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Research Article

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Correlation between Balance and Attention in Children with Attention Deficit Hyperactivity Disorder

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ABSTRACT

Objective: The purpose of the current study was to investigate balance in children with attention deficit hyperactivity disorder contrasted to normal subjects. Furthermore, it studied the relationship between their balance and the total percentile scores of ADHD Rating Scale-IV. Design: The study was a cross-sectional design. Methods: Sixty children were involved in this research from both sexes (42 boys and 18 girls) with age ranged from 60 to 84 months. They were subdivided into two groups based on the ADHD Rating Scale-IV. The control group included 30 normally developed children from both sexes (20 boys and 10 girls) with a mean age of 67.53 ± 1.41 months, and the total percentile scores of ADHD Rating Scale-IV ≤ 50. The study group comprised of 30 children from both sexes (22 boys and 8 girls) with attention deficit hyperactivity disorder (ADHD) with a mean age of 68.60 ± 4.62 months. The total percentile scores of ADHD Rating Scale-IV were ≥ 93. Both groups were investigated for their balance by Pediatric Balance Scale (PBS). Results: According to the PBS scoring, the children with ADHD had significantly lower balance and total percentile scores of ADHD Rating Scale-IV than the children who are normally developed. Furthermore, the PBS score and the percentile scores of ADHD Rating Scale-IV had a significant negative correlation. Conclusion: It can be concluded that children with ADHD had significant balance disturbance as contrasted to normal subjects. The disturbance in their balance was inversely correlated with the percentile scores of ADHD.

Key words: *ADHD Rating Scale-IV, balance, attention, Pediatric balance scale.*

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a highly reported condition, influencing preschool children. It is distinguished by inattention, impulsivity, and hyperactivity. The pervasiveness of ADHD varies among various countries. It ranges from 2% to 16% according to the diagnostic criteria and estimation tools. Boys are three times more prone to be diagnosed with ADHD than girls [1-3]. The recorded prevalence of ADHD among primary school children ranged between 6.5% and 7.9% [4 -7]. Some factors induce ADHD, such as being born prematurely, having a low birth weight and smoking, alcohol or drug abuse throughout pregnancy [3]. Based on the established clinical criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM IV-TR), there are three types of ADHD, including hyperactive, inattentive, and combined types [8]. ADHD is associated with the frequent occurrence of motor deficiencies comprising fine as well as gross motor skills e.g. posture and gait deficiencies [8, 9].

Balance is a fundamental skill for the motor development and physical activity (PA) performance of children [10]. Balance in ADHD is not widely investigated. Subjects suffering from ADHD showed postural control and gait balance abnormality as compared to normal peers [11, 12]. In contrast, Schlee et al stated that there was no significant difference in the balance and postural capacity of children with ADHD as contrasted to normal subjects [13].

The balance was assessed by various methods and scales. It was evaluated by utilizing force platform, the Balance Error Scoring System (BESS), Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), and Pediatric

balance scale (PBS) [11, 14 -16]. PBS was a valid and reliable mean of assessing the School age children's balance [16].

So, the aim of the present study was to study the balance in children with attention deficit hyperactivity disorder contrasted to normal children. Furthermore, it studied the relationship between their balance and the total percentile scores of ADHD Rating Scale-IV.

SUBJECTS, INSTRUMENTATIONS, AND PROCEDURES:

Subjects:

This study was performed in the period from July 2018 to November 2018. Sixty children were involved in the present research from both sexes (42 boys and 18 girls) with age ranged from 60 to 84 months, which were subdivided into two groups (control and study groups). They were recruited from different kindergartens at Cairo, Egypt, based on the following criteria:

Study group: The study group included thirty children from both sexes (22 boys and 8 girls) with attention deficit hyperactivity disorder (ADHD) based on the ADHD Rating Scale-I. They had the total percentile scores of ADHD Rating Scale-IV ≥ 93, with no history of cerebral palsy, epilepsy or head trauma.

Control group: The control group included thirty normally developed children from both sexes (20 boys and 10 girls). They had the total percentile scores of ADHD Rating Scale-IV ≤ 50.

The study was approved by an Ethics Committee of Cairo University. Child's parents had signed a consent form about the goal of the study, its benefits and inherent risks, their committee with regard to time and money, as well as agreement to participate.

Instrumentations:

Before the following assessment, the objectives and procedures were fully described to the children's parents.

ADHD Rating Scale-IV checklist, school version [8]:

Both groups were investigated by the ADHD Rating Scale-IV checklist, school version to know if the child was diagnosed with ADHD or rule out.

Pediatric Balance Scale (PBS):

Both groups were assessed for their balance by PBS [9].

Procedures:

Each child in both groups was examined individually, using the ADHD Rating Scale-IV checklist. The child's teacher was asked to write the checklist. Then the therapist interpreted the total scores obtained from the checklist and she converted it to the percentile scores based on their total scores [17].

Both groups were assessed for their balance by PBS. PBS includes fourteen items, each of them with subsets scored as 4, 3, 2, 1 or 0. Finally, the total test score was determined [16].

Statistical analysis:

The mean value and standard deviation were determined for each variable measured during the research. Unpaired t-test was calculated for variables measured during this study. The significance level of 0.05 was utilized. The bivariate correlations methode calculated Pearson- a parametric test, to determine the correlation between PBS score and the total percentile scores of ADHD Rating Scale-IV variables with ordered categories and their significance levels.

