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ORIGINAL ARTICLE

Prevalence and Patterns of Learning Disabilities in School Children

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Abstract
Objective To assess the prevalence and patterns of learning disabilities (LD) in school going children in a northern city of India.
Methods The present cross-sectional study comprised of three-staged screening procedure for assessing learning disabilities of 3rd and 4th grade students studying in government schools. The first stage comprised of the teacher identifying at-risk student. In the second stage, teachers assessed at-risk students using Specific Learning Disability-Screening Questionnaire (SLD-SQ). The third stage comprised of assessment of the screen positive students using Brigance Diagnostic Inventory (BDI) part of NIMHANS Index of Specific Learning Disabilities for identifying the cases of LD.
Results A total of 1211 (33.6 %) children out of the total screened (n = 3600) were identified as at-risk by the teachers at the first stage. Of them, 360 were found to screen positive on the second stage using SLD-SQ. The most common deficits were missing out words or sentences while reading, misplacing letters or words while reading or writing, and making frequent mistake in spelling while writing or reading. Of these, 108 children were confirmed to have learning disability on the third stage using BDI, which represented 3.08 % of the total population.
Conclusions Learning disability is an important concern in young school aged children. Early identification of such students can help in early institution of intervention and suitable modifications in teaching techniques.

Keywords Learning disability · India · Young children · Prevalence

Introduction

Learning disability has been considered as a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities [1]. Though it may be the result of a range of overlapping biological and environmental etiologies, it is a useful clinical construct from the standpoint of teachers and clinicians to identify children who are at risk of falling behind in scholastic achievement [2]. The rubric of learning disability encompasses a broad set of situations where targeted remedial interventions may potentially improve learner outcomes. It has been seen that individuals with learning disability may suffer from disadvantage on educational and occupational domains [3]. Hence, understanding of this condition may identify those at-risk, so that they can be identified and helped using appropriate means.

Focusing on the broad construct of learning disability may be more helpful from the community perspective than diagnosis of specific causes like dysgraphia and dyscalculia. It may be difficult to delineate specific learning disorders clearly due to high degree of co-morbidity with other disorders [4–7], difficulty in making reliable and stable diagnosis in the young age groups [8, 9], and additive influence of psychosocial

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considerations [10]. Rigorous epidemiological studies have faced difficulties in accurately ascertaining prevalence of specific learning disorders [11]. Hence attempts at ascertaining the overall occurrence of learning disorders rather than specific subtype may be more useful from the perspective of the community policy makers while planning intervention services.

Though some work in India has been done on learning disabilities in the clinical setting [12–15], there is lack of ample evidence from school-based community prevalence studies [16, 17]. Moreover, no community based study from India has attempted to assess parents' opinions about learning disability though they are important stakeholders in child's education. Hence this study was conducted to assess the prevalence and patterns of learning disorders in young children and to assess parental reports of issues with learning in their children.

Material and Methods

The present cross-sectional school based study was conducted among the government co-educational schools within Chandigarh. Chandigarh is a Union Territory in India located about 250 km north of national capital, New Delhi and covers an area of about 114 km^2. The population of the Union Territory is around 1.1 million as per the 2011 Census of India [18]. Chandigarh primarily (over 90 % population) comprises of urban areas, but also has 14 villages around the city. The city boasts of one of the highest literacy rate of the country and good health indicators [18].

Sample size for the study was calculated in Epi-info software. The required sample size with expected prevalence of 3 % and alpha error of 0.05 and margin of error as 1 % was 1118, whereas with a prevalence of 10 % and margin of error as 1 %, it was 3458. The maximum sample size estimates was taken in the study. Probability Proportion to size (PPS) sampling was done to gather the data and a stratified random sampling was used. To give proportionate representation to each area of Chandigarh, the whole city was categorized as urban, rural and slum areas based on Census 2011. Urban area represented 60 % students, rural area 30 % students and slum area represented 10 % students.

List of all schools was obtained from Director Public Instruction, Chandigarh. Chandigarh has a total of 103 government schools. On basis of their location, all schools were categorized into urban, rural and slum. Out of this list, a total of 20 schools were selected randomly by lottery method with 11 schools from urban areas, 7 schools from rural areas and 2 schools from slum areas. Students of third and fourth grade from selected schools were chosen as study population with a target of about 180 students from each school.

