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Study of Clinical and Academic Profile of Children Presenting to the Learning Disability Clinic in a Tertiary Care Centre

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Abstract: ***Background: Specific Learning disabilities (SLD) are a diversified group of neuro - behavioural features illustrated by difficulty in mathematical abilities, efficient reading and writing. These disabilities often lead to low self - esteem, lack of confidence and negativity among the students. However, the signs and symptoms are often ignored by the teachers and the parents due to unawareness. Objective: This study is aimed to evaluate the clinical and academic profile of children presenting to the Learning Disability Clinic. Methodology: This is a cross - sectional observational study. A total of2656 students presented to the hospital with the symptoms of SLD, among them the students whose parents were willing to participate were included. The demographic, clinical and academic data were collected and analysed using R studio software (1.2.5001). Results: Of the total 2656 students, 80.5% (n=2139) were diagnosed with SLD. High number of students presented the impression of Dyslexia along with Dysgraphia and Dyscalculia (91.8%). Age, birth weight and the mother tongue were significantly associated with SLD (P<0.05). Clinical variables including neurological signs such as dysdiadochokinesia, finger identification, finger tapping, graphesthesia, left - right orientation, praxis and sequential tapping and academic variables including concepts of calendar and time, maths fluency, loud reading, better oral work, phonetical reading, spelling errors and poor organization of content are significantly associated with SLD (p<0.05). Conclusion: Learning disabilities can be diagnosed early by identifying certain clinical impressions, social behaviour and academic performance. Therefore, awareness among teachers and the parents concerning clinical and academic profile of students with SLD is crucial.***

Keywords: Dyslexia, Dysgraphia, Dyscalculia, Learning Disability

1. Introduction

Specific Learning disabilities (SLD) are developmental disorders presented by severe disabilities in reading, writing or performing arithmetical calculations, despite adequate instructions [1]. Globally, the prevalence of SLD varies widely between 3 - 12% [2]. In India, more than five students have SLD in every normal - sized class [3]. Risk factors of SLD includes a family history, premature delivery, prenatal exposure to alcohol and poverty along with neurobiological origin [4].

Previous studies have documented the presence of co - morbidities such as attention deficit hyperactivity disorder (ADHD), conduct disorder, autism, depression, anxiety and other emotional and behavioural disorders along with SLD [5, 6, 7]. However, SLD with or without co - morbidity leads to poor academic performance which in turn contributes towards lack of confidence, low self - esteem, poor peer - relationship, negativity and low expectations from oneself [8]. These characteristics are often ignored by the teachers and the parents depicting their unawareness regarding SLD.

In the recent years, studies have been conducted to create awareness regarding SLD among the teachers, worldwide [2]. However, such studies in Indian continents are rather sparse due to cultural issues including poverty, multilingualism and teacher - student ratio which makes assessment difficult. This contributes widely to the delayed diagnosis and may give rise to associated complications. For any effective remedial management, it is crucial to have an in - depth knowledge of clinical and academic problems of SLD students. Unfortunately, there is paucity of the studies that exclusively deals with clinical and academic profiles of SLD students in India. Therefore, this study aimed to evaluate the clinical and academic profile of the students with SLD.

2. Methodology

This cross - sectional study was conducted at the department of Pediatrics at a tertiary health care centre in Mumbai, Maharashtra, India between January 2010 to December 2014. Informed and written consents were obtained from parents/guardian prior to the study. Sample size was calculated in R studio software (v.1.2.5001) using standard R code **(**pwr. Chisq. test (w = 0.065, power = 0.9, df = 1, sig. level = 0.05), where, w is the effect size, power of the study is 90% and df is the degrees of freedom. The minimum sample size obtained from this calculation was 2487. Therefore, a total of2656 students presented to the hospital with academic issues with referral letters from their respective schools and the students whose parents were willing to participate in the study were included. Whereas, the students with other conditions including major medical or neurological disorders, impairment in speech, vision or

hearing (disability percentage >40 %) were excluded from the study.

The demographic data including age, sex, birth weight, mother tongue and the clinical data was collected from the parents of the students by the clinicians. Academic performances based on understanding of the basic concepts, memorizing certain mathematical formulae, their application, reading, speaking and writing abilities of each student were evaluated by clinicians and recorded in a predesigned proforma.

Statistical Analysis

The data collected was organized in MS Excel (2016). Frequency distribution concerning demographics, diagnostic, academic and clinical data were studied. Data was represented as frequency, percentage and mean ± SD when relevant. Association of these variables with learning disability was analysed by Chi - square test with Yates Continuity Correction in R studio software (v.1.2.5001). $P<0.05$ was considered as statistically significant.

