Physical activity in autistic young patients: a critical review of literature

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ABSTRACT

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Children with autistic spectrum disorders (ASD) may be at risk for being physically inactive because characteristics of the disability interfere with successful participation in traditional forms of physical activity. Children without disabilities acquire a majority of their physical activity during transportation (i.e., walking to school), informal play (i.e., unstructured neighborhood play), and formal play (i.e., competitive sports). Children with ASD demonstrate (a) restricted, repetitive, and stereotyped patterns of behavior, interests, and activities; (b) qualitative impairments in social interaction; and (c) qualitative impairments in communication. These impairments may interfere with a variety of physical activity opportunities. It is expected that children with ASD would be less active than children without ASD after school because prior research has indicated individuals with disabilities have limited opportunities for active leisure time The majority of children with ASD spend after-school leisure time in light physical activity (PA), and few participate in competitive or inclusive community activities. The majority works in segregated programs, including private dance lessons and an activity program specially designed for children with disabilities, but these are not sufficiently frequent to promote regular PA. Institutional change is difficult and long-term; therefore, physical activity interventions for this group should focus on promoting individual or dual activities that often require fewer societal supports. Efforts should focus on identifying appropriate in-school and leisure-time physical activity options that encourage PA and meet the unique needs of youth with ASD.

KEY WORDS: *autism, physical activity, review*

INTRODUCTION

Autism is a complex developmental disorder of biological origin caused by brain dysfunction and defined by impairments in social development and interaction, communication, and by unusual activities, interests, and behaviours. Other characteristics often associated with autism are unusual responses to sensory experiences, engagement in repetitive activities and stereotypical movements and resistance to environmental change or change in daily routines. Children with autism vary in their presentation, course and outcomes, in the quality and intensity of their core autism symptoms, their adaptive and cognitive levels and responses to therapy. In 1994, the diagnostic term "'infantile autism" was replaced by "autistic spectrum disorder" (ASD) implying that the autism phenotype comprises a spectrum of disorders varying in severity, associated symptoms and causality.

Children with autistic spectrum disorders (ASD) may be at risk for being physically inactive because characteristics of the disability interfere with successful participation in traditional forms of physical activity. Children without disabilities acquire a majority of their physical activity during transportation (i.e., walking to school), informal play (i.e., unstructured neighborhood play), and formal play (i.e., competitive sports; Fox & Riddoch, 2000). Children with ASD demonstrate (a) restricted, repetitive, and stereotyped patterns of behavior, interests, and activities; (b) qualitative impairments in social interaction; and (c) qualitative impairments in communication (American Psychiatric Association, 2000). These impairments may interfere with a variety of physical activity opportunities, such as riding a bike to school without supervision or playing tag with peers during recess.

The limited available research on movement and

children with ASD has focused on using exercise to reduce maladaptive behaviors (Celiberti, Bobo, Kelly, Harris, & Handleman, 1997; Levinson & Reid, 1993). These studies found that vigorous exercise has a temporal effect on stereotypies or self-stimulating activities; however, there is relatively little information regarding physical activity behaviors in children with disabilities and only one study (Levinson & Reid, 1991) that includes children with ASD. The authors used a questionnaire to measure parent-perceived physical activity of children with various developmental disabilities, including those with autism, between the ages of 4 to 21. Findings indicated that 75% of parents of children ages 4 to 10 perceived their child to engage in three or more hours of activity per week for nine or more months per year as compared to 56% of parents of children ages 11 to 21. The study provides support that physical activity decreases with age, but it does not provide specific information as to the daily physical activity of the participants. Furthermore, there were no details on the children with autism. Related research in youth with mental retardation is somewhat equivocal. Lorenzi, Horvat, and Pellegrini (2000) compared the recess physical activity levels of children with and without mental retardation grades kindergarten through fifth using heart rate monitoring, accelerometry, and systematic observation. No significant differences existed between group physical activity, as measured by systematic observation. Accelerometry and heart rate monitoring indicated males with mental retardation were more active than were males without mental retardation. Sharav and Bowman (1992) measured physical activity of 30 sibling pairs with and without Down syndrome using a parent-report questionnaire, and found that children with Down syndrome were less active than siblings were. Faison-Hodge and Porretta (2004) used systematic observation to measure the physical activity of children with and without disabilities during physical education and recess. The authors observed no difference in group physical activity levels within either setting. Large variability in assessment methods from the aforementioned studies limit generalization; however, this lack of agreement among these findings supports the rationale that diagnosis is a determinant of physical activity behavior (Longmuir & Bar-Or, 2000).

