Ages and Stages Questionnaire as a Screening Tool for Developmental Delay in Indian Children

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Objective: To evaluate the ability of 'Ages and Stages Questionnaire', a parent completed developmental screening questionnaire to detect developmental delay in Indian children.

Design: Cross-sectional study.

Setting: Child Development Clinic of a tertiary care center located in Northern India

Participants and Methods: 200 children, 50 each in the age groups of 4±1, 10±1, 18±1 and 24±1 months were recruited (20 high risks and 30 low risks in each age group). The Ages and Stages Questionnaire (ASQ) was translated into Hindi and administered to the parents, followed by standardized development assessment using Developmental Assessment Scale for Indian Infants (DASII).

Results: 102 (51%) children failed on ASQ and 90 (45%) children failed on DASII. The overall sensitivity of ASQ for detecting developmental delay was 83.3% and specificity was 75.4%. The sensitivity was best for the 24-months questionnaire (94.7%) and specificity was best for the 4-month questionnaire (86.4%). The sensitivity of ASQ was much higher in the high risk group (92.3%) as compared to the low risk group (60%).

Conclusion: ASQ has strong test characteristics for detecting developmental delay in Indian children, especially in high risk cases. It may be easily converted into other Indian languages and used widely for developmental screening.

Key words: *Ages and Stages Questionnaire, Developmental delay, Developmental screening, Diagnosis, Hindi.*

Most of the traditional screening tools for detection of developmental disabilities involves direct elicitation of the child's skills and are cumbersome to use. They are not only time consuming and costly, but also require child's cooperation in the clinic setting [1]. Recently, there has been a growing interest in parent-based assessment. Studies have shown that parental report of the current skills is predictive of developmental delay and parental concerns about language, fine motor, cognitive, and emotional and behavioral problems are highly predictive of true problems [2-7].

Ages and Stages Questionnaire (ASQ) has been a valuable addition to the group of developmental screening tools based on parent completed questionnaire. It is simple, cost-effective, and has the advantage of parents being active participants in the evaluation of their children. After the revision of ASQ in year 1997, it has been translated into many languages. Studies on ASQ in both high risk and low risk populations have shown that it has good psychometric properties [8-13]. However, there are no published studies on the use of this questionnaire in the Indian context. This study was planned to evaluate ASQ for detecting developmental delay in Indian children.

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METHODS

The study was conducted at the Child Development Clinic (CDC) of Lok Nayak Hospital, New Delhi, India from February, 2009 to January, 2010. Children in the four age groups; 4±1 months, 10±1 months, 18±1 month and 24±1 months, attending the Pediatric Out Patient Department or High Risk Clinic of the hospital were included in the study. The included children were stratified into high and low risk groups. The high risk group comprised of children with any of the following risk factors: history of hospitalization in the first four days of life, birthweight <2 kg, gestation age <37 weeks, history of central nervous systems infections, known dysmorphic syndrome or chromosomal anomalies, suspected cerebral palsy or developmental delay, and or history of two or more episodes of afebrile seizures. Children with none of the above mentioned risk factors comprised the low risk group. Children with non-

availability of birth records or the primary caregiver at the time of evaluation were excluded.

A convenience sample of 200 children of either sex, 50 in each of the four specified age strata were enrolled in the study. In each age group, 30 low risk and 20 high risk children were enrolled. A detailed history and physical examination was done in all the children at the time of enrollment, followed by administration of ASQ by a pediatric Resident to any of the available parent, mostly mothers. On the same day, developmental assessment of the child was also done by Clinical Psychologist using Developmental assessment Scale for Indian Infants (DASII). All the parents were administered ASQ by the same Resident; however, DASII was administered by any of the Clinical Psychologists at CDC. Clinical psychologists were blinded to the scores on ASQ.

Assessment tools: The Ages and Stages Questionnaire-Second Edition is a set of 19 age-specific parent-completed questionnaires aimed at assessing the developmental status of infants and young children up to 5 years of age. Each questionnaire is valid for 1 month on either side of the target age and consists of 30 simple worded developmental items, equally divided into five domains of child development: communication, gross motor, fine motor, problem solving and personal social skills. The reading level of the items ranges from fourth to sixth grade. For each item, there is a choice of three responses: 'Yes', 'Sometimes', or 'Not yet', which are scored as 10, 5, or 0, respectively. Domain scores are then obtained by the sum of the items. Children with ASQ score below the cut off (<2SD) in any of the domain are taken as screen failed [14].

For the present study, only 4, 10, 18 and 24 months questionnaires were used. The questionnaires were translated into Hindi language and back-translated into English and this procedure was repeated until the back-translation matched the English versions.

