

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

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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.


Specific learning disorder (SLD) is a neurodevelopmental disorder. It includes impairment in reading, written expression, and mathematics.^[1] Combined types of SLD occur more frequently than isolated types.^[2] The prevalence estimate of SLD varies between 5% and

15%.^[1] In a study done in India at the National Institute of Mental Health and Neurosciences (NIMHANS) Bangalore, the total prevalence rate of SLD was 12%.^[3]

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In the school population, the prevalence of SLD in written expression was 8–15% and 6% of the school population had mathematical difficulties.^[4,5] 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.^[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.^[1,7] The prevalence of SLD was found to be higher in lower classes compared to higher classes.^[8] There is a significant risk for the child to develop reading disability if either parent reports difficulty in reading.^[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.^[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^[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.^[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).^[15] It has 11 subsets, classified into verbal and performance

subsets. The test-retest 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, $P < 0.001$), place of residence ($P = 0.005$), 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, $P < 0.001$)

Table 1: Proportion of sociodemographic variables and diagnosis

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.^[8] 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%)		
Syllabus	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 10 th standard	57 (23.36%)	577 (48.36%)	50.36 (<0.001*)	0.33 (0.23-0.45)
Mother's education	Above 10 th standard	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 backwardness	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

Table 4: Reduced model of Binary Logistic Regression

Variables	Z	OR	95% CI	P
Low birth weight	-4.61	1.79	1.21-2.64	<0.001*
Developmental delay	2.94	2.88	1.56-5.31	<0.001*
Family history of scholastic backwardness	3.38	9.29	6.07-14.20	<0.001*
Male Gender	10.25	1.96	1.42-2.70	<0.001*
State Syllabus	-4.10	4.50	2.66-7.59	<0.001*

* $P < 0.05$, OR – Odds ratio; CI – Confidence Interval

regression. In a study, the socioeconomic status of those suffering from developmental dyscalculia was significantly lower than rest of the sample and 42% had first-degree relatives with LD.^[19]

The children pursuing state syllabus were more affected by SLD compared to those following the CBSE syllabus. The majority of CBSE schools in the state are in the private sector. These schools follow strict admission criteria, and this could be the reason for the above finding.

SLD was seen in a higher proportion in children staying in panchayat and municipality areas than in those staying in the corporation area where access to early detection and remedial education is easier. Both maternal and paternal education were significantly associated with SLD, and the chances for developing SLD decreased as the educational status of the parents increased. This finding is similar to that of a previous study.^[10] Our study showed a definite relationship between SLD and developmental delay, which is similar to the findings of other studies.^[20,21] Moreover, SLD was more common in children with preterm birth and a previous study also gave the same finding.^[22]

A family history of poor scholastic performance was associated with SLD.^[9,21,23] We found no significant association between SLD and birth order or consanguinity among parents, unlike some previous studies.^[10,17]

Low-birth weight of the child was associated with SLD. This finding is similar to that of some previous studies.^[10,22,24] Our study showed that SLD is more common among children born preterm, as confirmed by a previous study.^[17]

Bivariate analysis revealed a significant association between the type of delivery and SLD. On dichotomizing the type of delivery into normal and cesarean, it was found that delivery by cesarean section was significantly associated with SLD, as in a previous study.^[17]

Physical illness in childhood was associated with SLD. According to earlier studies, there is an increased prevalence of neurodevelopmental disorders such as

SLD with a physical illness like epilepsy.^[25,26] Another study had shown that hypothyroidism is associated with poor memory, attention, and visuospatial abilities and learning problems.^[27]

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.^[17,28] An Indian study had found that the prevalence of impairment in reading and written expression was 22% each and impairment in mathematics was 16%.^[29] 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.^[6] In a study conducted on 1,476 children, the prevalence of mathematics disorder was 3.6% and that of reading disorder was 2.2%.^[30] 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.^[31] 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 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.

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Conflicts of interest

There are no conflicts of interest.

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