



HHS Public Access

Author manuscript

J Phys Act Health. Author manuscript; available in PMC 2016 April 28.

Published in final edited form as:

J Phys Act Health. 2015 April ; 12(4): 529–534. doi:10.1123/jpah.2013-0271.

Barriers to physical activity in children with autism spectrum disorders: Relationship to physical activity and screen time

A. Must,

Department Public Health & Community Medicine, Tufts University School of Medicine, Boston, MA, USA

S. M. Phillips,

Department Public Health & Community Medicine, Tufts University School of Medicine, Boston, MA, USA

Curtin Carol, and

Eunice Kennedy Shriver Center, University of Massachusetts Medical School, Charlestown, MA, USA

L. G. Bandini

Department Public Health & Community Medicine, Tufts University School of Medicine, Eunice Kennedy Shriver Center, University of Massachusetts Medical School, Charlestown, MA, USA

Abstract

Background—Individual, social, and community barriers to physical activity (PA) experienced by children with autism spectrum disorder (ASD) make PA participation more difficult **and may contribute to increased screen time**.

Methods: We compared the prevalence of parent-reported barriers to PA among 58 **typically developing** (TD) children and 53 children with an ASD, 3-11 years, and assessed the association between barriers and PA participation and screen time among children with ASD.

Results—Parents of children with ASD reported significantly more barriers than parents of TD children. Based on parent-report, 60% of children with ASD required too much supervision compared to no TD children ($p<0.001$). Parents of children with ASD were more likely to report that adults lack skills needed to include their child (58%), that their child has few friends (45%), and that other children exclude their child (23%). The number of parent-reported barriers to PA was inversely correlated with the hours spent in PA per year ($r=-0.27$, $p=0.05$) and positively related to total screen time ($r=0.32$, $p<0.03$).

Conclusions—These findings underscore the need for community-based PA programs designed to meet the special requirements of this population and policies that compel schools and other government-supported organizations for inclusion and/or targeted programming.

Keywords

disability; youth; health behavior; special needs populations

Introduction

The majority of children in the United States do not meet the current national objectives for physical activity.¹ There are many barriers to physical activity that may limit opportunities for both structured and unstructured exercise. Limited access, the quality and location of resources for physical activity, opportunities for play and sports in school, an absence of parental encouragement, and competing demands for family and free time after school and on weekends are among the most prevalent obstacles.^{2,3}

Among children with developmental disabilities, barriers to physical activity are more numerous and appear to be more complex than those faced by typically developing (TD) children. In particular, the social and behavioral impairments experienced by children with autism spectrum disorder (ASD) appear to make participation in structured and unstructured forms of physical activity more difficult. Prior research using accelerometry has shown that children with ASD fail to meet the recommended amount of sustained bouts of moderate and vigorous physical activity (MVPA), especially in older children.^{4,5} While some researchers have found significant differences in the levels of objectively measured physical activity between children with ASD and their TD peers,⁶ we found similar estimates of daily overall physical activity levels based on accelerometry between children with ASD and TD children.⁷ Using questionnaire-based measures of PA, however, parents have reported that children with ASD participated in fewer types of activities than their TD counterparts.^{7,8}

Assessing barriers to physical activity is a complex, multifaceted process. Guided by the social-ecological model,^{9,10} barriers to physical activity can be understood in multiple levels of influence that include **child-level factors (e.g., behavioral problems, poor motor skills)**, **peer-and family-level factors (e.g., time constraints, transportation)**, **community-level factors (e.g., access to facilities and programs)**, and public policy and other societal-level factors that affect physical activity participation. Parents of children with ASD have reported that their child's **limited** motor, social, and communication skills are child-level barriers to participation in PA after school.¹¹ Other peer, family, and community barriers cited by children with ASD include the absence of a same-age exercise partner, competing parental commitments, lack of transportation, and limited opportunities to participate in PA programs.¹²

Research has documented that children with ASD spend significantly more time in sedentary pursuits compared to their TD peers.¹³⁻¹⁶ A major component of sedentary behavior is time spent watching television, movies, and playing video games, often referred to as 'screen time'. Engagement with electronic screen media and technology after school is the most common child-level reason expressed by children with ASD themselves for not engaging in MVPA.¹² This finding was confirmed in an interview study conducted among parents of children with ASD.¹¹ The combination of increased availability and use of electronic media, decreased levels of physical activity, and an increase in the prevalence of obesity has led to concerns that sedentary behaviors may be displacing more physically active ones in children.

