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Research Paper: Relationships between Physical Activity and Balance Performance among Children with Autism Spectrum Disorder

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Abstract

It has been shown that physical activity (PA) is related to motor proficiency in children. Nevertheless, relationships between PA and balance performance among children with autism spectrum disorders (ASD) has been rarely examined. Hence, the aim of this study was to examine the relationships between PA and static and dynamic balance performance among children with ASD. The method used in this study was correlational. Eighty children with ASD (range age between 8 to 14 years old, average 11.51 years old) attended in special schools participated in this study. PA was measured using Physical Activity Questionnaire for Older Children (PAQ-C). Static and dynamic balance tests were used to measure balance performance. Pearson correlation test and regression analysis were used for data analysis. Children with ASD had low amount of PA and balance performance. PA was significantly and directly associated with static and dynamic balance performance. In addition, PA has significantly and directly predicted both static and dynamic balance performance. PA plays a very important role in the motor proficiency in children with ASD. Hence, there is a need for targeted strategies and interventions to increase the level of PA in this population.

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1. Introduction

Autism spectrum disorder (ASD) is considered as a common disability in children. Children with ASD suffers from deficits in peer relationships, social skills, and stereotyped behaviors. ASD is also associated with a high rate of psychiatric problems such as mood and anxiety disorders, and cigarette and substance use disorders (Birchwood et al., 2012; Goulardins et al., 2017). Furthermore, children with ASD suffer from poor motor skills performance (American Psychiatric Association, 2000). Research has shown that children with ASD show poor motor proficiency such as locomotor, object control, and gross motor skills (Aqdassi et al., 2021; Gkotzia et al., 2017; Ketcheson et al., 2018; Lourenco et al., 2020; Mohd Nordin et al., 2021). Evidence suggested that deficiencies in information processing, cognitive motor planning, and timing and sequencing of muscle activity patterns might be underlying mechanisms for poor motor skills performance in children with ASD (Aqdassi et al., 2021; Gkotzia et al., 2017; Ketcheson et al., 2018; Lourenco et al., 2020; Mohd Nordin et al., 2021). However, there might be some factors that can positively affect poor performances of children with ASD in motor skills. One influential factor might be participating in regular physical activity (PA).

PA is defined as any voluntary bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity encompasses all activities, at any intensity, performed during any time of day or night. It includes both exercise and incidental activity integrated into daily routine. Several studies have shown that participating in regular PA have numerous benefits for physical and mental health in all age categories, including children (Caspersen et al., 1985; Thivel et al., 2018; Ghorbani et al., 2021). These benefits included, but not limited to, improvement in brain health, helping in weight management, reduction of the risk of disease, strengthening bones and muscles, improving quality of life, and improving ability to do everyday activities (Abdoshahi et al., 2022; Basterfield et al., 2021; Dana & Christodoulides, 2019; Dana et al., 2021; Hashemi Motlagh et al., 2022; Gholami & Rostami, 2021; Ghorbani et al., 2020, 2021; Lahart et al., 2019; Mohammad Gholinejad et al., 2019; Mohammadi et al., 2022; Naeimikia et al., 2018; Naeimikia & Gholami, 2018, 2020; Schwartz et al., 2019; Tremblay et al., 2011; Wafa et al., 2016; Yaali et al., 2018; Zhang et al., 2021). As such, world health organization (WHO) recommend that children and adolescents aged 7 to 18 engage in at least 60 minutes of moderate-to-vigorous PA (MVPA) across per day (Bull et al., 2020). However, several studies have shown that children with ASD do not meet WHO recommendation of 60 minutes of MVPA per day (Chu et al., 2020; Haegele et al., 2018; Ketcheson et al., 2018; Nguyen et al., 2021; Pan et al., 2016; Stanish et al., 2017). A recent review found that only 42% of the children with ASD aged 6-17 years met the PA guidelines of at least 60 min of daily MVPA (Liang et al. 2020). Rostami Haji Abadi et al., (2021) conducted a meta-analysis and showed that children with ASD engage 30 min lower in daily MVPA than typically developing children. Inactivity among children with ASD is largely because of their personal and physical limitations. In fact, inactivity of individuals with ASD predisposes them for its negative consequences such as enhancing the risk of chronic diseases such as type 2 diabetes,

cancer and cardiovascular disease (Kinne et al., 2004; Rimmer et al., 2007).

