

## Original Research Article

# Status of neurodevelopmental impairments among children using rapid neurodevelopmental assessment attending a tertiary care hospital

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### ABSTRACT

**Background:** Developmental and childhood neuropsychiatric disorders have a large burden throughout the world, including the developing countries. Many children with clinically identifiable developmental problems present late for medical help due to lack of simple measures for their early recognition. These missed opportunities increase the level of dependence and disability of an individual and decrease the productivity of the community at large. So simple measures are needed to determine NDIs at an early age where professional expertise is sparse. Authors objective was to estimate the proportion of children having NDIs in a tertiary care hospital, and to estimate the specific types of NDIs, and their grades of severity, within the study population.

**Methods:** It was a cross sectional study conducted at the Department of Pediatrics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh and the duration of the study was six months. Children aged 0-2 years who were attending Pediatric OPD were included in the study. Sample was collected by lottery method and who fulfilled the inclusion criteria. A two-stage design was followed for detection of NDIs. Stage I was consisted of screening of all children in the sample by Development Screening Questionnaire (DSQ). Stage II consisted of neurodevelopmental assessment using a validated RNDA method of evaluation of all children with DSQ positive screening result.

**Results:** 7.26% children were found to have DSQ positive for NDIs. Cognition and speech was the mostly affected domain. By RNDA, NDIs were found in all DSQ positive cases. Severe impairment was 35.29% of the affected children in speech by RNDA. Detection of NDIs was more in gross motor (52.94% vs 35.29%), fine motor (94.18% vs 17.65%), speech (76.47% vs 64.71%), cognition (94.18% vs 64.71%), behavior (58.82% vs 5.89%) respectively by RNDA than the DSQ.

**Conclusions:** The frequency of NDIs is 7.26% of all children. In certain developmental domain (i.e. gross motor, fine motor, cognition, speech, behavior) RNDA is more effective than DSQ as found in the small-scale study.

**Keywords:** Children, Development, Development Screening Questionnaire, Disability, Impairment, Neurodevelopmental, Rapid Neurodevelopmental Assessment

### INTRODUCTION

WHO estimates that about 10% of the world's population has some form of disabilities.<sup>1</sup> Using a two phase design survey of 22000 children two to nine years old children,

Durkin et al, reported childhood disability prevalence of 15.2% in Jamaica, 14.7% in Pakistan and 8.2% in Bangladesh.<sup>2</sup> Many children with clinically identifiable developmental problems present late for medical help due to low rate of early recognition.<sup>3</sup> In an epidemiologic

survey of disabilities among 2-9 years old children in Bangladesh, an estimated 68 of 1000 had some form of disability related to motor, vision, hearing, cognitive disabilities and seizure disorders.<sup>4</sup> With a total population of >146 million people including >20 million children <5 years of age, large unrecognized population may be at risk for neurodevelopmental morbidity, particularly considering that 85% of deliveries occur at home, often with no skilled care; only 7% of births are ever registered, and primary health care services do not include screening for the developmentally delayed child.<sup>5</sup>

Pediatricians use developmental screening tests infrequently and probably only after evidence of developmental delay has been established by other criteria.<sup>6</sup> So large unrecognized population of children in low-income countries are at risk for neurodevelopmental impairments (NDIs) from an early age.<sup>7</sup> These missed opportunities increase the level of dependence and disability of an individual and decrease the productivity of the community at large.<sup>6</sup> In Bangladesh there is the rise in prevalence of children who are at risk for disabilities from 8% 1988 to 20% in 2005.<sup>8</sup>

Recent reviews of early intervention studies in high-risk populations have demonstrated the potential to improve long-term cognitive and psychosocial development in children across low- and high-income countries.<sup>9,10</sup> Without these services, most children with NDIs are likely to progress to more permanent functional limitations, disabilities, and handicaps.<sup>11</sup>