The health benefits of participating in adequate amounts of physical activity and the fact that health behaviors are established during childhood are well documented (Raitakari et al., 1994). It is recommended that children engage in more than 60 min and up to several hours of moderate to vigorous physical activity (MVPA) per day, 10 to 15 min or more in duration (Corbin & Pangrazi, 1999), but it is unclear whether children with ASD are meeting these guidelines. Since impairments associated with the disability may place individuals with ASD at risk for inactivity, addressing positive physical activity habits early in life could contribute to regular participation in physical activity, which leads to enjoyment of health benefits and contributes to maximal community participation (i.e., employment and recreation) as an adult.

The lack of information on this topic in those with ASD is regrettable because the importance of physical activity to overall health for all individuals has been well-documented and increasing physical activity among youth is a critical, national health objective (U.S. Department of Health and Human Services (USDHHS), 2000). Regular physical activity participation reduces risk for morbidity and mortality associated with chronic diseases such as cardiovascular disease, certain cancers, diabetes, and obesity (USDHHS, 2002), and multiple cardiovascular disease risk factors have been observed in youth (Berenson & Srnivasan, 2005). Physical activity also leads to positive selfesteem, behavior, happiness, and intellectual, and social outcomes in youth (Biddle, Sallis, & Cavill, 1998; Strauss, Rodzilsky, Burack, & Colin, 2001). The only related research in youth with ASD has been the use of exercise to decrease self-stimulating or maladaptive behavior, although no long-term studies on this topic exist (Celiberti, Bobo, Kelly, Harris, & Handleman, 1997; Elliott, Dobbin, Rose, & Soper, 1994). Despite a lack of research, it is reasonable to assume that the general physical and mental health benefits of physical activity would also extend to youth with ASD. Related literature is focused on prevention or treatment of primary and associated conditions and there appear to be no studies that have addressed healthy living in this population. This is a concern for two reasons: (a) as previously mentioned, autistic traits might predispose youth with ASD to be inactive; and (b) weight gain is a common side effect of medications used to treat autistic symptoms (Scahill & Koenig, 1999), both of which could negatively affect healthy living. Research is needed to understand the risk for developing chronic disease associated with inactivity in youth with ASD.

Current physical activity recommendations based on youth without disabilities are generally that: (a) children should engage in at least 60 min or more of age and developmentally appropriate physical activity on all or most days of the week and (b) adolescents should be active every day, including 20 min bouts of continuous moderate to vigorous physical activity (MVPA) three or more times per week (USDHHS, 2002). These guidelines should also apply to youth with ASD, but it is not clear if they are meeting these

minimum standards. The paucity of similar research on youth with other disabilities indicates that those with mental retardation (Suzuki et al., 1991), physical disabilities, sensory impairments, and other health impairments (Longmuir & Bar-Or, 2000) do not meet these guidelines and are generally more sedentary than peers without disabilities. Disability is a primary physical activity determinant and students with conditions perceived as less physically or cognitively restrictive (e.g., hearing impairments) are more active than those with mental or physical disabilities (Longmuir & Bar-Or, 2000; Suzuki et al., 1991). Therefore, reports on this topic cannot be generalized across disabling conditions. Research is needed to determine if the unique characteristics associated with ASD present a greater risk for inactivity compared to other types of disabilities and those without disabilities.

