Memory Performance among Children with ADHD

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ABSTRACT

Introduction: The present post-eventual research study was conducted with the purpose of comparing the memory performance between two distinct groups of 50 healthy children and 50 attention deficit hyperactivity disorder (ADHD) children (25 girls and 25 boys) in Tehran with an age range of 10-12.

Methods: The whole students were selected through simple random sampling method and were assessed in children's medical center, the Clinic of Roozbeh Hospital, and Tehran's Andishe primary school (both girls' and boys' branches). The applied tools for data gathering were the Benton test and Wechsler memory sub-test (form A).

Results: The results showed a significant difference between Benton test scores and Wechsler memory sub-test scores (i.e. personal and general information, orientation, mind control, logical memory, repeating numbers straightly or reversely, learning and memory) among healthy children and those with ADHD.

Discussion: memory performance in children with ADHD was weaker than healthy children. In general, with regard to the memory deficit and attention disorder, these patients require both memory and attention rehabilitation for a better quality of life.

1. Introduction

Cognitive neuroscience is a branch of basic neuroscience which deals with cognitive and behavioral evaluation. Cognition encompasses highest functions of the human brain such as memory, speech, verbal functions, comprehension, attention, concentration, etc. The clinical application of neuropsychological evaluation associates with diagnosis of brain traumas, neurology and behavioral and psychological disorders (Bruce et al., 2004). Memory is a mental process which consists of encoding, saving, retrieving information (Castel et al., 2009). Memory is one of the brain's highest cognitive applications that structural brain damages lead to its deficiency (Baddeley, 1992, 2007; Johnstone et al., 2010). By using one's memory, one feels and comprehends, saves information, and recovers it when it is needed. Memory problems are associated with recording ability, mental tracking, memory span, and learning (Baddeley, 2007). The memory dysfunction is the most common initial complaint and generally the most debilitating characteristic of non-organic diseases (Halperin et al., 2008). ADHD is the most common diagnosed cause of behavioral disorders in childhood, with an incidence rate of 3% to 5%, which implicates 20% of

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school-age children (Gambar et al., 2004). Activation of rear and foreside tissue of the frontal lobe of the brain has a significant role in memory performance. Because of the damage to this region, in children with ADHD, the memory function decreases (Levy et al., 2003). One of the skills in which a school-age child must show proficiency is reading. In case a child suffers from visual memory dysfunctions, a parent or teacher must identify the problem, determine what the primary cause might be and come up with a solution. The ability to read depends upon many neural components working together. These neurological components are the verbal and auditory areas of the brain connected to give the child the ability of identifying words by their characters and sounds. If a child can't do this, he would have a learning disability, dyslexia or attention deficit hyperactivity disorder according to the children's vision information Network (Van De Voorde et al., 2011). Environmental causes, food allergies, brain trauma, genetics and neuro-chemical defects of brain can be mentioned as the causes of this disease (Oostrom et al., 2002). Some of the patients may have mild brain traumas which could have been caused by hard delivery conditions, impaired circulation, poisoning, fever, strike, or infection. The cause of ADHD is probably a mixture of reciprocal effects of damaging factors and there is no single cause for ADHD. Attention and memory in children with ADHD shows defect and downfall from itself (Levy et al., 2003) and leads to their educational downfall and failure and weakness in communicating with their classmates (Shang et al., 2011). Most of the hyperactive children have no sign of brain trauma. A significant number of children with ADHD, exhibit no signs of brain dysfunction (Sergeant et al., 2003). A research showed that children with ADHD mostly have problems in learning and have exhibited weak performances in mental control and visual memory (Levy et al., 2003). In a research the performance of children with ADHD was compared with a control group in a series of tests; the results showed that the scores of the children with ADHD were lower than that in the control group in Wechsler test (Stalon & Beatty, 2003; Dige et al., 2008). A research was done with the purpose of comparing the differences in children with ADHD and healthy children and the results have shown that children with attention deficiency expose more problems (Kuehne et al., 1997; Kray et al., 2011). Playing, attention, and social behavior of children with ADHD and at primary school age were assessed in a research and it was determined that they have problems in observational scales of attention and social-cognitive games and also in keeping attention during the game (Rickman, 2004). In another research it was shown that children with ADHD get distracted with different sounds and pay low attention to the topics mentioned in the class (Herbert, 1990). The cognition games of these children chiefly consist of performance or are sensory-motor (for instance moving feet muscles without subject) and it is less symbolic. A research with the title of "cognitive processing speed in children with ADHD" was done and the speed of categorizing the homework was studied in 43 children with ADHD; the results have shown that their performance was significantly lower than the control group (Ohaliand et al., 1999). The present research has been done with the aim of comparing memory performance in healthy children and those with ADHD through Wechsler and Benton tests.

