BARODA DEVELOPMENT SCREENING TEST FOR INFANTS

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ABSTRACT

A screening test for the assessment of the motor-mental development of infants was developed by selecting items from the Bayley Scales of Infant Development (BSID). Baroda norms as a simple and quick test for use in the door to door survey by health workers. The reason for choosing BSID and the criteria for the selection of items are described. The method of using the screening test in community surveys (by health workers) and in office practice is discussed. Some aspects of the development of our screening test and the Denver Development Screening Test (DDST) are compared. A routine use of our test is recommended for following the development of normal children as well as for screening from the community children with possibility of development delay. The latter must be referred for detailed testing on the full scales.

Key words: *Developmental screening, Infant development.*

In July 1983, the Baroda Citizens Council (a Non-Government Organisation) was to launch a UNICEF-aided programme for the prevention, early detection and intervention of childhood disability in urban slums[1]. House to house survey was to be carried out by trained community health workers. Assessment of motor-mental development was necessary for any meaningful programme for early detection of disability. A simple, quick, cheap and precise test was required for the door to door survey by the health workers. Some screening tests like the Denver Development Screening Test (DDST)[2] and the Munich Functional Developmental Diagnosis[3] are available but did not have Indian norms. They were also considered somewhat more complicated for our health worker. So it was decided to develop a screening test from the Bayley Scales of Infant Development (BSID). Baroda norms[4], since they have been standardized on Baroda infants. The BSID also have an advantage that calculation of developmental age and quotients is possible. Abridged BSID[5] was considered unsuitable as it requires some special equipment and set-up.

Material and Methods

The BSID Full Scales: The BSID was standardized on the basis of 4141 longitudinal test records (treated cross-sectionally) of normal Baroda babies upto the age of 30 months. Each record was made within 3 days of the birth date. Except for the first month which had 60, the sample of each of the subsequent months was more than 100 (maximum 173). The full scales have a total of 230 items--67 for motor development and 163 for mental development. The age placements of each item at various percentage pass levels (3, 5, 10... 50.... 90, 95,

97%) have been worked out. For instance the age placement of sitting with good co-ordination (No. 26 in *Table I*) is 6.5 months at 50% and 9.2 months at 97% pass levels. It means that half the normal children attain the skill at 6.5 months and almost all by 9.2 months and those who do not attain the skill by that age belong to the lower 3% of the normal population.

Preparation of the Screening Test

Many items of the BSID use standardized equipment (cubes, pegboard, formboard, *etc.*) and standardized techniques (certain performances timed by stopwatch). The age-placements cannot be presumed to be the same when non-standardized tools and techniques are used. For instance, it was reported that the size, weight and surface of the cubes affects the performance of the child in building a tower of cubes(6) and using any cubes or boxes is wrong. The BSID is a detailed test and has many items for testing the development of one skill-some of them very close in the developmental sequence. For instance, there are ten items related to the skill of sitting. Items like: sits with support, effort to sit, sits alone momentarily; sits alone-30 sec or more and sits down require some experience and good judgement on the part of the health worker. For instance one must be sure that the child sat down and did not slump down. Only those items which were simple and easy to administer and to assess and not requiring any special training, experience and equipment were selected. Further duplication of items with similar age-placement was avoided. while some items of similar nature like eye co-ordination were grouped together. In this way a total of 54 items--22 motor and 32 mental--were selected for the screening test.

Checklist (Grouped Items) For the Field Worker

The items were arranged sequentially according to their 97% pass age-placements. They were then grouped age-wise: one-monthly for the first 12 months, three monthly for the next six months and six monthly for the next 12 months (*Table I*). A child who fails the items in his chronologic age group is screened out for detailed study.

Developmental Curves for Follow-up Office and Well Baby Clinics

The 50 and 97% level age palcements of each item were plotted against its serial number and then joined to have two smooth curves--the upper representing the 50% pass level and the lower representing the 97% pass level (*Fig. 1*). The level of

DEVELOPMENTAL SCREENING
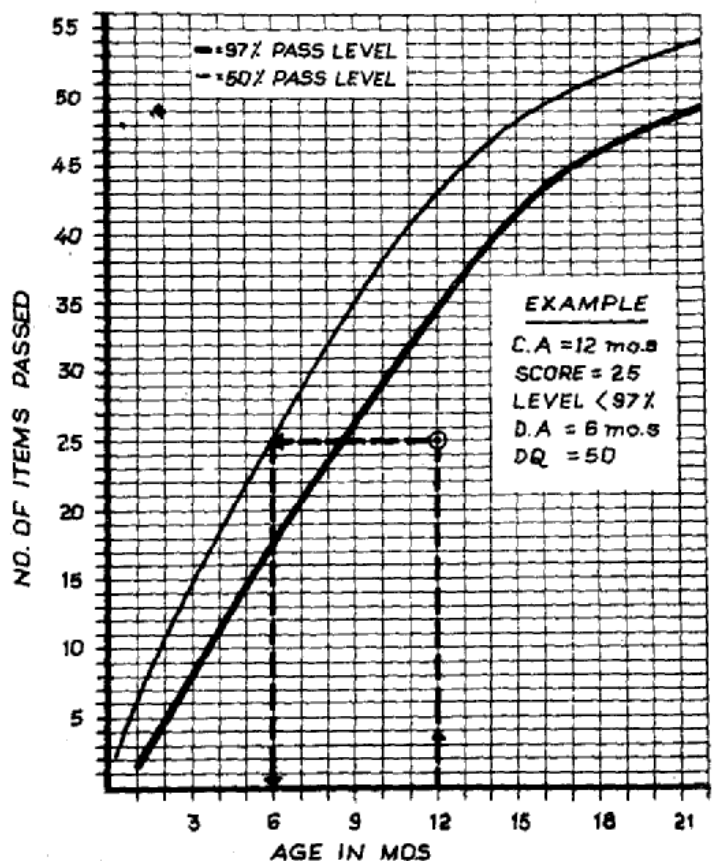### (BASED ON B.S.I.D.- BARODA NORMS)