Developmental assessment Scale for Indian Infants (DASII), based on Bayley Scale of Infant Development (BSID) was used in this study as gold standard for developmental assessment. It assesses development in the age range of birth to 30 months and provides a measure of Motor development and Mental development as Motor Developmental Quotient (DQ) and Mental DQ, respectively, as in BSID. The normative values on DASII have been established based on a sample of Indian Children [15]. Although the published literature on it's use is scarce, it is commonly used in India [16,17]. Developmental delay is defined on DASII as DQ score ≤70 (≤2SD) in either the mental or motor scale.

Ethics and consent: Informed consent was obtained from parents of all the children enrolled in the study. Ethical approval was taken for conducting this study from the Institutional Ethical Committee. Children found to have developmental delay were offered appropriate intervention and management at CDC.

Statistical analysis: The data was entered and analyzed using Epi Info. The psychometric pro-perties of ASQ were calculated using DASII as gold standard. Pearson correlation coefficient was used for correlation between the ASQ and DASII scores.

RESULTS

Overall, 268 children were screened for inclusion in the study. Out of these, 51 did not meet the inclusion criteria and 17 denied consent for the study. The final study group comprised of 200 children, 50 each in the 4 age groups. **Table** I shows the demographic characteristics of the study sample. The risk factors present in the high risk group are tabulated in **Table** II.

On detailed clinical evaluation, 17 (8.5%) children were found to have feeding problems, 20 (10%) had hearing impairment, 11 (5.5%) had visual impairment, 8 (4%) had squint, and 15 (7.5%) had cerebral palsy; all of them belonged to the high risk group.

A total of 102 (51%) children failed on ASQ. Among the high risk group, 66 (82.5%) children failed ASQ whereas in the low risk group 36 (30.0%) failed. The results of ASQ according to domain are shown in **Web Table** I. The largest number of failures was found in the fine motor domain (36.5%) and lowest number in personal social domain (27%). Maximum numbers of the failures in fine motor domain were in the 4 months age group. Overall 90 (45%) children failed on DASII (DQ ≤70 in either Motor or Mental Scale). Among the high risk group 65 (81%) failed DASII, whereas in the low risk group 25 (21%) failed. There were greater numbers of failures in the motor than mental scale (**Web Table** II).

The overall sensitivity of ASQ in detecting developmental delay was 83.3% and specificity was 75.4% with a negative predictive value of 84.6% (**Table** III). The sensitivity was best for the 24 months questionnaire (94.7%) and the specificity was best for the 4 month questionnaire (86.4%). The sensitivity was much higher in the high risk group.

The ASQ Communication, fine motor, problem solving and personal social domain scores were correlated with the Mental DQ of DASII (**Table** IV). The ASQ Gross motor domain score was correlated with the Motor DQ of DASII. All correlations were found to be good (*r*, 0.76-0.80).

TABLE I Demographic Characteristics of the Study Sample (*N*=200)

Characteristic	No (%)
Gender, Male	112 (56)
Mother's age, years	
<20	5 (2.5)
20-29	155 (77.5)
30-35	32 (16)
>35	8 (4)
Primiparous mother	115 (57.5)
Antenatal problems, *n* (%)	
Fever with rash	2 (1)
Anemia	31 (15.5)
PIH/preclamsia/eclampsia	1 (0.5)
Antepartum hemorrhage	5 (2.5)
Gestational diabetes mellitus	1 (0.5)
Mode of delivery	
Vaginal delivery	175 (88)
Cesarean section	24 (12)
Birthweight, g, mean±SD	2.56±0.60
Mother's education	
Illiterate	17 (8.5)
Primary	11 (5.5)
Secondary	71 (35.5)
Graduation	46 (23.0)
Post-graduation	55 (27.5)
Father's education	
Illiterate	5 (2.5)
Primary	38 (19)
Secondary	120 (60.0)
Graduation	29 (14.5)
Post-graduation	8 (4.0)
Socioeconomic class*	
Upper	20 (10)
Upper Middle	55 (27.5)
Lower Middle	87 (43.5)
Upper Lower	7 (3.5)
Lower	31 (15.5)

*According to Kuppuswamy scale [21].