3. Results

Socio- demographic

The age of the students ranged between 4 - 28 years with the mean age of 12.61±2.76 years. The gender distribution showed male predominance with 75% (n=1982). Majority of the students had birth weight between 2.0 - 2.5 kg. Marathi was the most common mother tongue (24.2%).

Clinical Profile

Neurological signs were identified by the consultants and were grouped as general neurological signs and typical neurological signs. Among the general neurological signs, dexterity was evaluated in 100% of the students (n=2656), of which 91.2% (n=2423) were right - handed, 7.75% (n=206) were left - handed and remaining 1.01% (n=27) were ambidextrous, followed by presence of neuro cutaneous markers (2.65%), hypo pigmented (1.58%), flat feet (1.24%), café - au - lait (0.67%) and dysmorphic features (0.22%). The typical neurological signs included 2 - point discrimen (99.35%), continuous finger tapping (89.49%), standing on 1 foot (85.69%), difficulty in finger identification (82.45%), L - R orientation (73.94%), sequential tapping (68.07%), dysdiadochokinesia (52.59%), graphesthesia (43.59%) and praxis (21.08%).

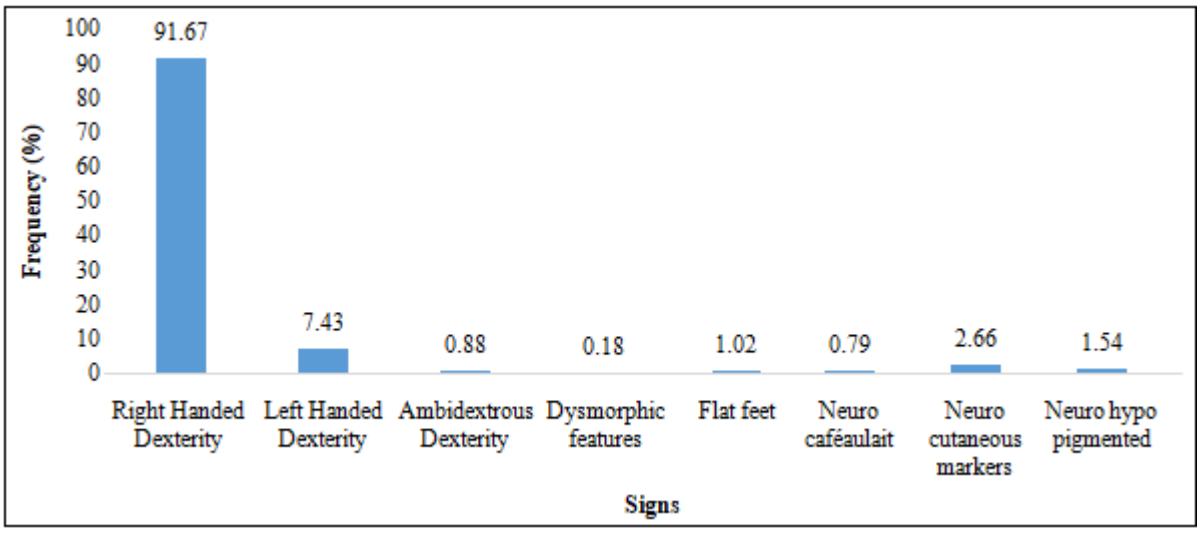
Academic Profile

Academic difficulties as described by teachers and parents were grouped into three - (a) difficulty with reading and language (b) difficulty in writing (c) difficulty in maths. Concerning the reading and language difficulties, lack of phonemic and phonological awareness (n=2646; n=2647), poor reading fluency (n=2644) and difficulty in alphabetic principle (n=2645) were evident in majority of the students. Additionally, most of the students had problem of illegible writing (n=2626) and were unable to solve mental problems (n=2655).

