

Neuropsychological functioning in children with and without specific learning disorder

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Abstract

Objective: To investigate neuropsychological functioning in children with and without Specific Learning Disorder.

Methods: The comparative cross-sectional study was conducted in schools affiliated with Punjab Education Foundation, Gujrat, Pakistan, from January -to June 2019, and comprised children diagnosed with Specific Learning Disorder and age-matched and class matched high achievers as controls. Bender Gestalt Test II with copy test, recall test, perceptual test and motor test subscales was administered on both the groups for the assessment of neuropsychological functioning. Data was analysed using SPSS 21.

Results: Of 116 subjects, 64(55.2%) were cases and 52(44.8%) controls. Overall, there were 64(55.2%) girls and 52(44.8%) boys with a mean age of 10.41 ± 1.14 . There was significant difference on recall test ($p < 0.01$) between the groups which had 100% predictive power.

Conclusion: Memory function was significantly impaired in children with Specific Learning Disorder.

Keywords: Specific learning disorder, Memory processing, Visuo-motor skills, Cognitive functioning.

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Introduction

Specific Learning Disorder (SLD) is a neuro-developmental disorder characterised by difficulties in reading, writing and arithmetic expressions.¹ It is one of the most prevalent disorders because of its rapid increase.² It is the most frequently recognised category of disorders among students in public schools in the United States. However, its prevalence is not well determined in developing and under-developed countries due to scarcity of literature.³

The term SLD is relatively recent in Pakistan.⁴ In a prevalence study conducted in Rawalpindi, out of 700 students, 5.57% were identified as children with reading disability.⁵ Although the causes and reasons of SLD is still not known, neuropsychological and cognitive studies have shown connections among SLD, brain abnormalities, memory functioning, perception and attention.^{6,7} Children with SLD face difficulties in memory functioning, visual motor tasks and perceptual tasks compared to children without SLD.⁶⁻⁸ The importance of visual motor skills and perceptual processes and memory functioning in brain functions is well established.² These visuo-motor skills are imperative for various aspects of reading and writing, and impairment in these skills may result in low academic achievement.⁹ A study reported that visual perception skills involves visual identification and visual memory as a significant predictor of arithmetic

expression.¹⁰ Moreover, visuo-motor perception is also a strong indicator of phonological difficulties in SLD children compared to healthy children.¹¹ Phonological coding interrupts the underlying connection between reading ability and memory span. A study explained that slow phonological processing hinders functioning of working memory and impedes its proficient execution.¹² Also, short-term memory functioning plays fundamental role in reading due to its connection with phonological skills,¹³ and alphabetic information depends upon phonological memory which is highly associated with learning.¹⁴ Moreover, phonological memory mediates long-term learning because it is essential to form enduring account language acquisition.¹⁵

Learning to read is important, and is a complicated task the growth of which involves the combined functioning of different brain areas. Therefore, it is important to understand its nature and components associated with cognitive functioning of children with SLD.¹⁶ The current study was planned to investigate the underlying neuropsychological functioning in children with SLD, and to compared their performance with healthy controls.

Subjects and Methods

The comparative cross-sectional study was conducted in semi-government schools affiliated with Punjab Education Foundation (PEF), of Gujrat, Pakistan, from January to June 2019. Schools were selected using convenience sampling technique. Initially, all government, private and semi-government schools in the city were approached. However, only those schools were

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short-listed which gave permission for data collection. As a result, the semi-government schools under PEF were selected on the basis of convenience and cooperation. Of the 9 schools under PEF in Gujrat, 6(66.6%) gave consent for data collection. In these 6 schools, all students in grades 3rd, 4th and 5th were assessed. Relevant teachers identified students having below-average academic record which was provided by the school administration. Then teachers filled out the teacher rating checklist (Appendix)¹⁷ developed based on Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)¹ criteria of SLD, for every below average child in a classroom for the initial screening of children with SLD.⁵⁻¹⁸ Consequently, the students were screened out for SLD, and structured clinical interview for DSM-5 (SCID-5)¹⁷ was used for SLD diagnosis. It is an extensively used semi-structured to structured tool to examine whether the individual meets the diagnostic criteria presented in DSM-5.¹⁹ All students having no physical and psychological illness aged 9-12 years were included, while those having any physical or psychological illness and family history of psychological illness were excluded. Data was collected in respective schools in a calm and quiet environment without any interruption after getting consent from parents and the school administration concerned.