The availability of simple and low cost measures to monitor disabilities affecting children of all ages is a global priority.<sup>8</sup> Developmental screening is aimed at identifying children who may need more comprehensive evaluation.<sup>12</sup>

The Rapid Neurodevelopmental Assessment (RNDA) is a comprehensive assessment procedure for ascertaining neurodevelopmental status of children aged 0 to 24 months in a developing country. The RNDA has developed to determine functional status in the following domains: primitive reflexes, gross motor, fine motor, vision, hearing, speech, cognition, behavior, and seizures. The tools have been validated against psychometric tests and tests of adaptive behavior which were either developed or adopted for Bangladesh. The RNDA can be used by professionals from a range of background with high reliability and validity for early identification and intervention to mitigate NDIs in large populations that live in developing countries where professional expertise is sparse.<sup>13</sup>

The Developmental Screening Questionnaire (DSQ) was developed in Child Development Centre, Dhaka Shishu Hospital, Bangladesh and in keeping with the Ten Questions for older children, was designed to be administered to mothers of children from birth to <2 years of age to screen their child's neurodevelopment.

The DSQ is a validated screening tool for screening <2-year-old children at risk for NDIs showed high specificity and was able to identify all children at risk for vision and hearing impairments, nearly three-fourth with speech impairments, two-third with gross motor impairments, and half with behavioral, cognitive and fine motor impairments. The DSQ tool has potential for use by frontline workers to screen large population link to definitive assessment as well as intervention services.<sup>14</sup> This study intends to determine the proportion of NDIs in a tertiary care hospital setting by simple measures like DSQ and RNDA.

## METHODS

The study was a cross-sectional observational study taken place in Department of Pediatrics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh from May 2017 to November 2017. For sample collection six working days per week except Friday from 8 am to 2 pm time frame was included into this study. During this time frame first a list was made of all children of 0-2 years who were enrolled for initial study sample. Then a second list was made of above children by applying inclusion & exclusion criteria (Only the children who were very sick requiring emergency management) & by excluding children whose parents/guardians were unwilling to be included into this study. Finally 3 children per day were selected by lottery method from the 2nd list for convenience of data collection.

Informed written consent from parents of eligible children was taken. History was collected comprising development, prenatal, natal and postnatal history, immunization, family and socioeconomic information from parents or attendance. Children were undergone an initial general & nervous system examination. The children identified with disability were advised to be enrolled as regular patient of pediatric neurology OPD of BSMMU for appropriate medical and other intervention services by the multidisciplinary team.

A two-stage design was followed for assessment of NDIs.

### Stage I

The developmental screening questionnaire (DSQ) was designed to be administered to mothers of children from birth to less than two years of age to assess their child's neurodevelopment. Questions were grouped by age in months. Once child's age was determined, eight questions related to the following eight functional domains were asked: gross motor, fine motor, vision, hearing, cognition, socialization, behavior, and speech. A 'yes'/'no' format for each item was recorded in the pre-coded form. At the end of the interview, any child positive on one or more functional domain was considered 'screen positive'.

**Stage II**

Neurodevelopmental assessment was done using a validated Rapid Neurodevelopmental Assessment (RNDA) method of evaluations of all children with positive screening results. RNDA as administered to identify the type of impairments and grades of severity. The RNDA was administered for use in children aged 0 to 24 months and consisted of 7 forms. One each for the following age groups: 0 to <1 month, 1 to < 3 months, 3 to <6 months, 6 to <9 months, 9 to <12 months, 12 to <18 months, 18 to <24 months under the following developmental parameters: gross motor, fine motor, vision, hearing, speech, cognition, behavior, and seizures for all age groups and for the age 0 to <1 month, additional primitive reflexes are examined along with other parameters. Children were tested on all age-appropriate items in each parameter. For every item, severity of functional limitations was also determined. For children aged 0 to <1 month, these were graded as “low,” “moderate,” and “high” risk for NDIs; “low risk” corresponds to age-appropriate development. For children aged ≥1 month, completion of the main item was considered age appropriate, and decreasing levels of competence was listed as “mild”, “moderate,” or “severe.” A summary sheet was completed at the end of the assessment.