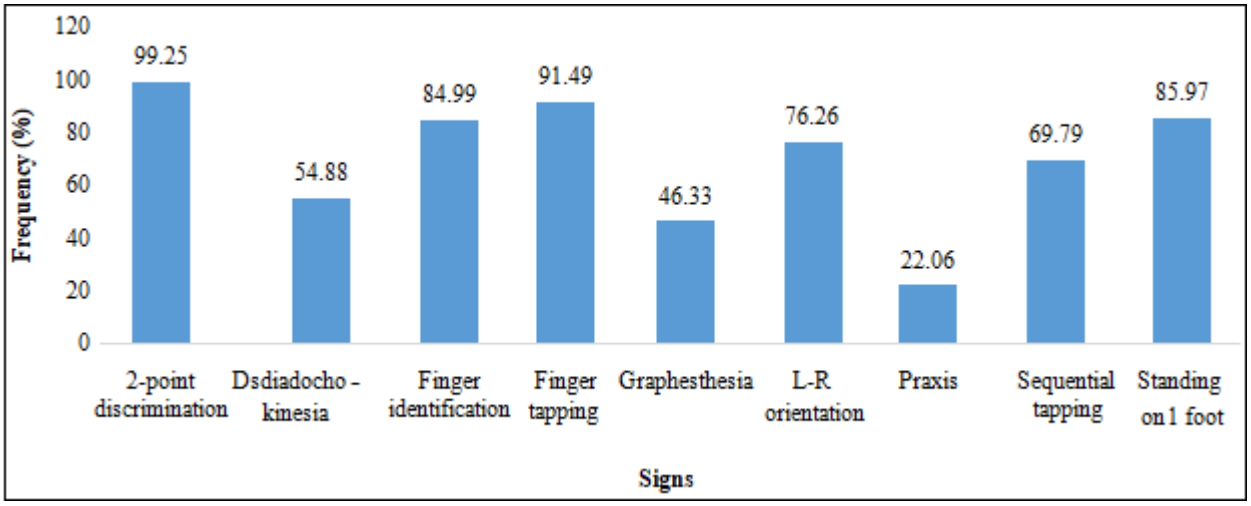
On further diagnosis, 80.5% (n=2139) were diagnosed with SLD of which 91.8 % (n = 1964) had dyslexia along with dysgraphia and dyscalculia.

Association of SLD with sociodemographic variables, clinical profile and academic profile

Chi - square test with Yates Continuity Correction test revealed that SLD was significantly associated with the sociodemographic variables including the age ($P<0.001$), birth weight ($P=0.003$) and the mother tongue ($P<0.001$). Figure 1 (a) and (b) represents the frequency distribution concerning clinical profile among the students with SLD (n=2139).



(a)



(b)

Figure 1: Clinical profile of students with SLD (a) Frequency distribution of general neurological sign (b) Frequency distribution of typical neurological sign

Furthermore, chi - square test with Yates Continuity Correction test depicted that learning disability was significantly associated with dysdiadochokinesia (P<0.001), finger identification (P<0.001), finger tapping (P<0.001), graphesthesia (P<0.001), L - R orientation (P<0.001), praxis (P=0.013) and sequential tapping (P<0.001).

Table 1 - 3 represents the association of SLD and academic profile.

Table 1: Difficulty in reading and language

Variables	Total No (%)	Learning Disability		**P value**
		Present (%)	Absent (%)	
Difficulty in Alphabetic principle	2645 (100)	2130 (80.53)	515 (19.47)	1
Difficulty in loud reading	2268 (100)	1803 (79.50)	465 (20.50)	0.001*
Better Oral work than writing	1105 (100)	992 (89.77)	113 (10.23)	<0.001*
Lack of Phonemic Awareness	2645 (100)	2129 (80.46)	516 (19.54)	0.247
Lack of Phonological Awareness	2645 (100)	2130 (80.47)	515 (19.53)	0.291
Poor Sentence formation	079 (100)	71 (89.87)	08 (10.13)	0.047*
Poor Reading Fluency	2644 (100)	2128 (80.48)	516 (19.52)	0.541
Reads Phonetically	023 (100)	23 (100.00)	00 (0.00)	0.035*
Word - by - word Reading	2592 (100)	2083 (80.36)	509 (19.64)	0.205

CT - Chi - square test with Yates Continuity Correction; * - Statistically significant

Table 2: Difficulty in Writing

Variables	Total No (%)	Learning Disability		P value
		Present (%)	Absent (%)	
Difficulty in Spelling	362 (100)	309 (85.36)	53 (14.64)	< 0.001*
Illegible writing	2626 (100)	2112 (80.43)	514 (19.57)	0.277
Cannot stay online	526 (100)	440 (83.65)	86 (16.35)	0.050
Frequent Erasing	30 (100)	28 (93.33)	02 (6.67)	0.121
Substitution	121 (100)	103 (85.12)	18 (14.88)	0.234
Inversion	06 (100)	06 (100.00)	00 (0.00)	0.490
Omission	211 (100)	192 (91.00)	19 (9.00)	<0.001*
Addition	88 (100)	76 (86.36)	12 (13.64)	0.204
Poor Organization of Content	99 (100)	93 (93.94)	06 (6.06)	<0.001*
Confusion in Upper lower case	17 (100)	16 (94.12)	01 (5.88)	0.266
Poor Writing fluency	03 (100)	03 (100.00)	00 (0.00)	0.902

