The Prevalence of Specific Learning Disorder among School-going Children in Ernakulam District, Kerala, India: Ernakulam Learning Disorder (ELD) Study

Deenu Chacko, Karunakaran Vidhukumar

ABSTRACT

Background: Specific learning disorder (SLD) is a neurodevelopmental disorder characterized by impairment in reading, written expression, and mathematics. The government provides several educational and social benefits to students with SLD, hence, an accurate assessment of the prevalence of SLD is important. This study is an attempt to find the prevalence of SLD and its determinants among the school-going children in Ernakulam district, Kerala, India.

Methods: School-going children from the fourth standard to the seventh standard were included in the study. Multistage stratified cluster sampling was used. The screening for SLD was done using the LD screening tool, and confirmation of the diagnosis was made using the NIMHANS index for SLD and Malin’s Intelligence Scale for Indian Children (MISIC).

Results: The prevalence of SLD was 16.49% (95% CI =14.59-18.37). The prevalence of impairment in reading, written expression, and mathematics was 12.57%, 15.6%, and 9.93%, respectively. Binary logistic regression analysis showed that male gender, low birth weight, presence of developmental delay, family history of poor scholastic performance, and syllabus were independently associated with SLD.

Conclusions: The study found a higher prevalence of SLD (16.49%) and certain modifiable determinants of SLD were identified. It highlights the need for early detection and remedial measures for children with SLD.

Key words: Ernakulam, India, prevalence, specific learning disorder

Key messages: The prevalence of SLD was found to be 16.49%. Impairment in written expression was the most common type of SLD identified. Some modifiable obstetric determinants of SLD were also identified.
In the school population, the prevalence of SLD in written expression was 8–15% and 6% of the school population had mathematical difficulties.\(^\text{[1,7]}\) In a study done in south India, the prevalence of SLD was 15.17%; while 12.5%, 11.2%, and 10.5% had dysgraphia, dyslexia, and dyscalculia, respectively.\(^\text{[6]}\)

Although, some studies have shown that there is no significant gender difference in reading disability, several others have shown that SLD is more frequent in boys.\(^\text{[1,7]}\) The prevalence of SLD was found to be higher in lower classes compared to higher classes.\(^\text{[8]}\) There is a significant risk for the child to develop reading disability if either parent reports difficulty in reading.\(^\text{[9]}\) Low maternal education, very low birth weight, low 5-minute APGAR score, and other obstetric factors are associated with a high risk for learning disability.\(^\text{[10−12]}\)

Prevalence studies on SLD using a validated screening tool exclusively for SLD and studies on determinants of SLD are sparse in India, especially in Kerala. Therefore, we aim to study the prevalence and determinants of SLD through our present research.

**SUBJECTS AND METHODS**

This cross-sectional study was carried out from February 2018 to January 2019, among children studying in the fourth standard to the seventh standard in private (both financially aided by government and unaided by the government) and government schools in Ernakulam district. Children with visual, hearing, or locomotor impairments that interfere with the assessment; children above 12 years of age; children from whose parents a valid consent could not be obtained, as well as children from whom assent could not be obtained were excluded from the study.

The sampling technique adopted was multistage stratified cluster sampling. The proportion of children following different syllabi (central board for secondary education [CBSE and State]) were maintained in the sample selected. The schools were randomly selected from each stratum, and clusters of children were taken from the selected schools. Each cluster consisted of 20–40 children. Based on the prevalence of 10%, a design effect of 1.5, and a nonresponse of 20%, the sample size calculated was 1560. The sample available to find an association between variables was 1437, after excluding intellectual disability and borderline intelligence.

