



Research Paper: Effects of Physical Activity Participation on Fine and Gross Motor Skills in Pre-School Children with ADHD




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Abstract

The purpose of this study was to investigate the association between physical activity with fine and gross motor skills in pre-school children with ADHD. The present study is a descriptive-correlational study. The participants were 58 children (20 girls) aged 4 to 6 years who were selected using a convenience sampling method. We utilized Physical Activity Questionnaire for Children (PAQ-C) to measure physical activity. The short form of the Bruininks-Oseretsky Test of Motor Proficiency Ed. 2 (BOT-2) was used to measure the fine and gross motor. Independent *t* test and regression analysis were used to analyze the data. Children in this study had low levels of physical activity and motor proficiency. Boys had significantly higher physical activity and motor proficiency than girls ($P < 0.001$). In addition, physical activity was directly and significantly associated with fine and gross motor skills (both $P < 0.001$). These findings indicate that there is a need to increase the level of physical activity in pre-school children with ADHD, especially girls. Moreover, it is recommended that physical education teachers and sports coaches use programs in physical education lessons to facilitate motor skills in children.

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1. Introduction

In the first five years of their life, children develop in four main areas: motor (physical), communication and language, cognitive, and social-emotional (Brian et al. 2020; Seyedi Asl et al., 2016; Saeedpour-Parizi et al., 2020, 2021; Mohammadi et al., 2022; Hazrati et al., 2022; Hashemi Motlagh et al., 2022s). Motor development means physical growth and strengthening of bones, muscles and the child's ability to move and touch the surrounding environment (De Meester et al., 2018; Taghva et al., 2016). Motor skills are skills that enable movements and tasks that every human being performs from birth to old age. These skills are the movements that enable us to perform daily tasks, from the ability to eat to moving from one place to another (Gallotta et al., 2018). Normally, children learn certain motor skills at certain ages, however some children may be slow in acquiring motor skills due to various reasons including developmental delay (Baniyadi et al., 2022c; Chaharbaghi et al., 2022; Hernandez & Caçola, 2015; Khosravi et al., 2023). In general, motor skills are divided into two categories: fine motor skills and gross motor skills. Fine motor skills are skills that require high control and precision in the small muscles of the hand (such as using a fork). In gross motor skills, children use the large muscles of the body to build balance, coordination, reaction time, and body strength to perform larger movements such as walking and jumping (Baniyadi et al., 2022b; Chaharbaghi et al., 2022; Logan et al., 2011; Morley et al., 2015). The development of gross motor skills can be important for improving self-esteem and fine motor skills

for many daily tasks such as dressing, combing and writing (Mukherjee et al., 2017). During childhood, these skills provide a good opportunity to communicate with others and cooperate with them, and it has been proven that there is a direct relationship between positive social acceptability and movement capabilities, especially in boys (Baniyadi et al., 2022a; Guadagnoli et al., 2002; Seyedi Asl et al., 2021; Slotte et al., 2015). Children and adolescents with mobility problems face problems in performing gross motor skills, which results in their non-participation in sports, loss of physical fitness, withdrawal from society, and reduced self-esteem (Khosravi et al., 2023; Seyedi Asl et al., 2021; Venetsanou & Kambas, 2016, 2017; Wrotniak et al., 2016).

Attention Deficit/Hyperactivity Disorder (ADHD) is a group of biological-neurological disorders that disrupt the regulation of the level of activity, inhibition of behavior (impulsivity) and the range of a person's attention (Birchwood & Daley, 2012). This disorder is one of the first or second most common disorders of childhood and adolescence, with different variations and a prevalence of 3 to 10 percent in school-age children, and the severity of the disorder decreases in the ages above 10 years (Farhangnia et al., 2020). This disorder is three to nine times more common in boys than girls. One of the areas of attention in ADHD children is the physical and movement aspects that are studied by physical education specialists, doctors and rehabilitation centers (Goulardins et al., 2017; Li et al., 2021). Daily activities require sustained attention and impulse inhibition, so

children with ADHD may have difficulty in these actions. Several studies that have investigated the movement performance and movement processes of ADHD children have pointed out the weakness of balance and coordination, weakness of gross motor skills, weakness of fine motor skills and weakness of physical fitness indicators among these children (Mastoras et al., 2018; Sabzi et al., 2021).

