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The Comparison of Visual Perception Skills in 7 - 12-Year-Old Children With or Without Dyslexia Who have Attention Deficit Hyperactivity Disorder

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Abstract

Background: The recognition of problems occurring with ADHD comorbid disorders can largely facilitate their diagnosis and treatment.
Objectives: The present study aims to compare the visual perception skills of 7 - 12-year-old children with or without dyslexia who have ADHD.
Methods: This is a descriptive-comparative study that encompasses a statistical population of 7 - 12-year-old children with ADHD in Iran who were convenience-sampled in Tehran's therapeutic centers in 1394. The groups completed visual perception skills tests and the results were compared by independent T-test.
Results: The results of the independent T-test demonstrate that the children with ADHD but without dyslexia had better form constancy, visual discrimination, visual closure, visual-spatial relationship, visual sequential memory, visual memory, and figure ground discrimination ($P < 0.01$).
Conclusions: Due to the difficulties suffered by children with ADHD and dyslexia, we recommend early diagnosis, medical screening, and use of suitable therapeutic methods to identify and minimize the number of children exposed to the high risks of undiagnosed ADHD and dyslexia.

Keywords: ADHD, Dyslexia, Visual Perception

1. Background

Attention deficiency hyperactive disorder (ADHD) is a developmental neurological disorder which deteriorates the patient's abilities to think, organize, focus, and realistically plan before execution of an action. The patient may also suffer from anxiety, inability to adapt to changing conditions, rebelliousness, and aggression (1). Children with ADHD show high levels of neglect, impulsivity, and hyperactivity unfitted to their developmental age, which expose them to situations such as school failure, emotional problems, learning disabilities, and behavioral and social-interaction disorders (2). ADHD prevalence and epidemiology studies of populations and clinical samples demonstrate that ADHD frequently occurs simultaneously with learning disabilities (LDs). To further examine this, a wide range of studies have investigated the problems associated with attention deficit in a large percentage of children with LDs (3). Alizadeh et al. (2008) found that 10% - 25% of ADHD patients suffer from at least one type of special learning disability (4). Other similarities between attention deficit disorder and learning disorders include attention problems, hyperactivity and frustration tolerance at the lowest level, low self-esteem, lack of ethics and social skills, poor academic achievements, and high rates of dropout (5). Various studies have evaluated the role of genetic and environmental factors, aspects of anatomy and brain function, cognitive processes, and therapeutic interventions, ultimately proving a strong and meaningful relationship between ADHD and LD (6-8). Of the symptoms of ADHD, visual-spatial perception deficit also displays a significant relationship with executive dysfunction, altered

writing quality, and psychomotor agitation (9). Moreover, studies show that visual perception deficits can be traced in children with ADHD (10), and Bailey affirmed that these deficits can lead to academic difficulty (11).

Perception is a psychological process in discovering the meaning of a sensation. It organizes, categorizes, and interprets auditory, visual, and tactile stimuli. Children suffering from cognitive disabilities often experience trouble in finding and interpreting meaning in environmental stimuli (12). As visual perception skills are important factors in the diagnosis of dyslexia, it is important that they be appropriately assessed (13, 14). Visual perception disabilities include cognitive problems and inability to distinguish between illustration and background. An inability to distinguish the illustration from the background causes the student to not discriminate between stimuli, which may contribute to a lack of focus on a word or sentence in the text. Additionally, background stimuli may mislead students, further complicating this problem. Moreover, children with LDs frequently have difficulties in discriminating shapes, regardless of their size, status, gender, or color. This hinders proficiency in word discrimination, regardless of size or print of the word (15). Smith (2002) associated visual perception problems with LDs. According to his study, people with LDs who see visual stimuli as unrelated parts cannot consistently understand stimuli. In other words, they may understand separate letters of a word rather than the whole word; therefore, they do not understand the meaning of that word (16). According to previous studies, visual attention as well as processing deficit leads to dyslexia (17-19). It should also be mentioned that direct teaching of visual perception likely improves learning (20, 21).

Distinguishing ADHD and LD co-morbid disorders from ADHD disorders is vital, as suitable diagnoses facilitate treatment. This study aims to compare the visual perception skills of 7 - 12-year-old children with ADHD with and without dyslexia.

2. Methods

This is a descriptive comparison that encompasses a convenience-sampled population of 7 - 12-year-old Iranian children diagnosed with ADHD and dyslexia who were treated at medical centers in Tehran, Iran, in 1394. Inclusion criteria included attention deficit and hyperactivity, medication use as prescribed by appropriate physicians, appropriate vision screening inputs based on school records, and lack of other medical disorders. Patients were excluded if they were reluctant to participate in the study. We informed all participating families about the tests and the participants and their parents later received printed consent statements.