Data analysis was done with Statistical Package for Social Sciences (SPSS-22 version) software (SPSS Inc, Chicago, IL, USA).

**Ethical implication**

Ethical clearance was taken from the Institutional Ethical Committee to perform the study.

**RESULTS**

**Baseline characteristics of children**

A total of 234 children of 0-2 years old were included into this study. A slight male predominance was observed ( male 50.85%) in the screened children. Mean age was 11.90±2.45 months. Most of the children were from the city area where the hospital is situated (Dhaka 72.65%). (Table 1).

**Table 1: Characteristics of the screened children (n= 234).**

Characteristics	Number	%
<b>Gender</b>		
Male	119	50.85%
Female	115	49.15%
Age in months (mean±SD)	11.90±2.45	
<b>Residence</b>		
Dhaka	170	72.65%
Outside Dhaka	64	27.35%

Among screened children male are slightly higher than female and mean age of the children is 11.90±2.45 months.

**Baseline characteristics of screen positive children**

**Table 2: Characteristics of screening positive children (n=17).**

Characteristics	Number	%
<b>Gender</b>		
Male	9	52.94%
Female	8	47.09%
Age in months (mean±SD)	12.06±3.15	
<b>Monthly income of household (in taka)</b>		
<10000	4	23.53%
10000- <25000	9	52.94%
25000- <50000	2	11.76%
>50000	2	11.76%
<b>Residence</b>		
Dhaka	10	58.82%
Outside Dhaka	7	41.18%

**Table 3: Clinical characteristics of screening positive children (n= 17).**

Parameters	Number	%
Consanguinity	0	0%
Maternal illness (GDM-2, HTN-3, hypothyroidism-1, IUD-1)	7	41.18%
Prolonged labour	3	17.65%
Delayed cry after birth	2	11.76%
Small for gestational age	2	11.76%
LBW	3	17.65%
Underweight	7	41.18%
Stunting	4	23.53%
Microcephaly	2	11.76%
Muscle tone abnormalities: (hypertonic-1, hypotonia-1)	2	11.76%
Prematurity	1	5.88%
Absence of exclusive breast feeding	9	52.90%
Neonatal jaundice	1	5.88%

Out of 234 children 17 children were positive for NDI which is 7.26% of the total children. Here a slight male predominance has been seen (Male 52.94%). Mean age of the children was 12.06±3.15 months. Majority of the NDI positive families were from lower income group (52.94% had only 100 - 300 USD/10000-25000 BDT income per month). More than half of the NDI positive children were from the city area where this hospital is situated. Commonest risk factor of the NDI positive children was maternal illness (41.18%). More than one third of the children were underweight and more than half of the

children were not on exclusive breast feeding in first 6 months after birth (Table 2,3).

Screening positive children are mostly associated with lower income (<25000 Tk./ month) group of families.

Among screening positive children maternal illnesses were found in 7 cases; malnutrition was found in 11 cases (underweight 7 and stunting 4).

Profile of DSQ positive children: More than one third of the children were from 18-24-month age group (35.29%) however, least number of children were from less than 6 month group as well as from 12-18 month group. Most affected domain in which delay observed were speech and cognition (64.71%). Gross motor delay was observed in 35.29% children (Table 4,5).

**Table 4: Age distribution of children in DSQ positive cases (n=17).**

Age in month	Number	%
0-6	3	17.65%
6-12	5	29.41%
12-18	3	17.65%
18-24	6	35.29%
Total	17	100%

Highest number of DSQ positive cases were in the age group of 18-24 months.

**Table 5: Distribution of NDIs in DSQ positive cases (n=17)\*.**

Parameters	Number of children affected	%
Gross motor	6	35.29%
Fine motor	3	17.65%
Vision	4	25.53%
Hearing	5	29.41%
Speech	11	64.71%
Cognition	11	64.71%
Behavior	1	5.89%
Socialization	0	0.0%

\*Total will not correspond to 100% for multiple NDIs in the same individual.