Although several studies have documented the barriers to PA experienced by children and families of children with ASD, few have systematically explored child/family, social, and community barriers **to PA** in relation to reported levels of PA and screen time, nor have they compared them to those encountered by TD children. The goal of this study was to compare the prevalence of child/family, social, and community barriers between children with ASD and TD children. We also sought to assess the cross-sectional association of parent-perceived barriers to physical activity with parent-reported levels of PA and total screen time among children with ASD. We hypothesized that children with ASD would experience more child/family, social, and community barriers than TD children. We further expected that among children with ASD, the number of barriers experienced overall would be inversely related PA levels and directly related to total screen time.

Methods

The Children's Activity and Meal Patterns Study (CHAMPS), a cross-sectional study conducted between January 2007 and December 2008, enrolled children with ASD and TD children ages 3-11 years. Details of the recruitment and inclusion criteria have been previously reported.⁷ Participants were recruited via outreach to local schools and community programs, on-line postings, existing participant databases at the University of Massachusetts Medical School-Shriver Center, autism support organizations, and via the Interactive Autism Network (IAN) Project at the Kennedy Krieger Institute in Baltimore, Maryland. Our recruitment efforts were designed to frequency-match the two groups in order to achieve balance by age and sex. The diagnosis of ASD was verified via the Autism Diagnostic Interview-Revised (ADI-R),¹⁷ which was administered by research-reliable clinicians to the parents of children who indicated their child had ASD. All participants met the cut-off for diagnosis on this instrument. The Vineland Adaptive Behavior Scales (2nd edition)¹⁸ was used to characterize adaptive skills (Adaptive Behavior Composite), and we administered the Differential Abilities Scale (original 1990 version)¹⁹ to assess the cognitive abilities of the children with ASD. The study was approved by the Institutional Review Board at the University of Massachusetts Medical School.

Assessment of Barriers to Physical Activity

Parents completed a questionnaire that queried **their** perceived **child/family**, social, and community barriers to their child's participation in physical activity. The survey instrument was developed by our interdisciplinary research team comprising individuals with expertise in nutrition, social work, epidemiology, survey design, occupational and physical therapy, physical activity and behavioral science. The specific questions included on the questionnaire are detailed in Table 2. We calculated the total number of barriers in each category, as well as the total number of barriers across all of the categories.

Assessment of PA and Screen Time

A parent-completed questionnaire designed to determine a child's participation in organized and unstructured physical activities was used to estimate both the total number of different activities a child participated in each year and the number of hours spent in physical activity each year.⁷ Parents were asked to indicate the types and frequency of physical activities their

children engaged in over the previous 12 months (17 activities total). The reliability of these questions has been established.⁷

To determine each child's level of screen time, parents completed a questionnaire developed by our research team. Parents were asked, "Over the past month, on average, how many HOURS PER WEEK did your child spend sitting (or lying down) engaged in the following activities?" The screen-time activities queried included television viewing, video games, and computer time (including computers used for homework). The number of hours spent in each activity on weekdays and on weekend days was queried separately. We calculated average hours per weekday and per weekend day for each activity by dividing the reported hours in each activity by 5 and 2 days, respectively. Television, video game, and computer time were summed for total screen time. Only participants with complete information on all three components of screen viewing were included in the summary measure; we also assessed each of these three screen time components separately. The reliability of these questions has also been established.¹⁶

