School Time Physical Activity of Students With and Without Autism Spectrum Disorders During PE and Recess

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This study compared moderate-to-vigorous physical activity (MVPA) of students with autism spectrum disorders (ASD) and students without disabilities during inclusive physical education and recess. Students (7–12 years) wore a uniaxial accelerometer in school for 5 consecutive school days. Results indicated a significant difference between settings, $F(1,46) = 15.94, p < .01$, partial $\eta^2 = 0.26$, observed power = 0.97. Students with and without ASD spent a higher proportion of time in MVPA during physical education than during recess, relative to the amount of time spent in those settings. In addition, structured physical education offers opportunities to increase students’ MVPA engagement.

General physical activity guidelines, which address the important role played by moderate-to-vigorous physical activity (MVPA), are widely adopted to describe multiple health-related physical activity benefits in children. These guidelines recommend that children should be engaged in a minimum of 60 min MVPA each day (U. S. Department of Health and Human Services, USDHHS, 2002). Reports in the US and Taiwan, however, have indicated that children did not engage in enough physical activity (King Car Education Foundation, 1998; USDHHS, 2002). The reliance on sedentary activities rather than physical activities after school in Taiwan has drawn great attention. These sedentary leisure-time activities include watching television, playing video games, or taking private lessons such as English, painting, and piano (Huang, 1999). Because children spend a large majority of their day in school during which physical education and recess provide the opportunity to accumulate time spent in MVPA, the importance of school in the provision of activity guidelines during the school day appears to be a critical environment that defines the children propensity for physical activity.

Current guidelines for physical education suggest that children should be active for at least 50% of class time during the physical education class, and schools should provide daily lessons for children in order for physical education to meaningfully contribute toward the daily MVPA accumulation (USDHHS, 2002). Although the empirically tested physical activity guidelines do not exist for...
recess, Stratton and Mullan (2005) suggested that children should be physically active for 50% of recess time because it provides daily opportunities for physical activity participation. These recommendations, though not specific to individuals with disabilities, may hold true for healthy individuals with mild or high-functioning Autism Spectrum Disorders (ASD) who are often included into general physical education and recess contexts.

The primary classification system used to identify ASD in Taiwan is the DSM-IV-Revised system developed by the American Psychiatric Association (American Psychiatric Association, 2000) and the Identification Standard for Students with Special Needs developed by the Ministry of Education (Ministry of Education, 2006b). The most common characteristics typically used as diagnostic criteria include impairments in social interaction, communication, and restricted repetitive and stereotyped patterns of behavior, interests, and activities. Level of severity (mild, moderate, severe, and very severe) is based on functioning in the social adaptive skill areas and language comprehension and expression (Executive Yuan, 2006b). In addition, empirical evidence converges to confirm the existence of motor difficulties for many youth with ASD (Berkeley, Zittel, Pitney, & Nichols, 2001; Rinehart et al., 2006; Vernazza-Martin et al., 2005); however, not all youth with ASD demonstrate motor skill deficits and considerable variability exists (Amato & Slavin, 1998; Rinehart, Bradshaw, Brereton, & Tonge, 2001). The social, behavioral, and perhaps motor deficits associated with the condition could limit opportunities for individuals with ASD to successfully participate in physical activity.

Physical activity in students with ASD can also be explained to some extent by the self-determination model (Wehmeyer & Gamer, 2003). In general, this theory operates on an assumption of reciprocity between the individual and the environment. Both environmental and personal characteristics contribute to enhance physical activity behavior; however, environment in which people live, learn, work, and play provide opportunities for them to make choices contributed significantly and positively to greater behaviors. This is also related to the degree to which other people enable and support the person with disabilities or the degree to which other supports like technology are in place. Therefore, physical activity behaviors of students with ASD may be more affected by social and environmental constraints than the actual impairment. Research is needed to determine if the unique characteristics associated with ASD and social and environmental factors place them at greater risk for inactivity compared with peers without disabilities when they have equal opportunities to be active.

Longmuir and Bar-Or (2000) and Suzuki et al. (1991) performed the only studies that compared different disability groups. Longmuir and Bar-Or (2000) investigated physical activity of youth, ages 6–20, with disabilities who completed a mailed survey in Ontario, and observed that youth with visual impairment and physical disabilities, especially cerebral palsy and muscular dystrophy, were significantly less active than youth with hearing impairment and chronic medical conditions. Suzuki et al. (1991) compared physical activity of students, aged 3–22, with disabilities using pedometer measurements in Tokyo, and reported that physical activity levels in youth with physical disabilities were significantly lower than those with other disabilities such as hearing impairment, visual impairment, and mental retardation. 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). Reports on physical activity, therefore, cannot be generalized across disabling conditions.

A number of studies have assessed physical activity in students without disabilities during physical education (McKenzie et al., 1995; Simons-Morton, Taylor, Snider, & Huang, 1994) and during recess (McKenzie et al., 1997; Riddo-ers, Stratton, & Fairclough, 2005; Zask, van Beurden, Barnett, Brooks, & Dietrich, 2001). It is a concern that students in these studies did not achieve 50% of physical education class time and recess time in physical activity. The activity engagement of the same students with and without disabilities, however, has rarely been examined in both settings. Two such studies using the methodology of direct observation and accelerometry have been reported. Faison-Hodge and Porretta (2004) used direct observation to measure the physical activity of students with mild mental retardation and students without disabilities grades third through fifth. The authors observed no difference in group physical activity levels within either setting, but students with and without mental retardation were more active during recess than during physical education. Rosser-Sandt and Frey (2005) compared daily physical education, recess, and after school physical activity levels of students with and without ASD aged 5–12 using accelerometry. No significant differences existed between group physical activities at any setting. Both groups were more active during recess compared with after school, and students with ASD engaged in relatively similar MVPA in recess (58%) and physical education (41%). However, the study did not control recess environment variables such as inclusive or segregated setting; therefore, additional knowledge about the effect of placement could not be provided.

