

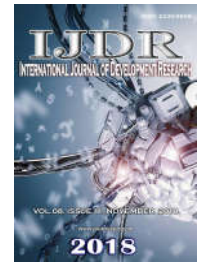


ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

IJDR

International Journal of Development Research
Vol. 08, Issue, 11, pp. 23967-23973, November, 2018



ORIGINAL RESEARCH ARTICLE

OPEN ACCESS

RISK FACTORS OF SPEECH DELAY IN OTHERWISE NORMAL UNDER-FIVE CHILDREN: A CASE-CONTROL STUDY

*¹Tanjina Sharifa, ¹Wahida Khanam, ²Zahid Hassan Arefin, S. M. and ³KaziIstiaque Sanin

¹Department of Pediatrics, Institute of Child and Mother Health (ICMH), Matuail, Dhaka, Bangladesh

²Department of Epidemiology, Institute of Child and Mother Health (ICMH), Matuail, Dhaka, Bangladesh

³Nutrition and Clinical Services Division, ICDDR, Dhaka, Bangladesh

ARTICLE INFO

Article History:

Received 19th August, 2018

Received in revised form

21st September, 2018

Accepted 07th October, 2018

Published online 28th November, 2018

KeyWords:

Developmental Speech Delay,
Risk Factors, Under-5 children.

ABSTRACT

Background: Significant deficits in speech development can occur in children without frank sensor motor or neurological disabilities. These children are at risk of less successful developmental and educational outcomes along with social exclusion. So identification of the probable risk factors for speech delay in children is important.

Objectives: The aim of this study was to identify the sociodemographic, family/birth-related and environmental risk factors for delayed speech in under-five children.

Materials and Methods: A case-control study was conducted in the Child Development Centre of Institute of Child and Mother Health, Dhaka during January to December 2017, on a sample of 120 under-five children (40 cases and 80 controls) by interviewing the parents, using a semi-structured questionnaire.

Results: In multivariate regression analysis, it was found that being single child, having family history of speech/language delay, history of neonatal complication, deleterious feeding habits, exposure to extended screen-on time and presence of stress in family/environment had significant association with speech delay in otherwise normal children under five years of age. No statistically significant socio-demographic risk factor was identified in this study.

Conclusions: Influence of accumulated risk factors, rather than individual ones, may play a greater role in delayed speech development in under-five children.

Copyright © 2018, Dr. Tanjina Sharifa et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Dr. Tanjina Sharifa, Wahida Khanam, Zahid Hassan Arefin, M. and KaziIstiaque Sanin. 2018. "Risk factors of speech delay in otherwise normal under-five children: a case-control study", *International Journal of Development Research*, 8, (11), 23967-23973.

INTRODUCTION

Speech is the verbal production of language and language is the conceptual process of communication. Development of speech requires an intact mechanism (eg. hearing, intelligence, structural integrity) with a favorable environment that provides adequate speech exposure and stimulation. But significant speech deficits can occur in children with normal hearing/intelligence and without neurological disabilities. Such developmental phonological disorders of unknown origin have been labeled as 'speech delay' when they occur in children who are still in the developmental period of speech acquisition (Shriberg et al., 1980).

*Corresponding author: Dr. Tanjina Sharifa,
Department of Pediatrics, Institute of Child and Mother Health (ICMH), Matuail, Dhaka, Bangladesh

Speech delay is diagnosed when child's conversational speech either is more unintelligible than would be expected for his or her age or is characterized by speech sound error patterns not appropriate for his/her age (Shriberg, Austin, Lewis, McSweeney and Wilson, 1997). The spectrum of such problem may include delayed phonation, stuttering or dysfluency, articulation disorders, apraxia of speech and unusual voice quality. Speech problems may be primary or secondary in origin. Expressive speech delay may occur without receptive delay but often they exist together in children as a mixed expressive-receptive speech delay. Prevalence rates for speech and language delay have been reported across wide ranges around the world. Delayed development of speech and language needs to be intervened into early, because frequently it is seen to be associated with poor intelligence and affected children are more vulnerable to academic failure, social exclusion, behavioral and emotional