Statistical Analysis

Using t-tests for continuous variables and chi-square or Fisher exact tests for categorical variables, we determined whether TD children and children with ASD differed relative to the following variables: age, sex, race (white, non-white), parental education (earned a college degree or not), siblings (0 vs. 1), and child weight status (underweight, normal weight, or overweight). We also compared the prevalence of **parent-reported barriers** between children with ASD and TD children **by t-test**. Because the prevalence of reported barriers in TD children was found to be very low, subsequent analyses were restricted to children with ASD. We used correlation analyses to assess the relationship between **PA participation** and screen time and barriers to PA; Spearman correlations were used for the subcategories of total barriers (child/family, social, and community) where the distributions showed large departures from normality and Pearson correlations were used for all other variables. T-test and linear regression analyses were used to assess the relationship between PA participation, screen time, and total barriers to PA, with the latter analyses to assess the influence of adjusting for age and sex. All analyses were conducted in SAS Version 9.2 (SAS Institute, Cary, NC) and IBM SPSS Statistics Version 21. We considered statistical significance where $p < 0.05$, and borderline significance where $p = 0.05$ and < 0.10 . We elected not to adjust for multiple comparisons because as an exploratory investigation, we wanted to identify associations for further study.

Results

Fifty-three children with ASD and 58 TD children completed the study. None of the socio-demographic variables differed between children with ASD and TD children, except that TD children were more likely **to have no siblings** (Table 1).

Comparison of Parent-Reported Barriers between children with ASD and TD children

We found statistically significant differences in the number of child/family, social, and community barriers to PA between children with ASD and TD children for nearly every

barrier question asked of the parents (Table 2). About 51% of parents of children with ASD reported 6 or more total barriers to PA, while none of the parents of TD children reported the number of barriers at this level. The most commonly reported barrier to PA among TD children was family time constraints. Among child/family barriers, 60% of parents of children with ASD reported that their child required too much supervision, 53% reported that their child had behavioral problems, and 42% reported that their child had poor motor skills. Overall, 85% of parents of children with ASD reported 2 or more child/family barriers to PA. A high prevalence of social barriers was also observed. Sixty-two percent of parents of children with ASD reported 2 or more social barriers; difficulties with social skills was reported most frequently (77%), followed by the perception that adults who supervise activities lacked the skills they need to include their child (59%). Among community barriers, 32% of parents of children with ASD reported lack of opportunities and 22% reported that opportunities were too costly. The median number of barriers in each category was also significantly different between the groups, with a greater number of barriers reported for children with ASD. Because the majority of barriers reported were only among children with ASD, the analyses that follow are limited only to those children.

Correlates of Barriers to PA in Children with ASD

Among children with ASD, there was a significant positive correlation between age and both the total number of barriers reported (Pearson's $r=0.31$, $p=0.03$) and the total number of social barriers reported (Spearman's $r=0.29$, $p=0.04$). We observed no significant gender differences in the total number of barriers reported or by category (all $p>0.05$). No significant relationship between parental education level or only child status and the number of barriers reported was identified (all $p > 0.05$).

Question-By-Question Analysis of Barriers in Association with PA and Screen Time among children with ASD

Children with ASD whose parents **indicated**: “Sports are too over-stimulating for my child” participated in significantly fewer total activities than parents who answered ‘No’ to that question (5.6 activities vs. 7.4 activities, $p<0.05$). Children with ASD whose parents answered ‘Yes’ to the question, “It is difficult to make arrangements for my child” had significantly higher screen time on weekdays (3.7 hours vs. 2.0 hours, $p < 0.01$) and weekends (5.2 hours vs. 3.4 hours, $p<0.05$) compared to children whose parents answered ‘No’ to that question. Among the social barriers queried, children with ASD whose parents answered ‘Yes’ to the question, “Adults lack the skills they need to include my child” had significantly higher screen time on weekdays (3.1 hours vs. 1.9 hours, $p<0.05$) compared to parents who answered ‘no’ to that question. Finally, children with ASD whose parents indicated, “Children participating in activities exclude my child” **engaged** in significantly fewer total activities (5.5 activities vs. 7.4 activities, $p < 0.05$) and PA hours/year (119 hours vs. 169 hours, $p<0.05$); these children also had more screen time on weekends (5.3 hours vs. 3.6 hours, $p=0.05$) compared to children whose parents did not feel that their child was excluded by other children. When these analyses were adjusted for age and sex in linear regression models, the results were essentially unchanged.

