ORIGINAL ARTICLES

A STUDY OF BARODA DEVELOPMENT SCREENING TEST FOR INFANTS

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ABSTRACT

Baroda Development Screening Test for Infants based on Baroda Norms on BSID-Research Form 1961 were studied at the Child Development Unit of the Department of Pediatrics in the K.E.M. Hospital, Pune. Screening validity, sensitivity, specificity, over-referrals and under-referrals were calculated in three samples--(i) 730 records of 130 babies evaluated on BSID-Baroda Norms during 1979 and December 1984; (ii) 101 records of babies tested at six months out of the first sample; and (iii) 50 babies screened by interviewing the mothers and tested on the full scales by the experts. Screening validity, sensitivity and specificity were more than 76, 66 and 77%, respectively. Over-referrals were highest (35%) in the sample screened by interview. Suggestions are made to improve the screening by interview. Baroda Development Screening Test for Infants is recommended for use in the field for further evaluation.

Key words: *Development screening, Early detection of development delay.*

Survey of populations for screening children who are delayed on psychomotor development is one of the urgent problems today, especially when we are entering the last decade of the National Programme of Health for every child born alive by the year 2000. The purpose of screening children for delayed psychomotor development is to locate such children who need critical diagnostic assessment so as to determine the intervention programme(1,2). The need for screening is enhanced because of (*i*) vast population, (*ii*) limited expertise, and (*iii*) dearth of paramedical and medical experts for critical evaluation of every child. Hence, the development and use of screening tests can hardly be underrated.

Material and Methods

Tests

1. Baroda Development Screening Test for Infants(3,4): The Baroda Citizen's Council was to undertake a programme of house to house survey for early detection of disabled infants. It was supported by the UNICEF. A screening test was an urgent need. Dr. Phatak selected items for Bayley Scales of Infant Development (BSID)-Research Form 1961. Using 97% pass

placements of Baroda Norms he arranged 54 selected items from the motor and mental scales to make the screening tests for survey. The 54 items selected and rearranged by Dr. Phatak are given in *Table I*. After using them in the field, office practice and well-baby clinics he found them to be reliable and useful.

2. BSID-Research Form 1961 with Baroda Norms as they were used in the Testing Units(5,6).

Samples

1. 730 records of 130 babies (31 normal, 99 at risk) performance on BSID collected in our Unit at K.E.M. Hospital from 1979 to 31st December 1984. They covered the age range of one to 30 months.

2. 101 records of performance at 6 months from the same 730 records.

3. Mothers who brought their babies for infant testing were interviewed and assessed on the screening items by a person introduced to BSID. The babies were tested on the full scales on the same day by experienced testers. Fifty babies who were screened by interview covered the age range of 2.9 to 19.4 months.

Screening Procedure

Seven hundred and thirty records were used to assess the performance on the screening items. The number of items passed from Baroda Development Screening Test for Infants were counted. The child scoring the number of items placed at his chronological age in the Baroda Development Screening Test for Infants or less was considered to be delayed in development; *e.g.,* a child scoring 9 at three months or 35 at 12 months was noted as delayed in development (This was guided by the fact that the screening items are arranged on the basis of 97% pass placements). Exception was made at 54 as there is no scope for further score on the tests. Even at the age of 30 months a child scoring 54 was not considered as delayed. The same criteria were used in assessing the information collected by interview.

On the full scales assessments, the motor and mental quotients were calculated by using the formula:

$$\frac{\text{Motor age/Mental age}}{\text{Chronological age}} \times 100$$

If the child's motor or/and mental development quotients were calculated to 77.5 (-1.5 SD) or less, the child was assessed as of delayed development on the full scales (the full scales are based on 50% pass placements).

Results

All the records were critically scanned and classified into four groups, namely: (*i*) Delayed on the screening test and delayed on the full scales too (correctly screened as delayed); (*ii*) Normal on Screening Test and normal on the full scales too (correctly screened as normal); (*iii*) Delayed on screening test but normal on the full scales (wrongly screened as delayed-over-referrals); and (*iv*) Normal on screening test but delayed on the full scales (wrongly screened as normal-under-referrals).

Using the frequencies in the four groups, Baroda Development Screening Test for Infants was studied for sensitivity, specificity, over and under referrals and screening validity. The following percentages were calculated:

(*i*) *Sensitivity:* Out of the total number of babies screened as 'delayed' the percentage of babies who were delayed on the full scales.