In addition, some studies have shown that higher amount of PA will lead to better motor proficiency (e.g., balance performance) in children (Balaban, 2018; Carvalho et al., 2021; Jones et al., 2021; Wrotniakm et al., 2006). However, this issue has not been investigated in children with ASD. Thus, the aim of this study was to examine the associations between PA with balance performance among children with ASD.

2. Methods

2.1 Participants

This study applied a correlational approach. Participations were 80 children with ASD (rage age between 8 to 14 years old, average 11.51 years old) attended in special schools. They have voluntarily participated in this study and their parents gave informed consents. This study was conducted in accordance with ethical guidelines of declaration of Helsinki. All children were already diagnosed as ASD, however, in this study, an experienced psychologist measured the symptoms of ASD in children using the American Psychiatric Association's (2000) *Diagnostic and Statistical Manual of Mental Disorders Text Revision. 4th* ed, too.

2.2 Measures

2.2.1 Physical Activity

We measured PA using Physical Activity Questionnaire for Older Children (PAQ-C). The PAQ-C is a self-administered, 7-day recall instrument. It assesses general levels of PA throughout the elementary school year for students approximately 8 to 14 years of age. The PAQ-C can be administered in a classroom setting and provides a summary physical activity score derived from nine items, each scored on a 5-point scale (Crocker et al., 1997). In this study, we measured its validity with a Cronbach's alpha coefficient of 0.90.

2.2.2 Balance Performance

In this study, both static and dynamic balance performances were assessed. Static balance performance was measured using Warrior III Pose task. Children were asked to balance on the right foot while lifting the left foot off the ground and holding the hands above the head. The purpose of this test was to maintain static balance as much as possible. The time each child was at balance was measured by a digital stopwatch. The stopwatch started in a balanced position and stopped when an error occurred, such as when the left hand or foot hit the ground. In addition, to measure dynamic balance, we asked children to walk on a balancing stick with a length of 4 meters and a width and height of 10 cm. In this way, at the beginning of the movement, the participant was placed at the beginning of the balance stick and started to move with the "go" sign. After walking, he/she put his foot on the ground and came back. The criterion of measurement was the time (in seconds) that a person gains balance on the stick once going back and forth. This test was performed three times and its average was recorded as the final score of the participant for his/her dynamic balance performance.

2.3 Data analysis

Mean and standard deviation were utilized for describing the research variables including PA and both static and dynamic balance. We used Kolmogorov-Smirnov test for measuring the normality of data. Then, we used Pearson correlation test to evaluate the associations between PA and both static and dynamic balance. Finally, regression analysis was applied to investigate whether PA predicts static and dynamic balance performance in children with ASD. SPSS software version 26 was used to analyze the data. P-value was set at $P < 0.05$.

3. Results

3.1 Descriptive Findings

Table 1 shows the mean and standard deviations and relationships between PA and static and dynamic balance performances. In general, the level of PA was low inechildren with ASD. In addition, children with ASD had low scores in both static and dynamic balance performances. Results of Kolmogorov-Smirnov tests showed that our data were normally distributed (all P>0.05).

Table 1

Mean, standard deviation and relation between research variables

Variables	*M*	*SD*	1	2	3
1.Physical Activity	1.47	0.93	-		
2.Static Balance	15.84	10.89	0.58***	-	
3.Dynamic Balance	14.63	5.71	0.49***	0.63***	-

Results demonstrated that PA was significantly related to static balance performance among children with ASD (p=0.000). Moreover, PA was significantly related to dynamic balance performance among children with ASD (p=0.000).

