed developmental milestones

development. Note that you have to take anthropometric measurements; look for major and minor congenital anomalies; examine carefully the skin, eye, ear, extremities in detail; and conduct a thorough neurological examination. Also look for the presence of hepatosplenomegaly. A few warning signs of developmental delay are listed in **Key Box 11**.

6.6 INTERPRETATION OF DEVELOPMENTAL ASSESSMENT

A. Development Quotient (DQ)

On the basis of his performance in developmental tests, child is assigned a developmental age (DA) that may or may not match with chronological age (CA).

Example:

A child is 2-year-old. He has not attained the milestones expected at his age. After assessment, it is found that he has attained only those milestones which should have been attained by 1 year of age. Thus, CA of child is 2 years but his DA is 1 year.

Based on the DA and CA, DQ is calculated as follows:

$$DQ = DA/CA \times 100.$$

DQ is calculated separately for each developmental domain. Ideally, CA should be equal to DA and DQ should, therefore, be 100. *A child having DQ ≤70 is considered to be developmentally delayed*.

B. Developmental Delay and Developmental Regression

Developmental delay is said to be present, if the child does not achieve the developmental milestones at the age by which it is expected to be achieved with adequate consideration for the broad variation among normal children.

Developmental regression refers to loss of milestones that were achieved previously. Regression of milestones is characteristic of neurodegenerative disorders. It is important to note that there may be some temporary loss of milestones with acute severe illnesses which should recover in 3–4 weeks with recovery in general wellbeing. This should not be considered indicative of neuroregression.

C. Global Developmental Delay and Dissociative Delay

Development in one field usually parallels development in other fields.

Global developmental delay (GDD) is said to be present, if there is significant delay (two standard deviations or more below the mean) in 2 or more fields (out of—gross and fine motor, speech and language, cognition, socio-personal and activities of daily living) of development.

The term global developmental delay is usually used for younger children (*i.e.* typically less than 5 years of age), whereas the term *intellectual disability* is usually applied to older children when IQ testing is more valid. However, GDD may also result from cerebral palsy, certain neuromuscular disorders, and other conditions such as early environmental deprivation, and therefore not all children with GDD are destined to develop intellectual disability.

In *dissociative delay*, there is delay in one particular field with otherwise normal development in other domains; or delay is more pronounced in one domain as compared to others.

Sometimes development in one field may not necessarily parallel that in other fields. When the rate of attainment of development skills varies significantly between two or more

domains, it is termed '*Developmental dissociation*'. For example, a child with myopathy will have motor delay, but development in other fields will usually be normal.

D. Developmental Screening

Developmental screening is the process of using validated and standardized tools (that are norm referenced and standardized for target population) to assess development of a child. These tools provide objective information about the child's development and also inform the practitioner and the parents regarding the next important milestone to watch out for. Screening tools are really helpful as informal evaluation of development has been shown to be unreliable in early timely detection of developmental delay which can be missed if not specifically looked for. American Academy of Pediatrics recommends routine developmental screening of children at 9, 18, and 24–30 months or earlier if concerns are elicited.

An ideal screening test should be brief, with good psychometric properties (sensitivity and specificity >70–80%), available in local language and consist of items that have been culturally adapted and validated on local population. From an Indian perspective, such a screening test does not exist. Commonly used screening tests are listed below:

- *Denver Development Screening Test* (DDST): This is a very popular international screening test for use in children up to 6 years of age. However, it is no longer recommended due to poor sensitivity and specificity.
- *Bayley Infant Neurodevelopment Screen* (BINS): This is another international, interviewer administered screening test that screens children between 3 and 24 months of age and has acceptable psychometric properties.
- *Ages and Stages Questionnaire* (ASQ-3): This is a parent reported questionnaire to screen children between 3 and 66 months with acceptable psychometric properties and has been shown to have acceptable standards in a study done in India (after translation and substitution of a few items).
- *Parent's Evaluation of Developmental Status* (PEDS): This is another parent reported developmental assessment tool to screen children up to 8 years of age, takes only 2–10 minutes to administer and has been found reliable in some developing countries (Indian data lacking).
- *Developmental Profile III* (DP III) This is also a parent reported tool (for children between 0 and 9 years of age) that has been used in numerous studies in India though has not been validated.

Developmental tools designed for use in community surveys of Indian population include Phatak's Baroda Developmental Screening Test (0–30 months) and Trivandrum Development Screening Chart (0–24 months) and ICMR Psychosocial Developmental Screening Test (0–6 years). However, drawbacks of these tests are less than optimal psychometric properties and lack of re-validation studies since initial formulation of these tests (more than two decades ago).

E. Development Diagnostic Tests

As intelligence cannot be reliably assessed in young children, following development based tests are used for them:

Bayley Scale of Infant Development (BSID IV)

BSID has been extensively used worldwide to assess development of infants and toddlers between 1 and 42 months of age. The latest edition (BSID IV) evaluates children along 5 scales—cognitive, language, motor, social, emotional, and adaptive behavior.

Developmental Assessment Scale (DAS II) for Indian Infants

DAS II is Indian adaptation of Bayley Scale of Infant Development. It is the most widely accepted, effective and comprehensive tool for confirmation of developmental delay in Indian infants and toddlers (0–30 months). It consists of a motor scale (assesses gross motor

and fine motor skills) and a mental scale (assesses cognitive and personal social development) and allows calculation of mental age and motor age and corresponding DQ. Composite DQ is calculated as average of Mental and Motor DQ.

F. Intelligence Tests

Various tests are available for testing the intelligence in an older child. These tests assess the problem-solving abilities of a child for his age and measure intelligence quotient (IQ). Some common tests used to measure intelligence include:

- Stanford Binet Intelligence Test
- Weschler Intelligence Scale for Children (WISC)
- Goodenough draw-a-man test
- Leiter International Performance Scale
- Wechsler preschool and primary scale of intelligence—revised
- Malin's Intelligence Scale for Indian Children (MISIC)—Indian adaptation of WISC
- Binet-Kulshreshtra—Hindi adaptation of Stanford Binet Intelligence Test.

G. Adaptive Scales

These scales assess adaptive behavior dysfunction, which is one of the essential criteria for the diagnosis of intellectual disability. The results are expressed as social quotient (SQ). Intellectual disability is usually diagnosed when SQ is ≤ 70. Vineland Adaptive Behavior Sclae (VABS) is the most commonly used scale for this purpose.

Intellectual disability (formerly called mental retardation) is characterized by a triad of (*i*) sub-average intelligence (intelligence quotient (IQ) ≤70); (*ii*) impairment of adaptive behavior; and (*iii*) onset before 18 years of age. Children less than 5 years with subnormal intelligence are labeled as having global developmental delay. Intellectual disability is classified on the basis of intelligence quotient (IQ) as mild: IQ 50–55 to 70; moderate: IQ 35–40 to 50–55; severe: IQ 20–25 to 35–40; and profound: IQ <20–25.