difficulties (Patricia A. *et al.* 2008). Various factors influence the development of speech and use of language including sociodemographic factors such as family size, parental education, occupation and working hour, poverty, birth and family-related factors, e.g. positive family history of speech delay, deleterious oral habits, heavy TV watching or fussy temperament of the child (Ellis E. M. *et al.*, 2008; Tomblin J. B. *et al.*, 1997) and environmental risk factors such as living in an unsafe/stressful surroundings, poor child-parent interaction, lack of resources available for stimulation etc. All of these factors need to be taken into careful consideration to fully understand and support children's social and emotional health through a comprehensive, ecological approach. Studies have already proven that early intervention in children, aged less than six years with delays in speech development and language acquisition, will decrease the impact on their academic lives and also on social relations (Ramey & Campbell, 1984). This particular study was designed to identify the sociodemographic, personal and environmental risk factors of delayed speech development in under-five children so that it might be helpful for the professionals to look into the probable risk factors and provide an early intervention for a better outcome.

MATERIALS AND METHODS

A total of 120 under-five children (40 cases and 80 controls) were enrolled in this case-control study done in the Department of Paediatrics, Institute of Child and Mother Health, Matuail, Dhaka during January 2017 to December 2017. Cases with complaint of speech delay with no obvious underlying reason, who were 9 months to 5 years of age and previously seen in the Child Development Centre (CDC) of ICMH according to the complaints of parents and confirmed by responsible paediatric consultant (Developmental paediatrician / psychologist / speech therapist) were selected purposively for this study. A control group, never having any complaint of /diagnosed with speech delay was taken from the

Out-patient department of Paediatrics, ICMH. Before data collection, informed written consent was taken from the respondents. A pre-tested, semi- structured questionnaire was filled up by the principal investigator in a face-to-face interview of both the parents group of cases and controls. Information regarding cases were also taken from individual master files of CDC. Exclusion criteria were any diagnosed case of: Hearing impairment, Congenital oral anomalies (cleft lip/palate, tongue-tie), Autism and other pervasive disorders, Cerebral palsy, Genetic disorders (e.g. Down syndrome), Metabolic disorder (e.g. Hypothyroidism). Data were checked and edited before incorporating into statistical software (SPSS-Version17). Initially chi-square test was done to identify association of other variables with being case (having delayed speech). Those variables which were found to be significant during initial analysis were included in the multivariate regression model to test for the effect of arisk variable after adjustment for the remaining independent variables and to test for possible interactions among variables related to speech delay. Multivariate regression model accounted the presence of multiple factors and therefore it provided adjusted odds ratio.95% confidence intervals were calculated and p-value below 0.05 was considered as significant. Ethical clearance of this study was taken from the Ethical committee of Institute of Child and Mother Health (ICMH), Dhaka.

RESULTS

In this study majority of subjects belonged to age range of 25 to 48 months; mean age in case group was 34±13 months. (Figure 1). A greater number of boys were found to have delay as compared to girls (Male to female ratio was 3:1 in case group) with the difference being statistically significant (Table 1). Among the types of speech delay, combined expressive-expressive delay was most prevalent (37%) followed by articulation disorder (28%) (Figure 2). No statistically significant difference was observed for any of the socio-demographic characteristics between two groups (Table 2).

