Date Received : 02 APRIL 2023 I Accepted: 20 JUNE 2023

INDIAN JOURNAL OF DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS RESEARCH ARTICLE

Prevalence and pattern of specific learning disabilities among middle school students in Chennai city

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Acknowledgements: We are grateful to the respective authorities of Education Department, Greater Chennai Corporation in Chennai for granting permission to conduct this study. We thank all the School teachers and all the wonderful students for their co-operation and patience in undergoing the assessments.

Abstract:

Purpose: Specific learning disability (SLD) impedes ability to learn specific academic skills. The objective of study was to determine SLD prevalence among middle school students in Chennaiand estimate difference in prevalence based on gender and age & relationship between various types of SLD.

Methods: A Cross Sectional Survey using Expost Facto research design was adopted. Source population was government middle school students of fifth, sixth and seventh standards. Study period was November 2019-November 2020. Using purposive random sampling, 344 students were enrolled. Those with score average, above average and intellectually superior in Raven's Progressive Matrices IQ Assessment were included and those with defective and below average were excluded. NIMHANS Index was used to assess SLD. Using confidence interval (95%), relative error(5%), z for 95% C.I. (1.64), ε(5%), N(11645), p̂(15%), required sample size was 138. Data was analyzed using SPSS-19, MedCalc, Descriptive statistics, Pearson Product Moment correlation, ANOVA and 't' test.

Results: Among 144 students, Spelling Dyslexia (13.88%), Reading Dyslexia (16.66%), Dysgraphia (7.63%), Dyscalculia (2.08%), memory deficits (10.41%) and attention deficits (10.41%) were noted. All SLDs were more in boys. Significant gender difference occurred in mean scores of Spelling Dyslexia and Memory Deficit and percentage scores of Reading Dyslexia and Dysgraphia. Spelling and Reading dyslexia had significant correlation with Memory deficit. Significant difference in Spelling Dyslexia, Memory deficit and Raven's score was noted in various age groups.

Conclusion: The study provides insight to higher SLD prevalence and advocates developing school curriculums, inclusive of this population.

Keywords: Specific learning disability, NIMHANS index, Dyslexia, Attention Deficit

Introduction: Specific learning disability (SLD) is a type of Neurodevelopmental Disorder that impedes ability to learn or use specific educational skills [DSM-5 315 &; ICD-10-CM] [1]. SLD includes difficulties in specific processing areas like "Dyslexia, Dysgraphia,

Dyscalculia, Dyspraxia, Perceptual disabilities and Developmental aphasia"[2]. Children with SLD are unable to acquire their age appropriate cognition, language and analytical skills inspite of adequate learning opportunities, intellectual capacity, appropriate sensory systems and physical abilities. Children who have learning problems due to visual/hearing defect, motor handicaps, mental retardation, emotional disturbance, environment, cultural or economic disadvantage are not considered to have SLD. The spectrum of SLD consists of 1) Reading dyslexia, which is the commonest affecting 80% of all those identified as learning-disabled [3]. They have errors in oral reading skills like omissions, substitutions, distortions or additions of words; slow reading rate, long hesitations, word reversals and deficits in reading comprehension; 2) Dysgraphia - Dysgraphic children have problems in handwriting, spelling or organizing concepts. It affects around 4% of school children [4]; Dyscalculia - These children have lack of understanding of mathematical signs and numerical symbols. Prevalence ranges from 3-14% [4]. SLD Prevalence is influenced by factors such as heterogeneity of definitions, clinical assessment tools, study design and population demographics. Tests for SLD have two major components: Testing for Potential: Performance Discrepancy and Testing Processing skills. A two-year discrepancy between potential and performance is an indicator of possible SLD [5].

