

Accelerometer-Based Physical Activity and Health-Related Quality of Life in Children with ADHD

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Abstract

Background: Self-reported studies showed that physical activity is associated with health-related quality of life in children with ADHD. Considering the limitations of self-reporting methods, we aimed to assess the association between accelerometer-measured physical activity and health-related quality of life among children with ADHD.

Methods: 68 participants (28 girls, mean age of 10.22±1.55 years) wore the accelerometer for seven consecutive days. PedsQL was used to measure health-related quality of life. Mann-Whitney U, Spearman correlation test, and regression analysis were used to analyze data.

Results: On average, the daily moderate-to-vigorous physical activity (MVPA) was 36.46 minutes, which is below the WHO guideline. Boys engaged significantly more in daily MVPA than girl. Moreover, gender significantly predicted health-related quality of life ($F = 4.58$, $p = 0.03$, Adjusted $R^2 = 0.08$, $\beta = 0.75$). Sedentary time% has inversely predicted health-related quality of life ($F = 2.81$, $p = 0.04$, Adjusted $R^2 = 0.03$, $\beta = 0.53$). Finally, daily MVPA predicted health-related quality of life ($F = 5.73$, $p = 0.02$, Adjusted $R^2 = 0.09$, $\beta = 0.13$).

Conclusion: These finding indicate that physical activity and quality of life are critical concerns for children with ADHD. Accordingly, it is necessary to adopt appropriate strategies to develop more active lifestyles among this population.

Key Words: ADHD, accelerometer, gender, physical activity, quality of life.

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1- INTRODUCTION

Regular physical activity has many health benefits such as preventing chronic illnesses and premature deaths, improving physical and mental health, and increasing quality of life (1-3). Hence, World Health Organization's (WHO) guidelines provide recommendations for all age categories on the amount of physical activity and sedentary behavior. In the case of children, WHO guidelines recommend that children and adolescents aged 6-17 years should engage at least in 60 minutes of daily moderate-to-vigorous-intensity (MVPA) physical activity across the week. In addition, they should limit the amount of sedentary time, especially the amount of recreational screen time (4). Nevertheless, previous studies consistently demonstrated that only 20 to 25 percent of girls and 35 to 40 percent of boys follow the WHO's guidelines of 60 minutes of daily MVPA (5-6). Given that, it can be assumed that children with attention deficit hyperactivity disorder (ADHD) are more likely to be physically inactive and participate less in sports activities compared to typically developing children. ADHD is one of the most common neurodevelopment disorders in children that can persist into adolescence and adulthood. Research has shown that children with ADHD suffer from cognitive problems such as attention deficit, impulsiveness, and hyperactivity disorder. Furthermore, they have academic problems as well as difficulty with motor functioning (7-8). Previous studies have also revealed that children and adolescents with ADHD do not meet WHO recommendation of 60 minutes of daily MVPA (9-10), and are therefore at risk for inactivity and its negative consequences. Although previous studies have shown that children with ADHD have low physical activity, these studies lack the necessary validity because they are based on self-report questionnaires. Due to the fact that

there are large differences in time spent on moderate-to-vigorous physical activity measured by questionnaire and accelerometer in children and adolescents (11-13), the validity of questionnaires remains questionable. Therefore, there is uncertainty regarding the physical activity patterns of children with ADHD; and it is necessary to assess physical activity objectively by using accelerometers. Thus, the main purpose of this study was to objectively measure physical activity and sedentary behavior among children with ADHD.

In addition, some evidence has shown that physical activity is associated with health-related quality of life in different age groups, including children (14-18). Health-related quality of life is a broad multi-dimensional concept including physical, mental, and social functions. In children, enhancing HRQoL is essential for their present and future wellbeing; and is thus considered as a priority area for health interventions. Specifically, health-related quality of life focuses on the children's subjective self-perception about their current health status and ability to perform daily activities in different life domains (14-16). Systematic review evidence indicates that higher levels of physical activity are associated with higher health-related quality of life scores in healthy child populations (19). Among children with ADHD, there are, also, some evidence demonstrating that physical activity is associated with health-related quality of life among children and adolescents with ADHD (9-10). However, these studies have not measured physical activity objectively by using accelerometers and, therefore, this issue needs to be further investigated. Thus, the second purpose of this study was to investigate the association between the objectively measured physical activity and health-related quality of life among children with ADHD. Altogether, this

study aimed 1) to characterize the objectively measured physical activity patterns among children with ADHD, and 2) to examine the association between the objectively measured physical activity and health-related quality of life among children with ADHD.

2- MATERIALS AND METHODS

2-1. Participants

The present study applied a descriptive-correlational approach. Sixty-eight children (28 girls) attending a special school for children with ADHD, in Tehran city, Iran during 2020 participated in this study (mean age of 10.22 ± 1.55 years). The statistical sample was selected based on convenience sampling method.