Relationship between Barriers to PA and Questionnaire-based measures of PA and Screen Time among Children with ASD

The total number of barriers reported was inversely correlated with the number of PA hours per year ($r=-0.27$, $p=0.05$), as was the total number of types of activities per year ($r=-0.24$, $p=0.08$), although this was of borderline statistical significance (Table 3). The total number of barriers reported was directly related to total weekly screen time ($r=0.32$, $p=0.03$) and weekday screen time ($r=0.32$, $p=0.03$). There was no significant relationship between the total number of barriers reported and weekend screen time. Results were virtually unchanged by adjustment for age and sex.

We observed no significant correlations among family, community, or social barriers and PA hours per year, or among community and social barriers and total activities per year (all $p>0.05$). There was a correlation of borderline statistical significance between the number of family barriers reported and the total number of activities per year (Spearman's $r=-0.25$, $p=0.07$).

The number of social barriers reported was positively correlated with weekday and weekend TV time (Spearman $r=0.34$ and 0.40 , respectively, $p<0.01$) and with weekend screen time (Pearson $r=0.34$, $p=0.02$). The correlation between the number of social barriers and weekday screen time was of borderline significance (Pearson $r=0.27$, $p=0.07$). The number of community barriers reported was positively correlated with video game time on weekdays and weekends (Spearman $r=0.36$ and 0.35 , respectively, $p=0.01$). The number of child/family barriers was not related to weekday or weekend screen time ($p>0.05$).

Discussion

We hypothesized that parents of children with ASD would report more barriers to PA than parents of their TD peers, and this hypothesis was supported. For children with ASD, we found significantly higher rates for 13 of the 17 child/family, social, and community level barriers queried. Importantly, the only barriers where the rates for the two groups were similar were for family time constraints, lack of available transportation, and neighborhood safety. We also hypothesized that the number of barriers to PA reported would be inversely related to levels of PA **participation** measured by questionnaire and positively related to the level of screen time. Among children with ASD, we found some evidence of a relationship between barriers to physical activity and **participation in physical activity**. Barriers to PA were positively related to levels of screen time behavior in children with ASD for several of the variables examined.

Among the child/family level barriers that were queried, poor motor skills, behavior and learning problems, and the need for supervision were frequently cited as barriers to physical activity in our sample of children with ASD. Obrusnikova et al. (2011) assessed both barriers and facilitators to after-school participation in MVPA using the Photovoice method in 14 children with ASD. An interest in sedentary activities, particularly those involving technology, was the most frequently cited barrier to MVPA after school.¹² The authors did note that for some participants, engagement with electronic screen media served as a facilitator of physical activity, such as the use of a Nintendo Wii™. In our sample, difficulty

with social skills, limited friendships, and the lack of ability to accommodate the needs of children among adults who direct activities were highly cited as PA barriers. These findings were consistent with those of Obrusnikova et al. (2012) who conducted a similar assessment among 103 parents of children with ASD ages 8-14 years, and reported that the lack of a peer exercise partner, parental time constraints, and transportation as common interpersonal barriers to activity.¹¹ Many of the barriers most frequently reported in our analysis of younger children were also mentioned by the sample of parents interviewed by Obrusnikova et al.

Other investigators have related various measures of physical activity to parent-perceived facilitators and barriers. Obrusnikova et al.¹² found that participants with ASD who met the recommended 60 min of MVPA daily based on accelerometry generally cited more facilitators of than barriers to MVPA. In contrast, participants who never met the recommendation cited similar numbers of barriers and facilitators.¹² Pan et al (2011) focused on activity levels during PE class and found that among children with ASD, PA during school PE was positively related to their interactions with their peers, and MVPA was associated with the physical environment (indoor, outdoor, or a combination) and instructor-related characteristics, such as gender and specialized training in physical education.²⁶ **Based on parent interviews**, LaVesser et al. (2011) identified difficult behaviors among young children with ASD as a common reason for non-participation in this population rather than limited opportunity for PA. They speculated that child behavior problems may lead to increased parental stress, which in turn may affect child participation.⁸ Despite the differences in age group studied, the variety of PA measures, and wide ranging sample sizes, these studies generally point to social factors as important barriers to PA.