One of the possible factors that can affect the development of children's motor skills is participation in physical activity. Basically, physical activity refers to any movement of the body that is caused by the contraction and expansion of the skeletal muscles and requires energy (Abdi et al., 2020; Basterfield et al., 2021; Gritten Campos et al., 2019). It has been extensively shown that physical activity is a key to reducing the risk of serious diseases, such as heart disease, stroke, diabetes and cancer in children (Dishman et al., 2009; Gallego-Méndez et al., 2020; Ghorbani et al., 2020; Haidar et al., 2019). Research shows that regular physical activity can increase a child's self-esteem, mood and sleep quality and make him less prone to stress, depression and dementia (Lahart et al., 2019; Schwartz et al., 2019; Sheikh et al., 2021, 2022; Wafa et al., 2016; Zhang et al., 2021). However, the impact of physical activity on fine and gross skills in preschool children with ADHD has received less attention. Therefore, the aim of this study was to investigate the effects of physical activity on fine and gross skills in preschool children with ADHD.

2. Methods

The method of current study was descriptive-correlation, which investigated the relationships between physical activity with fine and gross skills in preschool children with ADHD. The parents of children gave written consents for the participation of their children in this study. The protocol of this study was in accordance with the Declaration of Helsinki.

2.1. Participants

The statistical population of the study consisted of all preschool children with ADHD who attended in a special preschool for exceptional children with behavioral disorders in Tehran. Of them, 58 children with ADHD (20 girls) aged 4-6 years old were selected using a convenience sampling method as the statistical population of this study.

2.2. Measures

Physical activity was measured using Physical Activity Questionnaire for Children (PAQ-C). This questionnaire was designed by Kowalski et al. (1997). This questionnaire contains 8 questions that the participants answered on a 5-point Likert scale. The validity of the questionnaire structure was confirmed through the confirmatory factor analysis and the high loading rate was over 0.4. Also, the reliability of the questionnaire was obtained through the Cronbach's alpha coefficient of 0.86 (Kowalski et al., 1997).

The short form of the Bruininks-Oseretsky Test of Motor Proficiency Ed. 2 (BOT-2) was used to measure the motor proficiency of children. BOT-2 is a set of standard-reference tests that is used to measure the motor performance of children aged 4.5 to 14.5 years old. Bruininks (2005) designed this test

by modifying Oseretsky's motor proficiency test. It takes 15-20 minutes to complete the short form. The short form of this test has eight subtests and 14 items, which are part of the 46 items, which include abilities such as 1) running speed and agility (one item), 2) static and dynamic balance (two items), 3) coordination bilateral (two items), 4) leg muscle strength (one item), 5) upper limb coordination (two items), 6) reaction speed (one item), 7) visual-motor control (three items), and 8) upper limb agility and speed (measures two substances). Items 1 to 4 of the test are indicators of gross motor skills, items 6 to 8 are indicators of fine motor skills, and item 5 is a combination of both motor skills. The retest reliability coefficient of this test is 0.86 in the short form. This test has been standardized in Iran as well (Mohammadi Orangi et al. 2018). Each child receives a raw score, which is converted into points according to the guide table. The range of gross and fine motor skill scores is 0-53 and 0-51. A higher score means a better motor skill

2.3. Data analysis

Data was analyzed using SPSS software version 26. Mean and standard deviation were used for descriptive statistics. Independent t test was used for considering gender differences. Regression analysis was used to obtain the effect of the physical activity on fine and gross motor skills. P-value was set at $p < 0.05$.

3. Results

3.1. Descriptive data and gender differences

In Table 1, the descriptive characteristics of the participants, physical activity, fine motor skill, and gross motor skill of the boys and girls are shown. As appeared, boys and girls have almost identical age, height, and weight (all $P > 0.05$). However, boys had significantly higher levels of physical activity ($P < 0.001$), fine motor skill ($P < 0.001$), and gross motor skill ($P < 0.001$) than girls. Means of physical activity, fine motor skill ($P < 0.001$), and gross motor skill across genders are shown in Figure 1, 2, and 3.

Table 1
Descriptive data of the study

| | Boys | Girls | Gender differences |
|--------------------|--------------|--------------|----------------------|
| Age (years) | 5.25 ± 0.70 | 5.16 ± 0.81 | t=0.269 P>0.05 |
| Height (m) | 1.09 ± 0.15 | 1.04 ± 0.10 | t=0.193 P>0.05 |
| Weight (kg) | 20.33 ± 7.28 | 19.70 ± 6.38 | t=0.634 P>0.05 |
| Physical activity | 2.25 ± 0.70 | 1.16 ± 0.81 | t=-7.161* P<0.001 |
| Fine motor skill | 24.54 ± 4.28 | 20.16 ± 3.62 | t=6.337* P<0.001 |
| Gross motor skills | 28.39 ± 5.28 | 24.16 ± 4.10 | t=-5.727* P<0.001 |