TABLE I—*Phatak's Screening Test Items and Age-Grouping*

Sl. No.	Items	Sl. No.	Items
	1st Month		**9th Month**
1.	Arms and logs thrust in play	23.	Retains two things in two hands
2.	Momentary regard	24.	Pulls to stand
3.	Lateral head movement (Prone)	25.	Playful response to mirror image
		26.	Sits with good co-ordination
	2nd Month		**10th Month**
4.	Responds to sound	27.	Pulls string—secures toy
5.	Follows moving person	28.	Co-operation in play
6.	Free inspection of surrounding	29.	Crawling (pre-walking)
	3rd Month		**11th Month**
7.	Social smile/vocalizes	30.	Rings bell purposefully
8.	Eye co-ordination	31.	Fine prehension
9.	Head erect and steady	32.	Raises to sit
		33.	Stands by furniture
	4th Month		**12th Month**
10.	Holds head steady	34.	Adjusts to words
11.	Recognizes mother	35.	Say da-da
12.	Elevates on arms		
	5th Month		**13th Month to 15th Month**
13.	Play with rattle/hand play	36.	Inhibits on command
14.	Reaches for dangling ring	37.	Midline skills
15.	Sits with slight support	38.	Walks with help
		39.	Turns pages
	6th Month		**16th to 18th Month**
16.	Turns head to sound	40.	Imitates words
17.	Turns from back to side	41.	Stands alone
18.	Exploitive paper play	42.	Spontaneous scribble
		43.	Throws ball
	7th Month	44.	Aufstein I
		45.	Walks alone
19.	Discriminates strangers	46.	Gestures for wants
20.	Pulls to sit		
			19th to 24th Month
	8th Month	47.	Shows shoes, *etc.*
		48.	Two words
21.	Bangs in play	49.	Walks up and down stairs with help
22.	Sits alone steadily	50.	Words for want

TABLE I—(Contd.)

Sl. No.	Items
	25th to 30th Month
51.	Two word sentences
52.	Names three objects
53.	Stands on one foot
54.	Walks up and down stairs without help

(*ii*) *Specificity:* The percentage of babies screened as normal and were normal on the full scales out of the total number of babies screened as normal.

(*iii*) *Screening validity:* Percentage of the number of babies screened correctly as 'delayed' and as 'normal' out of the total sample.

(*iv*) *Over-referrals:* Percentage of babies screened as 'delayed' but were normal on the full scales out of the total number of babies screened as 'delayed'. These are the babies who would be referred to experts for full evaluation and would be noted as normals.

(*v*) *Under-referrals:* Percentage of babies screened as normal but were delayed on the full scales, out of the total number of babies screened as normal. These babies would be ignored and not referred to experts for full evaluation.

The results of these calculations are given in *Table II*.

Discussion

Screening tests for survey are meant for applying to large population. Hence, they should be (*i*) inexpensive, (*ii*) short, consuming less time and space, and (*iii*) easy or less technical in administration so that they can be used by less specialized persons, such as child psychologists, health or social workers. It is inevitable that a screening test for survey will be less accurate in judging delayed development than a technically standardized tool for critical evaluation. Some children noted as delayed on a screening test might not be so when assessed on a standardized tool accurately. This error is described as 'false positive'. On the other hand, some children not noted as delayed might measure delayed on the standardized tool. This error is described as 'false negative'. The first type of error leads to over-referrals for critical evaluation, taxing, the experts with work load and parents with anxiety and visits to experts. The second type of error leads to under-referrals making the health care workers and parent complacent about the development of children who need attention(7).

In our three samples the screening validity of Baroda Development Screening Test for Infants range from 76 to 94%. The sensitivity and specificity are above 65%. The over-referrals range from 6.67 to 34.37% and under-referrals vary between 5.6 to 22.6%. A critical look at the percentages presented in the *Table II* point out that the sensitivity percentage and over-referrals in the group screened by interview are the lowest and the highest, respectively.