The total number of social barriers reported was positively related to television time and screen time on weekdays and weekend days. Taken together, these findings are in broad agreement with other studies that have suggested that children and youth with disabilities, including ASD, spend substantial after-school and weekend time using electronic media and less time engaged in other leisure, recreational, or physical activities.²⁰⁻²² Pan et al. (2005) observed that sedentary pursuits and youth PA levels were negatively correlated (-0.47 , $P < 0.05$) and accounted for 13% of the variance in youth PA levels.²³ The finding that social barriers, but not child/family level barriers, were associated with screen time may reflect the use of electronic media by parents as a way to expose their child with ASD to social interactions indirectly (A. Must, unpublished observations). Although this population has been noted to exhibit preference for electronic media,^{24,25} these differences may also reflect the physical activity barriers reported by us here. In addition other constraints, including children's difficulties with motor skills and motor planning, the high costs of programming, lack of facilities, and children's lack of confidence and perceived competence in physical domains may explain high levels of screen time in this population.²⁰⁻²²

The lack of association between several of the individual barriers with physical activity is not surprising. Parents may identify barriers but successfully work to overcome them or to find other ways to help their offspring be active. In addition, the physical activity information reflects the prior year experience; the barriers reported may have been influenced by recent events, which would lead to misclassification.

The magnitude of the correlations between physical activity or screen time and parent-reported barriers was only modest, and suggests other factors influence activity patterns in these young people. Other factors that influence physical activity patterns, not considered here, include child preference, parent physical activity patterns, and strategies that overcome barriers. Additionally, the reporting period of the prior year for physical activity may have been challenging for some parents, particularly for seasonal activities, and contributed to measurement error. Similarly, other determinants of screen time include child preference, presence of a television in the child's bedroom, and household rules.

The availability of physical and community resources have been shown to facilitate engagement in PA in the general population.²⁷ The lack of availability cited by parents in our study and other studies identifies an area where policy interventions and specialized programming may help to increase participation in PA. In the U.S., some positive trends are noteworthy. In 2013, the U.S. Department of Education issued guidance to clarify schools' legal obligations to provide students with disabilities an equal opportunity to participate in after-school athletics and clubs.²⁸ In addition, also in 2013, the second annual "Inclusion Forum" held by the National Collegiate Athletic Association urged campus leaders to evolve school policies to be more welcoming for disabled athletes, among other marginalized groups.²⁹

Several limitations in this study are noteworthy. First, as with all self- or parent-reported information, our measurements of reported physical activity and sedentary behavior for both children with ASD and TD children are subject to reporting error and/or recall bias, which may also be differential by group. However, in our reliability analyses, conducted on a subset of 44 participants comprising both children with ASD and TD children, we found high correlations between estimates of time spent in sedentary behaviors gathered a few weeks apart. Given that our sedentary behavior items asked about the previous month and the reliability questionnaires were administered 10-30 days after the initial survey, the high correlations we observed lend support to notion that screen time behaviors are habitual. We did not conduct reliability studies for the barrier questions, but would expect these would be at least as reliable as estimates of actual behavior. The intensity with which a family experiences each of the barriers listed was not assessed, which may explain, in part, the generally modest correlations observed. It is also possible that the questionnaire did not capture some barriers that are more common among TD children. Finally, despite our efforts to recruit a sample with socioeconomic and racial/ethnic diversity, the enrolled sample was predominantly white and well-educated, which may limit generalizability.