Rationale for study: No other disabling condition affects so many people and yet has such a low public profile and low level of understanding as SLD [6]. Given the immense consequences of SLD in academic performance & issues with its identification in Indian schools, there is a need to gain insight about extent of presence of SLD among middle school students. It is vital to identify SLD early before poor school performance and its attendant emotional sequelae sets in. Prompt diagnosis and timely intervention will improve their self-confidence and social competency. Prevalence of various types of deficits of scholastic skills was reported to be 3-10% among Indian student population [7]. Moreover, prevalence studies are rare with respect to SLD as compared to general learning disabilities due to general lack of awareness of its symptoms. Since there is a paucity of studies on SLD done in Chennai, present study was conducted to fill in research gap.

Aims and Objectives:

1. To estimate prevalence of various types of SLD among middle school students in Chennai.

2. To determine difference in prevalence of SLD if any between gender and age.

3. To find out relationship between various types of SLD.

Material & Methods:

Study Design: A Cross Sectional Survey using Expost Facto research design was adopted. This studywas conducted in two levels. In level one, overall prevalence was surveyed. In level two, connection between various types of SLD and impact of gender and age on SLD was studied.

Study Setting: Government schools in Chennai. Chennai was purposively sampled for two reasons. First, there was few number of studies on prevalence of SLD and secondly, Chennai covers a large number of Government Schools.

Source Population: Middle school students studying in fifth, sixth and seventh standards.

Study Population: Study population included 344 students of which 140 (59 boys,81 girls) were from Corporation Middle School (CMS) Manjakollai, 133 (72 boys, 61 girls) were from CMS Arumbakkam and 71 (44 boys, 27 girls) were from CMS Aminjikarai. Totally 175 boys and 169 girls were studied. Consent was taken from parents and assent was taken from participating students.

Study Period: The study was conducted from November 2019 to December 2020.

Selection Criteria: Raven's Progressive Matrices was administered to selected students (N= 344) toidentify IQ level. Those who were intellectually defective (N=32) and below average (N=168) were excluded. Students who were intellectually superior (N=2), above average (N= 25) and Average (N=117) were then administered part of NIMHANS Index of SLD.

Inclusion Criteria: Students studying in fifth, sixth and seventh standards whose score was average, above average and intellectually superior in IQ Assessment who consented for the study were included.

Exclusion Criteria: Students whose IQ Assessment score was defective and below average, those with intellectual disability, sensory deficits (Visual/ Hearing impairment) and physical impairment and those diagnosed with any other psychiatric conditions were excluded from the study.

Sampling Design:Written permission was taken from commissioner of education for conducting study. Random sampling was done. Study was conducted in 3 schools randomly allotted by education officer.

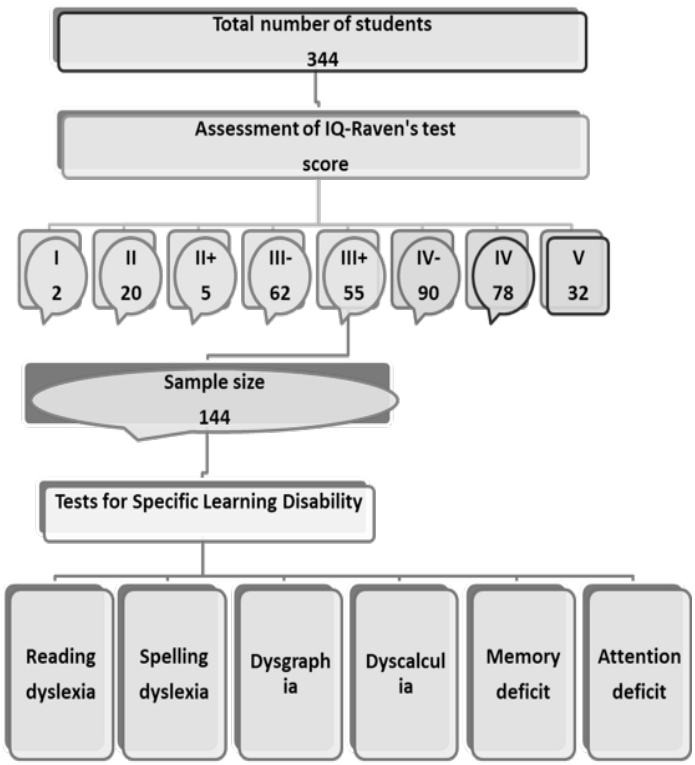
Sampling Procedure:

Sample Size :According to Government of Tamil Nadu Department of Economics and Statistics-District Statistical Hand Book Chennai District 2016-2017 there are 185 institutions in Chennai providing middle school education, with 11645 students studying middle school out of which 6260 were boys and 5385 were girls. So middle school population strength was taken as 11645 [8]. Being a finite population, following formula was used for sample size estimation.