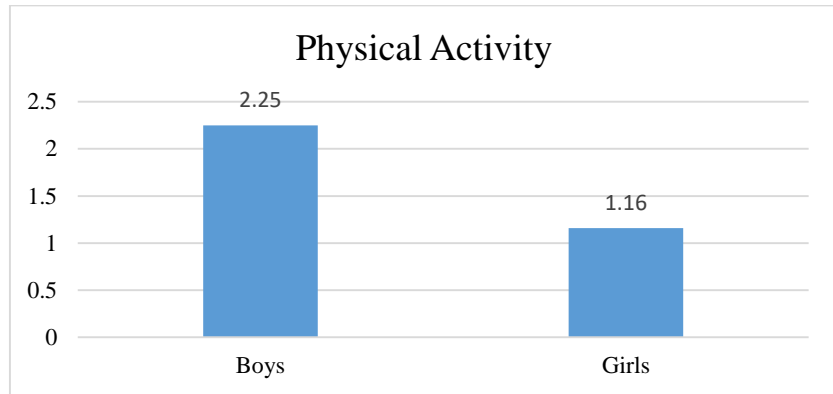


Figure 1. Mean of physical activity across genders

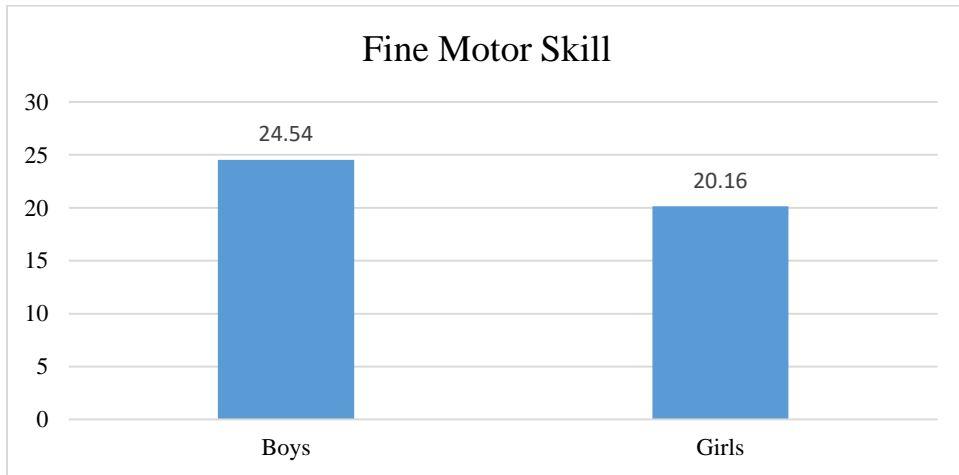


Figure 2. Mean of fine motor skill across genders

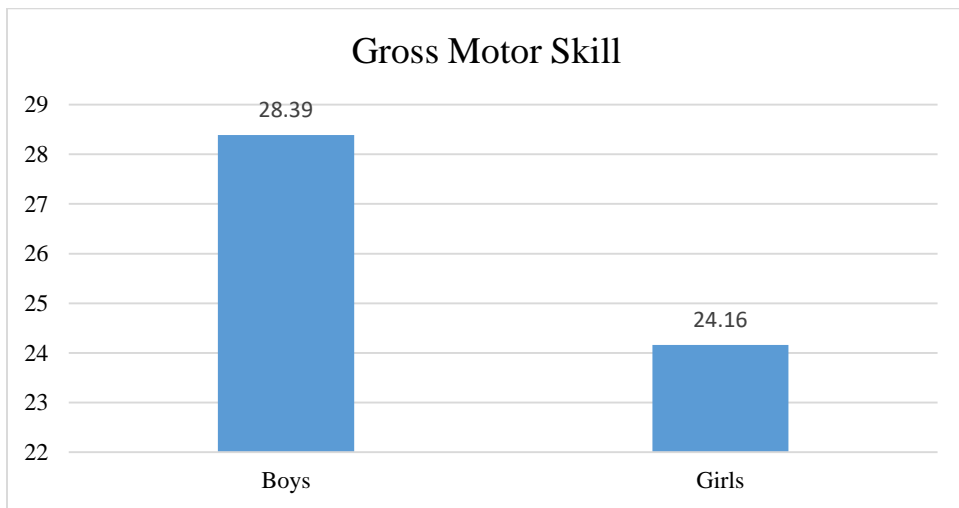


Figure 3. Mean of gross motor skill across genders

3.2. Regression analysis

Regarding the regression analysis with forward selection, the results (Table 2) showed that physical activity has a direct and

significantly link with fine motor skill ($P < 0.001$). In addition, physical activity has a direct and significantly link with gross motor skill ($P < 0.001$).