The study was approved by the Institutional Ethics Committee of Punjab University, Chandigarh. Permissions from the principals of the schools were sought, and subsequently the teachers were contacted. The data was collected by the author (SSD) after adequate training provided by the first author, and the data collection was periodically supervised and monitored by the author (SKP). In the first stage, standardized instructions were given to the teachers who were asked to screen about one-third students from each class whom they thought had some form of learning difficulty. The teachers were then asked to rate these students on Specific Learning Disorder-Screening Questionnaire (SLD-SQ) [19] to systematically screen for learning disability. Those students who had scored above the cut-off on the SLD-SQ were administered Brigance Diagnostic Inventory (BDI) [20] part of the NIMHANS Index for Specific Learning Disabilities [21] by one of the researchers (SSD) in the third stage. A questionnaire was sent to the parents with questions relating to the child's educational issues. The questionnaire was sent along with the children who were considered at-risk for learning disability and completed questionnaires were collected by the teachers. The questionnaire sent to the parents was kept brief to elicit maximum completed responses.

SLD-SQ: The test-retest reliability of the questionnaire at the interval of one month time period is 0.87. Cut-off score of 4 has yielded sensitivity of 0.83 and specificity of 0.77 and is considered most appropriate cut-off [19]. This questionnaire on specific learning disabilities comprises of 12 questions that can be rated by the teachers. The 12 questions cover different aspects of learning like problems related to mathematics, reading, writing, both reading and writing, memory *etc*.

Brigance Diagnostic Inventory (BDI) [20]: This tool was devised in 1977 and comprises of 24 items. The questionnaire comprises of items relating to color recognition, visual discrimination, simple visuo-motor skills, visual memory, body image, gross motor co-ordination, identification of body parts, articulation of sounds, *etc*. The scale requires responses from the students for grading. If a child above 7 y is unable to pass the items, he is referred to as being learning disabled and requires remedial training [21]. This has been applied in Indian population as a part of NIMHANS (National Institute of Mental Health and Neurosciences, Bangalore) Battery for assessment of Learning Disabilities [21]

Data analysis was conducted using SPSS version 16. Descriptive analysis was conducted using frequencies and percentages of the children's variables relating to age group, gender, type of school, and school location. The frequencies of individual items of SLD-SQ were computed and compared with other nominal data using χ^2 test. Similarly, the proportion of children with abnormality on BDI was compared to other

variables. Sub-group mean imputation was done for the missing values to compute the overall prevalence. Prevalence was calculated using BDI as the measure for case definition.

Results

The sampling procedure is depicted in Fig. 1. Out of the 3600 students from 20 schools, 1211 were considered to be at-risk by the teachers and were rated on SLD-SQ. Out of them, 360 (10.0 % of the total sample of students, and 35.7 % of those considered at-risk by the teachers) scored above the cut-off on SLD-SQ (Table 1). Majority of the students were boys, and belonged to urban areas. Those who scored above the cut-off on SLD-SQ did not significantly differ from others on age, gender, or language of instruction except for school location. Of the 360 students who had elevated scores on SLD-SQ, 358 (99.4 %) could be assessed using BDI by the investigators. Out of these children, 108 (29.3 %) were found to have abnormality on BDI. This gave prevalence estimate of learning disability at 3.03 % (95 % confidence interval 2.51 % to 3.64 %) for the entire sample of 3600, after accounting for missing cases. When cases which had learning disability as per BDI and those which did not were compared, significant difference emerged on type of location of school ($\chi^2 = 8.060$, p 0.018), with those from slum areas having greater risk of being screened positive. Gender, type of school, age group of the child and the medium of instructions did not have significant relation for a child being diagnosed as having learning disability as per BDI.

The item wise analysis of individual items of SLD-SQ is depicted in Table 2. The most common deficits were missing out words or sentences while reading, misplacing letters or words while reading or writing, and making frequent mistake in spelling while writing or reading. Table 2 also shows the association of each of the items with other variables. Gender was not associated with differences in rates of any of these items. Studying in English medium schools was associated with greater likelihood of being reported missing words while reading, misplacing letters or words while reading or writing and forgetting lessons easily. Similarly, some of the items were associated with Hindi (local) language like difficulty in differentiating similar sounding words.