2.1. Procedure

Children diagnosed with ADHD were referred to us by psychiatrists at the medical centers. We explained in writing the goals and methods of implementation of this project to the parents and received participants' and their parents' or guardians' consent in writing. Participants underwent additional testing to confirm the dyslexia diagnosis, as well as a visual perception skills test to measure visual perception skills. Finally, we selected 34 children with ADHD without dyslexia and 34 children with both ADHD and dyslexia in visual perception variables (visual distinction, figure constancy, shape discrimination from the text, visual closure, spatial relationships, visual sequential memory, and visual memory). The patients were given dyslexia and visual perception skills tests, and their results were compared. We used independent T-test to process the average statistical indicators and standard deviation to compare normally distributed variables. Statistics were interpreted by use of SPSS ver. 19. A P-value of 0.05 was considered statistically significant.

2.2. Study Tools

This study employed a demographic information questionnaire in order to collect information including age, school grade, medications, history of seizures, head injuries, and physical and mental disorders.

2.3. Test of Visual Perception Skills

The visual perception test contains seven subtests of visual discrimination, including visual memory, visual-spatial relationships, visual constancy, visual sequential memory, shape discrimination, and visual closure. Subtests, which last 9 - 25 minutes, depending on the patient's age, include sixteen parts, each representing various pictorial questions. The researchers presented the children with fresh images, and they selected the word corresponding to the image. The tests are designed for all children aged 4 - 12 years and account for the participant's gender, race, education, culture, and language. Khayatzadeh (1383), Dehghan (1383), and Moradi (1376) have normalized the validity and reliability and later approved the subtests.

2.4. Reading Test and Dyslexia

This test was designed by Reza Karami and Alireza Moradi in August 2008, and it has since been normalized for the Persian, Azeri, and Kurdish languages. It consists of ten subtests, including reading words (with

high, medium, and low frequency), reading comprehension (one common text for all participants and two other texts specific for each grade), chain of words, word comprehension, rhymes, missing sounds, reading non-words (words without meaning), and reading images as well as letter signs. We used the finalized version of the tests on a total 1614 patients (770 boys and 844 girls) in five grades in Tehran, Sanandaj, and Tabriz.

3. Results

A total of 34 children (29 boys and 5 girls) with both ADHD and dyslexia, and 34 children (32 boys and 2 girls) with ADHD but without dyslexia were included in the study. Of the patients who suffered from both ADHD and dyslexia, 4 (11.8%) were 7 - 8 years old, 11 (32.4%) were 8 - 9 years old, 18 (52.9%) were 9 - 10 years old, and 1 patient (2.9%) was 10 - 11. Of the patients with ADHD but not dyslexia, 10 (29.4%) were 7 - 8 years old, 6 (17.6%) were 8 - 9 years old, 9 (26.5%) were 9 - 10 years old, and 9 patients (26.5%) were 10 - 11 years old.

Table 1 shows the average and standard deviation of the visual perception skills test of the patients with both ADHD and dyslexia. We found that the average (standard deviation) of visual perception constancy subtest scores of these children was6.9 ($\pm$ 3.09), visual distinction was 9.50 ($\pm$ 3.66), visual closure was 4.94 ($\pm$ 2.78), communication was 5.59 ($\pm$ 5.03), visual sequential memory was 6.53 ($\pm$ 4.23), visual memory was 9.56 ($\pm$ 2.29), and shape discrimination from the context was 3.78 ($\pm$ 7.91).

Table 2 shows the average and standard deviation visual perception test scores of the patients with ADHD but without dyslexia. We found that the average (standard deviation) of visual perception constancy subtest scores of these children was12 ($\pm$ 9.06), visual differentiation 12.88 ($\pm$ 2.59), visual closure was 10 ($\pm$ 2.73), visual communication was 13.62 ($\pm$ 1.47), visual sequential memory was 11.38 ($\pm$ 3.22), visual memory was 11.38 ($\pm$ 3.22), and shape discrimination from the context was 12.88 ($\pm$ 2.59).

Table 3 shows the independent T-test comparing the scores of visual perception between the groups. The independent T-test revealed a meaningful relationship between visual communication in ADHD patients with dyslexia and those without ($P < 0.01$).