DSQ was positive for NDIs in the highest number both in speech and cognition.

**Profile of children with RNDA**

Most affected domain were fine motor and cognition in RNDA (94.18% each). Speech was affected in 76.47%, behavior in 58.82% and gross motor in 52.94%. Hearing and vision were the least affected domain. Significant difference in severity of grade of impairment was found in fine motor and cognition. (p value <0.05), most of the children were of mild variety. No statistically significant

difference was found in other domains in grading of severity ( Table 6,7).

**Table 6: Distribution of NDIs by RNDA (n= 17)\***

Parameters	Number of children affected	%
Gross motor	9	52.94%
Fine motor	16	94.18%
Vision	4	23.53%
Hearing	5	29.41%
Speech	13	76.47%
Cognition	16	94.18%
Behavior	10	58.82%
Seizures	0	0.0%

\*Total will not correspond to 100% for multiple NDIs in the same individual.

The highest number NDIs of 16 (94.18%) were found in both cognition and fine motor; the second highest number 13 (76.47%) of NDIs were found in speech.

**Table 7: Distribution of children by grades of severity of NDIs by RNDA (n= 17).**

Parameters	Severity: number of children affected			Chi-square test
	Mild No. (%)	Moderate No. (%)	Severe No. (%)	
Gross motor (n=9)	3 (17.65%)	3 (17.65%)	3 (17.65%)	$\chi^2= 0.0, p=1.000$
Fine motor (n=16)	12 (70.59%)	3 (17.65%)	1 (5.89%)	$\chi^2= 12.8, p=0.002^*$
Vision (n=4)	2 (11.76%)	1 (5.89%)	1 (5.89%)	$\chi^2= 0.50, p=0.779$
Hearing (n=5)	4 (23.53%)	0%	1 (5.89%)	$\chi^2= 1.80, p=0.180$
Speech (n=13)	5 (29.41%)	2 (11.76%)	6 (35.29%)	$\chi^2= 2.0, p=0.368$
Cognition (n=16)	5 (31.25%)	7 (43.75%)	4 (25.00%)	$\chi^2= 0.875, p=0.646$
Behaviour (n=10)	9 (52.94%)	0%	1 (5.89%)	$\chi^2= 6.40, p=0.011^*$
Seizures (n=0)	0%	0%	0%	-

\*significant

Fine motor (p=0.002) and behavior (p=0.011) had statistically significant difference among different grades of NDIs assessed by RNDA

**Comparison of DSQ and RNDA in NDI children**

While comparison of DSQ and RNDA has been done, it was revealed that RNDA was able to identify NDI in all DSQ positive children however RNDA found more NDI in some domains than by DSQ namely in gross and fine

motor function, speech, cognition and behavior. This NDI detection by RNDA was statistically significant in fine

motor, cognition and behavior (Table 8).

**Table 8: Comparison between DSQ and RNDA to detect NDIs.**

Developmental domain	Number of cases positive by DSQ (n=17 ) No. (%)	Number of cases detected for NDIs by RNDA (n=17 ) No. (%)	p value
Gross motor	6 (35.29%)	9 (52.94%)	0.300 <sup>ns</sup>
Fine motor	3 (17.65%)	16 (94.12%)	<0.001*
Vision	4 (23.53%)	4 (23.53%)	1.000 <sup>ns</sup>
Hearing	5 (29.41%)	5 (29.41%)	1.000 <sup>ns</sup>
Speech	11 (64.71%)	13 (76.47%)	0.451 <sup>ns</sup>
Cognition	11 (64.71%)	16 (94.12%)	0.033*
Behavior	1 (5.89%)	10 (58.82%)	0.001*
Seizures	-	0%	
Socialization	0%	0%	

P value reached from Chi-square test, \*significant, ns= not significant

NDIs were found in all DSQ positive cases by RNDA. Detection of NDIs were more in gross motor, fine motor, speech, cognition and behavior by RNDA than the DSQ.