$\acute{n}$ = n divided by 1+ [$\{z^2 x \hat{p} (1-\hat{p})\}/ \varepsilon^2 N$]

where z is z score; ε is margin of error; N is population size; $\hat{p}$ is population proportion. Sample size was calculated based on reported SLD prevalence of 15% [9]. Being a social study with small total population 95% confidence interval and relative error of 5% was taken. z for a95% confidence level is 1.64; ε, margin of error is 5%; N, population size is 11645; $\hat{p}$ proportion is 15%. Applying the formula, required sample size for this study is 138children.

Figure 1- Flowchart of Sampling Process



A total of 144 students with 67 Boys and 77 Girls in age ranging from 9 to 13 years were selected for study.

Research tools used in study: Raven's Progressive Matrices was used for initial IQ assessment. Test-retest reliability (N = 968) of Raven's test ranged between 0.69 and 0.85, while Cronbach coefficients alpha ranged from 0.88 to 0.93, showing acceptable to good temporal stability and good to high internal consistency.

[10]. Raw score results was then converted to percentile ranking. NIMHANS Index is widely used for assessing SLD in India. Reliability is 0.53 and criterion validity 0.75 [11]. It has 2 levels. Level I is for children between 5-7 years and Level II is for children between 8-12 years. Level II comprises of following tests Attention (Number Cancellation); Language Test (Reading, Writing, Spelling and Comprehension); Arithmetic(Addition, Subtraction, Multiplication, Division and Fractions) and Memory (Auditory and Visual). Modified Kuppuswamy scale (Feb 2019) was used to stratify study population [12].

Data Collection: Socio-economic data of study population was collected in standard proformas. Raven's IQ test was administered. Scores from Spelling test, Maths test, Attention test and Memory recall test were collected. Handwritten copies were analysed for dysgraphia. Individually reading test was conducted. All collected data were entered in excel sheet.

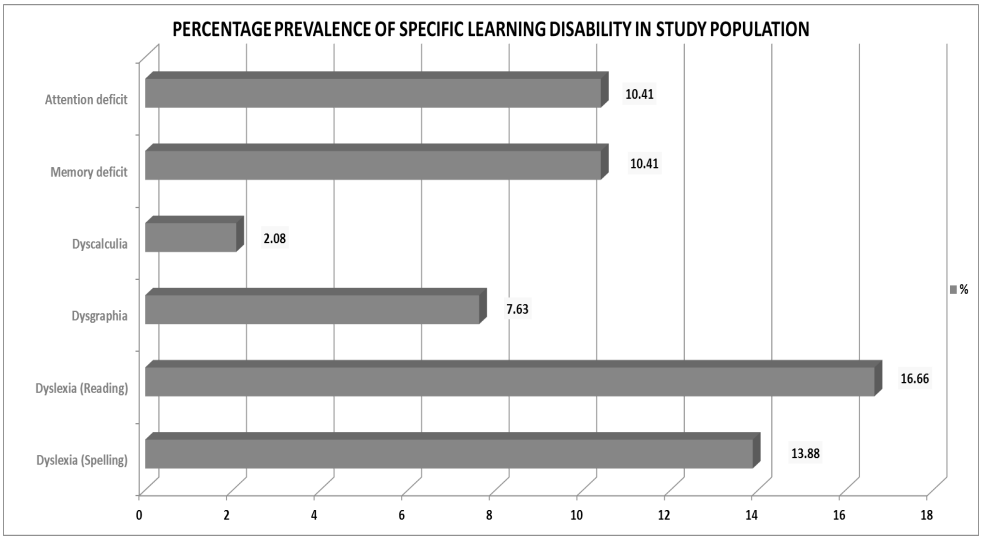
Statistical Analysis: Data collected was analyzed using Statistical package for Social Sciences (SPSS-19) and Med Calc. Quantitative data were analyzed using descriptive statistics. Pearson Product Moment correlation was used to findthe relationship between various types of SLD. Independent 't'-test was done to find out significant difference in SLD between genders. ANOVA was done to find out significant difference in SLD between different age groups and among students with different Raven's scores.