4. Discussion

This study aimed to compare the visual perception skills of children with ADHD with and without dyslexia. We found a significant difference of visual perception skills between children with ADHD with and without dyslexia. The children with ADHD who were co-morbid with dyslexia presented lower-level performances in visual perception constancy, visual differentiation, visual closure, visual communication, visual sequential memory, visual memory, and shape discrimination from the context, compared to the non-dyslexic patients. Our findings are in agreement with previous studies that reported visual perception problems in children with dyslexia (12, 15, 17, 22-27). This study is one of a few cases that focus on a comparative analysis of the visual perception of children with and without dyslexia. Moreover, we found that the children with both ADHD and dyslexia had visual perception co-morbid with other inattention and impulsivity system problems.

The conceptual anchor theory renders an illuminating elaboration on visual perception problems. It accounts for children with dyslexia who demonstrate defects in phonological and auditory assignments due to their inability to shape cognitive tasks based on a small collection of consecutive stimuli. Considering the viable predictions of the theory, defects associated with rapid naming should be presented only in small collections of repeated (seen) materials. We suggest direct teaching of visual perception skills to ensure the improvement of students with dyslexia (23, 28).

It seems logical that children diagnosed with ADHD and also suffering from dyslexia have lowered perception skills. Visual perception problems can dramatically affect daily activities, and they may particularly have a negative impact on educational performance. These children may face a number of difficulties in discriminating letters and words. They may also see words and numbers upside down, hampering their ability to interpret tabulations, maps, and symbols. It is unfortunate when specialists ignore some aspects of a child's visual perception problems, as the defects can badly influence the high and low physically demanding activities such as handwriting and distinguishing left from right (29). With regards to the negative impacts of visual perception problems on educational performance, Same Siah Kordi et al. (2009) found that students with dyslexia and visual perception problems improved their performances in reading, reading comprehension, and word discrimination in text when they received direct visual perception skills training. Moreover, the teachers whose students receive visual perception skills training stated that the students participated more frequently in class discussions and demonstrated greater enthusiasm and more significant progress in reading and in other subjects such as math and spelling (12).

4.1. Limitations and Suggestions

The small percentage of females as well as the range of samples in our study was major obstacles we faced while

Table 1. Average and Standard Deviation of Children's Visual Perception Test Scores With Attention Deficit Disorder, Hyperactivity, and Dyslexia

Variable		Average	Standard Deviation
Visual perception	Visual perception constancy	6.91	3.09
	Visual distinction	9.50	3.66
	Visual closure	4.94	2.78
	Visual communication	9.59	5.03
	Visual sequential memory	6.53	4.23
	Visual memory	9.56	2.29
	ground ground discrimination	3.78	7.91

Table 2. The Average and Standard Deviation of Children's Visual Perception Test Scores With Attention Deficit Disorder and Hyperactivity

Variable		Average	Standard Deviation
Visual perception	Visual perception constancy	12	9.06
	Visual distinction	12.88	2.59
	Visual closure	10	2.73
	Visual communication	13.62	1.47
	Visual sequential memory	11.38	3.22
	Visual memory	11.38	3.22
	ground ground discrimination	12.88	2.59

Table 3. Independent T-test to Compare the Scores of Children's Visual Perception With Attention Deficit Disorder, Hyperactivity, and Dyslexia as Well as Children With Attention Deficit and Hyperactivity

Variable	Average (SD)[a]	Average (SD)[b]	T Statistics	Significant Level
Visual perception constancy	6.91 (3.09)	9.06 (2.28)	-3.25	0.002
Visual distinction	9.50 (3.66)	12.88 (2.59)	-3.38	0.00
Visual closure	4.94 (2.78)	10 (2.73)	-7.56	0.00
Visual communication	9.59 (5.03)	13.62 (1.47)	-4.47	0.00
Visual sequential memory	6.53 (4.23)	11.38 (3.22)	-5.31	0.00
Visual memory	9.56 (2.29)	12.24 (1.90)	-5.22	0.00
ground ground discrimination	9.50 (3.66)	12.88 (2.59)	-4.39	0.00

[a] Hyperactivity, attenuation deficit disorder, and dyslexia group.
[b] Hyperactivity and attention deficit disorder group.

conducting this study. Both of these limitations impact the generalizability of the results.

4.2. Conclusion

Considering the results of this study, we primarily recommend the office of education prioritize the screening and early identification of students at risk of ADHD and diagnosis of visual perception problems, as ADHD is frequently co-morbid with dyslexia, which can pose severe impacts on a child's learning. Additionally, not only should therapists employ treatment procedures to reduce inattention and impulsivity problems, but they should also utilize appropriate rehabilitation programs to alleviate the student's visual perception problems.

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