RESEARCH PAPER

Screening for Language Delay between 6 Months and 3 Years of Corrected Age in Very Low Birth Weight Children

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Objective: To screen for language delay in very low birth weight (VLBW) children between 6 months to 3 years using Language Evaluation Scale Trivandrum, 0-3 years. **Methods:** VLBW inborn neonates at a corrected age of 6 months to 3 years visiting follow-up clinic were enrolled. Children with hearing loss were excluded. Prevalence and predictors of language delay were ascertained. **Results:** Of 200 enrolled subjects, out of the 1400 VLBW discharged, 64 (32%) had language delay. On multivariate analysis, late onset sepsis, patent ductus arteriosus and poor socioeconomic status were significant predictors of language delay. Abnormal neurological examination and suspect development were also associated with language delay. **Conclusions:** In VLBW children, the frequency of language delay is quite high. These children should be screened for language delay.

Keywords: *Development, Prematurity, Speech*.

Very low birth weight (VLBW) infants are prone to significant morbidities in immediate postnatal life, which increase the risk of developmental delay in childhood [1,2]. Early identification of delay helps in timely intervention and prevention of the consequences [3]. Language Evaluation Scale Trivandrum, 0-3 years (LEST 0-3) is a simple, reliable and validated screening tool to identify children between 0-3 years with language delay, and has been validated in the community as well as office practice [4,5]. We aimed to assess the language development in VLBW children between 6 months to 3 years corrected age using LEST 0-3 scale.

METHODS

This cross-sectional study was conducted in neonatal follow-up clinic from April 2017 to February 2018. All VLBW preterm inborn children were consecutively enrolled at the age between 6 months to 3 years of corrected age after written informed consent. The Institute research ethics committee approved the study. Children diagnosed with hearing loss either by clinical assessment or Brainstem evoked response auditory (BERA) were excluded. Baseline demographic details including socioeconomic status and neonatal morbidities were recorded.

Denver Development Screening Tool II and Amiel-Tison scale were used for developmental screening and neurological examination, respectively. Language was assessed by LEST 0-3 scale [4], and hearing assessment was done by clinical examination and BERA, if feasible. LEST administration and interpretation was done as per standard protocol and considered delayed/abnormal if either suspect/questionable or delay was found on LEST 0-3 scale.

Statistical analysis: Assuming speech delay prevalence as 13% [6] with 5% variability, the calculated sample size was 181. Allowing a 5% margin for child's non-cooperation, a final sample size of 200 was planned. Chi-square test or Fisher's exact test and students t-test or Mann-Whitney U test were used as applicable. Multivariate logistic regression was used for the analysis of predictors. SPSS version 20 software was used.

RESULTS

There were 1440 VLBW infants discharged between July 2014 till June 2017, of which 490 attended follow-up clinic; we enrolled consecutive 200 children. One child had abnormal BERA and was excluded. Baseline characteristics are described in ***Table* I**. Sixty-four (32%) children had language delay, of which 37 (18.5%) were questionable, 18 (9%) were suspect and 9 (4.5%) were delayed. Forty (62%) children had isolated language delay, and rest had it as a part of global development delay. Thirty-three (16.5%) children had suspect development by Denver II and 18 (9%) had either suspect

TABLE I BASELINE CHARACTERISTICS OF THE STUDY PARTICIPANTS (*n*=200)

Characteristic	*Value*
*Gestation (wk)	31 (2.47)
*Birth weight (g)	1204 (209)
#Male	126 (63)
#Small for gestational age	88 (44)
$Chronological age (mo) at assessment	16 (11,25)
$Corrected age (mo) at assessment	14 (9,22)
#Socioeconomic status	
Upper	15 (7.5)
Upper middle	80 (40)
Lower middle	61 (30.5)
Upper lower	43 (21.5)
Lower	1 (0.5)
#*Neonatal morbidities*	142 (71)
Early onset neonatal sepsis	46
Late onset neonatal sepsis	52
Hyaline membrane disease	47
Apnea	44
Patent ductus arteriosus	24
Pneumonia	23
Hypoglycemia	17
Intraventricular hemorrhage	13
Bronchopulmonary dysplasia	7
Hypoxic ischemic encephalopathy	6
Seizures	2
Congenital malformations	1
Others (including neonatal jaundice)	83
#Ventilated	111 (55.5)
Highest modes of ventilation	
Continuous positive airway pressure	111
Nasal intermittent mandatory ventilation	20
Synchronized intermittent mandatory ventilation	20
High frequency oscillatory ventilation	7
#Ototoxic drugs	74 (37)
Amikacin	70 (35)
Vancomycin	3 (1.5)
Colistin	1 (0.5)
$Duration of ototoxic drug used (d)	3 (3,5)