Elliman *et al.*(8) have presented comparative performance of 133 preterm infants on Denver Development Screening Tests (DDST) and Griffiths Mental Development Scales (GMDS) at 6, 9 and 12 months of their real age and also at corrected age, making a total of 266 records. The babies were classified into questionable/abnormal performance and normal performance on the basis of predetermined criteria on DDST. The frequencies in the two groups are further divided into those who had GMDS DQ less than 80, and those who had DQ more than 80. *Table II*

TABLE II—Comparison of Results on Baroda Development Screening Test for Infants (BDSTI) and BSID Baroda Norms

Sr. No.	Samples	Age range & No. of infants	No. of records	Delayed on screening		Delayed on BDSTI, BSID DQ <77.6 Mo/Me/both (sensitivity)		Delayed on BDSTI, BSID DQ >77.6 Mo/Me/month (over referrals)		Not delayed on BDSTI, BSID DQ >77.5 Mo/Me/both (specificity)		Not delayed on BDSTI, BSID DQ <77.6 Mo/Me/both (under referrals)		Screening VALIDITY (correct screening)
				F	%	F	%	F	%	F	%	F	%	%
1.	Longitudinal data treated cross sectionally	1-30 mo 130	730	151	20.68	133	88.07	18	11.0	448	77.37	131	22.63	79.58
2.	From longitudinal records	5.6-6.5 mo 101	101	30	29.7	28	93.33	2	6.67	65	91.54	6	8.45	94.05
3.	Screened by interview	2.9-19.4 mo 50	50	32	64.0	21	65.62	11	34.37	17	94.44	1	5.56	76.0

from Elliman's paper is reproduced as *Table III.* Using the frequencies in this table the present authors calculated sensitivity, specificity, screening validity, over-referrals and under-referrals, following the same procedures as followed in studying Baroda Development Screening Test for Infants in this paper. *Table IV* gives the relevant results along with the similar calculations of the study under report. A comparative look at the percentages noted in *Table IV* shows highest sensitivity (65%) and lesser over-referrals (35%) for Baroda Development Screening Test for Infants. Templin(1) as a part of her larger study of developing norms on a screening test of articulation has compared the use of 50 screening sound elements out of 176 speech sounds which forms the full measure. She has noted, 'Since 50 of the same items are included in both the scores the

correlation between the two measures are somewhat increased'. It is likely that the screening of Phatak's screening items against BSID might be higher than what it would might have been in comparison with an independent diagnostic tool. The percentages in the present study are not directly comparable with the percentages in DDST vs GMDS study as the composition of the screening test (DDST) and the contents of the standardized tests (GMDS) are not studied. However, at this stage it may be inferred that the results of DDST (widely used screening test in our country) vs GMDS support the use of Baroda Development Screening Test for Infants.

As regards the screening by interview on Baroda Development Screening Test for Infants the low sensitivity percentage and high over-referrals might be bettered by improving the collection of information.

TABLE III– *Comparison of Denver Development Screening Test (DDST) and Griffiths Mental Development Scales (GMDS) Results Obtained on the Same Day. (Quoted from Elliman et al. Table II (8).*

Age (mo)	GMDS <80			GMDS >80		
	DDST Questionable/ abnormal	Normal	Total	DDST Questionable/ abnormal	Normal	Total
6 (n=52) Real age	15	3	18	13	21	34
Corrected age	2	16	18	0	34	34
9 (n=42) Real age	10	1	11	8	23	31
Corrected age	4	7	11	0	31	31
12 (n=39) Real age	5	0	5	9	25	34
Corrected age	2	3	5	4	30	34

TABLE IV—*Screening Efficiency of Baroda Development Screening Test for Infants (BDSTI) and DDST*

Parameter	BDSTI vs BSID full scale			DDST vs GMDS
Sensitivity	65.62	to	93.33	52.78
Specificity	77.37	to	94.44	84.54
Over-Referral	6.67	to	34.37	47.20
Under-Referral	5.56	to	22.63	15.46
Screening Validity	76.00	to	94.05	75.90

It may be suggested that to improve efficiency of screening by interview the information collected be supplemented by (*i*) possible observations of the infant on the items during the visit for interview; (*ii*) repeated screening by the same person after a day or so; and (*iii*) independent/joint screening by two persons.

To sum up, as the screening validity, sensitivity and specificity of Baroda Development Screening Test for Infants are above 65% they may be accepted as valid for reliable screening tests for early detection of infants with delayed motor and mental development.

As the present study is mainly based upon the records of performance on the full scales administered in the testing unit it may be proposed that Baroda Development Screening Test for Infants be used in a regular survey of population upto 2 years of age so as to facilitate the study of the scale in use.

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