Fig. 1. The development curves and calculation of developmental age and quotient.

TABLE I —*Screening Test Items with Serial Numbering and Age Grouping: The Corresponding Number on the Motor (*) and Mental (without asterick) Scales of BSID and the 50% and 97% Age Placements are also Presented*

Age group (mo)	Sr. No.	Items	BSID No.	Age placements (mo)	
				50%	97%
1	1.	Arms and legs thrust in play	*3, 4	0.5	1.0
	2.	Momentary regard	1	0.5	1.0
	3.	Lateral head movement (prone)	*5	0.6	1.1
2	4.	Responds to sound	5, 7, 8	0.6	1.1
	5.	Follows moving person	10	0.7	1.6
	6.	Free inspection of surrounding	12	0.8	1.9
3	7.	Social smile/vocalises	19, 20	1.4	2.9
	8.	Eye co-ordination	13, 14, 15, 18	1.4	3.0
	9.	Head erect and steady	*10	1.5	3.1
4	10.	Holds head steady	*14	2.2	3.7
	11.	Recognises mother	28	2.3	3.8
	12.	Elevates on arms	*13	1.9	3.9
5	13.	Play with rattle/hand play	37, 38	2.9	4.7
	14.	Reaches for dangling ring	36	2.8	4.9
	15.	Sits with slight support	*16	2.8	4.9
6	16.	Turns head to sound	46, 47	3.9	5.7
	17.	Turns from back to side	*18	3.4	5.8
	18.	Exploitive paper play	52	4.4	5.9
7	19.	Discriminates strangers	59	4.9	6.9
	20.	Pulls to sit	*22	4.9	6.9
8	21.	Bangs in play	69	5.6	7.0
	22.	Sits alone steadily	*30	6.2	7.9
9	23.	Retails two things in two hands	75	6.1	8.6
	24.	Pulls to stand	*29	6.1	9.0
	25.	Playful response to mirror image	76	6.3	9.2
	26.	Sits with good co-ordination	*31	6.5	9.2
10	27.	Pulls string-secures toy	81	7.1	9.4
	28.	Co-operates in play	79	6.9	9.9
	29.	Crawling (pre-walking)	*35	6.9	10.0
11	30.	Rings bell purposefully	85	7.7	10.7
	31.	Fine prehension	*41	8.6	10.9

<div align="center">**TABLE I** (*Contd.*)</div>

Age group (mo)	Sr. No.	Items	BSID No.	Age placements (mo) 50%	97%
	32.	Raises to sit	*37	8.2	11.0
	33.	Stands by furniture	*40	8.5	11.0
12	34.	Adjusts to words	85	8.3	11.7
	35.	Says da-da	88	9.0	11.9
13 to 15	36.	Inhinits on command	90	9.7	12.6
	37.	Midline skills	*42	9.4	12.7
	38.	Walks with help	*43	9.7	13.0
	39.	Turns pages	100	11.0	13.9
16 to 18	40.	Imitates words	103	11.9	15.7
	41.	Stands alone	*45	10.8	15.9
	42.	Spontaneous scribble	108	13.1	16.5
	43.	Throws Ball	*48	12.6	16.7
	44.	Aufstein I	*46	12.3	17.3
	45.	Walks alone	*47	12.5	17.4
	46.	Gestures for wants	112	13.7	18.3
19 to 24	47.	Shows shoes, *etc.*	115	14.1	18.8
	48.	Two words	114	14.1	19.1
	49.	Walks up and down stairs with help	*53, 54	16.5	24.5
	50.	Words for wants	124	17.5	24.8
25 to 30	51.	Two word sentences	134	21.2	28.8
	52.	Names three objects	144	24.1	29.0
	53.	Stands on one foot	*60, 61	26.6	29.0
	54.	Walks up and down stairs without help	*57, 58	24.4	29.6

performance of the child is known by plotting the total number of items passed by him/her (score) against the chronologic age. Any child below the 97% pass level is screened out for further study for developmental delay. The intersection of the horizontal level of this score with the 50% level curve gives the developmental age (DA) of the child, *i.e.,* the age at which 50% normal children are expected to have the same score. The developmental quotient can then be easily calculated. If a child with chronologic age (CA) of 12 months has a score of 25, it is obvious from *Fig. 1* that his development is delayed. It is seen that 50% of normal children attain the score of 25 at the age of 6 mo (DA) and the development quotient (DQ = DA/CA × 100) will be 50. At the time of revisit, the child's development can be followed on the same curve.