Results:

Among 144 students, 78(54.16%) were from CMS Manjakollai, 43(29.86%) were from CMS Arumbakkamand 23(15.97%) were from CMS Aminjikarai. Majority 77(53.47%) were girls. Around 33(22.91%) were 9 years, 63(43.75%) were 10 years, 16(11.11%) were 11 years, 27(18.75%) were 12 years and 5(3.47%) were 13 years old. Around 99(68.75%) were Fifth standard students, 15 (10.41%) from Sixth standard and 30 (20.83%) were Seventh standard students. Majority107(74.3%) belonged to Socio-Economic status IV and 36(25%) belonged to status III. Among 144 students, 61(42.36%) were first born, 56(38.88%) were second, 17(11.8%) were third and 7(4.86%) were fourth child. Majority (97.91%) were right handed. Majority 90(62.5%) belonged to nuclear family. Around 71(49.3%) belonged to small size family, 67(46.52 %) belonged to medium size and 6 (4.16 %) belonged to large size family.

Prevalence of SLD:

Figure 2- Percentage prevalence of SLD in study population



As depicted in Figure 2, 20 children (13.88%) had Spelling Dyslexia, 24(16.66%) had Reading Dyslexia, 11(7.63%) had Dysgraphia, 3(2.08%) had Dyscalculia, 15(10.41%) had memory deficits and 15(10.41%) had attention deficit.

Table 1- Correlation Coefficient of various types of SLD

	Attention Deficit	Memory Deficit	Spelling Dyslexia	Dyscalculia	Raven	Dysgraphia	Reading Dyslexia
Attention Deficit	-	0.2376	0.2461	0.2473	0.1758	0.1723	0.1967
Memory Deficit	-	-	0.7433	0.2276	0.3007	0.2268	0.5056
Spelling Dyslexia	-	-	-	0.1731	0.3952	0.2579	0.4419
Dyscalculia	-	-	-	-	0.1930	0.0234	0.1589
Raven	-	-	-	-	-	0.0591	0.1822
Dysgraphia	-	-	-	-	-	-	0.2222

As depicted in Table 1, Correlation coefficient between Spelling Dyslexia and Memory deficit was particularly high at 0.7433. Correlation coefficient between Memory deficit and Reading Dyslexia was also high at 0.5056. Hence, null hypothesis-1 stating that, "Various types of SLD will not be related to each other" was rejected.

Prevalence of SLD with respect to gender: Prevalence of various SLD was higher in Boys as compared to girls. Comparing Boys vs Girls, Spelling Dyslexia was 19.4% vs 9.09%, Reading Dyslexia was 23.88% vs 10.38%, Dysgraphia was 16.41% vs none, Dyscalculia was 2.98% vs 1.29%, Memory deficit was 13.43% vs 7.79% and Attention deficit was 11.94% vs 9.09% respectively.

Table 2- Comparison of percentages of SLD between boys and girls

	Boys (%)	Girls (%)	CHI SQ	DF	P
Dyslexia (Spelling)	19.4	9.09	3.162	1	0.0754
Dyslexia (Reading)	23.88	10.38	4.67	1	0.0307
Dysgraphia	16.41	0	13.585	1	0.0002
Dyscalculia	2.98	1.29	0.50	1	0.4796
Memory deficit	13.43	7.79	1.213	1	0.2707
Attention deficit	11.94	9.09	0.31	1	0.5779

As depicted in Table 2, Difference in dysgraphia between boys and girls was most significant with p value 0.0002. Reading dyslexia was also higher in boys as compared to girls with significant statistical difference of 0.0307 which was significant ($p < 0.05$). Hence, null hypothesis-2 stating that, "Boys and Girls will not differ significantly in various types of SLD" was rejected.