*Values are expressed as *Mean (SD) or #n (%) or $Median (IQR).*

or abnormal neurological examination. All had clinically normal hearing; BERA could be done in 45 (22.5%) children, and was normal.

The multivariate analysis of predictors for language development showed that late onset neonatal sepsis, patent ductus arteriosus (PDA) and poor socioeconomic status were independent predictors for language delay (***Table* II**). Abnormal neurological examination, and suspect development on the Denver II scale were also significantly associated with language delay.

DISCUSSION

In this study, one-third VLBW children with clinically normal hearing had language delay when assessed between 6-36 months corrected age. Late onset neonatal sepsis, PDA, and low socioeconomic status were significant predictors of language delay. We corrected age upto 3 years as most of the children were extreme/ early preterm and cannot be directly equated to term children for first 2-3 years [7].

Limitations of the study were inability to do BERA in all cases, and low (34%) follow-up rate in the clinic. Also, we did not screen these children for autism.

Previous studies in apparently healthy Indian children reported prevalence of language delay ranging from 4%-25% [1,5]. VLBW children have higher prevalence ranging from 16-27% [1,8,9]. Mondal,

TABLE II UNIVARIATE AND MULTIVARIATE ANALYSIS OF THE PREDICTORS OF LANGUAGE DELAY IN VLBW CHILDREN

Variable	*Univariate analysis OR (95% CI)*	*Multivariate analysis OR (95% CI)*
Male sex	1.78 (0.94-3.40)	
PDA	4.32 (1.77-10.52)	3.72 (1.37-10.06)
IVH	3.74 (1.17-11.9)	2.09 (0.56-7.81)
Apnea	2.12 (1.07-4.22)	1.21 (0.53-2.77)
HMD	2.07 (1.05-4.04)	1.34 (0.65-2.77)
Abnormal neurological examination	9.24 (2.90-29.41)	
Suspect Denver II	8.47 (3.63-19.70)	
Neuroimaging Abnormality (*n*=194)	1.60 (0.65-3.93)	
Ototoxic drugs intake	2.03 (1.10-3.73)	1.04 (0.48-2.24)
Ventilated	2.51 (1.33-4.74)	1.34 (0.65-2.77)
LONS	3.62 (1.87-7.04)	3.08 (1.49-6.39)
SES Score ≤10	2.02 (1.15-4.50)	3.45 (1.64-7.24)

PDA: Patent ductus arteriosus; IVH: Intraventricular hemorrhage; HMD: Hyaline membrane disease; LONS: Late onset neonatal sepsis; SES: Socioeconomic status.

WHAT THIS STUDY ADDS?

- Late-onset neonatal sepsis, patent ductus arteriosus and poor socioeconomic status are independent risk factors for language delay in VLBW preterm infants.

et al. [10] reported the similar prevalence of language delay in term infants discharged from intensive care unit, using LEST 0-3 scale. They found negative home environment and family history of language disorders as risk factors for language delay. They did not find any association between language delay and socioeconomic status or sepsis. However, these results cannot be compared to ours as most of those children were term, normal birth weight with very few neonatal morbidities. Socioeconomic status is an important predictor of language development and previous studies have shown the adverse effects of poverty and low socioeconomic status on language and executive function areas of brain, leading to language delay [10,11], similar to our study. There is a strong adverse association between neonatal sepsis and white matter injury, brain structure metrics, and diffusion in preterms [12]. Other studies also reported neonatal sepsis as an independent predictor of language delay [12,13]. A significant independent association between PDA and language delay noted in the present study was also observed by Singer, *et al*. [14], who reported that presence of PDA accounted for 13 point decrement in the language score. Unlike previous studies [15], no significant relationship between gestational age and language development, was noted in the present study.