2. Methods

The current study is a post-eventual research. The statistical population of this research was boys and girls of 4th and 5th grade in primary school (10 to 12 years old). The statistical sample volume was 100out of which 50 were with ADHD (25 girls and 25 boys) from the behavioral disorders center (the Clinic of Roozbeh Hosital and Pediatric Center) that, by diagnosis of a psychiatrist, were given Ritalin; diagnostic criteria of ADHD was on the basis of DSM-IV standards. Individuals with any other disorders were excluded from the study. Also 50 healthy children (25 girls and 25 boys) were chosen from district 6 of Tehran. ADHD and healthy children had average scores above seventeen out of twenty and their selection was done through simple random sampling. After referring to department of education for children with special conditions and education department of Tehran, the conditions of the subjects were described and the accepted criteria was requested to be considered. With the permission of the authorities the dossiers were examined and tests were performed in a calm and quiet place. The instructions for all subjects were equal and the tests were performed in 20 to 30 minutes; the least time was applied for the group with ADHD and the most was applied for the healthy group. Firstly, the Wechsler's memory subtests and then Benton's test were performed. The tests used in this research were:

2.1. Wechsler Memory Test (form A)

This test is used as an objective scale for assessment of memory and yields data that can separate the organic disorders of memory from functional ones. Performing this part usually takes 15 minutes and has the following advantages: A- This is a standard test. B- Attends to differences of memory in different ages. C- The yielded

MQ could be compared with IQ to some extents. This scale has high degree of validity. The medial internal consistency reported by Wechsler in 1974 was 96% (Wechsler, 1945, 1997). The validity of this test is derived from its universal relation with related criteria such as ability tests, grades, and educational progress tests. The medial correlations assessed and reported by Wechsler (1998) are correlation with group memory tests (66%), Peabody test (71%), and class grades (39%). It is worth notifying that this test has also been used before in an Iranian population (Saramy, 1993). The Wechsler memory scale (form A) consists of 7 subtests:

1. Personal awareness and general information: this subtest is made of 6 simple questions related to personal and general information and has a lot of usages on the subjects who have dementia and aphasia; the maximum score is 6.

2. Orientation: this test is made of 5 simple questions in order to orient time and place (immediately) and the maximum score is 5.

3. Mental control: this test is made of subsets and is used for the brain defects of patients with brain organic disease. Reverse counting from 20 to 1 in 30 seconds, reciting the names of months in 30 seconds, counting in 3 to 3 sequence to number 40 in 45 seconds; the maximum score in these three subtests are 9.

4. Logical memory: this test consists of two memory texts which should be in memory. This test evaluates the logical recalling and the maximum score is 23.

5. Repeating digits straightly or reversely: this test consists of two subsets, each of which is done individually; digits forward span and digits reverse span. The test starts for all subjects with 1, and after a fraction in each sequence in both subtests, the test will be stopped. This test is accepted as attention and short-term memory (Cowan, 2001).

The areas that are assessed and measured with this subtest are short-term memory, immediate auditory memory, concentration and attention, the ability of changing the pattern of thinking (from straight digits to reverse digits), order and sequence, and parrot-like learning.

The correct performance in these subtest requires two stages: A- The reception stage which requires attention and encoding, thus, persons who are absent-minded won't show a good performance in this stage. B- The stage of remembering the correct sequence of numbers and expressing the data.