TABLE II Risk Factors of the High Risk Group (*N*=80)

Risk factor*	No (%)
Prematurity	21 (26.2)
Low birthweight (< 2 kg)	33 (41.2)
Hospitalization in the first four days of life	55 (68.7)
History of CNS infection	5 (6.2)
Suspected CP or Developmental delay	15 (18.7)
Known dysmorphic syndrome or chromosomal anomalies	6 (7.5)
Seizure disorder	4 (5.0)

Multiple risk factors were present in many patients; CP: cerebral palsy; CNS: central nervous system.

specificity was 86.21% and percentage agreement with the standardized assessment was 84.11% [8]. After the study that validated ASQ-Second edition, a number of other authors have also evaluated ASQ in different populations and in different age groups, using a combination of multiple gold standard assessment tools and found good results [8-13]. In the present study, the sensitivity was found to be good for 10, 18 and 24 months, and modest for the 4 month questionnaire. The specificity was best for the 4 month questionnaire but was particularly low for the 18 months. The lower sensitivity in our study of 71% for the 4 month questionnaire is consistent with finding of 51% sensitivity in the study that validated the revised ASQ [8]. This may be related to the fact that parental assessment of language and cognitive delay in infancy is less objective allowing more favourable reporting at lower ages. The high sensitivity and specificity of the 24 months ASQ is also noted by other authors [11].

The present study also showed that the sensitivity was higher in the high risk group whereas specificity was higher in low risk group. The over-referral and under-referral rate was also lower in the high risk group. Two Australian studies also showed similar results while evaluating ASQ in population medically at risk for developmental delay, premature infants and survivors of hypoxic ischemic encephalopathy [12,13].

In the present study, there was good correlation between the domain scores of ASQ and DASII. Most other studies have not presented this data, but in one study, the correlation of ASQ domain scores with BSID-II scales was moderate except for ASQ fine motor and BSID-II motor scale, which was negligible [11]. This poor correlation obtained could be because the items in fine motor domain of ASQ are included in the mental scale of developmental tests and not in the motor scale.

This study had certain limitations. This being a hospital based study, it involved only a small number of

DISCUSSION

This study shows that ASQ has strong test characteristics for detecting developmental delay in Indian children. This study also reaffirms the value of ASQ as an effective developmental screening tool.

The validity and reliability of this revised edition of ASQ was established in year 1997, in a sample of 2008 children, comprising of both high risk and normative sample. The sensitivity of ASQ was found to be 74.56%,

TABLE III SCREENING TEST CHARACTERISTICS OF ASQ

Age group/ Risk group	Sensitivity (%)	Specificity (%)	PPV[†] (%)	NPV[‡] (%)	Percentage agreement (%)	OR[#] (%)	UR[§] (%)
4 months	71.4	86.4	86.9	70.3	82	6	16
10 months	80	76	76.9	77	74	12	10
18 months	94.4	65.6	60.7	95.4	78	22	2
24 months	94.7	77.4	72	96	82	14	2
Low risk	60	77.8	41.6	79.1	74.1	17.5	8.3
High risk	92.3	60	90.9	64.2	86.2	7.5	6.2
Overall	83.3	75.4	73.5	84.6	79	13.5	7.5

[†]*PPV – Positive Predictive Value,* [‡]*NPV - Negative Predictive Value,* [#]*OR- Over-referral,* [§]*UR - Under-referral.*

children. The lower reading ability of our population entailed the administration of the questionnaire by a doctor although it was originally constructed as a take-home questionnaire. Even though, the questions in the ASQ were made suitable for our population by replacing some words like *kishmish* (raisins) for "cheerio", some questions were almost universally unanswered because of the cultural inappropriateness of the questions, for example, questions on looking at large mirror at 4 months of age and the use of fork were answered by few.

This study is the first to evaluate ASQ in Indian population. The test characteristics of the ASQ were studied both in low risk children and those at risk for developmental delay. It included children from different socioeconomic backgrounds and also those in early infancy, where timely intervention is more likely to be beneficial.

In conclusions, this study shows that ASQ has strong test characteristics for detecting developmental delay in Indian children, especially at 18 and 24 months of age and in high risk children. Though further large scale community based studies are needed to evaluate ASQ in Indian population at all age groups, it can be easily converted into other Indian languages and used, especially for younger age groups where early intervention is more likely to be beneficial.

TABLE IV CORRELATION OF ASQ SCORES WITH DASII SCORES

ASQ domain	DASII Mental, Pearson r
ASQ Communication	0.761
ASQ Fine motor	0.799
ASQ Problem solving	0.788
ASQ Personal social	0.795
	DASII Motor, Pearson r
ASQ Gross motor	0.808

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WHAT IS ALREADY KNOWN?

• Age and stages questionnaire has not been evaluated in the Indian population.

WHAT THIS STUDY ADDS?

• ASQ has strong test characteristics for detecting developmental delay even in low resource settings

• The sensitivity of ASQ is higher in the high risk group, whereas specificity is higher in low risk group.

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