Study procedure: The Ethics Committee’s approval for the study was obtained. Children studying in the fourth standard to the seventh standard, who satisfied the inclusion and exclusion criteria, were included in the study after taking permission from the school authorities, consent from the parents, and assent from children. From each of the four educational districts in Ernakulam’s revenue district, the schools were selected randomly by taking lots. Then, clusters of children from the fourth standard to the seventh standard were chosen from these selected schools. An awareness program was conducted for the teachers from these selected schools. The teachers distributed the screening proforma, the proforma for the collection of sociodemographic and other variables, and the consent forms to the parents. The filled up proformas were later collected back by the teachers and handed over to the investigator. Those children who scored more than ten in the screening questionnaire were considered positive for SLD. These children were individually evaluated by using NIMHANS Index for SLD and Malin’s Intelligence Scale for Indian Children (MISIC) to confirm the diagnosis. In Kerala, the English language is taught in all schools from the first standard. In the cases wherein we had a doubt whether the language problem in the child was due to English language used in NIMHANS Index, we reassessed the child with Malayalam textbook from the same school, and if the child was not able to read or write up to 2 standards below his/her standard, then the child was considered as having SLD. The subtypes of SLD were also identified. Parents of 40 children whose LD score was less than ten were randomly selected and contacted by the principal investigator to check the quality of the data collected. The children diagnosed were referred for further management.

**Tools**

1. Proforma for the collection of sociodemographic and other variables
2. Learning disorder screening tool: This is a 26-item, self-administered screening tool given to teachers or parents to screen children for SLD. It has a sensitivity of 100%. It was developed and validated in Malayalam, among the school children of Kerala. LD score of more than ten is considered a test positive.\(^\text{[13]}\)
3. NIMHANS Index for SLD was developed in the Department of Clinical Psychology, NIMHANS, Bangalore. It consists of tests of reading, writing, spelling, and arithmetic abilities, to identify children with disabilities in these areas. It consists of two levels. A performance of two standards below the child’s present standard is considered as a diagnostic feature of SLD.\(^\text{[14]}\) The Rights of Persons with Disabilities (RPWD) act 2016 recommends the NIMHANS index for the diagnosis of SLD
4. MISIC (Malin’s Intelligence Scale for Indian Children) is the Indian adaptation of the Wechsler Intelligence Scale for Children (WISC).\(^\text{[15]}\) It has 11 subsets, classified into verbal and performance
subsets. The test-reset reliability is 0.91; concurrent as well as congruent validity has also been established. This tool has been widely used in the Indian context for assessing intellectual abilities in children. We used it to identify children with intellectual disabilities and borderline intelligence.

**Analysis plan and Statistical methods**

The statistical analysis was done by R statistical software. The data were summarized, as means and proportions with their 95% confidence interval (CI) for continuous and categorical variables, respectively. The Chi-square test was used to test associations and the odds ratio was used to express the strengths of associations. Binary logistic regression was used for adjusted analysis.

**RESULTS**

The total number of filled-up screening proformas collected was 1548. We had to exclude 68 proformas due to poor quality and as we could not get some children for individual assessment. The final sample available for analysis was 1480; among them, 429 children screened positive for SLD. The children screened negative were considered as not having SLD.

The sample contained children of the age group 8–12 years. There was almost an equal representation of students from each standard. The majority (61.82%) of the sample were from middle and high-income groups. Most children were from the panchayat or municipality area and 71.22% were following state syllabus. The prevalence of SLD was estimated to be 16.49% (95% CI = 14.59-18.37) [Table 1].

The prevalence of impairment in reading, written expression, and mathematics was found to be 12.57%, 15.6%, and 9.93%, respectively. The prevalence of mixed type (reading/writing impairment along with mathematics impairment) was 9.26%. Among those with SLD (n = 244), 75% had a combination of impairment in reading and written expression, 54.92% had a combination of impairment in written expression and mathematics, 44.67% had a combination of reading, written expression, and mathematical impairment, 9.43% had impairment in written expression only, and 4.1% had impairment in mathematics only.