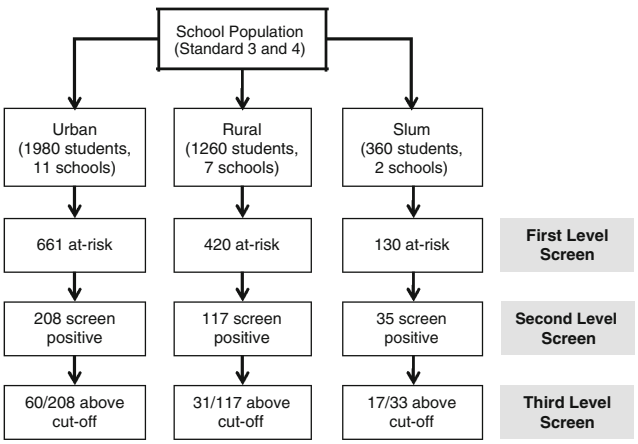

Fig. 1 Sampling procedure and stage-wise screening

Table 3 shows the items on BDI part of NIMHANS index of specific learning disabilities, with the most common abnormality being those of visual memory, gross motor coordination and visual motor skills. The number of items which showed abnormality on BDI is depicted in Fig. 2. The graph suggests that abnormalities were present in one or few domains and lesser number of children had abnormalities on 6 or more domains.

Responses from the parents are shown in Table 4. Out of 1211 questionnaires, 560 were returned (response rate of 46.2 %). It was seen that majority of the parents spent less than 1 h teaching their children. The most common problems faced during teaching were related to reading and writing. About one-fifth of the parents checked their child's homework. Less than five percent of the sample endorsed that they knew about learning disorder. On further exploratory analysis, time spent on teaching the child was significantly less in the slum group ($\chi^2 = 14.812$, p 0.001), but did not differ significantly across the socio-economic classes. Knowledge about learning disorders was not significantly associated with locality of residence or socio-economic class.

Open ended questions were also asked to know the parents' views and suggestions about helping students with learning disability. Twenty-six suggested to increase awareness, eighteen suggested special attention from school and other educational facilities, twelve suggested for new treatment and educational facility, eight suggested special teacher's training, eight suggested providing more facilities, and ten suggested other supportive measures.

Discussion

The present study finds that learning disability is present in about 3 % of the 3rd and 4th grade students. Another study from the region has suggested about 1.58 % prevalence of specific learning disorders in 7th to 12th grade students [17]. However, certain other studies have found comparatively higher prevalence of learning disorders in the school setting [16, 22], with reported rates of learning disorders in the range of 10 to 15%. The differences the constructs looked into and the means of ascertainment of cases might have led to differences in the rates reported. Interestingly, one epidemiological prevalence study from the region did not find a single case of specific learning disorder during the process of recruitment [23].

On the third screen, students from slum areas seemed to have a greater proportion of students who had learning

Table 1 Characteristics of students who scored above the cut-off on SLD-SQ

Variable	First stage screen: Considered at-risk by the teachers (n = 1211)	Second stage screen: Above cutoff of SLD-SQ (n = 360)	Third-stage screen: Above cutoff on BDIBS (n = 108)	Comparison second screen *vs.* first screen χ^2 (p value)	Comparison third screen *vs.* second screen χ^2 (p value)
Gender					
Male	747 (61.7 %)	232 (64.4 %)	71 (65.7 %)	1.651 (0.199)	0.104 (0.747)
Female	464 (38.3 %)	128 (35.6 %)	37 (34.3 %)		
Age					
Up to 8 y	230 (19 %)	73 (20.3 %)	22 (20.4 %)	2.209 (0.530)	0.861 (0.835)
9 to 10 y	769 (63.5 %)	232 (64.4 %)	68 (63 %)		
11 to 12 y	193 (15.9 %)	51 (14.2 %)	16 (14.8 %)		
Above 12 y	19 (1.6 %)	4 (1.1 %)	2 (1.9 %)		
School location					
Urban	661 (54.6 %)	208 (57.8 %)	60 (55.6 %)	2.151 (0.341)	6.564 (0.038)
Rural	420 (34.7 %)	117 (32.5 %)	31 (28.7 %)		
Slum	130 (10.7 %)	35 (9.7 %)	17 (15.7 %)		
Medium of teaching reported					
Hindi	691 (57.1 %)	188 (52.2 %)	55 (50.9 %)	0.047 (0.828)	0.104 (0.747)
English	620 (51.2 %)	172 (47.8 %)	53 (49.1 %)		

BDI Brigance diagnostic inventory; *SLD-SQ* Specific learning disability- screening questionnaire

disability with screen positive rate of 51.5% from the schools in slum area compared to 28.8% and 26.5% from urban and rural areas respectively. One explanation could be due the discrepancy between the teacher rating and objectively observed performance by the research team. A teacher from a school in slum area might have lower expectation, and might rate less conservatively on the SLD-SQ. The other explanation could be that students from slum areas might suffer from additional psychosocial challenges like lesser parental supervision which might lead to learning disability. Disentangling effect of biological vulnerability from psychosocial adversity may be quite difficult if not impossible, and both may contribute to problems with learning in an individual child [24, 25].