Prevalence of SLD with respect to age: Prevalence of Spelling Dyslexia among students of age 9 was 9.09%, age 10 was 17.46%, age 11 was 18.75%, age 12 was 7.4% and age 13 was 20%. Prevalence of Reading Dyslexia among students of age 9 was 6.06%, age 10 was 23.8%, age 11 was 25%, age 12 was 7.4% and age 13 was 20%. Prevalence of Dysgraphia among students of age 9 was 6.06%, age 10 was 6.34%, age 11 was 25%, age 12 was 3.7% and age 13 was 0%. Prevalence of Dyscalculia among students of age 9 was 3.03%, age 10 was 1.58%, age 11 was 0%, age 12 was 3.7% and age 13 was 0%. Prevalence of Memory deficit among students of age 9 was 9.09%, age 10 was 17.46%, age 11 was 0%, age 12 was 3.7% and age 13 was 0%. Prevalence of Attention deficit among students of age 9 was 9.09%, age 10 was 7.93%, age 11 was 25%, age 12 was 11.11% and age 13 was 0%.It was found that prevalence of Spelling Dyslexia was highest among students in 11 years (18.7%) and 10 years(17.4%) age group. Prevalence of Reading Dyslexia and Dysgraphia was highest among students in 11 years age around 25% in each. Prevalence of Dyscalculia was highest among students in 12 years (3.7%) age group. Prevalence of memory deficit was highest among students in 10 years (17.4%) age group and attention deficit was highest among students in 11 years (25%) age group. The score in Memory test was significant ($p=0.043$) when ANOVA analysis was done between age groups 9,10,11,12 and 13 years. Spelling dyslexia was also significantly different between age groups ($p=0.016$). Hence, null hypothesis-3 stating that, "Students of different ages wouldn't differ significantly in various types of SLD" was rejected.

Discussion: Prevalence of SLD: Prevalence of Spelling Dyslexia in our study was 13.88% which was comparable to Kumar and Suman (12.31%) [13] & Mogasale et. al., (11.2%)[14]. Reading dyslexia was note d in 16.66% which is higher than Mogasale et.al (11.2%)[14], Sheetal et al., (10%)[15] and Calicut study (8.2%)[16]. We noticed dysgraphia in 7.63% which was lower

than Mogasaleet.al., (12.5%)[14]. Dyscalculia was lower (2.08%) in our study as compared to Mogasaleet.al., (10.5%)[14] and Dhanda et al.,(15.54%)[17]. Sree Chithira Thirunal Institute of Medical Sciences showed 8-10% of school population had SLD[18].

Prevalence of individual learning disabilities among children with SLD: Among children with learning disabilities 24(48%) had Reading Dyslexia, 20(40%) had Spelling Dyslexia, 15(3%) had attention deficits, 15(30%) had memory deficits, 11(22%) had dysgraphia and 3(6%) had Dyscalculia. Neeraja et al., also found that among children with SLD, majority 94% had Reading problems, 81.7% had writing problems and 78.3% had problems in Mathematics[19].

Prevalence of SLD with respect to gender: In our study Reading dyslexia was higher in boys, 23.88% as compared to 10.38% among girls.Boys: Girls ratio for Reading dyslexia was around (4:1) as per Goswami U et al.,[20], Smith etal.,[21] and Shaywitz, S. et al.,[22]. In our study Dysgraphia was higher in boys, 16.41% as compared to 0% among girls which was similar to Katussic SK et al.,[23], Berninger VW etal.,[24] and Smithet al.,[21]. In our study Dyscalculia was higher in boys, 2.98% as compared to1.29% among girls which was similar to Barbaresi WJ et al.,[25]. Male preponderance was attributed to a referral bias in school-identified children[26].