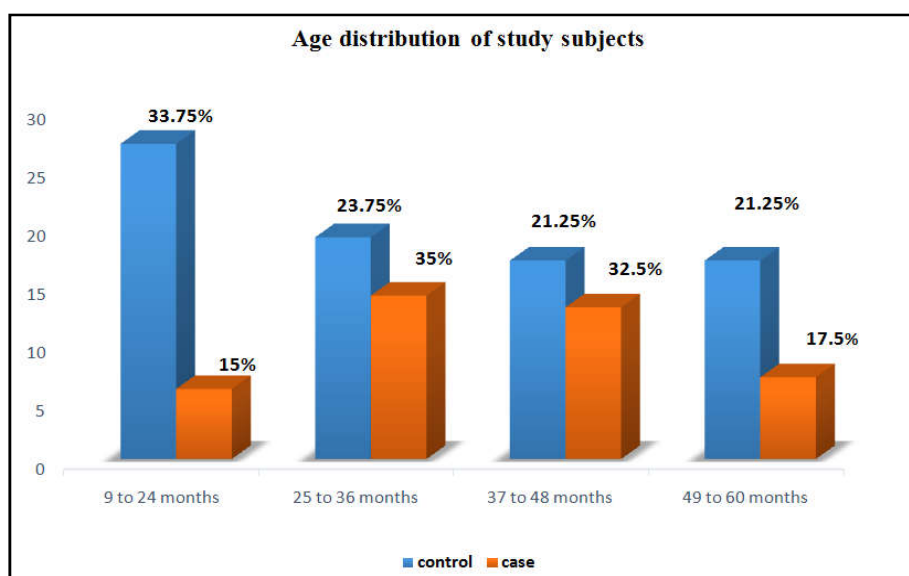


Figure 1. Distribution of age-group among controls and cases

Table 1. Distribution of gender between controls and cases

Variables	Controls (total =80) N (%)	Cases (total = 40) N (%)	p-value
Gender			
Male	44 (55.0%)	30 (75.0%)	0.034
Female	36 (45.0%)	10 (25.0%)	

P value <0.05 considered as significant. P value was obtained by chi-square test

Table 2. Socio-demographic characteristics of study subjects

Demographic characteristics	Controls (total=80) N (%)	Cases (total= 40) N (%)	p-value
Religion			
Muslim	77 (96.25%)	38 (95.0%)	0.881
Hindu	02 (2.50%)	01(2.50%)	
Buddist	01(1.25%)	01(2.50%)	
Father's age			
Upto 30 years	27(33.75%)	09(22.5%)	0.617
31 to 40 years	41(51.25%)	23(57.5%)	
Above 40 years	12(15.0%)	08(20.0%)	
Father's education			
Primaryorbelow	13(16.25%)	04(10.0%)	0.207
Secondary level	39(48.75%)	15(37.5%)	
Above secondary level	28(35.0%)	21(52.5%)	
Father's occupation			
Service	51(63.75%)	32(80.0%)	0.211
Business	29(36.25%)	08(20.0%)	
Mother's age			
Upto 20 years	12(15.0%)	03(7.50%)	0.452
21 to 30 years	51(63.75%)	24(60.0%)	
Above 30 years	17(21.25%)	13(32.5%)	
Mother's education			
Primaryorbelow	14(17.5%)	03(7.50%)	0.089
Secondary level	41(51.25%)	16(40.0%)	
Above secondary level	25(31.25%)	21(52.5%)	
Mother's occupation			
Housewife	61(76.25%)	27(67.5%)	0.404
Service	19(23.75%)	13(32.5%)	
Demographic characteristics	Controls (total=80) N (%)	Cases (total= 40) N (%)	p-value
Residence			
Rural	50(62.5%)	24(60.0%)	0.791
Urban	30(37.5%)	16(40.0%)	
Monthly income (tk)			
Up to 20,000	36(45.0%)	16(40.0%)	0.873
20,001 to 50,000	24(30.0%)	13(32.5%)	
>50,000	20(25.5%)	11(27.5%)	

P value <0.05 considered as significant. P value was obtained by chi-square

Table 3. Distribution of family factors between the controls and cases

Variables	Controls (total=80) N (%)	Cases (total= 40) N (%)	p-value
Type of family			
Single family	55 (68.75%)	27 (67.5%)	0.890
Joint family	25 (31.25%)	13 (32.5%)	
Number of family members			
Less than 4	28 (35%)	15 (37.5%)	0.788
More than 4	52 (65%)	25 (62.5%)	
Children in family			
Single child	22 (27.5%)	20 (50%)	0.015
Multiple children	58 (72.5%)	20 (50%)	
First born	42 (52.5%)	25 (62.5%)	0.298
Not first born	38 (47.5%)	15 (37.5%)	
Consanguinity of parents			
Yes	06 (7.5%)	04 (10%)	0.640
No	74 (92.5%)	36(90%)	
Family history of speech delay			
Yes	08 (10%)	19 (47.5%)	0.000
No	72 (90%)	21 (52.5%)	
Primary care-giver			
Mother	77 (96.3%)	30 (75%)	0.000
Other than mother	03 (3.7%)	10(25%)	
Mother's working hour			
< 8 hours	76 (95%)	34 (85%)	0.062
>8 hours	04 (5%)	06 (15%)	

P value <0.05 was considered as significant. P value was obtained by chi-square test

We studied the association of eight family related factors, including type of family, number of family members, parity of mother, birth order of child, consanguinity, family H/O speech delay, primary caregiver and maternal working hour (Table 3). Out of these, being a single child, having positive family history of speech delay and primary care-giver other than mother had very strong association with speech

delay. Small family (<4 members) and long maternal working hour (>8 hrs) seemed to have effect on speech delay (being more frequent in case group) but did not stand statistically significant. The only two birth-related factors that was significantly associated with speech delay was perinatal asphyxia and H/O any neonatal complication (Table 4).