Our moderately-sized study also has numerous strengths. We confirmed the ASD diagnosis through neurodevelopmental testing and our protocol included a comprehensive assessment of barriers across several domains. Further, we established the reliability of our questionnaire items for parent/guardian-reported measures of physical activity and screen time. Barriers that one would not expect to differ between children with ASD and TD children, such as transportation, neighborhood safety, and family time constraints, were indeed not significantly different in our study, lending credibility to validity of our questions.

In sum, our findings suggest the presence of numerous barriers to PA in children with ASD and at levels far greater than for TD children. In contrast to barriers such as time, financial resources, and transportation, the barriers that were elevated in the children with ASD were those associated with the characteristics of their disability as well as exclusion by peers, and/or the inability of adults to include them appropriately. Community-based physical activity programs designed to meet the special requirements of this population are urgently needed, as are policies that compel schools and other government-supported organizations for inclusion and/or targeted programming. Limitations in motor, learning, and social skills may be overcome by appropriately tailored programs directed by adults with specialized training. A systematic evaluation of such programs with respect to child and parent satisfaction, as well as minutes of MVPA children receive in these programs, will contribute to the development of best practices for physical activity programming for children with ASD. Such programming, and associated policies to ensure implementation and access, represents important elements in optimizing the health status of this special population.

Acknowledgements

The authors thank James Gleason for his technical assistance with accelerometry data, Melissa Maslin for her many contributions as research coordinator, Sharon Cermac for her help in developing the questionnaires, and Sarah Anderson and Renee Scampini for their efforts in data collection.

This work was supported by supported by National Institutes of Health Grants R21HD048989, 5P30HD004147-40, and NIHDK46200.

References

1. U.S. Department of Health and Human Services. Office of Disease Prevention and Health Promotion. Healthy People 2020. Available at <http://www.healthypeople.gov/2020/topicsobjectives2020/nationalsnapshot.aspx?topicId=33>
2. Trost SG, Rosenkranz RR, Dzewaltowski D. Physical activity levels among children attending after-school programs. *Med. Sci. Sports Exerc.* 2008; 40(4):622–629. [PubMed: 18317385]
3. Whitt-Glover MC, Taylor WC, Floyd MF, Yore MM, Yancey AK, Matthews CE. Disparities in physical activity and sedentary behaviors among US children and adolescents: prevalence, correlates and intervention implications. *J. Public Health Policy.* 2009; 30:S309–S334. [PubMed: 19190581]
4. Pan CY, Frey GC. Physical activity patterns in youth with autism spectrum disorders. *J. Autism Dev. Disord.* 2006; 36(5):597–606. [PubMed: 16652237]
5. MacDonald M, Esposito P, Ulrich D. The physical activity patterns of children with autism. *BMC Research Notes.* 2011; 4:422. [PubMed: 22008607]
6. Pan CY. Objectively measured physical activity between children with autism spectrum disorders and children without disabilities during inclusive recess settings in Taiwan. *J. Autism Dev. Disord.* 2008; 38:1292–1301. [PubMed: 18157623]
7. Bandini LG, Gleason J, Curtin C, et al. Comparison of physical activity between children with autism spectrum disorders and typically developing children. *Autism.* 2013; 17(1):44–54. [PubMed: 22807562]
8. LaVesser P, Berg C. Participation patterns in preschool children with an autism spectrum disorder. *OTJR: Occupation, Participation and Health.* 2011; 31(1):33–39.
9. Bronfenbrenner U, Postlethwaite TN, Husen T. Ecological models of human development. *International Encyclopedia of Education (2nd ed).* 1994; 3:1643–1647.
10. Sallis, JF.; Owen, N.; Fisher, EB. Ecologic models of health behavior.. In: Glanz, K.; Rimer, BK.; Viswanath, K., editors. *Health Behavior and Health Education: Theory, Practice and Research.* Jossey-Bass; New York: 2008. p. 465-482.