An analysis of the association of various parameters with the diagnosis of SLD showed that SLD was more common among boys (Odds Ratio [OR] = 2.02, CI = 1.50-2.73, P < 0.001) and in children from low socioeconomic status (OR = 1.96, CI = 1.49-2.59, P < 0.001). State syllabus (OR = 6.97, CI = 4.17-11.57, P < 0.001), high maternal education (OR = 0.237, CI = 0.156–0.359, P < 0.001), high paternal education (OR = 0.325, CI = 0.23–0.447, P < 0.001), mode of delivery (P = 0.009), low-birth-weight (OR = 2.69, CI = 1.93–3.75, P < 0.001), preterm birth (OR = 2.8, CI = 1.63–5.05, P < 0.001), presence of developmental delay (OR = 6.75, CI = 3.98-11.50, P < 0.001), presence of physical illness (OR = 4.8, CI = 2.35-9.88, P < 0.001), and family history of poor scholastic performance (OR = 14.4, CI = 9.59-21.60, P < 0.001)

| Variables | Group | Frequency | Percentage of the total sample | 95% CI |
|-----------|-------|-----------|-------------------------------|--------|
| Standard  | 4     | 349       | 23.58                         |        |
|           | 5     | 372       | 25.14                         |        |
|           | 6     | 379       | 25.61                         |        |
|           | 7     | 380       | 25.68                         |        |
| Gender    | Male  | 752       | 50.81                         |        |
|           | Female| 728       | 49.19                         |        |
| Socioeconomic status | High and middle | 915 | 61.82 |        |
|           | Low   | 565       | 38.18                         |        |
| Religion  | Hindu | 721       | 48.72                         |        |
|           | Christian | 484 | 32.7 |        |
|           | Muslim | 275       | 18.58                         |        |
| Place of stay | Panchayath | 594 | 40.14 |        |
|           | Municipality | 597 | 40.34 |        |
|           | Corporation | 289 | 19.53 |        |
| Syllabus  | Kerala state | 1054 | 71.22 |        |
|           | CBSE  | 426       | 28.78                         |        |
| Diagnosis | Nil   | 1193      | 80.61                         |        |
|           | SLD   | 244       | 16.49                         | 14.59-18.37 |
|           | Borderline intelligence | 33 | 2.23 | 1.47-2.98 |
|           | Mental retardation | 10 | 0.68 | 0.25-1.09 |

CBSE – Central Board for Secondary Education, SLD – Specific learning disorder
were the other variables significantly associated with SLD in bivariate analysis. There was no significant association between age of the child, religion, standard in which the child is studying, maternal or paternal age at childbirth (32 years was taken as median cut off for paternal age, and 26 years was taken as median cut off for maternal age), or birth order of the child, and the diagnosis of SLD [Tables 2 and 3].

Binary logistic regression analysis for various parameters showed that male gender, low-birth weight, presence of developmental delay, family history of poor scholastic performance, and studying in state syllabus schools were independently associated with SLD [Table 4].

**DISCUSSION**

In our study, 244 (16.49%) children were having SLD. Previous studies on SLD had shown a variable prevalence of 5%–15%.[1] In a study by Mogasale, the prevalence of SLD in a city in southern India, which is geographically near to Ernakulam district, was found to be 15.17%.[6] However, a study done in NIMHANS Bangalore found the prevalence of SLD to be 12%, and a study done at Varanasi found the prevalence of SLD as 13%.[3,16]

Compared to later studies, our study has a higher prevalence. This may be due to the different diagnostic tools used in the various studies and differences in the populations studied. Another important observation was that, though the prevalence of SLD was higher in the study, none of the children with SLD had been evaluated or identified as having SLD earlier, and none were undergoing any remedial education. This shows the lack of a system for early identification of SLD and a lack of awareness about SLD among teachers and parents.

We did not find any relationship between age or standard in which the child is studying and SLD, unlike previous studies which showed that SLD is more common in the younger age groups. This indicates the lack of early identification and interventions for SLD in the state, especially in lower primary and upper primary classes.