A pre-designed demographic form was used to collect

information about gender, age, socioeconomic status (SES) of the subjects. An age-matched and class-matched control group was raised from among those who were academic high achievers with >80% marks in their last examination. Bender Gestalt Test Second Edition (BDT-II)²⁰ was administered to both groups of students to measure visual motor integration skills, perceptual ability, memory functioning and cognitive impairment. BDT consisted of 16 cards; cards 1-13 were administered on children with age ranging between 4 years and 7 years and 11 months, while cards 5-16 were used for those aged 8 years or above. Average time of the administration ranged 28-40 minutes.

Data was analysed using SPSS 21. Mean, standard deviations as well as frequencies and percentages were calculated to express demographic characteristics. Multivariate analysis of covariance was done to study inter-group differences in different variables. Neural network analysis was done to determine the predictive factors of SLD.

Results

Of the 1224 students, teachers identified 178(14.5%) students who were screened. The final sample of 64(36%) were included as cases, while 52(44.8%) controls were also enrolled. Of the total 116 subjects, there were 64(55.2%)

Table-1: Mean Differences in various tests between cases and controls (N=116).

Variables	Group		t(114)	P	95% CI		Cohen's d
	Not diagnosed M(SD)	diagnosed M(SD)			LL	UL	
Copy test	35.42(7.12)	11.68(5.22)	21.03	0.00	21.49	25.97	3.80
Recall test	29.26(8.72)	3.06(2.17)	23.18	0.00	23.96	28.44	4.12
Perceptual test	9.73(.44)	7.12(2.13)	8.64	0.00	2.00	3.20	1.69
Motor Test	12.00(.01)	8.42(1.66)	15.44	0.00	3.11	4.03	3.04
BGT total	86.42(15.07)	30.29(8.39)	25.35	0.00	51.74	60.78	4.60

M: Mean. SD: Standard Deviation. P: Significance. CI: Confidence Interval. LL: Lower Limit. UL: Upper Limit. BGT: Bender Gestalt Test.

Table-2: Multivariate analyses between cases and controls on various tests (N=116).

Variable	Multivariate tests	Value	Sum of Squares	Mean Square	F	P
Group	Pillai's Trace	0.51			27.47b	0.00
	Wilks' Lambda	0.49			27.47b	0.00
	Hotelling's Trace	1.03			27.47b	0.00
	Roy's Largest Root	1.03			27.47b	0.00
Copy test			18753.13a	3750.63	261.71	0.00
Recall test			21335.55b	4267.11	184.34	0.00
Perceptual test			210.32c	42.06	16.43	0.00
Motor Test		421.18d	84.24	76.11	0.00	
BGT total		99638.96e	19927.8	323.8	0.00	

BGT: Bender Gestalt Test.