Table 2

Results of regression analysis to discover the link between physical activity with fine and gross motor skills

| | | Coefficient | SE | Standardized Coefficient | P-values |
|-------------------|-------------------|-------------|------|--------------------------|----------|
| Physical activity | Fine motor skill | -0.640 | 8.16 | -0.621 | <0.001 |
| | Gross motor skill | 0.552 | 6.02 | 0.522 | <0.001 |

4. Discussion

The purpose of this research was to investigate the relationship between physical activity and fine and gross motor skills in preschool children with ADHD. First, it should be stated that the level of physical activity in the children in this research was very low. These results are consistent with the results of previous studies regarding the participation of children with ADHD (Farhangnia et al., 2020; Goulardins et al., 2017; Li et al., 2021; Mastoras et al., 2018; Sabzi et al., 2021) and indicate that these children have low health-oriented physical activity. Therefore, considering the positive effects and consequences of participation in physical activity on the physical and mental health of children, the need for interventions and strategies to increase the level of physical activity of these children is felt. Therefore, it is essential that child sports professionals take the necessary measures to improve the level of physical activity of children with ADHD.

In addition, the results of the present research showed that the level of

implementation of gross and fine motor skills in preschool children with ADHD is in the average level. It is consistent with the results of previous studies (Gallotta et al., 2018; Hernandez & Caçola, 2015; Logan et al., 2011; Morley et al., 2015; Mukherjee et al., 2017; Venetsanou & Kambas, 2016, 2017; Wrotniak et al., 2016) and indicates that these children have a low level of fine and gross motor skills. Therefore, considering the important effects of motor skills implementation on children's daily and social activities, the need for interventions and strategies to increase the level of motor skills implementation in these children is felt. Therefore, it is necessary that child sports specialists take the necessary measures to improve the level of execution of movement skills of children with ADHD.

In particular, gender differences, the results of the present research showed that girls have a lower level of physical activity than boys. Also, girls have a lower level of fine and gross motor skills than boys. These results show that regarding children with ADHD, special attention should be paid to

girls because their motor skills are lower than boys. Therefore, interventions and strategies to improve physical activity and movement skills in children with ADHD should focus and pay special attention to girls.

Regarding the effect of physical activity on the implementation of fine and gross motor skills in children with ADHD, the results of the present study showed that the greater the participation of children in physical activity, the higher their ability to perform fine and gross motor skills. These results are consistent with the results of previous research on the effect of physical activity and sports on the performance of motor skills in children (Dishman et al., 2009; Gallego-Méndez et al., 2020; Ghorbani et al., 2020; Haidar et al., 2019; Lahart et al., 2019; Schwartz et al., 2019; Sheikh et al., 2021, 2022; Wafa et al., 2016; Zhang et al., 2021) and indicate the positive effect of regular participation in physical and sports activities on the performance of motor skills in children, including children with ADHD.

In general, teachers and physical education planners need to understand and recognize patterns and health factors affecting physical activity (such as motor competence, perceived competence and physical fitness related to health), because it affects the levels of physical activity and motor performance of children. Educational leaders should provide environments in which the effects of motor skills (especially gross skills) on children's physical activity are considered, and physical education teachers should implement these programs according to the age of children. Schools should have valid and relevant tools for

measuring children's motor skills. provide teachers with tools to measure progress in children's movement skills. Considering the role of perceived competence in children's tendency to physical activity, teachers should provide environments and provide suitable movement tasks, and encourage and give positive feedback from experiences (above) increasing the perceived competence of children. In the end, it should be said that it is necessary to pay more attention to these factors in physical education programs and exercises in order to improve the physical activity of male children.

5. Conclusion

The purpose of this research was to investigate the effect of physical activity on the implementation of fine and gross motor skills in preschool children with ADHD. In summary, the results of the present research showed that preschool children with ADHD have low physical activity and moderate motor ability. Also, girls have a lower level of physical activity and motor ability than boys. These results show that the need for interventions to increase the level of physical activity and motor ability in preschool children with ADHD should be specially focused on girls. Finally, the results of this research showed that physical activity can positively affect the performance of fine and gross motor skills in preschool children with ADHD. Therefore, child professionals can use physical activity as one of the ways to improve the motor ability level of preschool children with ADHD.

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Conflict of interests

The Author declares that there is no conflict of interest with any organization. Also, this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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