Prevalence of SLD with respect to age: We found that Reading Dyslexia, Spelling Dyslexia, Attention Deficit and Dysgraphia was highest among 11 years and Dyscalculia was highest among 12 years age group students. Dhanda et al., also observed that SLD was higher in higher age group[17].

Conclusion: Prevalence of Spelling Dyslexia was 13.88%, Reading Dyslexia was 16.66%, Dysgraphia was 7.63%, Dyscalculia was 2.08%, Memory Deficit was 10.41% and Attention Deficit was 10.41%. There was difference in SLD based on Gender and Age. There was a statistically significantly positive relationship between various types of SLD. The study provides insight to higher SLD prevalence and advocates developing school curriculums, inclusive of this population.

Limitations: This study was limited to a sample only from Chennai, only from Government schools, and from fifth, sixth and seventh standards only.

Policy Implications: The study provides an insight to higher rate of SLD which would help teachers and parents to understand the causes of scholastic backwardness. The study results strongly advocate needfor developing school curriculums which are more inclusive of this population.

Suggestions: Future research can be more inclusive with regard to different boards of education, can be done at a younger at-risk age population and in rural setting to get a more holistic picture of SLD. With statistics of present study, Government can definitely think about adapting relevant teacher training courses, bringing changes in curriculum and in methods of teaching.

Key Messages:

What is already known: Our educational system has over emphasis on memory reproduction and theory rather than application which is not suitable for children with SLD.

What this study adds: Present study aimed at finding SLD prevalence apart from being descriptive also gives idea on where to work on to improve conditions of such students.

Keywords: Specific learning disability, NIMHANS index, Dyslexia, Attention Deficit

Abbreviations:

SLD - Specific Learning Disability

NIMHANS-National Institute of Mental Health and Neuro Sciences

CMS - Corporation Middle School

Declarations:

Compliance with Ethical Standards

Funding: No funds, grants, or other support was received to assist with the preparation of this manuscript or conducting this study.

Competing interests: All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Ethics approval: Clearance from Institutional Ethics Committee was obtained on 24/10/2019, Ref Oct 2019 before proceeding to Education Department, Greater Chennai Corporation to obtain permission to conduct research. Written permission was obtained. E.D.C.NO. A3/11650/2019 Dated 07/11/2019.

Consent to participate and to publish; Written informed consent to participate and to publish data was obtained from the parents. Informed assent was obtained from all individual participants included in the study. Participants willingly cooperated in giving required information without coercion or bribery.

Authors' contribution statements: All authors contributed to the study conception and design. Conceptualization, Material preparation, data collection and analysis were performed by Dr. Rabindran Chandran & Dr. Darshini Madanagopal. The study was supervised by Dr. Rema Chandramohan. The first draft of the manuscript was written by Dr. Rabindran Chandran and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

References:

1. Diagnostic and Statistical Manual of Mental Disorders, 5th Edn.;. (DSM-5)American Psychiatric Association. American Psychiatric Association Publishing. 2013. https://doi.org/ 10.1176/ appi. books.9780890425596
2. Ministry of Social Justice and Empowerment. Notification, 2018, Gazette of India (ExtraOrdinary); 2018 Jan 4. Department of Department of Empowerment of Persons with Disabilities (Divyangjan). Available from: https://groups.google.com/d/topic/wethepwd/XuRiT0VdWsg.
3. Rochelle Kenyon. "Facts and statistics on learning disabilities and literacy." A Project ofFlorida Human Resources Development Sep 2003; 1-15.
4. Szklut S, Breath. "Learning disabilities and Neurological rehabilitation." Virginia University.2001; 308-350.
5. Hirisave U, Oomen A, Kapur M. Psychological assessment of children in the clinical setting. 1st Edn. Bangalore: Nimhans; 2002, p. 79-80
6. Reid L, Tom H, Andrew H, Ann K. Washington summit on learning disabilities. Notes on the summary report of the 1994. March; Available from: URL: http://www.ldhope.com/ wash.html
7. Neeraja P, Anuradha K. Impact of special education among children with learning disabilities; International Journal of Home Science 2016; 2(3): 203-207. ISSN: 2395-7476.
8. District statistical hand book chennai district 2016-2017- Page 56.; https://cdn.s3waas.gov.in ›uploads › 2018/06.
9. Shah HR, Trivedi SC. Specific learning disability in Maharashtra: Current scenario and roadahead. Ann Indian Psychiatry. 2017; 1(1):11. DOI: 10.4103/aip.aip_6_17
10. Abdel-Khalek AM. Reliability and factorial validity of the standard progressive matrices among Kuwaiti children ages 8 to 15 years. Percept Mot Skills. 2005;101(2):409-12. doi: 10.2466/pms.101.2.409-412. PMID: 16383072.
11. Handler SM, Fierson WM. Learning disabilities, dyslexia, and vision. Pediatrics. 2011 Mar;127(3): e818-56. doi: 10.1542/peds.2010-3670. Epub 2011 Feb 28.
12. Saleem, Sheikh. Modified Kuppuswamy socioeconomic scale updated for the year 2019. Indian Journal of Forensic and Community Medicine. 6. 2019. 10.18231/2394-6776.2019.0001