Table 4. Distribution of birth-related factors between controls and cases

Variables	Controls (total=80) N (%)	Cases (total= 40) N (%)	p-value
Antenatal checkup			
Yes	73 (91.25%)	38 (95%)	0.462
No	07 (8.75%)	02 (5%)	
Risk in pregnancy			
Yes	12 (15%)	09 (22.5%)	0.751
No	68 (85%)	31 (77.5%)	
Place of delivery			
Hospital	59 (73.75%)	34 (85%)	0.023
Home	21 (26.25%)	06 (5%)	
Mode of delivery			
Vaginal	37 (46.25%)	20 (50%)	0.389
Caesarian section	43 (53.75)	20 (50%)	
Gestational age			
Preterm(<36week)	08 (10%)	02 (5%)	0.35
Term	72 (90%)	38 (95%)	
BirthWeight			
≥2500g	68 (85%)	38 (95%)	0.108
<2500g	12 (15%)	02 (5%)	
Perinatal asphyxia			
Yes	17 (21.25%)	20 (50%)	0.001
No	63 (78.75%)	20 (50%)	
H/O Neonatal complication			
Yes	16 (20%)	18 (45%)	0.004
No	64 (80%)	22 (55%)	

P value <0.05 was considered as significant. P value was obtained by chi-square test

Table 5. Distribution of environmental factors between controls and cases

Variables	Controls (total=80) N (%)	Cases (total= 40) N (%)	p-value
Allocation of time spent with mother			
< 8 hours/ day	24 (30%)	23 (57.5%)	0.006
>8 hours/ day	56 (70%)	17 (42.5%)	
Feeding habit			
Prolong bottle-feeding/ Blendfood/poor chewing	07 (8.75%)	23 (57.5%)	0.000
Normal feeding	73 (91.25%)	17 (42.5%)	
Screen-on time (TV watching/ Gaming on tab/phone/computer)			
<2 hours/day	58 (72.5%)	19 (47.5%)	0.002
>2 hours/day	22 (27.5%)	21 (52.5%)	
Peer group relation			
Satisfactory	71 (88.75%)	31 (77.5%)	0.104
Not satisfactory	09 (11.25%)	09 (22.5%)	
Outing in a month			
Yes	35 (43.75%)	19 (47.5%)	0.697
No	45 (56.25%)	21 (52.5%)	
Bilingualism in family environment			
Yes	02 (2.5%)	02 (5%)	0.472
No	78 (97.5%)	38 (95%)	
Any stressful environment/family stress			
Yes	13 (16.25%)	11 (27.5%)	0.000
No	67 (83.75%)	29 (72.5%)	

P value <0.05 considered as significant. P value was obtained by chi-square test

Table 6. Distribution of controls and cases by different stressful environmental factors

Any family stress/problem	Controls(total=80) N (%)	Cases(total=40) N (%)
No stress factor	67 (83.8%)	29 (72.5%)
Authoritarian parent	01 (1.25%)	04 (10.0%)
Parent staying out/died	05 (6.25%)	03 (7.50%)
Separation/divorce	01(1.25%)	02 (5.0%)
Abuse/violence/bullying	02 (2.50%)	04 (10.0%)
Sibling rivalry	04 (5.00%)	00 (0.00%)

*Multiple response table

Place of delivery other than hospital showed a trend towards association, though not statistically significant. Among the studied environmental risk variables, it was observed that less time spending with mother (<8 hrs/day), abnormal feeding habit, more screen-on time (TV watching/video-gaming) and

presence of any stressful factor in family or environment was strongly associated with speech delay (Table 5). Regarding different stress factors in both groups, it was seen that one child might have exposure to more than one stress conditions. Authoritarian parent and exposure to abuse/bullying at home,