CT - Chi - square test with Yates Continuity Correction; * - Statistically significant

Table 3: Difficulty in maths

Variables	Total No (%)	Learning Disability		P value
		Present (%)	Absent (%)	
Difficulty in Basic Sums	2638 (100)	2123 (80.48)	515 (19.52)	0.548
Difficulty in understanding Concept of Calendar	2425 (100)	1928 (79.51)	497 (20.49)	<0.001*
Difficulty in understanding Concept of Time	2409 (100)	1916 (79.54)	493 (20.46)	<0.001*
Difficulty with word problem	984 (100)	841 (85.47)	143 (14.53)	<0.001*
Difficulty in understanding directionality	2643 (100)	2128 (80.51)	515 (19.49)	0.982
Difficulty in Finger Counting	1787 (100)	1431 (80.08)	356 (19.92)	0.424
Difficulty in remembering Formula	2651 (100)	2134 (80.50)	517 (19.50)	0.592

Poor Maths Fluency	2458 (100)	1959 (79.70)	499 (20.30)	<0.001*
Unable to solve Mental Sums	2655 (100)	2138 (80.53)	517 (19.47)	1
Difficulty in understanding concept of Money	2650 (100)	2133 (80.49)	517 (19.51)	0.490
Sign Confusion	59 (100)	53 (89.83)	06 (10.17)	0.097
Can't remember tables	13 (100)	09 (69.23)	04 (30.77)	0.495
Forgets to carry over	10 (100)	08 (80.00)	02 (20.00)	1
Problem in compute	72 (100)	67 (93.06)	05 (6.94)	0.010*
Unable to a solve horizontally	55 (100)	48 (87.27)	07 (12.73)	0.269

CT - Chi - square test with Yates Continuity Correction; * - Statistically significant

Diagnosis and comorbidities

Post assessing the clinical and academic profile of the students, diagnosis and the presence of comorbidity were made of Table 4 represents the frequency distribution of students with SLD based on impressions and other disorders. High number of students had Dyslexia along with Dysgraphia and Dyscalculia (91.8%) followed by Dyslexia with Dysgraphia (5.0%) and Dyslexia with Dyscalculia (1.2%). However, the impressions were significantly associated with learning disability (P<0.001) (Table 4).

Moreover, high number of students with SLD were diagnosed with attention deficit disorder/attention deficit hyperactivity disorder (52.6%). Whereas, anxiety disorder was observed in the least number of students (0.4%) (Table 4).

Table 4: Frequency distribution of students with SLD based on presence of impressions and comorbidities (n=2139).

Diagnosis	Frequency (%)
Impressions	
Dyslexia	16 (0.7)
Dysgraphia	08 (0.4)
Dyscalculia	08 (0.4)
Dyslexia + Dysgraphia	107 (5.0)
Dyslexia + Dyscalculia	25 (1.2)
Dysgraphia + Dyscalculia	11 (0.5)
Dyslexia + Dysgraphia + Dyscalculia	1964 (91.8)
Comorbidities	
Attention deficit disorder/attention deficit hyperactivity disorder (ADD/ADHD)	1125 (52.6)
Poor English Language Performance	203 (9.5)
Seizure Disorder	23 (1.1)
Autism	22 (1.0)
Anxiety disorder	09 (0.4)

4. Discussion

SLD in academics are not very conspicuous at early age and are presented in the form of clinical and academic deficits. Therefore, the signs and symptoms of SLD are often ignored by the teachers and the parents. Hence, it is important to recognize the clinical and academic problems of these students to manage it timely.

The mean age and the gender distribution were comparable with the previous study conducted by Sahu A et al. where, the mean age was 9.6 ±1.5 years and male students were predominant with 76.7% [8]. Recent research has reported that the characteristics of SLD is influenced by student's age and birth weight [9, 10, 11]. This is also reflected in the present study. This study also, depicted that the students aged 10 - 16 years were at higher risk of SLD. Furthermore, predominance of male students can be attributed to the differences in aetiology of SLD and differences in the styles of learning among male and female [12]. Marathi was the mother tongue of high number of students in this study. This is obvious as Marathi is the local language of Mumbai, India. Mother tongue too contributes in SLD and this is also reflected in the present study. However, this can be justified as India is multilingual country and therefore English, although the language of instruction in school, is not used as the preferred language of communication by the students. Getting exposed to multiple languages at very young age might lead to confusion which may results into SLD [13].