11. Obrusnikova I, Miccinello DL. Parent perceptions of factors influencing after-school physical activity of children with autism spectrum disorders. *Adapt Phys Activ Q*. 2012; 29(1):63–80. [PubMed: 22190053]
12. Obrusnikova I, Cavalier AR. Perceived barriers and facilitators of participation in after-school physical activity by children with autism spectrum disorders. *J Dev Phys Disabil*. 2011; 23:195–211.
13. Chonchaiya W, Nuntnarumit P, Pruksananonda C. Comparison of television viewing between children with autism spectrum disorder and controls. *Acta Pædiatrica*. 2011; 100(7):1033–1037.
14. May, M.; Garrison, C.; Dreyer, M.; Schweiger, A. Abstract presented at: Society for Developmental & Behavioral Pediatrics Annual Meeting. Boston, MA.: Sep 11-14. 2010 Screen time use in children with autism spectrum disorders compared to typical peers..
15. Mazurek MO, Wenstrup C. Television, Video Game and Social Media Use Among Children with ASD and Typically Developing Siblings. *J. Autism Dev. Disord*. 2013; 43(6):1258–1271. [PubMed: 23001767]
16. Must A, Phillips SM, Curtin C, et al. Comparison of sedentary behaviors between children with autism spectrum disorders and typically developing children. *Autism*. In press.
17. Rutter, M.; Le Couteur, A.; Lord, C. *Autism Diagnostic Interview-Revised*. Western Psychological Services; Los Angeles: 2003.
18. Sparrow, S.; Cicchetti, D.; Balla, D. *Vineland Adaptive Behavior Scales*. 2nd ed.. AGS Publishing; Circle Pines, MN: 2005.
19. Elliott, C. *Differential Ability Scales*. The Psychological Corporation; San Antonio, TX: 1990.
20. Brewster S, Coleyshaw L. Participation or exclusion? Perspectives of pupils with autism spectrum disorders on their participation in leisure activities. *British Journal of Learning Disabilities*. 2010; 39:284–291.
21. King G, Law M, King S, Rosenblum P, Kertoy MK, Young NL. A conceptual model of the factors affecting recreation and leisure participation of children with disabilities. *Phys Occup Ther Pediatr*. 2003; 23(1):63–90. [PubMed: 12703385]
22. Murphy NA, Carbone PS. Promoting participation of children with disabilities in sports, recreation, and physical activities. *Pediatrics*. 2008; 121:1057. [PubMed: 18450913]
23. Pan CY, Frey GC. Identifying Physical Activity Determinants in Youth with Autistic Spectrum Disorders. *Journal of Physical Activity and Health*. 2005; 2:412–422.
24. Mazurek MO, Shattuck PT, Wagner M, Cooper BP. Prevalence and correlates of screen-based media use among youths with autism spectrum disorders. *J. Autism Dev. Disord*. 2012; 42(8): 1757–1767. [PubMed: 22160370]
25. Shane HC, Albert PD. Electronic screen media for persons with autism spectrum disorders: results of a survey. *J. Autism Dev. Disord*. Sep; 2008 38(8):1499–1508. [PubMed: 18293074]
26. Pan CY, Tsai CL, Hsieh KW. Physical activity correlates for children with autism spectrum disorders in middle school physical education. *Res. Q. Exerc. Sport*. 2011; 82(3):491–498. [PubMed: 21957708]
27. Sallis JF, Johnson MF, Calfas KJ, Caparosa S, Nichols J. Assessing perceived physical environment variables that may influence physical activity. *Res. Q. Exerc. Sport*. 1997; 68:345–351. [PubMed: 9421846]
28. Galanter, SM. United States Department of Education, Office for Civil Rights. 2013. available at <http://www2.ed.gov/about/offices/list/ocr/letters/colleague-201301-504.pdf>
29. Johnson, G. NCAA inclusion forum builds collective voice. available at <http://www.ncaa.org/wps/wcm/connect/public/NCAA/Resources/Latest+News/2013/May/NCAA+Inclusion+Forum+builds+collective+voice>