Table 7. Distribution of the study population by favourite pass-time

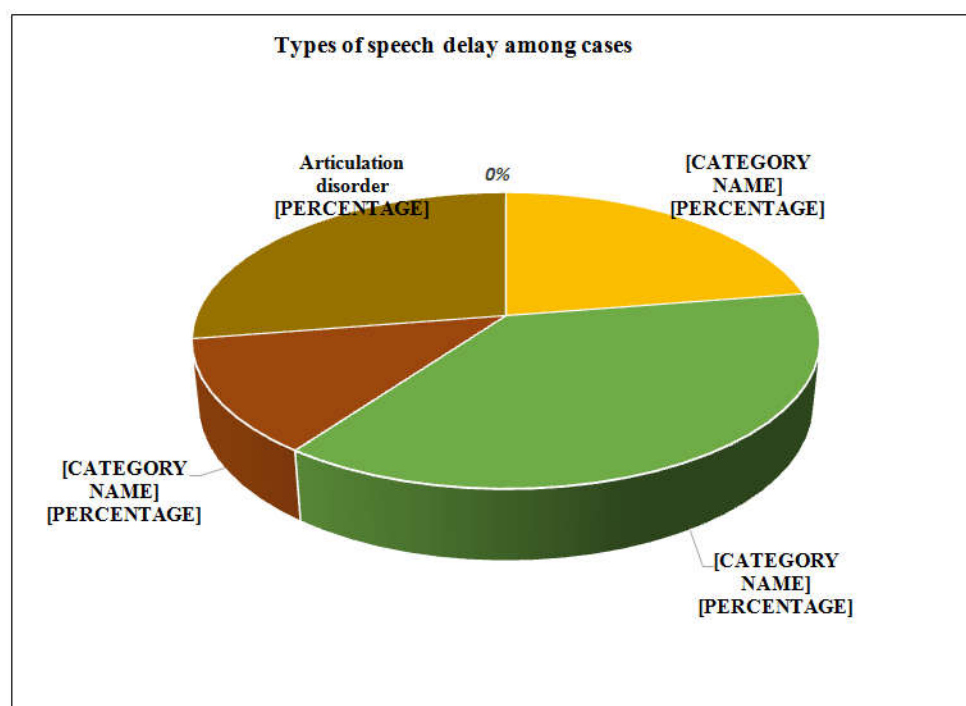
Pass-time activity	Controls (total = 80) N (%)	Cases (total = 40) N (%)
Toys	48 (60.0%)	15 (37.5%)
TV watching	09 (11.25%)	15 (37.5%)
Gaming with tab/ phone/ computer	17 (21.5%)	14 (35%)
Books	08 (10%)	00 (0%)
Physical play	02 (2.5%)	08 (20%)

*Multiple response table

Table 8. Risk factor analysis for speech delay associated with socio-demographic, birth and family-related and environmental factors in multivariate logistic regression model

Variables	Unadjusted OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Gender				
Male	2.45 (1.05, 5.7)	0.034	1.01 (0.35, 3.56)	0.849
Female (Reference)				
Children in family				
Single child	2.63 (0.96, 5.77)	0.016	3.90 (1.36, 7.38)	0.007
Multiple children (Reference)				
Positive family history				
Yes	8.14 (3.11, 21.3)	0.000	9.75 (3.09, 30.7)	0.000
No (Reference)				
Perinatal asphyxia				
Yes	3.70 (1.31, 9.82)	0.002	0.30 (1.1, 2.4)	0.121
No (Reference)				
H/O neo. complication				
Yes	3.27 (1.18, 7.84)	0.005	4.54 (1.4, 14.66)	0.011
No (Reference)				
Primary caregiver				
Mother	0.12 (2.14, 9.61)	0.001	0.269 (1.3, 2.9)	0.08
Not mother (Reference)				
Time spent with mother				
More than 8hr/d	0.29 (0.13, 0.64)	0.003	0.43 (0.12, 1.48)	0.183
Less than 8hr/d (Reference)				
Feeding habit				
Prolong bottle-feeding/ Blend food/poor chewing	11 (4.19, 28.84)	0.000	12.65 (3.14,50.9)	0.000
Normal feeding (Reference)				
Screen on time (TV/phone)				
More than 2 hrs	4.31(1.91, 9.73)	0.000	4.72 (1.55, 14.3)	0.006
Less than 2 hrs (Reference)				
Any stress in family/environment				
Yes	6.64 (1.98, 12.35)	0.000	8.75 (2.16,14.35)	0.037
No (Reference)				