Among children with SLD, the majority (65.16%) were boys. In the bivariate and adjusted analysis, male gender was found to be associated with SLD. This finding is similar to the previous studies done in this area.[2,6,17,18] Some studies have shown that boys are affected more with spelling disorder and girls with arithmetic disorder.[2]

A higher proportion of children from the low-income group had SLD than those from the high- and middle-income groups, and this finding is similar to the previous studies.[10,17] This association may be due to the fact that children in middle- and high-income groups may have better access to early identification and remedial education for SLD and better support from parents. But socioeconomic status was not an independent predictor of SLD as evidenced by logistic

### Table 2: Association of sociodemographic variables with SLD

| Variables                  | Group          | SLD (n=244) | No diagnosis (n=1193) | Chi-square (P) | Odds Ratio (95% CI) |
|----------------------------|----------------|-------------|-----------------------|----------------|---------------------|
| Gender                     | Male           | 159 (65.16%) | 573 (48.03%)          | 23.8 (<0.001*) | 2.02 (1.50-2.73)    |
| Socioeconomic status       | Low            | 125 (51.23%) | 416 (34.87%)          | 22.4 (<0.001*) | 1.96 (1.49-2.59)    |
| Place of stay              | Panchayat      | 107 (43.85%) | 467 (39.14%)          | 10.34 (0.005*) |                    |
|                             | Municipality   | 107 (43.85%) | 472 (39.56%)          |                |                    |
|                             | Corporation    | 30 (12.30%)  | 254 (21.29%)          |                |                    |
|                             | State          | 227 (93.03%) | 784 (65.72%)          | 71.17 (0.001*) | 6.97 (4.17-11.57)  |

*P<0.05, CI – Confidence interval, SLD – specific learning disorder

### Table 3: Association of other variables with SLD

| Variables                          | Group          | SLD (n=244) | No diagnosis (n=1193) | Chi-square (P) | Odds Ratio (95% CI) |
|------------------------------------|----------------|-------------|-----------------------|----------------|---------------------|
| Birth weight                       | <2.5 kg        | 65 (26.63%) | 142 (11.9%)           | 34.49 (<0.001*) | 2.69 (1.93-3.75)    |
| Type of delivery                   | Normal         | 114 (46.72%)| 681 (57.08%)          | 9.4 (0.009*)    | 1.22 (1.06-1.44)    |
|                                   | Instrumental   | 11 (4.51%)  | 34 (2.5%)             |                |                    |
|                                   | Cesarean       | 119 (48.77%)| 478 (40.06%)          |                |                    |
| Birth                              | Preterm        | 20 (8.2%)   | 36 (3.01%)            | 14.7 (<0.001*)  | 2.8 (1.63-5.05)     |
| Father’s education                 | Above 10th std | 57 (23.36%) | 577 (48.36%)          | 50.36 (<0.001*) | 0.33 (0.23-0.45)    |
| Mother’s education                 | Above 10th std | 27 (11.06%) | 411 (34.45%)          | 51.18 (<0.001*) | 0.24 (0.16-0.36)    |
| Developmental delay                | Present        | 33 (13.52%) | 27 (2.26%)            | 61.42 (<0.001*) | 6.75 (3.98-11.50)   |
| Family history of scholastic backw. | Present       | 84 (34.42%) | 42 (3.5%)             | 238.03 (<0.001*)| 14.4 (9.59-21.60)   |
| History of physical illness        | Present        | 15 (6.15%)  | 16 (1.30%)            | 19.95 (<0.001*) | 4.8 (2.35-9.88)     |