RESULTS

Descriptive data of both control and study groups:

The mean values ± standard deviations of the ages were 67.53 ± 1.41 and 68.60 ± 4.62 for control and study groups respectively, which revealed no significant difference ($P > 0.05$). The mean values ± standard deviation of the total percentile scores of ADHD rating scale-IV were 35.73 ± 5.94 and 96.53 ± 1.87 for control and study groups respectively, which revealed a significant difference ($P < 0.05$). The results are shown in table (1).

The frequency distribution of gender in both the control and study groups:

The distribution of males and females in the control group was 66.7% and 33.3%, respectively. Moreover, the distribution of males and females in the study group was 73.3% and 26.7%, respectively.

Comparison between pediatric balance scale scores in both the control and study groups:

The mean values ± standard deviation of pediatric balance scale scores were 53.93 ± 2.26 and 43.87 ± 2.75 for control and study groups respectively, which revealed a significant difference ($P < 0.05$). The results are shown in table (2).

Pearson bivariate correlation between the pediatric balance scale scores and the gender, age and ADHD rating scale-IV for the study group:

As shown in table (3), there was a significant negative correlation between the PBS score and the total percentile scores of ADHD Rating Scale-IV in the study group. Moreover, there was a significant positive correlation between the PBS score and the gender in the study group, which was revealed to have significant relationships at a 5% significance level.

Table 1: Age (months) for both the control and the study groups.

Item	Groups		Means ± standard deviation	Mean difference	t Value	P Value	Sig
Age (months)	Control	Males	64.20 ± 3.71	1.07	1.160	0.256	NS
		Females	65.40 ± 3.20				
		Total	67.53 ± 1.41				
	Study	Males	68.59 ± 4.81				
		Females	68.63 ± 4.37				
		Total	68.60 ± 4.62				
ADHD rating scale-IV	Control	Males	38.3 ± 4.88	60.80	49.609	0.000	Sig
		Females	30.6 ± 3.42				
		Total	35.73 ± 5.94				
	Study	Males	96.91 ± 1.85				
		Females	95.50 ± 1.87				
		Total	96.53 ± 1.60				
Sig: Significance				NS: Non-significant			

Table 2: Comparison between pediatric balance scale scores in both the control and study groups.

Item	Groups		Means ± standard deviation	Mean difference	t Value	P Value	Sig
Pediatric balance scale (PBS) score	Control	Males	53.65 ± 2.28	10.07	14.85	0.000	S
		Females	54.50 ± 2.22				
		Total	53.93 ± 2.26				
	Study	Males	43.23 ± 2.78				
		Females	45.63 ± 1.85				
		Total	43.87 ± 2.75				
Sig: Significance				S: significant			

Table 3: Pearson bivariate correlation between the pediatric balance scale scores and the gender, age and ADHD rating scale-IV for the study group.

Item		Study group			Control		
		Age	Gender	ADHD rating scale-IV	Age	Gender	ADHD rating scale-IV
Pediatric balance scale score	Pearson Correlation	-0.137	0.392*	-0.475**	0.489**	0.180	-0.084
	Sig. (2-tailed)	0.469	0.032	0.008	0.006	0.340	0.660
*. Correlation is significant at the 0.05 level (2-tailed).							
**. Correlation is significant at the 0.01 level (2-tailed).							

DISCUSSION

This research was performed to contrast balance in children with attention deficit hyperactivity disorder to normal children. Additionally, it tried to understand the association between the attention and balance in the children with ADHD. The age of the children involved in the present research ranged from five to seven years old as it was recorded that ADHD influences 3-5% of children of primary school age [18]. The findings of this investigation revealed that there was no significant difference between the mean values of the age for both control and study groups. This proposed that there was a matching between the control and study groups. Furthermore, the findings revealed that boys were suffering from ADHD more than girls. Both groups were evaluated by PBS, which is a trustworthy measure of balance utilized with a child with motor impairment [16].

Furthermore, the findings of this investigation revealed a significant difference in PBS scores in the study group (ADHD group) as contrasted to the control group (normally developed children group). This revealed that there was balance disturbance in children with ADHD. The PBS in children with ADHD is lower than the normally developed children by 19.42 % and 16.28% for males and females, respectively. These results are in concordance with Kim et al., who stated that the children with ADHD had a disturbance of balance [19]. Furthermore, it was verified by Mao et al., who proposed that balance ability skill levels in children with ADHD were generally not as high as those of the controls in different viewpoints, comprising static and dynamic balance [15]. The children with ADHD had posture and gait performance abnormalities, especially in the movement coordination test and paced stepping task [8].

Furthermore, the findings of this research reveal there was a significant negative correlation between the PBS score and the percentile scores of ADHD Rating Scale-IV in the study group. This result showes that the disturbance of the balance in the children with ADHD was inversely correlated with their percentile scores of ADHD. This result is in concordance with Abuin-Porras et al., who proposed that there was a significant correlation between attention and balance and gender differences that may condition the way to address balance issues in boys and girls [20].

The disturbance of balance in children with ADHD can be attributed to a reduction in the volume of cerebrum and cerebellum in children with ADHD as compared to healthy children. Furthermore, there was cerebellum dysfunction in the children with ADHD because of the reduction in brain conductivity from the cerebellum to the middle frontal and medial frontal gyri in those children [9, 19, 21].

CONCLUSION

It can be concluded that children with ADHD had significant balance disturbance as contrasted to normal subjects. The disturbance in their balance was inversely correlated with the percentile scores of ADHD.

Conflict of interest

Author (s) has not declared any conflict of interest.

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