2-2. Measures

2-2.1 Physical activity

Physical activity was measured objectively using the accelerometer ActiGraph wGT3X-BT (ActiGraph LLC, Pensacola, FL, USA). Accelerometers measure frequency, intensity and duration of physical activity as well as sedentary time. ActiGraph accelerometer has a good validity and reliability (20). The participants wore accelerometer for seven consecutive days and then, the data was downloaded, processed, and analyzed using the software ActiLife v6.13.4 (Actigraph Inc, USA).

2-2.2. Health-Related Quality of Life

Health-related quality of life was assessed using The Pediatric Quality of Life Inventory Version 4.0 Generic Core Scales (PedsQL) (21), consisting of 23 items based on a 5-point Likert scale from 0 (never) to 4 (almost always) that fall into four categories: physical, emotional, social, and school functioning. The three latter subscales can be combined as psychosocial functioning. Items are reversed scored and linearly transformed to a 0-100 scale as follows: 0=100, 1=75,

2=50, 3=25, 4=0. The maximum score is 100, and the minimum score is 0. The reliability of PedsQL has been confirmed among children with ADHD to be $\alpha=0.92$ (21). In this study, we measured the Cronbach's alpha of the PedsQL as $\alpha=0.89$. Eight experts in this study assessed the validity of this questionnaire as CVI=1.00 and CVR=1.00.

2-3. Data analysis

We analyzed the data by the use of SPSS Statistics (version 26). Descriptive analysis was used to calculate the means and standard deviations of research variables. Normality of data was measured by using Kolmogorov-Smirnov test. Mann-Whitney U was performed to calculate gender differences. Spearman correlation test was utilized to measure bidirectional associations between research variables. Finally, we implemented the regression analysis to investigate the prediction of health-related quality of life through MVPA. The significance level was considered at the alpha of 0.05.

3- RESULTS

3-1. Demographic data

Demographic characteristics of the study sample are presented in **Table 1**. A total of 68 participants (28 girls) attended the study. Means of age, height, and weight of our sample are presented in **Table 1** representing that the mean age and BMI of boys and girls were identical. Moreover, most of the parents were at the medium level of financial status, and had college education.

3-2. Physical activity

Table 2 shows the mean and standard deviation of physical activity pattern, as well as the results of the gender differences. First, the results of Kolmogorov-Smirnov test showed that the data were not normally distributed (all $P<0.05$). Therefore, we used Mann-Withey U test for computing gender differences.

Table-1: Demographic Characteristics of Study Sample

Variables		Mean \pm SD	
Age (years)	Boy(n=40)	10.06 \pm 1.45	
	Girl(n=28)	10.36 \pm 1.63	
	Total(n=68)	10.22 \pm 1.55	
Height(cm)	Boy(n=40)	136.67 \pm 10.44	
	Girl(n=28)	135.49 \pm 9.07	
	Total(n=68)	135.88 \pm 10.11	
Weight(kg)	Boy(n=40)	35.41 \pm 6.17	
	Girl(n=28)	36.69 \pm 5.76	
	Total(n=68)	35.96 \pm 6.43	
BMI	Boy(n=40)	18.90 \pm 2.13	
	Girl(n=28)	19.61 \pm 1.69	
	Total(n=68)	19.23 \pm 1.90	
Parental Financial Status		N	Percent
Low		9	13%
Medium		53	78%
High		6	9%
Parental Education	High-School and less	15	22%
	College	53	78%

Table-2: Comparing the research variables among boys and girls

Variables	Mean \pm SD	Gender Differences	P Value
Sedentary Time%	Boy(n=40)	Mann Whitney U = 29936.00	0.364
	Girl(n=28)		
	Total(n=68)		
Light Physical Activity%	Boy(n=40)	Mann Whitney U = 29964.50	0.654
	Girl(n=28)		
	Total(n=68)		
MVPA%	Boy(n=40)	Mann Whitney U = 29852.50	0.005*
	Girl(n=28)		
	Total(n=68)		
Daily MVPA (min)	Boy(n=40)	Mann Whitney U = 29742.50	0.001*
	Girl(n=28)		
	Total(n=68)		
Physical Functioning	Boy(n=40)	Mann Whitney U = 29993.50	0.654
	Girl(n=28)		
	Total(n=68)		
Emotional Functioning	Boy(n=40)	Mann Whitney U = 29913.50	0.671
	Girl(n=28)		
	Total(n=68)		
Social Functioning	Boy(n=40)	Mann Whitney U = 29907.50	0.286
	Girl(n=28)		
	Total(n=68)		
School Functioning	Boy(n=40)	Mann Whitney U = 29967.50	0.957
	Girl(n=28)		
	Total(n=68)		
Global Score	Boy(n=40)	Mann Whitney U = 29638.50	0.601
	Girl(n=28)		
	Total(n=68)		

*P<0.01

Accelerometer data showed that the boys spent 76.44% and girls 75.92% of their total time in sedentary behaviours, and there was no significant gender difference ($P=0.364$). Boys' and girls' light physical activities took 17.22% and 18.96% of their total time, respectively, and no significant gender difference was observed ($P=0.654$). Total time of MVPA was 6.34% for boys and 5.12% for girls, and the gender difference was significant ($P=0.005$). On average, the daily time spent in MVPA was 40.64 minutes for boys and 32.65 minutes for girls, which is below the WHO guideline. In fact, 76.6% ($n=12$) of children fulfilled the guideline. Here, the boys engaged significantly more in MVPA per day than girls ($P=0.001$).