The prevalence of language delay in VLBW preterm infants is high, and therefore, infants with significant morbidities should be routinely screened for early identification and intervention. Structured language assessment and speech stimulation should be routinely performed in high risk follow-up clinics.

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REFERENCES

1. Mukhopadhyay K, Malhi P, Mahajan R, Narang A. Neurodevelopmental and behavioral outcome of very low birth weight babies at corrected age of 2 years. Indian J Pediatr. 2010;77:963-7.
2. Jansson-Verkasalo E, Valkama M, Vainionpää L, Pääkkö E, Ilkko E, Lehtihalmes M. Language development in very low birth weight preterm children: A follow-up study. Folia Phoniatr Logop. 2004;56:108-19.
3. Cioni G, Inguaggiato E, Sgandurra G. Early intervention in neurodevelopmental disorders: Underlying neural mechanisms. Dev Med Child Neurol. 2016 ;58:61-6.
4. Nair MK, Nair GH, Mini AO, Indulekha S, Letha S, Russell PS. Development and validation of language evaluation scale Trivandrum for children aged 0-3 years—LEST (0-3). Indian Pediatr. 2013;50:463-7.
5. Nair MKC, Mini AO, Leena ML, George B, Harikumaran Nair GS, Bhaskaran D, *et al*. CDC Kerala 7: Effect of early language intervention among children 0–3 y with speech and language delay. Indian J Pediatr. 2014;81:102-9.
6. Schendel DE, Stockbauer JW, Hoffman HJ, Herman AA, Berg CJ, Schramm WF. Relation between very low birth weight and developmental delay among preschool children without disabilities. Am J Epidemiol. 1997;146:740-9.
7. Wilson-Ching M, Pascoe L, Doyle LW, Anderson PJ. Effects of correcting for prematurity on cognitive test scores in childhood: Age correction in children born preterm. J Paediatr Child Health. 2014;50:182-8.
8. Stolt S, Matomaki J, Lind A, Lapinleimu H, Haataja L, Lehtonen L. The prevalence and predictive value of weak language skills in children with very low birth weight – A longitudinal study. Acta Paediatr Oslo Nor. 2014;103:651-8.
9. Mondal N, Bhat BV, Plakkal N, Thulasingam M, Ajayan P, Poorna DR. Prevalence and risk factors of speech and language delay in children less than three years of age. J Compr Pediatr. 2016;2:7. Available from: *http://comprped.neoscriber.org/en/articles/19837.html*. Accessed April 26, 2018.
10. Letts C, Edwards S, Sinka I, Schaefer B, Gibbons W. Socio-economic status and language acquisition: children's performance on the new Reynell Developmental Language Scales: Socio-economic status and language acquisition. Int J Lang Commun Disord. 2013;48:131-43.
11. Pace A, Luo R, Hirsh-Pasek K, Golinkoff RM. Identifying pathways between socioeconomic status and language development. Annu Rev Linguist. 2017;3:285-308.
12. Lee I, Neil JJ, Huettner PC, Smyser CD, Rogers CE, Shimony JS, *et al*. The impact of prenatal and neonatal infection on neurodevelopmental outcomes in very preterm infants. J Perinatol. 2014;34:741-7.
13. Castellanos GRR, Riesgo Rodríguez S de la C. Impact of neonatal sepsis on neurodevelopment in very low birth weight infants. Medwave. 2016;16:e6422.

14. Singer LT, Siegel AC, Lewis B, Hawkins S, Yamashita T, Baley J. Preschool language outcomes of children with history of bronchopulmonary dysplasia and very low birth weight: J Dev Behav Pediatr. 2001;22:19-26.
15. Foster-Cohen S, Edgin JO, Champion PR, Woodward LJ. Early delayed language development in very preterm infants: evidence from the MacArthur-Bates CDI. J Child Lang. 2007;34:655-75.