Dexterity is an outcome of processed sensory information provided by numerous sensory subsystems in diversified layers of the nervous system. Therefore, is considered as the general neurological sign [14]. In the present study dexterity was evaluated in 100% of the students, majority of which 91.2% were right - handed, 7.75% were left - handed and remaining 1.01% were ambidextrous. Dysdiadochokinesia, two - point discrimination and praxis are among the typical neurological sign of SLD. Dysdiadochokinesia is the inability to execute prompt movements of alternating muscle. These may be quick finger and foot tapping, closing and opening of the fists, to name few [15]. Whereas, Praxis is the cognitive process through which a certain action involving movement is accomplished, being naturally bound to sensory feedback in the process of the action [16]. Praxis has two vital components - motor and cognitive. Although these components work simultaneously to attain a common target, are independently working and are associated with different regions of brain [17]. Previous studies concerning sensory processing have reported the difficulties in two - point discrimination affects identification of similar objects and graphesthesia. Both, the praxis and two - point discrimination are crucial to perform academic activities including learning and writing [17]. This is depicted in the present study as well since SLD was significantly associated with neurological signs dysdiadochokinesia, finger identification, finger tapping, graphesthesia, L - R orientation, praxis and sequential tapping.

Academic performance is usually evaluated based on the student's ability to read, learn, write and their ability to solve mathematics. It is very well known that learning disabilities affect the academic performance of the student. Academic profile observed in this study is comparable with that of the study conducted by Sahu A et al. [8]. The academic difficulties observed in this study can be justified by the clinical profile. Interestingly, difficulties in writing were evident in a smaller number of students compared to the difficulties concerning reading and maths. Learning disability was significantly associated with academic

variables including understanding the concepts of calendar, concept of time, difficulty with word problem, maths fluency, arithmetic problem in compute, loud reading, oral work better, poor sentence, phonetical reading, difficulty in spelling, omission and poor organization of content. Of these variables, difficulty with word problem, maths fluency, problems arithmetic in computation can be attributed to dyscalculia whereas, loud reading, better oral work, phonetic reading and omission can be attribute to dyslexia. Furthermore, poor sentence formation, difficulty in spelling and omission can be attributed to dysgraphia [4].

Specific SLD are a diversified group of neuro - behavioural features illustrated by remarkably specificand persistent difficulties in regards to efficient reading – dyslexia, writing – dysgraphia and abilities of mathematics – dyscalculia. This is evident in the present study as very high number of students had all these three impressions (91.8%). High rates of prevalence of dyslexia, dysgraphia and dyscalculia can be attributed to the lack of early assessment and screening strategies at school level [18]. Stunningly, most of the previous studies have not focused on the prevalence of co - occurrence of these impressions. This depicts lack of awareness about its symptomology and manifestation among the parents and the teachers which makes it difficult for early diagnosis and management. However, the individual prevalence of dyslexia, dysgraphia and dyscalculia were 0.7%, 0.4% and 0.4% respectively. Fascinatingly, in a study done in south India, the prevalence of dyslexia, dysgraphia and dyscalculia were 11.2%, 12.5% and 10.5% respectively [19]. This divergence in the prevalence can be justified as in the present study the prevalence was calculated based on the individual and co - occurrence of the impressions, whereas in the previous study the prevalence was calculated merely based on the presence of the individual impression irrespective of co - occurrence. According to the study conducted by Kohli A et al., prevalence of ADHD in the students with SLD ranges between 10 - 60% [20]. This concurs with the present study too as ADD/ADHD was evident among 52.6% of students with SLD. This also concurs with the findings of previous studies which reported that SLD and ADHD are the two frequently diagnosed learning and behavioural problems in schools [5]. However, this sheds light on the fact that detecting ADHD might play a crucial role in early diagnosis of SLD among children.

Strength and limitation

To the best of our knowledge, this is the first ever study in Mumbai, Maharashtra, India that have focused on neurological aspect of clinical diagnosis of students with SLD. This study limits as the correlation between clinical diagnosis and academic performance of these students was not studied. Additionally, since mother tongue is also found to influence the characteristics of SLD, assessment of the same in mother tongue would contribute widely to reach better conclusion.

5. Conclusion

Learning disabilities can be diagnosed early by identifying certain clinical academic and behavioural problems that lead to help in identifying early the impressions like dyslexia, dysgraphia and dyscalculia. Academic as well as behavioural problems of the students also contributes in early diagnosis. Therefore, awareness among teachers and the parents concerning clinical and academic profile of students with SLD is crucial.

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