Success in reverse digits shows the concentration flexibility and also the ability to tolerate stress. More reversed digits in this subtest exhibits a good short-term auditory memory, superb attention, and being lack of effectiveness from stress (Barkley, 2000; Rapee et al., 2000).

6- Visual memory: this test is a rebuilding of visual sense; the subject is asked to memorize the simple geometrical shapes given to him/her in 10 seconds and to draw them afterwards. This test consists of A and B card and the maximum score in all pictures is 14.

7- The figure learning test: the test consists of ten pairs of simple and difficult figures, and the subject tries to learn them in three attempts. The final total score of all simple figures are divided by 2 and then it is added to the final total score of difficult figures.

2.2. Benton Visual Retention Test

This test assesses abilities such as visual memory and shows defects in memory and visual reminding (McCullough et al., 1992; Walsh et al., 1990). The test has three forms (C, D, and E) and four methods. Benton has reported the reliability of this test as 95% (Benton, 1974), by measuring the correlation between counterpart forms, its reliability was shown to be 80% to 90%. This test has two methods of scoring. The first method is based on the number of correct remaking and the second one is based on error score. The statistical method in this research is one-way analysis of variance. During the test, it was attempted that the age range be controlled, and in order to differentiate the groups, the Turkey's comparison method was used. Also, it should be mentioned that this test has also been used before in an Iranian population (Mohabat, 2001)

3. Results

In this research 50 students with ADHD and 50 healthy students (100 in total) were surveyed. The mean, variance, and standard deviation of scores of healthy children and children with ADHD in Benton test and Wechsler memory subtests are presented in table 1, and indices expressed on the basis of gender are presented in table 2. The results in table 1 shows that the average scores of healthy children in Wechsler subtests and Benton test were significantly higher than children with ADHD. Through comparing the averages of girls and

boys in the mentioned tests, it could be noticed that there is no significant difference between healthy girls and boys, also there is not much difference in scores between boys and girls with ADHD, but the significant difference is between healthy children and children with ADHD. Table 3 is also representing the significant difference between Wechsler memory subtests (general and personal information, orientation, mental control, logical memory, repeating digits straightly or reversely, visual memory, and learning figures) and the Benton test in healthy children and those with ADHD.

Table 1. The measurement of scattering indices (mean, variance, and standard deviation) of scores of healthy children and children with ADHD in Benton test and Wechsler memory subtests.

Groups	Tests / Scattering Indices	Benton	Personal & General Information	Orientation	Mental Control	Logical Memory	Repeating Digits Straightly & Reversely	Visual Memory	Learning Figures	Total
Healthy Children	Mean	8.62	5.60	4.80	6.62	16.2	8.20	12.16	16	99.38
	Standard Deviation	1.41	0.57	0.53	0.75	1.7	1.10	1.54	2	8.26
Children with ADHD	Mean	4.96	4.80	4.42	4.12	11.10	4.96	7.34	13.12	73.02
	Standard Deviation	1.89	0.67	0.67	0.65	2.20	1.22	3.39	1.82	9.84

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Table 2. The measurement of scattering indices of scores of healthy children and children with ADHD in Benton test and Wechsler memory subtests on the basis of gender.

Groups	Subtests	Mean Difference	Standard Deviation Lapse	P-value
Children with ADHD	Benton	0.76	0.34	0.24
	Personal & General Information	0.98	0.13	0.02
	Orientation	0.86	0.11	0.60
	Mental Control	0.39	0.16	0.22
	Logical Memory	0.83	0.41	0.24
	Repeating Digits Straightly & Reversely	0.63	0.2194	0.20
	Visual Memory	0.59	0.55	0.54
	Learning Figures	0.19	0.36	0.64
Healthy children	Benton	0.00	0.34	3.90
	Personal & General Information	0.00	0.13	0.82
	Orientation	0.001	0.11	0.44
	Mental Control	0.00	0.16	2.28
	Logical Memory	0.00	0.41	5.38
	Repeating Digits Straightly & Reversely	0.00	0.2194	3.44
	Visual Memory	0.00	0.55	4.38
	Learning Figures	0.00	0.36	3.52

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*P-value <0.05

Table 3. The results of HSD test (Tukey) in order to survey the lowest mean difference between Benton test and Wechsler memory subtests scores in healthy children and children with ADHD.