3-3. Health-related quality of life

Responses to health-related quality of life as well as the results of the gender differences are presented in **Table 2**. The results showed that both boys and girls had relatively low health-related quality of life in which there were no gender differences.

3-4. Bidirectional associations

Due to the fact that the data were not normally distributed, we used Spearman correlation test for computing bidirectional associations between research variables. The results showed that there were significant direct associations between MVPA and health-related quality of life ($P<0.001$). Moreover, there was a significant inverse association between sedentary behavior and health-related quality of life ($P<0.001$).

3-5. Linear regression

A linear regression analysis was carried out to examine whether gender, MVPA, and sedentary behavior can predict health-related quality of life among children with ADHD. The results revealed that gender significantly predicts health-related quality of life ($F = 4.58$, $p = 0.03$, Adjusted $R^2 = 0.08$, $\beta = 0.75$). And sedentary time%

inversely predicts health-related quality of life ($F = 2.81$, $p = 0.04$, Adjusted $R^2 = 0.03$, $\beta = 0.53$). Finally, daily MVPA can predict health-related quality of life ($F = 5.73$, $p = 0.02$, Adjusted $R^2 = 0.09$, $\beta = 0.13$).

4- DISCUSSION

Previous studies have shown that physical activity is directly associated with health-related quality of life among children with ADHD (9-10). However, they are based on self-report questionnaires, where its validity remains questionable. The present study was designed to investigate this issue among children with ADHD by the use of accelerometers to objectively assess physical activity. The results showed that boys spent 76.44% of the total time in sedentary behaviors, 17.22% in light physical activity, and 6.34% in MVPA. On average, the daily time spent in MVPA was 40.64 minutes for boys, which is below the WHO guidelines. On the other hand, girls spent 75.92% of their total time in sedentary behaviors, 18.96% in light physical activity, and 5.12% in MVPA. On average, the daily time spent in MVPA was 32.65 minutes for girls, which is below the WHO guidelines. Results of gender differences revealed that boys engaged significantly more in MVPA than girls. These results are in accordance with previous findings (22-26).

Regarding health-related quality of life, the results showed that the global health-related quality of life and all its components including physical, emotional, social, and school functioning were relatively low among children with ADHD. The present findings are in accordance with those of previous studies (9-10, 14-18), indicating low levels of health-related quality of life among children and adolescents with ADHD. This low level is quite understandable, because of their difficulties with motor and cognitive functions. Therefore, it is

necessary to adopt appropriate strategies to improve the perception of quality of life among this population. Furthermore, no significant gender differences were observed in regard to the health-related quality of life. These findings are not in accordance with those of previous studies showing that boys had relatively better perceived quality of life than girls (9-10). These discrepancies might be due to different prevention strategies adopted by parents and families among various study samples. The results of linear regression analysis showed that a greater frequency of physical activity may contribute to a higher health-related quality of life in children with ADHD. On the other hand, it has been shown that the higher sedentary time score contributes to lower health-related quality of life in children with ADHD. These findings are in accordance with those of previous studies indicating positive effects of physical activity on quality of life in children and adolescents with ADHD (9-10). Therefore, it can be stated that physical activity is related to improved quality of life in children with ADHD.

4-1. Strengths and Limitations of the study

Among the strengths of the present study is the use of accelerometers for objectively assessing the levels of physical activity and sedentary time in children with ADHD which made it possible to avoid self-reporting bias. Furthermore, we measured physical activity and health-related quality of life among both male and female children with ADHD which made it possible to find out gender differences. Among the limitations of the present study is the relatively small sample size. Further studies with larger sample sizes are needed to increase the reliability of data.

5- CONCLUSIONS

This cross-sectional study revealed that our pediatric participants with ADHD

did not meet the recommended 60 minutes of MVPA per day, where boys engaged significantly more in daily MVPA than their female counterparts. Our sample showed relatively low health-related quality of life. Moreover, physical activity was found to be related to the improved quality of life. These findings, together, indicate that physical activity and quality of life are critical concerns for children with ADHD. Accordingly, it is necessary to adopt appropriate strategies to develop more active lifestyles among this population.

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