13. Kumar J, Suman S. Identification and Prevalence of Learning Disabled Students. International Journal of Scientific and Research Publications. 2017;7(3);317, ISSN 2250-3153.

14. Mogasale VV, Patil VD, Patil NM. Prevalence of specific learning disabilities among primary school children in South Indian city. Indian J Pediatr. 2012;79:342–377.

15. Sharma S. A study of Identification of Learning Disabilities among Elementary School Students in Jammu Province of Jammu & Kashmir State- An Issue in Early Education; International Journal of Research in Economics and Social Sciences (IJRESS). 2017; 7(11): ISSN(o): 2249-7382.

16. Bhakta P, Hackett RJ, Hackett L. The prevalence and associations of reading difficulties in a population of South Indian children. Journal of Research in Reading. 2002; 25(2):191–202.

17. Dhanda A, Jagawat T. Prevalence and pattern of learning disabilities in school children. Delhi Psychiatry Journal. 2013;6:386–90.

18. Suresh P. Epidemiological survey of developmental language disorders and learning disability. 1998.

19. Akhil D, Tushar J. Prevalence and pattern of learning disabilities in school children. Delhi Psychiatry Journal. 2013; 16(2):386-390.

20. Goswami U. Learning difficulties: future challenges. In: Cooper CL, Field J, Goswami U, Jenkins R, Sahakian BJ editors. Mental capital and wellbeing. UK: John Wiley and Sons. 2008:727-766.

21. Balkhande D, & amp; Damle, A. A study of cognitive abilities and learning disabilities among the rural and urban children of Nagpur. Indian Streams Research Journal. 2012;2(3):1-4.

22. Shaywit S, Alfred A. Knopf. Overcoming dyslexia: A new and complete science-based program for reading problems at any level. New York: 2003, 416. Am J Psychiatry 162:1, January2005

23. Katusic SK, Colligan RC, Weaver AL, Barbaresi WJ. The forgotten learning disability: epidemiology of written-language disorder in a population-based birth cohort (1976-1982),Rochester, Minnesota. Pediatrics. 2009;123(5):1306-13. doi: 10.1542/peds.2008-2098.

24. Berninger VW, Nielsen KH, Abbott RD, Wijsman E, Raskind W. Gender differences in severity of writing and reading disabilities. J Sch Psychol. 2008;46(2):151-72. doi: 10.1016/j.jsp.2007. 02.007. Epub 2007 Apr 2.

25. Barbaresi WJ, Katusic SK, Colligan RC, Weaver AL, Jacobsen SJ. Math learning disorder:incidence in a population-based birth cohort, 1976-82, Rochester, Minn. Ambul Pediatr. 2005;5(5):281-9.

26. Shaywitz SE, Shaywitz BA, Fletcher JM, Escobar MD. Prevalence of reading disability in boys and girls. Results of the Connecticut Longi-tudinal Study. JAMA. 1990;264(8):998-1002.