*P<0.05, CI – Confidence interval, SLD – specific learning disorder
We found the impairment in written expression as the most common type of SLD, followed by impairment in reading. This finding is in accordance with some previous studies. Another study had found that the prevalence of impairment in reading and written expression was 22% each and impairment in mathematics was 16%. In primary school children in India, the prevalence of dyslexia, dysgraphia, and dyscalculia has been reported to be 11.2%, 12.5%, and 10.5%, respectively. In a study conducted on 1,476 children, the prevalence of mathematics disorder was 3.6% and that of reading disorder was 2.2%. In a study on 1,075 children, the prevalence of reading disorder and mathematical disorder was 6% and 3.9%, respectively and 3.4% had both mathematics and reading disability. In studies conducted in different countries, the prevalence rates of subtypes of SLD were found to be different from each other, and it may be due to the differences in diagnostic tools used.

**Limitations**

Though the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) mentions the severity of SLD, we could not assess the severity of SLD due to the nonavailability of a validated tool for the same. Although neurodevelopmental disorders coexist, we were unable to assess the comorbidities of SLD as we were not able to directly contact the parents. Moreover, we were incapable to assess the type of scholastic problems that existed in the parents, as most of them have had no consultations for their problems.

**CONCLUSIONS**

From India, there are very few prevalence studies on SLD that are methodologically sound and that have tried to find the determinants of SLD; our study is one among them. The study revealed the prevalence of SLD as 16.49%, and it warrants the need for early detection of SLD and more facilities for remedial education. The government should make the early detection of SLD mandatory in schools. Teachers and parents should be given awareness on SLD. Impairment in written expression was the most common type of SLD. The study also found that male gender, low socioeconomic status, residing in panchayath and municipality areas, state syllabus, preterm birth, birth by cesarean section, developmental delay, low paternal and maternal education, history of poor scholastic performance in the family, and history of physical illness in childhood is associated with SLD. Children born with these risk factors are more prone to SLD.
factors should be carefully screened for deficits in academic skills from early school days, and remedial measures must be started without delay. These measures help the children to cope up with their deficits and to achieve better academic skills and thus provide better self-esteem and quality of life.