Table 1

Demographic characteristics in TD children and children with ASD

	TD children (<i>n</i> = 58)	Children with ASD (<i>n</i> = 53)	<i>p</i> ^{<i>a</i>}
Age, years ^{<i>b</i>} : <i>M</i> (SD)	6.7 (2.4)	6.6 (2.1)	0.75
VABS Score ^{<i>c</i>} : <i>M</i> (SD)	N/A	71.1 (12.4)	
DAS General Conceptual Ability Score ^{<i>d</i>} : <i>M</i> (SD)	N/A	85.8 (22.1) ^{<i>e</i>}	
Sex, male (%)	78%	83%	0.47
Race, white (%)	76%	83%	0.35
Maternal education, >college degree (%)	72%	74%	0.89
Paternal education, >college degree (%)	67%	54%	0.15
Child is an only child (%)	26%	11%	0.05
Overweight, 85 th percentile BMI (%) ^{<i>f</i>}	22% (n=13)	26% (n=14)	0.62
Obese, 95 th percentile BMI (%)	9% (n=5)	17% (n=9)	0.19
Underweight, BMI < 5 th percentile BMI (%)	0%	1.9% (n=1)	0.48

Note. ASD: autism spectrum disorder; TD: typically developing. Sample sizes differ slightly due to missing data

^{*a*} *p* values for differences in autism status groups

^{*b*} range of values 3-11 years in both groups

^{*c*} range of values 45-101

^{*d*} range of values 44-133

^{*e*} *n* = 47

^{*f*} includes children with obesity

Table 2

Comparison of Parent-reported Barriers to Child Participation in Physical Activity by Autism Status

	TD children (n=58)	Children with ASD (n=53)	p-value *
Child/Family Barriers	n (%)	n (%)	
Child has poor motor skills	1 (1.7)	22 (41.5)	<0.001
Child has behavioral problems	0 (0)	28 (52.8)	<0.001
Child has learning problems	1 (1.7)	20 (37.7)	<0.001
Child misses activities due to gastrointestinal problems	0 (0)	4 (7.6)	0.05 [†]
Child requires too much supervision	0 (0)	32 (60.4)	<0.001
Sports/PA are overstimulating for child	0 (0)	14 (26.4)	<0.001
Family time constraints	10 (17.2)	17 (32.0)	0.07
Difficult to make necessary arrangements	2 (3.5)	18 (34.0)	<0.001
<i>Median (interquartile range) Number of Child/Family Barriers</i>	0 (0.25)	3 (2)	<0.001
Social Barriers	n (%)	n (%)	
Child has difficulty with social skills	1 (1.7)	41 (77.4)	<0.001
Child has few friends	0 (0)	24 (45.3)	<0.001
Adults do not make child feel welcome	0 (0)	5 (9.4)	0.02 [†]
Adults lack the skills they need to include child	1 (1.7)	31 (58.5)	<0.001
Children participating in activities exclude child	0 (0)	12 (22.6)	<0.001
<i>Median (interquartile range) Number of Social Barriers</i>	0 (0)	2 (2)	<0.001
Community Barriers	n (%)	n (%)	
Opportunities not available/inadequate	0 (0)	17 (32.0)	<0.001
Opportunities too costly	4 (6.9)	12 (22.6)	0.02
Transportation unavailable	1 (1.7)	1 (1.9)	1.00 [†]
Neighborhood is not safe	1 (1.7)	1 (1.9)	1.00 [†]
<i>Median (interquartile range) Number of Community Barriers</i>	0 (0)	0 (1)	<0.001
Median Number of Total Barriers	0 (1)	6 (4)	<0.001

* Chi-square test, except where indicated by

[†] for Fisher's Exact Test; Mann-Whitney test for continuous variables

Correlations between total barriers and questionnaire-based measures of physical activity and screen time among children with ASD

Table 3

Total Barriers	
	Correlation ¹
	R p-value
PA hours/year	-0.27 0.05
Total activities/year	-0.24 0.08
Screen Time (hours) ²	
Weekly total	0.32 0.03
Weekday	0.32 0.03
Weekend day	0.22 0.13

¹ Pearson correlation

² Computed as the sum of television, video game, and computer time