Beyond overall physical activity levels, it is also important to examine physical activity patterns in this population. It is documented that physical activity significantly decreases during adolescence and varies according to day of week and time of day, although there is no consensus regarding optimal times for youth to be active (Gavarry, Giacomoni, Bernard, Seymat, & Falgairette, 2003; Mota, Santos, Guerra, Ribeiro, & Duarte, 2003). The observed decline in physical activity with adolescence is partially due to a reduction in school time devoted to physical education and recess with age (USDHHS, 2000). This might be particularly important for youth with ASD because this group acquires a significant portion of daily MVPA during recess (Rosser & Frey, 2005). In addition, youth with ASD have few opportunities for extracurricular physical activity. The competitive focus of community based programs often prohibits successful participation and these individuals are typically ineligible for segregated programs such as Paralympics or Special Olympics, because, depending on the severity of the condition, diagnostic criteria are not always met. Essentially, youth with ASD are in an indeterminate state regarding physical activity participation. There are few segregated programs that can address the special needs of those with ASD, but because of these special needs this group is likely to be excluded or unsuccessful in integrated activities. As a result, physical activity patterns in youth with ASD are probably different from peers who are afforded greater opportunities to be active.

Physical activity in youth with ASD can be explained to some extent by the social model of disability (Llewellyn & Hogan, 2000). The majority of theoretical approaches used to examine physical activity in youth are based on social- cognitive models. In general, these theories operate on an assumption of reciprocity between the individual and the environment (Taylor, Baranowski, & Sallis, 1994), which is difficult to apply to those with disabilities because this population has less control over and accessibility to the environment than the general population. Youth without disabilities have access to physical activity programs, but choices to engage in activity are determined by social, cognitive or cultural variables. Youth with ASD often do not have basic access to physical activity opportunities for various reasons related to the disability and consequently are not afforded the same choices to be active. For example, an individual with ASD might be prohibited from joining an after-school program due to concerns expressed by staff regarding behavior. According to the social model of disability, physical activity patterns of youth with ASD are more affected by social constraints than the actual impairment (Llewellyn & Hogan, 2000).

The most opportune time periods for children to engage in MVPA during the school year are during a physical education class, the recess period, and the hours after school. It is recommended that children engage in MVPA at least 50% of the time during physical education, but this objective is not being met (McKenzie, Marshall, Sallis, & Conway, 2000; United States Department of Health and Human Services, USDHHS, 2000). Although recess provides elementary-aged children with an opportunity to be active during the school day, studies indicate that children do not spend more than 50% of recess in MVPA (McKenzie et al., 1997; Scruggs, Beveridge, & Watson, 2003; Zask, van Beurden, Barnett, Brooks, & Dietrich, 2001). *Healthy People 2010* objectives call for a reduction in sedentary activities (USDHHS, 2000), but research indicates that children are primarily inactive during after-school leisure time (McKenzie, Sallis, Nader, Broyles, & Nelson, 1992). It is unknown whether children with ASD are experiencing similar trends because no data exist on physical activity patterns in this population.

MEASUREMENTS OF PA ACCORDING TO PAN & FREY (2006)

Physical activity of children is characteristically spontaneous and occurs in short durations (Bailey et al., 1995); therefore, two physical activity assessment methods were used to adequately describe physical activity behavior (Welk, Corbin, & Dale, 2000). Accelerometry and direct observation were employed in this study as both are considered objective, valid, and reliable measures of physical activity in children (Welk et al., 2000).

Accelerometry. Techniques for using accelerometers in ASD children have been recently set up (Pan &