Financial support and sponsorship
The study was funded by the Kerala State Board for Medical Research.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Washington, DC: American Psychiatric Association; 2013.
2. Moll K, Kunze S, Neuhoft N, Bruder J, Schulte-Körne G. Specific learning disorder: Prevalence and gender differences. PLoS One 2014;9:e103537.
3. Srinath S, Girimaji SC, Seshadri S, Subbakrishna DK, Bhola PKumar N. An epidemiological study of child and adolescent psychiatric disorders in urban and rural areas of Bangalore, India. Indian J Med Res 2005;122:67-79.
4. Lyon GR. Learning disabilities In Child psychopathology. In: Marsh EJ, Barkley RA, editors. New York, NY, US: Guilford Press; 1996. p. 441-58.
5. Fleishner JE. Diagnosis and assessment of mathematics learning disabilities. In: Lyon GR, editor. Frames of reference for the assessment of learning disabilities: New views on measurement issues. Baltimore: Paul H Brookes; 1994. p. 419-21.
6. Mogasale VV, Patil BD, Patil NM, MogasaleV. Prevalence of specific learning disabilities among primary school children in a South Indian city. Indian J Pediatr 2012;79:342-7.
7. Shaywitz SE, Shaywitz BA, Fletcher JM, Escobar MD. Prevalence of reading disability in boys and girls: Results of the connecticut longitudinal study. JAMA 1990;264:998-1002.
8. Siddiqui S, Tripathi N. Identification and assessment of children with dyslexia in Allahabad city. Universal Journal of Psychology 2014;2:205-11.
9. Vogler GP, Defries JC, Decker SN. Family history as an indicator of risk for reading disability. J Learn Disabil 1985;18:419-21.
10. Stanton-Chapman TL, Chapman DA, Scott KG. Identification of early risk factors for learning disabilities. J Early Interv 2001;24:193-206.
11. Holomon HA, Dobbins DR, Scott KG. The effects of biological and social risk factors on special education placement: Birth weight and maternal education as an example. Res Dev Disabil 1998;19:281-94.
12. MacKay DF, Smith GC, Dobbie R, Cooper SA, Pell JP. Obstetric factors and different causes of special educational need: Retrospective cohort study of 407 503 schoolchildren. An Int J Obstet Gynaecol 2013;120:297-307.
13. Vidyadhharan V, Thariyil HM, George B. Validation of a screening tool for learning disabilities in children. Indian J Psychol Med 2017;39:737-40.
14. Kapur M, John A, Rozario J, Oommen A, Uma H. NIMHANS index of specific learning disabilities. In: Hiriseve U, Oommen A, Kapur M, editors. Psychological Assessment of Children in the clinical setting. Bangalore: Vinayaka Offset Printers; 1991.
15. Malin AJ. Manual of Malini’s Intelligence Scale for Indian Children (MISC). Lucknow: Indian Psychological Corporation; 1969.
16. Agarwal KN, Agarwal DK, Upadhyay SK, Singh M. Learning disability in rural primary school children. Indian J Med Res 1991:94:89-95.
17. Görker I, Bozatli L, Korkmazlar Ü, YücelKaradağ M, Ceylan C, Soğüt C, et al. The probable prevalence and sociodemographic characteristics of specific learning disorder in primary school children in Edirne. Noro Psikiyat Ars 2017:54:343-9.
18. Rutter M, Caspi A, Fergusson D, Horwood LJ, Goodman R, Maughan B, et al. Sex differences in developmental reading disability: New findings from 4 epidemiological studies. JAMA 2004;291:2007-12.
19. Gross-Tsur V1, Manor O, Shalev RS. Developmental dyscalculia: Prevalence and demographic features. Dev Med Child Neurol 1996;38:25-33.
20. Singh S, Sawani V, Deskate M, Panchal S, Subramanyam AA, SHAH HR, et al. Specific learning disability: A 5 year study from India. Int J Contemp Pediatr 2017;4:983-8.
21. Shaywitz SE. Dyslexia. N Engl J Med 1998;338:307-12.
22. Taylor HG, Espy KA, Anderson PJ. Mathematics deficiencies in children with very low weight or very preterm birth. Dev Disabil Res Rev 2009;15:52-9.
23. Snowling MJ, Muter V, Carroll J. Children at family risk of dyslexia: A follow-up in early adolescence. J Child Psychol Psychiatry 2007;48:609-18.
24. Johnson EO, Breslau N. Increased risk of learning disabilities in low birth weight boys at age 11 years. Biol Psychiatry 2000;47:490-500.
25. Clarke T, Strug LJ, Murphy PL, Bali B, Carvalho J, Foster S, et al. High risk of reading disability and speech sound disorder in rolandic epilepsy families: Case-control study. Epilepsia 2007;48:2258-65.
26. Strug LJ, Addis L, Chiang T, Baskurt Z, Li W, Clarke T, et al. The genetics of reading disability in an often excluded sample: Novel loci suggested for reading disability in rolandic epilepsy. PLoS One 2012;7:e40696.
27. Rovet JF, Ehrlisch R. Psychoeducational outcome in children with early –treated congenital hypothyroidism. Pediatrics 2000;105:515-22.
28. Landers K, Moll K. Comorbidity of learning disorders: Prevalence and familial transmission. J Child Psychol Psychiatry 2010;51:287-94.
29. Dhanda A, Jagawat T. Prevalence and pattern of learning disabilities in school children. Delhi Psychiatry J 2013;16:386-90.
30. Lewis C, Hitch GJ, Walker P. The prevalence of specific arithmetic difficulties and specific reading difficulties in 9-to 10-year-old boys and girls. J Child Psychol Psychiatry 1994;35:283-92.
31. Badian NA. Persistent arithmetic, reading, or arithmetic and reading disability. Ann Dyslexia 1999;49:43.