RNDA picked up the NDIs significantly higher than DSQ in fine motor, cognition and behavioral abnormality ( $p < 0.05$ ).

## DISCUSSION

Many children are born with risk factors that predispose them to delayed development and developmental disorders. Early identification of developmental disorders is critical to the well-being of children and their families.<sup>15</sup> Despite rising interest in child disability, little is known about the frequency and situation of children with disabilities in countries with low and middle income.<sup>16</sup> In the present study the frequency of NDIs is 7.26% where males are (52.94%) more affected than females (47.09%). Almost similar observation was also reported by a collaborative study where disability had been found as 7% and the frequency was also slightly higher in boys than girls.<sup>17</sup>

Another community-based study has found at risk for NDIs is 17% which is much higher than the present study. Our data is hospital based, so it might not reflect the situation prevailing in the community. The most common at risk for NDIs identified in that study were speech (48.1%) and cognition (48.1%) which is consistent with the present study.<sup>14</sup>

In the present study by DSQ speech (64.71%) and cognition (64.71%) are found as the mostly affected domain which is followed by gross motor (35.29%) and hearing (29.41%). The previous study done in Bangladesh showed the mostly affected areas were hearing, speech and cognition among seriously disabled children.<sup>17</sup> Another study in India also reported speech and language problem as mostly affected domain.<sup>1</sup>

In the present study RNDA shows severe impairment as high as 35.29% and mild to moderate impairment is 5.89%-70.59% among the affected children. The previous study by “Ten Questions” showed severe impairment as 31% and mild to moderate impairment about 70%.<sup>17</sup> As the previous study was community based and the recent one is hospital based so severe impairment was found more frequently.

RNDA reported by Khan et al, basically provides an instrument to evaluate in detail of previously screened youngsters who have been thought to be at possible risk for developmental delays and handicaps.<sup>13</sup> As a next step after initial screening it can, indeed, be a useful tool to confirm and identify those who are really disabled and should be referred for specialized evaluations as needed, and possible early intervention considering RNDA as simple and easy tool.

In this study NDIs were detected in all DSQ positive children by RNDA. The DSQ sensitivity is 100% for vision and hearing but for speech, gross motor, behavior, fine motor and cognition it is 70%, 63%, 53%, 48%, 45% respectively.<sup>14</sup>

This study showed the effectiveness of RNDA was more than DSQ in gross motor (52.94% vs 35.29%), fine motor (94.18% vs 17.65%), cognition (94.18% vs 64.71%), speech (76.47% vs 64.71%) and behavior (58.82% vs 5.89%) respectively. RNDA picked up the NDIs significantly higher than DSQ in fine motor, cognition and behavioral abnormality ( $p < 0.05$ ). So, DSQ screening followed by RNDA has greater efficacy to detect NDIs. In a busy clinical setting and for large population DSQ followed by RNDA may be simple, and effective to detect NDIs.

There is scarcity of national surveys that have been carried out in Bangladesh to ascertain the precise magnitude of the problem of disability. Families living in rural Bangladesh have little access to services for

children with disabilities, due to lack of facilities and lack of knowledge about early detection and rehabilitation. Assessment and education are delayed until the child is of school going age or older. Programmed that provide services of early identification and intervention are very much needed in Bangladesh to identify the children with disability living in rural and remote areas.

## CONCLUSION

The frequency of NDIs is 7.26% of all children. DSQ can identify all the children at risk for NDIs of 0-2 years of age as compared to RNDA and in certain developmental domain (i.e. gross motor, fine motor, cognition, speech, behavior) RNDA is more effective than DSQ as found in the small-scale study. DSQ followed by RNDA may be a simple, effective method for identification of NDIs in large population in low resource countries however multi-center nationwide study is needed to validate this result.

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