Frey, 2006) The accelerometer is a small, lightweight electronic device (about the size of a pocket watch) designed to detect vertical acceleration as a measure of human motion. Accelerometers have been used extensively and reported as a valid measure of physical activity in children (Trost et al., 1998). The accelerometer is placed in a pouch, which is clipped to the child's pants or shorts, toward the back of the non-dominant side. The device has to be kept close to the body, and its placement discourages tampering. All children have to be instructed not to touch the accelerometer or let others touch it, and participants with ASD have to be read a social story, if appropriate, by the parent prior to the day that they were scheduled to wear the device. The social story has a twofold purpose: (a) to explain that the accelerometer belonged to the child and (b) to explain who was allowed to help the child put it on and take it off. In the above mentioned study (Pan & Frey 2006), each participant wore the accelerometer for four school days and one weekend day to measure daily physical activity. Data for each participant were collected within a 14-day period. It was not required that the participant wear the accelerometer five consecutive days because parents of children with and without ASD forgot to place the accelerometer on the child or the child refused to wear it on a particular day. Inter-day reliability in physical activity and youth has been demonstrated using nonconsecutive days (Janz, Witt, & Mahoney, 1995). Not all youth were measured on the same weekend day, and there exists no research to suggest there is a difference between Saturday and Sunday physical activity levels. The time periods of interest were all day (10:00 a.m. - 7:00 p.m.), physical education, recess, and after school (4:00 p.m. - 7:00 p.m.). The researchers were able to maximize compliance of participants by starting the monitoring time at 10:00 a.m. rather than 8:00. The 10:00 to 7:00 was acceptable since it represented at least 50% of a waking day. Pilot work revealed that parents of children with and without cognitive disabilities (not part of the current study) failed to comply with researchers' directions and allowed children to sleep late on the weekend, thus failing to place the accelerometer on the child prior to 10:00 a.m.. Although physical activity was not being measured until 10:00, parents were asked to place the accelerometer on the child by 8:00, prior to school, each day for two reasons: eliminating the requirement of the child's teacher to attach the accelerometer and establishing consistent directions for weekdays and weekends. Participants were excluded from the data analyses if (a) less than four weekdays and one weekend day of complete all day data during the 10:00 to 7:00 time period was measured, (b) the accelerometer was not worn for five or more min during the 10:00 to 7:00 time period any particular day, or (c) less than two days of accelerometer-measured physical activity in physical education or recess was collected. Data were collected in 1-min intervals for the measurement period. For each minute, the accelerometer provided an activity count as a measure of movement, with larger counts representing greater activity levels. The activity counts were uploaded into a computer program to determine time spent in four, age-specific, physical activity intensity categories using metabolic equivalents (METs): light (< 3.0), moderate (3.0 - 5.9), vigorous (6.0 - 8.9), and very vigorous (9; Trost et al., 1998). Participants, parents, and teachers were encouraged to maintain normal schedules and activities during the monitoring period. Parents were given time sheets to record which days were monitored and when the accelerometer was placed on and taken off the child. Teachers used time sheets to record days and time periods that the child received physical education and recess. The study was conducted over a two-year time period that excluded summers. Data were not collected during the first and last months of school to avoid schedule variations associated with holidays, new classes, testing, etc. as well as during periods of inclement weather when children were not allowed outside for recess.

Direct Observation.

Physical activity levels within the physical education and recess environments were assessed using physical activity behavior definitions from the validated instrument, Behavior of Eating and Activity for Children's Health: Evaluation System (BEACHES; McKenzie, Sallis, Nader, Patterson et al., 1991). Child physical activity behavior was coded into one of five subcategories relative to physical activity intensity (lying down, sitting, standing, walking, or very active) using a momentary time sampling procedure with a 25-second observe and 35-second record cycle. A cassette player and ear piece were used to maintain the 1-min interval pace of the observation. Each child was systematically observed one time in both physical education and recess, and observations of the two settings did not consistently occur on the same day. Informal observations on days prior to formal data collection helped reduce reactivity, and conversations with teachers after the formal observation verified that data were collected on typical physical activity behaviors.

Observer Training and Interrater Reliability.

The authors were formally trained by the creator of BEACHES to measure physical activity behaviors using systematic observation methods. The first

author engaged in at least six months of practice observations and additional training with the second author prior to data collection. Practice observations consisted of systematically observing physical activity of children with mental retardation, children with ASD, and children without disabilities in physical education classes and recess periods. A certified adapted physical educator was trained by the first author to use systematic observation methods and this study's direct observation instrument. Interrater reliability was established with this individual at the beginning of each semester that data was collected (90%, 91%, and 90%) using videotaped sessions. Interrater reliability was calculated using percent agreement during the total observation time. Due to limited staff and financial resources for the study, only the first author conducted observation sessions. Coding definitions were reviewed at least every three weeks.

SEARCHING FOR EVIDENCE

Activity levels of children with and without ASD were similar across all time periods in the study conducted by Pan & Frey (2006). This finding was unexpected since studies have reported that children with mental retardation (Davies & Joughin, 1993; Sharav & Bowman, 1992), physical disabilities (van den Berg-Emons et al., 1995), and cystic fibrosis (Nixon, Orenstein, & Kelsey, 2001) are less active than those without disabilities. However, the current findings are precedented as other studies have found children with mental retardation (Faison-Hodge & Porretta, 2004; Lorenzi et al., 2000), physical disabilities (Fredricksen et al., 2000), and juvenile rheumatoid arthritis (Henderson, Lovell, Specker, & Campaigne, 1995) to be similarly active or more active than children without a disability. The inconsistent findings in the literature highlight the importance of using objective assessment methods, support the examination of physical activity levels within various environments, and confirm the need to measure the physical activity of specific subgroups to avoid generalizations across different disabling conditions.