Gender	Groups	Scattering Indices of Tests	Benton	Personal & General Information	Orientation	Mental Control	Logical Memory	Repeating Digits Straightly & Reversely	Visual Memory	Learning Figures	Total
Girl	Healthy children	Mean	8.52	5.68	4.76	6.68	16.44	8.32	12.20	15.96	100.26
		Standard Deviation	1.41	0.55	0.43	0.69	1.52	1.15	1.32	1.64	4.11
	Children with ADHD	Mean	5.32	4.64	4.32	3.84	10.64	4.44	8.44	13.48	73.92
		Standard Deviation	1.70	0.75	0.74	0.62	1.52	1.15	3.81	1.98	11.22
Boy	Healthy children	Mean	8.72	5.52	4.84	6.56	16.04	8.04	12.12	16.04	98.52
		Standard Deviation	1.42	0.58	0.62	0.82	1.90	1.05	1.76	2.33	11.00
	Children with ADHD	Mean	4.60	4.96	4.52	4.40	11.56	5.48	6.04	12.76	72.12
		Standard Deviation	2.04	0.53	0.50	0.57	2.46	1.08	2.44	1.61	8.37
Total	Healthy children	Mean	8.62	5.60	4.80	6.62	16.24	8.20	12.16	16	99.38
		Standard Deviation	1.41	0.57	0.53	0.75	1.72	1.10	1.54	2	8.26
	Children with ADHD	Mean	4.96	4.80	4.42	4.12	11.10	4.96	7.24	13.12	72.02
		Standard Deviation	1.89	0.67	0.64	0.65	2.20	1.22	3.39	1.82	9.84

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4. Discussion

Results show a significant difference between the total scores of healthy children and children with ADHD on the Wechsler and Benton memory tests. Since the mentioned tests reflect the performance of the memory, it could be said that memory performance in healthy children is superior to children with ADHD. Memory is very effective in the learning process. Assessing memory performance in children with attention deficit demonstrates the relevance of memory and attention domains. As much as proper functioning of memory is the result of proper attention, confirming this difference in memory performance of these two groups again represents the fundamental relationship of attention and memory. The role of memory domain in learning could be an emphasis on better education of ADHD children than healthy ones. Performance results of healthy children compared to those with ADHD on visual sub-test were more suitable. This is another focusing on impressibility of attention domain from visual memory.

The orientation in first place, and personal and general information in second place have the lowest difference rate. This research is showing that the logical and visual memories of healthy children are higher than children with ADHD but there is not much difference in personal and general information and orientation.

Findings of the present research also represented that the mean scores of visual memory in girls with ADHD were higher than boys with ADHD, and conversely, the mean scores of repeating digits straightly and reversely in boys with ADHD were higher than girls with ADHD. This indicates that visual memories of girls of this group are rather higher than boys', but are lower than boys' in repeating digits straightly and reversely memory subtest. It seems that the communication role of attention and memory domains is much higher in girls rather than boys. However, these subtests have not shown any significant difference in healthy boys and girls.

The results of previous researches indicate that (Hirsch et al., 2003) children with ADHD have lower scores than healthy children and the reason is known to be due to the defects in numerical accuracy, mental calculation, and mental processing speed plus the deficiency in mental control in children with ADHD, are similar to another research (Robert et al., 2004;Gambar et al., 2004). The results of this study conform to the results of the research in which, 11 performance tests were done on children with ADHD in comparison with

the control group (Stalon & Beatty, 2003). Reports of other researchers (Stalon & Beatty, 2003; Kuehen et al., 1997; Rickman, 2004; Herbert, 1990; Ohaliand et al., 1999; Denny & Rabort, 2001) suggest significant differences regarding ADHD children's memory performance in comparison with healthy children. Also, the main limitation in this study line is that we cannot restrict the bias of poor attention in memory performance. This article boosts previous evidences on memory dysfunction among ADHD children which ascertains the necessity of education-based attention and memory rehabilitation amongst these children.

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