P value <0.05 was considered as significant

**Figure 2. Pie chart showing types of speech delay among the cases**

school or playground was seen more among the cases (Table 6). A large portion (combined 72.5%) from the case group opted for TV watching or gaming on devices as their favourite pass-time while 60% from control group liked toys (Table 7). Final multivariate analysis (Table 8) nullified male sex, perinatal asphyxia, less time spent with mother and primary care-giver other than mother as risk factor of speech delay. The risk factors related to the family, e.g. positive family history (AOR=9.75), being single child (AOR=3.90), the child's personal health (H/O any neonatal complication (AOR=4.54) and the environment (abnormal feeding habits (AOR=12.65), extended screen-on time (AOR=4.72), stressful environment (AOR=8.75) remained, reaffirming what are the risk factors that deserve attention of health professionals during child development.

DISCUSSION

There have been extensive studies on speech and language delay in western literature. However, there is lack of sufficient data and no national references have been located so far regarding the risk factors for different speech pathology in developing countries like Bangladesh. So we need to know the current situation and explore the contributing factors behind it. In our study the majority of cases were 2-4-year-old children. A recent study on risk factors of speech-language pathology in children (Regina D. *et al.*, 2017) has found the predominant age group of the participating children with speech delay was between 2 and 5 years. Christine *et al.* (2005) found the average age of children with speech delay at diagnosis was 3 years 10 months. These findings were similar to our study. Recent studies supported our finding of male preponderance. Regina D. *et al.* (2017) showed boys are 2.6 times more likely to be identified with speech-language disorders than girls. In contrast to previous studies, the socioeconomic level/ social disadvantage was not proved to be a factor in this study that might increase the risk of speech delay.

Concerning birth-related factors some of our findings were consistent with that of other previous researches while some findings showed disagreement. Our analysis showed that perinatal asphyxia and H/O neonatal complication had strong association with delayed speech development. This study also found that maternal medical condition, place/ mode of delivery, gestational age and birth weight had no association with speech delay in children. Some studies showed multiple birth, H/O one born complication, prematurity, low birth weight and any maternal medical history were significant risk factors (Fitzgerald K & Safley M. 2009; Christine E. 2005) for speech impairment. In contrast, Mondal N. *et al.* (2016) demonstrated no significant association of speech delay with low birth weight, low Apgar score and higher birth order. While analyzing the risk associated with early biological and environmental factors we found that positive family history had very strong association with speech delay. Other studies have also shown a greater prevalence of affected relatives among children with speech/language deficits than among children in control groups (Mondal N *et al.* 2017; Fitzgerald K & Safley M, 2009), a finding consistent with present study. This study demonstrated that being a single child, primary care-giver other than mother, less time spent with mother (<8 hrs/day), more Screen-on time (TV watching / Gaming on tab/ phone or computer) and presence of any stressful factor in environment or family had strong association with

development of speech delay. In their study of Korean toddlers with language delay, Byeon H & Hong S (2015) found that nursery teachers were major care-givers in 51.8% of young children with speech delay. They observed that with decreasing hours of mother's care, communication opportunities between mothers and young children naturally declines and young children have relatively more possibility of being exposed to use of media and other devices. Using a home screening questionnaire that reflected the degree of caring and stimulating environment a child finds at his home, Mondal N *et al.* (2016) found negative/poorly stimulating home environment to be a significant environmental risk factor for speech delay. Regarding screen-on time many researchers report similar findings. In their study Chonchaiya and Pruksananonda (2008) found that children who began watching TV before 12 months age and watched more than 2 hours of TV per day were six times more likely to have language delays. It is now established that the quality of early parent-child relationships does have an influence on later cognitive and language development of the child. So, the importance of mother-child relationships has become increasingly evident in association with the role of primary care-giver and the quantity and quality of stimuli provided to the child. Adams-Chapman *et al.* (2013) found abnormal feeding behaviors reported in 13% of his sample with lower composite language scores at 18-22 months adjusted age. Regina D. *et al.* (2017) showed deleterious oral habits (found 51.3% in sample) to be a significant risk factor of speech delay. These results are consistent with our study to identify poor chewing/ feeding habit as a risk factor for speech delay. No statistically significant association was observed in the present study for poor development of speech with unsatisfactory peer group relation, infrequent scope of outing/traveling and bilingualism in family. Analyzing stress factors in both groups, it was observed that authoritarian parent (10.0%) and exposure to abuse/bullying at home, school or at playground (7.5%) was seen predominant among cases. Studies showed children with speech delay often experience bullying in school (Conti-Ramsden & Botting, 2004) or get socially excluded by their peers (Bonica, *et al.*, 2003). Interestingly there was no sibling rivalry seen in the case group in contrast with the controls, which being a stress factor may conversely contribute to more vocalization practice and hence explain the lack of speech delay.