There is previous literature that has reported no difference in physical activity levels in children with mental retardation regardless of inclusive or segregated recess setting (Horvat & Franklin, 2001). Future studies would do well to control for recess variables and provide additional knowledge about the influential nature of segregated and inclusive settings on the physical activity levels of children with ASD.

Since recess is an apparently valuable source of MVPA for children with ASD, it should not be sacrificed to accommodate other curricula. Although both groups were allotted similar amounts of time in recess, it was observed that eight children with ASD were removed early by teachers, seven of whom were in selfcontained classrooms. Previous research has cited instances where recess is reduced or eliminated for the sake of academic time (Newman, Brody, & Beauchamp, 1996). Since it appears that children with ASD are engaging in a majority of MVPA during recess, additional reductions in this time could have a negative impact on their opportunity to engage in daily MVPA.

Children with ASD do not engage in adequate amounts of MVPA during physical education. According to national standards, children should be physically active at least 50% of the time during physical education (USDHHS, 2000), and children with ASD in this study were only active 41% of the time. This was less than the non-ASD group but not significantly different. Several factors may have contributed to this result. First, children with and without ASD frequently sat or stood prior to engaging in physical activity (i.e., waiting in line) in physical education. This is consistent with previous reports of physical activity during physical education in children without disabilities (McKenzie et al., 2000). Second, children with ASD were observed requiring verbal and physical prompts to complete activities. Time needed for extra assistance may limit the child's activity involvement. Third, excessive time dedicated to classroom management (i.e., taking roll, transitioning from one activity to another) may limit opportunities of all children to engage in activities that promote MVPA. Fourth, at least four children with ASD were receiving physical education instruction from special education teachers who were not certified to teach that content area. Teacher variables, such as expertise or effectiveness, were not components of the systematic observation instrument, thus discussion of teacher associated variables is beyond the scope of this study. Previous research suggests that effective teaching behaviors are associated with higher levels of student activity during physical education (Faucette & Patterson, 1990), but this should be explored further in children with ASD.

It is expected that children with ASD would be less active than children without ASD after school because prior research has indicated individuals with disabilities have limited opportunities for active leisure time (Schleien, Germ, & McAvoy, 1996). The majority of children with ASD spend after-school leisure time in light physical activity, and few participate in competitive or inclusive community activities. The majority works in segregated programs, including private dance lessons and an activity program specially designed for children with disabilities, but the-

se are not sufficiently frequent to promote regular MVPA

Technology-based activities such as video games and television distract children from the opportunity of being physically active (McKenzie et al., 1992). In many cases, television or video viewing is used to occupy children with ASD so parents could complete household duties or interact with other children in the home. This reliance on technology-based activities rather than physical activities during leisure presents a serious concern for children with ASD for several reasons: (a) It is well documented that physical activity significantly decreases from childhood to adolescence (Raitakari et al., 1994); (b) it may be difficult to find activity opportunities for children with ASD as they move into adolescence because of less involvement in play environments; and (c) available activity programs become more competitive during adolescence and competitive programs are typically not appropriate for youth with ASD (Schultheis, Boswell, & Decker, 2000). If this population does not develop participation in leisure-time physical activity as a regular health behavior, then it is likely they will become increasingly sedentary with age and predisposed to develop certain chronic diseases.

The small, cross-sectional sample of the few studies available on PA in ASD somewhat limits generalizability, and recruitment of participants from a variety of physical education and recess placements is a design weakness that must be considered when interpreting these findings. Examining the influence of educational placement on physical activity in this population is an area that requires further inquiry.

While the mean physical activity levels of children with ASD is tipically lower than peers without ASD, most children are capable of accruing minimum recommended minutes of daily MVPA. Children with ASD may still be at-risk for developing sedentary behaviors as they mature due to (a) the potential overuse of technology-based activities during leisure time and (b) loss of recess time as a primary source of MVPA in middle and high school.