3.2 Prediction of Balance by PA

Table 2 shows the results of regression analysis for prediction of balance performance by PA. Results revealed that PA has directly predicted static balance performance among children with ASD (p=0.000). In addition, PA has directly predicted dynamic balance performance among children with ASD (p=0.000).

Table 2

The results of multiple regression analysis for predicting balance performance by PA

criterion variable	B	SE	Beta	T	Sig	Tolerance	VIF
Static Balance	1.861	0.073	0.582	4.967	0.000		
Dynamic Balance	-0.165	0.051	0.493	3.415	0.000	0.297	3.413
		R=0.508	R^2=0.285	F=8.694	P=≤0.001		
		R=0.465	R^2=0.216	F=6.128	P=≤0.001		

4. Discussion

It is well documented that PA has direct relationship with balance performance in children (Balaban, 2018; Carvalho et al., 2021; Jones et al., 2021; Wrotniakm et al., 2006). Nonetheless, relationships between PA and balance performance among children in special groups such as ASD have been not examined. Therefore, the aim of this study was to examine the relationships between PA and static and dynamic balance performance among children with ASD. First of all, it has been found that our sample showed low level of PA. These results confirm those of previous findings (Chu et al., 2020; Haegele et al., 2018; Ketcheson et al., 2018; Nguyen et al., 2021; Pan et al., 2016; Stanish et al., 2017), indicating that children with ASD engage in less PA than typically developing children. Why children with ASD engage in less PA is not well understood, nevertheless, it may be related to social interaction impairment, motor skill difficulties, and physical barriers in individuals with ASD (Rostami Haji Abadi et al., 2021). In addition, both static and dynamic balance performances were almost weak in our sample, which are consistent with previous findings (Aqdassi et al., 2021; Gkotzia et al., 2017; Ketcheson et al., 2018; Lourenco et al., 2020; Mohd Nordin et al., 2021), indicating low motor proficiency in children with ASD. 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 PA and balance performance among this population.

Moreover, it has been found that PA has positive relationships with both static and dynamic balance performance among children with ASD. Furthermore, the results of regression analysis showed that higher amount of PA may predict higher scores of both static and dynamic balances in children with ASD. The present findings are in accordance with previous studies on typically developing children (Balaban, 2018; Carvalho et al., 2021; Jones et al., 2021; Wrotniakm et al., 2006), indicating the positive role played by PA in improving motor proficiency among children with ASD. Therefore, it can be stated that children who engage in more PA have more ideal body compared with those who engage in less PA. Balance performance takes place mostly in lower part of body and it seems that participating in PA leads to strengthening and enduring the muscles, including muscles of lower limbs, in children (Abdoshahi et al., 2022; Basterfield et al., 2021; Dana & Christodoulides, 2019; Dana et al., 2021; Hashemi Motlagh et al., 2022; Gholami & Rostami, 2021; Ghorbani et al., 2020, 2021; Lahart et al., 2019). During childhood, participating in PA gives optimal contribution in coordination ability and sufficient motor experiences (Baniasadi et al., 2019; Chaharbaghi et al., 2022; Mohammad Gholinejad et al., 2019; Mohammadi et al., 2022; Naeimikia et al., 2018; Naeimikia & Gholami, 2018, 2020; Schwartz et al., 2019; Tremblay et al., 2011; Wafa et al., 2016; Yaali et al., 2018; Zhang et al., 2021). Thus, it can be expected that improving PA in children results in better balance performance.

The fact that in this study PA was measured using a questionnaire which may has self-reporting bias (Ghorbani et al., 2021) can be considered as a limitation. In addition, sample size of this study was relatively small. Thus, future studies should address these limitations.

5. Conclusion

To conclude, in this study, it has been found that children with ASD have low amount of PA and motor proficiency which make it necessary to adopt appropriate strategies and interventions to increase PA and motor proficiency among this population. As the results of this study indicated, increasing PA may act as a proper strategy for improving motor proficiency in children with AS. Future studies should focus on findings other strategies that might increase the level of PA and motor proficiency in children with ASD.

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Conflict of interest

The Authors declare 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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