Research in Autism Spectrum Disorders 33 (2017) 21–28

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

journal homepage: http://ees.elsevier.com/RASD/default.asp

Cognitive and social functioning are connected to physical activity behavior in children with autism spectrum disorder

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ARTICLE INFO

Article history:
Received 23 February 2016
Received in revised form 1 October 2016
Accepted 5 October 2016
Number of reviews completed is 2
Available online xxx

Keywords:
Autism characteristics
Social skills
Accelerometery
Sedentary activity
Executive function

ABSTRACT

Background: For the first time this study aimed to examine the association of cognitive and social function with the physical activity behavior in a sample of children with autism spectrum disorder (ASD).
Method: Sixty eight children with ASD aged 6–16 years underwent an objective assessment of physical activity and cognitive flexibility. Parents were also asked to rate the social profile for their children.
Results: The results showed that age, gender and cognitive flexibility are associated with moderate-to-vigorous physical activity (MVPA). Analysis also showed that parent education and social function were associated with continuous minutes of physical activity.
Conclusions: These preliminary findings indicated that children with ASD who had poor cognitive or social skills would be less physically active and more sedentary. Moreover, the results highlighted the age and gender as possible risk factors of physical inactivity in children with ASD.

1. Introduction

Children with autism spectrum disorder (ASD) have significant impairments in critical areas of development including motor development and physical activity behavior (Berkeley, Zittel, Pitney, & Nichols, 2001; Memari and Ghaheri et al., 2013; Memari and Ghanouni et al., 2013; Memari and Ziaee et al., 2013). This is in addition to core features of ASD including impairments in social communication interactions, repetitive behaviors and restricted interests. Limited rate of participation in physical activity (PA) and recreational programs have led to inactivity (Pan, 2009) and consequently a high rate of obesity (one in each three children) in ASD (Curtin, Anderson, Must, & Bandini, 2010; Memari, Ziaee, Mirfazeli, & Kordi, 2012a; Memari, Kordi, Ziaee, Mirfazeli, & Setoodeh, 2012b). Furthermore children with ASD may miss out on the benefits of physical activity particularly positive psychological and social benefits (Hassmén, Koivula, & Uutela, 2000). Indeed regular physical activity enhances motor skills, reduces negative emotions and plays an important role in the maintenance of a healthy life (Houwen, Hartman, & Visscher, 2009). Also physically active individuals experience less anxiety, depression, stress and anger (all relevant to ASD) and they have more feelings of coherence and social interaction (Ströhle, 2009). It is therefore important

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http://dx.doi.org/10.1016/j.rasd.2016.10.001
1750-9467/

and relevant to understand whether autism characteristics (i.e., cognitive or social function) are associated with certain patterns of PA behavior commonly seen in children with ASD.