The influence of participant's residence on access to physical activity programs further supports the social model of disability as a partial explanation of the current findings. Most extracurricular physical activity depends on facility available within the community. In general, communities provide services and supports so that youth with ASD can successfully participate in physical activity (Llewellyn & Hogan, 2000). Unfortunately, and this is a main concern for ASD children living in Italy, other participants reside in communities that did not offer these supports; even though physical activity resources were available (e.g., youth sports programs, health club facilities, etc.). This suggests that availability of resources is not enough, and creating access to resources through appropriate programming, staff training, and activity modification is imperative for youth with ASD to successfully engage in physical activity. For this to occur, society must provide the necessary supports.

While the social model of disability has provided a reasonable framework for partially describing physical activity patterns in this group, no model can explicitly explain all aspects of behavior (Llewellyn & Hogan, 2000). Individual personality traits must also be considered when examining physical activity behavior and it is important to understand that autistic traits are part of the individual. For example, several youth with ASD report a lack of enjoyment for anything physical. These individuals chose to be inactive, coinciding with the majority of society which also chooses to be inactive (USDHHS, 2002). Most participants indicate a lack of enjoyment for team sports and prefer individual activities such as swimming. These activities typically occurre within a group context, but there is no performance expectations that could influence group outcomes and this make those experiences less stressful. Walking is the most frequently reported non school activity, and it is the only activity in which almost all youth consistently participate. Orsmond, Krauss, and Seltzer (2004) also found that adolescents and adults with ASD prefer recreational activities that do not present extensive social demands (e.g., walking). This is different from research examining common activities in 6th-8th graders without disabilities, where male adolescents predominantly engaged in team-oriented sports (Harrell et al., 2003). These findings suggest that youth with ASD might develop a greater predilection for physical activity if allowed to choose activities based on preference, rather than socialization opportunities.

Institutional change is difficult and long-term; therefore, physical activity interventions for this group should focus on promoting individual or dual activities that often require fewer societal supports. Team sports demand an ability to quickly understand, process, and respond to social cues under the pressure of competition, and expecting an individual with ASD to function or be accepted by peers in this setting is unrealistic. Individual or dual activities (e.g., running, swimming, tennis) present several advantages compared to traditional team sports (e.g., basketball, baseball), particularly for youth with ASD, because: (a) fewer social demands exist; (b) fewer people are needed to participate, which is more practical in terms of time and effort; (c) these activities are more easily continued into adulthood, again because there is less reliance on others; (d) the rhythmic nature of

many individual activities are conducive to repetitive traits often associated with ASD; and (e) these activities can be performed using family resources, without reliance on external supports. There exist several excellent references to assist professionals, practitioners, and parents with developing and implementing appropriate physical activity or recreation programs for youth with ASD (Hawkins, 1991; Houston-Wilson & Lieberman, 2003; Reid & O'Connor, 2003).

As to methodological issues concerning accelerometers, physical activity may be underestimated because accelerometers are less accurate when assessing non-weight bearing activities (e.g., swimming and bicycling). These devices are still one of the most commonly used, noninvasive, objective indicators of physical activity in field settings (Dale et al., 2002). Stereotypic behaviors in those without disabilities (e.g., fidgeting) are usually incorporated as part of overall activity; however, since stereotypic behaviors are more prevalent in youth with ASD, future research should assess the relative contribution of these movements to physical activity in this group. Differences in social skills, behaviors, cognitive abilities, and medications have to be evaluated and might influence findings. Further research is needed to understand the impact of these variables on physical activity behavior in this population.

Design limitations notwithstanding, these results provide meaningful, novel information regarding physical activity patterns of youth with ASD. Similar to youth without disabilities, this population is at risk for health problems associated with inactivity. Efforts should focus on identifying appropriate in-school and leisure-time physical activity options that encourage MVPA and meet the unique needs of youth with ASD. Additional inquiry is needed to (a) investigate gender differences, specific diagnostic categories, or evaluate physical activity based on some type of social skills inventory, and (b) identify the relative contribution of various physical activity determinants in this population. It is important that health issues in people with ASD are examined beyond the symptoms of the condition so that healthy lifestyles, including physical activity participation, can be promoted.

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