Missing out words or sentences while reading, misplacing letters or words while reading or writing, and making frequent spelling mistakes were the most common problems noted by

Table 2 Item wise analysis of SLD-SQ

Item	N (%)	Group with greatest proportion endorsing the item with $p < 0.05$
Misses out words or sentences while reading	694 (57.3)	English medium, Urban
Misplaces letters or words while reading or writing	620 (51.2)	English medium, Urban
Makes frequent mistake in spelling while writing or reading	565 (46.7)	Urban
Finds it difficult to take down what is written on the board	345 (28.5)	Hindi medium, Urban
Ignores capitals or punctuation while writing	318 (26.3)	Hindi medium, Slum
Have difficulty in understanding what is taught in the class	316 (26.1)	Hindi medium, Rural
Writes in ineligible writing	296 (24.4)	Hindi medium, Slum
Often gets confused in mathematical symbols	290 (23.9)	Hindi medium
Forgets lessons easily	290 (23.9)	English medium, Urban
Overall academic ability much below than his/her grade level	275 (22.7)	Hindi medium
Makes many mistakes in solving math problem	161 (13.3)	Hindi medium, Slum
Has difficulty in differentiating similar sounding words	157 (13.0)	Hindi medium, Slum

Statistical analysis using χ^2 test for gender, school type and location of the school; group with the maximum proportion is depicted in the table where $p < 0.05$

SLD-SQ Specific learning disability- screening questionnaire

Table 3 Items endorsed on Brigance Diagnostic Inventory

Item	N (%)
Visual memory	25 (23.1)
Gross motor co-ordination	23 (21.3)
Visual-motor skills	21 (19.4)
Visual discrimination	18 (16.7)
Alphabets	17 (15.7)
Body image	16 (14.8)
Identification of body parts	16 (14.8)
Sentence memory	15 (13.9)
Counting	14 (13)
Writing	14 (13)
Verbal directions	13 (12)
Articulation	13 (12)
Numerical comprehension	13 (12)
Recognition of upper case letters	13 (12)
Numbers in sequence	13 (12)
Lower case letters by dictation	13 (12)
Fine motor skills	12 (11.1)
Verbal fluency	12 (11.1)
Personal data response	12 (11.1)
Numeral recognition	12 (11.1)
Directional/positional skills	10 (9.3)
Color recognition	9 (8.3)
Upper case letters by dictation	9 (8.3)
Recognition of lower case letters	5 (4.6)

the teacher. Other studies have reported that reading, writing, comprehension and spelling deficits are more common in children with specific learning disorders when compared to controls [17]. Though one study suggests that the proportion with arithmetic deficits may not differ from controls [17], another suggests that the proportion of students with dyscalculia may

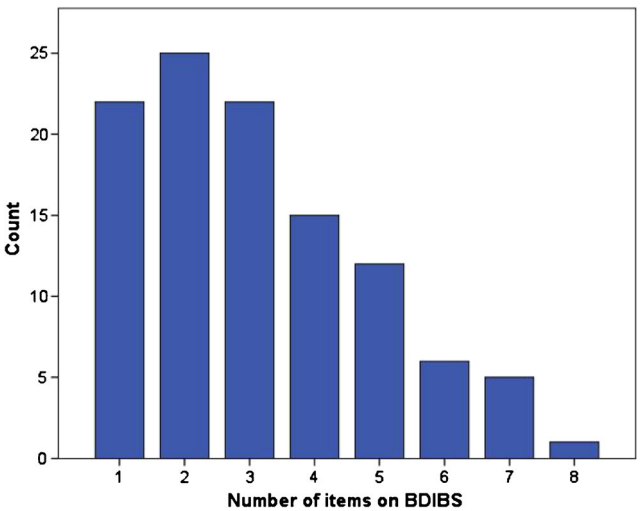

Fig. 2 Number of items endorsed on Brigance Diagnostic Inventory

Table 4 Responses of parents on questions related to teaching

Variable	N (%)
Locality	
Urban	252 (45.0)
Rural	216 (38.6)
Slum	92 (16.4)
Family	
Nuclear	260 (46.4)
Others	300 (53.6)
Socio-economic class	
Upper middle	244 (43.6)
Lower middle	270 (48.2)
Upper lower	46 (8.2)
Time spent with child	
0 to 3 h	372 (66.4)
3 to 6 h	148 (26.4)
More than 6 h	40 (7.1)
Time spent teaching	
Up to 1 h	458 (81.8)
More than 1 h	102 (18.2)
Learning problems at home	
Writing	116 (20.7)
Reading	126 (22.5)
Calculation	28 (5.0)
Grammar	68 (12.1)
Spelling	68 (12.1)
Attention	44 (7.9)
Combination/Others	110 (19.6)
Visited school	
Monthly or more frequently	176 (31.4)
Quarterly	174 (31.1)
Less than once in a quarter	210 (37.5)
Discussed learning problems with teachers	212 (37.9)
Checked child's homework	128 (22.9)
Know about learning disorders	24 (4.3)
Child likes going to school	422 (75.4)
Child shares happenings at school	158 (28.2)