Previous data revealed that PA links to cognitive function (Kramer & Hillman, 2006). For instance examining typically developing (TD) children showed that physical activity is positively associated with executive function (EF) skills such as cognitive flexibility and planning (Themanson, Pontifex, & Hillman, 2008). There are also sufficient theoretical grounds to expect a link between EF skills and PA. Temporal Self-Regulation theory implies that there is a reciprocal relation between physical activity and EF (Hall & Fong, 2015); and self regulation capacities could mediate the association between health behaviors (e.g., PA) and EF skills. Voss et al., (2013) showed that a number of brain regions involved in both self regulation skills and EF abilities including prefrontal cortex, cingulate and temporal cortices as well as subcortical brain networks are activated in relation to physical activity. In other words, children with greater self-regulation capacity (i.e., who can flexibly maintain goals over a long period of time) would more frequently participate in physical activities (Todd, Reid, & Butler-Kisber, 2010). Thus since children with ASD have trouble adapting to alterations in routine, we expected that the cognitive inflexibility in individuals with ASD affects their physical activity behavior that usually involves complex stimuli and interacting with others (Sorensen & Zarrett, 2014). To examine other determinant of physical activity in ASD, social function has also been emphasized in recent studies (MacDonald, Lord, & Ulrich, 2014; Pan, 2009). There is both empirical and theoretical support for the assumption that PA behavior is associated with social skills of children with ASD. Previous studies addressed that social support or social engagement could influence physical activity of children with ASD (Pan & Frey, 2005). Furthermore Memari et al. (2015) showed that during a collaborative physical activity, children with ASD were less likely to initiate social interactions with their peers. Indeed social dysfunction in addition to communication and motor impairments in ASD may decrease the opportunities for participation and interactions during physical activities (Memari and Ghaheri et al., 2013; Memari and Ghanouni et al., 2013; Memari and Ziaee et al., 2013). This impression is confirmed by the anecdotal reports that children with ASD are discouraged to participate in activities such as group walks, and team sports or games (Pan, 2009). Keeping in the mind that the most effective forms of physical activities are those with social qualities, low motivation of children with ASD to such activities can bring them to the risk of inactivity. The self-determination theory (SDT) may partially explain the connection of social skills and physical activity (Wehmeyer & Garner, 2003). SDT implies that behavior is a function of qualitatively different social-environmental (e.g., family support), and individual variables (e.g., motivation). In the case of ASD, there are several impairments in social and environmental factors that can in turn limit the opportunities of children for participating and learning in PA setting (Sebire, Jago, Fox, Edwards, & Thompson, 2013; Schenkelberg, Rosenkranz, Milliken, & Dzewaltowski, 2015).

Besides social and cognitive factors, epidemiological variables such as age and gender may contribute to level of PA in ASD. Memari and Ghaheri et al. (2013), Memari and Ghanouni et al. (2013), Memari and Ziaee et al. (2013) suggested that older children with ASD have lower opportunity for PA participation and a lower level of motivation to engage in complex PA behavior. As an alternative explanation, increase focus on academics, and also puberty and the following adolescent period are recognized as possible factors particularly lead to a reduction in physical activity as children get older. A further recent observation revealed that gender would influence the level of PA in children with ASD (Memari, et al., 2015), which could be due to significant differences in PA experiences and motor skills between boys and girls with ASD (Hartley & Sikora, 2009). Indeed girls with ASD compared to boys are more inclined towards sedentary activities that could be also described by limitations to access social opportunities (Memari & Ghaheri, 2014). Thus in this study we included age and gender as possible covariates in models designed to identify associations between physical activity and social or cognitive functioning in children with ASD.

Finally in this paper we used a method (i.e., accelerometery) to overcome the limitations of previous studies on physical activity assessment in ASD. The reliance on self-report or proxy-report data which were subject to recall bias and social desirability could significantly limit the utility of such reports in children with developmental disabilities including ASD (Batey et al., 2014). However accelerometers provided an objective measure of PA and a less biased estimate of PA behavior with a low degree of error and high inter-observer agreement. Accelerometers also provide an estimate of spontaneous bouts of activities, including structured or unstructured activities, which were difficult to record by questionnaires (Bandini et al., 2013). Previous studies showed that accelerometery data obtained from children participants could truly show the associations among environmental, social and individual factors with the overall level of PA in children (Bandini et al., 2013; Batey et al., 2014). To our best knowledge there has been no study on the association of PA with cognitive flexibility and social skills in children with ASD. We used triaxial accelerometers to in a large sample of children with ASD and examine the physical activity patterns and their associations with the cognitive and social function. We then hypothesized that social and cognitive abilities are positively associated with physical activity variables in children with ASD.

2. Methods

2.1. Participants

A sample of 68 children (42 boys and 26 girls) aged 6–16 years (Mean = 9.8, SD = 2.0) was selected from four public schools in Tehran (Table 1). These schools are located in different city regions and devoted to the education of students with autism (school size = 46-68). We visited all these schools and announced the study through the posters, letters and meetings then used the probability-proportional-to-size selection for sampling. It could present a probability (i.e. representative) sample.