Results

From the original test records of the full BSID, 191 test records for eight different months were picked up without selection. The combined motor-mental development age placement at 97% and 50% pass levels were computed from the full scales in a manner similar to that for the screening test. The age placement for the 50% and 97% pass levels, computed by application of the full scales and of the screening test, were compared in each of the 191 test records (*Table II*). The mean ages as calculated by applying the full scales and the screening test were very close in each age group at both levels.

TABLE II – *Mean Age Placements by Full Scales and Screening Test (Rounded to 2 Decimals)*

Chronologic age (mo)	N	Age placement (mo)			
		50% pass level		97% pass level	
		Full scales	Screening	Full scales	Screening
1	25	1.5	1.4	3.0	2.9
2	25	2.0	2.0	3.6	3.8
4	25	4.0	4.3	5.6	6.3
6	21	5.2	5.2	7.1	7.6
9	20	8.5	8.3	11.4	11.4
12	25	11.2	10.9	14.5	14.2
13	25	12.4	12.1	16.3	16.1
15	25	13.4	13.2	18.1	19.0

Discussion

A screening examination is meant to be given to as many people as can be reached in the entire target population. The test used must, therefore be inexpensive, cheap and easy to administer by non-professionals with reasonable accuracy though the result may not be perfectly accurate. The objective of a screening test should be to identify a smaller portion of the total population for more extensive study by the experts(7). Our screening test was developed out of the full scales of the BSID standardized on Baroda children and uses the same age placement but the number of items is much smaller.

Because of the nature of the test items (same as in locally standardized test) and because of the close results obtained on the normal sample, the screening test was put to use in the field survey as well as in clinical practice (especially well baby clinics). It is being used in the field for more than three years by the health workers of the Baroda Citizens Council and as reported by the Convenor of the 'Early Detection of Childhood Disability Programme' there is no difficulty in its application and interpretation. The health worker needs orientation into the importance of developmental screening of infants and into the administration and the interpretation of various test items(8)–for instance, the difference between sitting with slight support, sitting steadily and sitting with good co-ordination (Item Nos. 15, 22 and 26 in *Table I*). Indeed each one of the 54 items should be explained and the pitfalls pointed out. In our experience five or six one-hour sessions are sufficient for the training.

Although the screening test was useful in field and in the office, it was felt necessary to test its sensitivity and specificity and reliability in the hands of health-workers *vis-a-vis* results on full scales administered by trained testers. The work was taken up at another centre (Child Development Unit, KEM Hospital, Pune). Based on a study of 730 records of 130 babies (101 of them 'at risk'), 101 records of 6 months old

and the results of assessment of 50 children on the screening test by a non-technical person and on full scales by the trained tester, Phatak and her co-workers reported a sensitivity and specificity of 65%-95% in the 3 groups. Their results support the usefulness of the screening test (Personal communication).

Although the BSID (Baroda norms) is regularly used at 6-7 research centres in our country, the DDST appears to be better known amongst the pediatricians. It may not be therefore, out of place to consider some of its aspects. The DDST(2) was evolved by selecting 105 items after reviewing 12 developmental tests. The items were standardized on 1036 Denver Children aged between 2 weeks and 6.4 years. Sixty-seven of these items are applicable to children of the age upto 30 months—fifty-five of which are to be found in the BSID full scales(4). All the 54 items of our screening test are picked up from the BSID yet only 29 items are common between the DDST and our test (BDST). Both the screening tests have been developed for the 'non-professionals' and the level of his work and his local working conditions are bound to influence the selection of the items. For instance, it would be difficult for our field worker to distinguish between 'prone-lift head', 'prone-head upto 45°', and 'prone-head upto 90°' during the door-to-door survey. For reasons already stated, items related to the use of the cubes were also considered unsuitable.

The DDST distributes the items under four separate areas of development (gross motor, language, fine motor-adaptive, personal-social) and this is considered as an advantage by some. As stated earlier, the objective of a screening test is very limited --to pick up children for more specific evaluation by skilled professionals. Even the diagnosis of 'delayed development' should be after the detailed evaluation and not at the level of 'screening'. For intervention and stimulation programme, it would be necessary to identify many more areas of development than the two of Bayley(4), or four of Gessel(9) or five of Griffiths(10), e.g., auditory, visual, memory, spatial relation, cognition, communication, interaction, etc.(11). A detailed study of the infant's performance is needed for locating the various areas. The screening test should only pick-up the 'at-risk' infants for the detailed study. The authors feel that combining the items into a unified scale is an advantage for a screening test as it makes the test quick and simple for the health worker.

Considering that the Baroda Development Screening Test is based on local norms and is developed to suit the level of training and working conditions of our health worker, it is suggested that it would have a wide application in field surveys as well as in clinical practice.

Acknowledgements

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