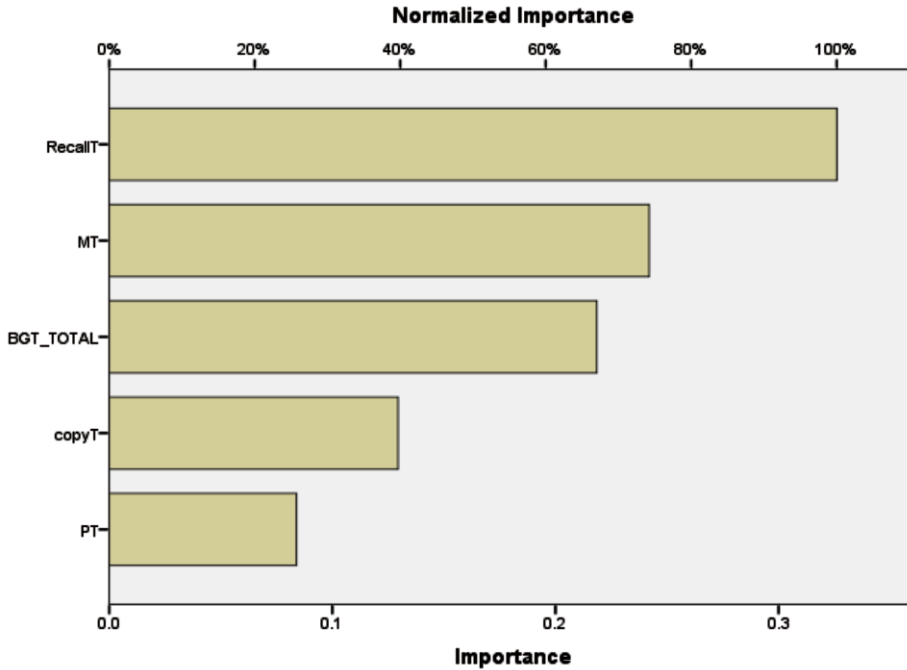


Figure: Importance of independent factors.

APPENDIX 05

نام: _____

تاریخ: _____

SPECIFIC LEARNING DISORDER

برائے مہربانی مندرجہ ذیل علامات کو ہاں / نہیں میں جواب دیں۔

نہیں	ہاں
	۱۔ طالب علم کو تعلیمی مہارتوں کو سیکھنے میں مشکل پیش آتی ہیں۔
	۲۔ طالب علم کو پڑھنے میں مشکل پیش آتی ہیں
	۳۔ طالب علم کی لکھائی کو سمجھنے میں مشکل پیش آتی ہیں۔
	۴۔ طالب علم کو سچے کرنے میں مشکل پیش آتی ہیں۔
	۵۔ طالب علم جو پڑھتا ہے اس کے مطلب کو سمجھنے میں مشکل پیش آتی ہیں۔
	۶۔ طالب علم کو اعداد کو جمع و تفریق کرنے میں مشکل پیش آتی ہے۔
	۷۔ طالب علم کو عددی سوال کرنے میں مشکل کا سامنا کرنا پڑتا ہے۔
	۸۔ طالب علم جملوں میں گرائمر کی غلطیاں کرتا ہے۔
	۹۔ طالب علم جملوں میں اوتاف کی غلطیاں کرتا ہے۔
	۱۰۔ طالب علم کو ایک جیسے الفاظ میں فرق کرنے میں مشکل پیش آتی ہیں

Appendix: Questionnaire.

girls and 52(44.8%) boys with a mean age of 10.4 ± 1.14 ; 60(51.7%) belonged to low socioeconomic status; and 56(48.3%) had middle socioeconomic status.

BDT-II and its subscales revealed significant differences

between the groups ($p < 0.05$), indicating better performance of controls compared to SLD children.

Multivariate analysis showed the effectiveness of BDT scores of the two groups (Table-2).

Recall test showed 100% power of SLD prediction, followed by motor test and overall BDT score (Figure).

Discussion

The findings illustrated that children with SLD had impaired neuropsychological functioning as their performance was poor on visuo-spatial tasks, memory tasks, motor and perceptual skills compared to the controls. All these tasks and skills are related to different facets of learning, such as reading, writing and mathematical expression which consequently affect academic achievement of the child.^{9,10} A study suggested that visuo-motor perception is imperative in the development of various cognitive functions.² The impairment in these cognitive functions is a significant contributory factor for SLDs.^{21,22} Visuo-perceptual tasks are also impaired in children with SLD. These results are consistent with an earlier study.²⁰ The current study found that children with SLD performed poor on motor skills, which is also supported by a study.²³

Memory function was the most significant predictor of neuropsychological impairment of children with SLD in the current study, which is consistent with an earlier study.²⁴ Acquisition of information depends on experience with letters and alphabets which, in turn, is related with storage of

information in the memory.²⁵

The current study has a few limitations. The sample was selected only from the schools under PEF due to the consent and permission issues. Therefore, its results cannot

be generalised. Moreover, studies should be conducted on both public and private schools in Gujrat district to estimate the prevalence, and to explore the role of demographics and other risk factors associated with SLD. Besides, the study could not determine the prevalence in all public and private schools due to lack of true sampling frame, permission and consent from school authorities.

Conclusion

Children with SLD performed at a lower academic level compared to healthy controls. Memory functioning was found to be the most significant predictor of SLD.

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Conflict of Interest: None.

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