Conclusion

Speech/language impairments are among the most prevalent childhood disabilities. The focus on under-5 children in the present study would allow the identification of the characteristics of children who develop these impairments at an early age, the group most in need of early intervention to limit the negative effects. The present study also suggested that the development of speech delay in under-5 children should not be attributed to a single factor, rather a multi factorial approach was required to estimate the accumulation of risk for speech deficits.

Limitations of the study

Several limitations to this study warrant consideration:

- The study population was small and taken from one selected centre in Dhaka city, so the result of this

single-point study may not reflect the exact picture of the country.

- The study population was hospital-based, which may lead to some selection bias.
- We relied on maternal reports on measurement of screen-on time (TV viewing, gaming on devices), quality of peer relation, familial/environmental stress etc, rather than using a standardized tool. This might not be an entirely accurate measure of the true status.

Acknowledgements

Thanks to all the members of the Child Development Centre, ICMH for their inspiration to complete this work.

REFERENCES

- Adams-Chapman I, Bann CM, Vaucher YE, Stoll BJ. 2013. 'Association between feeding difficulties and language delay in preterm infants using Bayley Scales of Infant Development-Third Edition'; *J Pediatr.*; 163(3): 680-5
- Bonica C, Arnold D H, Fisher P H, Zeljo A, &Yershova K. 2003. 'Relational aggression, relational victimization, and language development in preschoolers', *Social Development*, 12(4), 551-62.
- Christine E. E Delgado, Sara. J. Vagi, and KeithG .Scott 2005. 'Early Risk Factors for Speech and Language Impairments', *Exceptionality*; 13(3), 173-19, Copyright © 2005, Lawrence Erlbaum Associates.
- Conti-Ramsden, G. and Botting, N. 2004. 'Social difficulties and victimization in children with SLI at 11 years of age', *Journal of Speech Language and Hearing Research*, 47(1), 145-61.
- Ellis E M, Thal D J. 2008. 'Early language delay and risk for language impairment', *Perspect Lang Learn Educ.*; 15(3):93-100.
- Fitzgerald K. and Safley M. 2009. 'Contributing factors in Children At Risk for Speech/Language Delays'; *Paper presentation on November 19, 2009; Truman State University*
- Mondal N, Bhat B, Plakkal N, Thulasingham M, Ajayan P. 2016. 'Prevalence and Risk Factors of Speech and Language Delay in Children Less Than Three Years of Age', *J Compr Ped*; 7(2); e33173. doi: 10.17795/compreped-33173.
- Patricia A P, Tiffany H, Frances PG. 2008. 'Speech-Language Impairment: How to Identify the Most Common and Least Diagnosed Disability of Childhood. *Medscape J*; 10(6): 136-45
- Ramey C T & Campbell F A. 1984. 'Preventive education for high-risk children: Cognitive consequences of the Carolina ABC', *Special Issue: American Journal of Mental Deficiency*; 88(5), 515-23.
- Regina D. et al. 2017. 'Risk Factors for Speech-Language Pathologies in Children, Advances in Speech-language Pathology'; Dr. Fernanda Fernandes (Ed.), InTech, doi: 10.5772/intechopen.70107
- Shriberg L D, Austin D, Lewis B A, McSweeny J L & Wilson D L. 1997. 'The Speech Disorders Classification System (SDCS): Extensions and lifespan reference data', *Journal of Speech, Language, and Hearing Research*; 40,723-40
- Shriberg L D, HixonT. J. and Saxman, J. S. 1980. 'Developmental phonological disorders', *Introduction to communicative disorders*; Englewood Cliffs, NJ: Prentice Hall, (p. 262-309).