be similar to those with dyslexia and dysgraphia [19]. In the present study, problems related to arithmetics were lower as compared to those of reading and writing.

The medium of the school did not have differences in overall scores of SLD-SQ, but had differences on the individual items. Students of English medium school were more likely to miss out words or sentences while reading, and misplace letters or words while reading or writing. Conversely, Hindi medium students had more difficulty in differentiating similar sounding words, and understanding what is taught in the class. The focus of learning in the two languages (Hindi and English) might play a role, as Hindi is comparatively a more phonetic language than

English. Phonological differences have been found in bilingual individuals with learning disorders, especially with regard to the second language of acquisition [26, 27].

Using BDI, visual memory, gross motor co-ordination and visual-motor skills were the most commonly impaired domains in those who had learning disabilities. Studies on individuals with learning disabilities suggest that several cognitive deficits may be present, including visual perceptual and memory deficits underlie learning disorders [28]. Most of the students with learning disturbances on BDI had few types of abnormalities as in Fig. 2. This suggests that impairment was on selected domains, and was not global as expected in borderline intelligence.

The parental responses suggested that most parents spend less than 1 h in teaching their children. The time spent teaching was lowest among the respondents from slum areas, which also had the highest proportion of cases above cut-off on BDI. Reading and writing related problems were the most common ones encountered by the parents. Probably lesser involvement of parents in teaching might have lead to observable deficits.

The highest proportion of parents visited school less than once in 3 mo, and about one-fifth checked child's homework. This suggested a limited involvement of the parents in the teaching process. Less than 5 % were aware of learning disorders, which suggests that a substantial proportion of the parents are unaware. Elsewhere too, the overall awareness of learning disorders has been suggested to be low [25–32]. Awareness among the parents might be the first step towards timely recognition of problems with learning in a given child.

The findings of the study should be studied in the light of its strengths and limitations. The major strengths of the study include stratified random sampling of schools of the geographical region and using a three staged screening procedure to ascertain learning disorders in a large sample of students. Another positive aspect is the assessment of parents' responses about teaching of their children in a subset of the same study frame. This may help to gain better insights while developing targets for intervention.

The limitation of the study includes limited depth of assessment of each student (for example, In the *clinical setting* for diagnosis and adequate planning of remediation therapy, BDI along with level II of NIMHANS Battery for LD is ideally used. However, it was not feasible to apply level II of NIMHANS Battery for LD in community setting to such a large sample in the index study. Therefore authors have chosen to stick to only the BDI part of NIMHANS Battery for LD to confirm the cases of LD). Other limitations include, comparatively limited response rate of the parents, and assessment of only school going children. The study did not attempt to disentangle the various causes and subtypes of learning disability and [24, 27] impaired educational performance. The study also did not systematically look into the inter-rater reliability of the teachers for SLD-SQ. The results pertain to largely urban Union Territory of Chandigarh, and extrapolation to other settings should be done with caution. The study also focused on selected grades, and patterns of learning disability might be different across different grades [29, 32].

Conclusions

To conclude, the present study suggests that learning disability is present in about 3 % of 3rd and 4th grade students. Missing out words or sentences while reading, misplacing letters or words while reading or writing and making letters or words while reading or writing and making frequent mistakes in spelling were the commonest problems endorsed by the teachers while visual memory impairment was the most common symptom observed. This suggests for regular assessment of children and identification of those at-risk and implementing special education classes. The finding of less than 5 % of parents being aware of learning disability suggests for a further need of spreading the awareness about learning disorders so that those children having this conditions can be identified early and afforded appropriate help.

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Contributions SKP, SG, SSD, VS and MP: Conceived the idea and designed the study; SSD: Collected data; SKP, SG and VS: Involved in monitoring the data collection; SS and MP: Involved in writing the first draft and statistical analysis. All the authors read and approved the final paper. SKP will act as guarantor for this paper.

Conflict of Interest None.

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