Pan and Frey (2006) used an accelerometer to examine physical activity patterns (type of day and school day time period) in youth with ASD aged 10–19 and found that all participants achieved more total physical activity after school but engaged in more MVPA during school. The results indicated that youth with ASD were less active than previous reports on peers without disabilities (Trost et al., 2002), but physical activity declined with school level and some youth with ASD did not accumulate recommended daily amounts of MVPA. It appears that youth with ASD are at similar risk for being physically inactive as those without disabilities.

Because of Taiwan’s limited recreational market base and small sports industry, many students are forced to reduce the amount of exercise and sports participation after school, making school physical education and recess the primary opportunities for the promotion of student’s physical activity. Physical education is highly structured, and student’s participation is required; recess is typically unstructured, and student’s physical activity is voluntary. Therefore, physical education and recess should be viewed as separate settings for increasing students’ physical activity levels in school because the goals and conduct are distinctly different. Since most students are physically active with peers (Okely, Booth, & Patterson, 2001), individuals with ASD may be at risk for inactivity due to the impairments that may interfere with a variety of physical activity opportunities. It is important to examine similarities or differences in physical activity levels of students with ASD compared with their peers without disabilities during physical
education and recess settings since students would all be exposed to the same stimulus or opportunity to be active. If group differences are found in one or the other setting that would imply changes are needed to provide both groups of students with adequate amounts of physical activity at school.

Limited attention has been paid to differences between students with and without ASD as well as the contribution that elementary school physical education and recess can make to overall daily MVPA in students. It was hypothesized that students with ASD would be less active than chronologically age peers during both physical education and recess settings. This study (a) compared the physical activity levels of students with and without ASD during physical education and recess and (b) assessed the contribution of physical activity during physical education and recess to weekly total physical education and recess time available, health-related guidelines, and daily total school time MVPA among students with and without ASD.

Method

Participants and Settings

Students with ASD were diagnosed through medical and psychological assessment by trained and knowledgeable physicians in the public hospitals (Executive Yuan, 2006a). Numbers of ASD among special needs students in elementary school in the 2005 school year were 5% (Ministry of Education, 2006a). All city governments have established Exceptional Children Identification and Placement Consultation Committees to offer adequate educational placement based on the needs of exceptional children. Those who were diagnosed with mild and moderate ASD were usually assigned to the resource room on a regularly scheduled basis while continuing their other studies in regular classrooms during most of each school day. All students with ASD are eligible to receive special education services, which may include special education assistance, resource room assistance, integrated programs, speech therapy, occupational therapy, and physical therapy. They attended inclusive schools since first grade and typically lived at home.

Individuals with an intellectual disability as a co-occurring condition, as well as those with severe behavior problems that required formal intervention, were excluded. Diagnoses included Autism (mild or high-functioning, \( n = 12 \); moderate, \( n = 9 \)) and Asperger’s syndrome (\( n = 3 \)). Five manifested diagnosed associated conditions such as attention deficit disorder (\( n = 1 \)), Tourette’s syndrome (\( n = 1 \)), anxiety (\( n = 2 \)), and Glucose-6-Phosphate Dehydrogenase deficiency (\( n = 1 \)). They were on medication to relieve symptoms associated with ASD and associated symptoms, and none had multiple co-occurring conditions nor gross motor difficulties. General language skills included a few sentences (\( n = 3 \)) and normal speech patterns (\( n = 21 \)), as based on parent reports and researcher interaction with participants. All reside in urban settings and 23 live in a two parent household. None were enrolled in a segregated or inclusive school-based physical activity programs or sports teams.

To control for occasions of physical activities, facilities, and other environmental factors, students with and without ASD were matched based on gender and age from the same regular classroom and assessed physical activity on the same
days. A convenience sample of 24 students with ASD (grade 1–3, n = 12, 1 girl and 11 boys; grade 4–6, n = 12, all boys) and 24 students without disabilities, aged 7–12 years (9.2 ± 1.4) from 14 elementary schools in southern Taiwan returned signed informed parental consent to participate in the study. The schools were located in the same geographical area of high social and economic deprivation in a large urban city (n = 1,510,444). Mean height was 136.5 ± 10.8 cm and 135.2 ± 10.3 cm, and mean body mass was 35.4 ± 8.4 kg and 33.0 ± 8.8 kg for students with and without ASD, respectively. These values were within the normal ranges for Taiwanese students of this age (Ministry of Education, 2007). The average daily monitoring time was approximately 8 hr (8:00 a.m.–4:00 p.m.) for whole-day school days and 4.5 hr (8:00 a.m.–12:30 p.m.) for half-day school days. Days to attend school whole- or half-day in a week vary and depend on the school district and student’s grade level. All students participating in the study followed their regular daily school routine. The research protocol received approval from the National Science Council in Taiwan.

The mean daily recess length was 33 ± 2.8 min, 48 ± 9.6 min, and 38 ± 3.9 min in the morning, lunch break, and afternoon, respectively. School size ranged from 139 to 2,806 students (mean 1,438.1 ± 938.8). The space of the playground for all schools was limited because they were located in a crowded urban city. No schools had extra game equipment provided during recess, but students were allowed to bring their own balls, toys, etc. during recess. The physical education lesson was 40 min in duration, and students in grades 1–2 (classes, n = 9) and 3–6 (classes, n = 15) were required to take 1 and 2 lessons each week, respectively. One lesson was cancelled for the sake of academic time; therefore, a total of 38 lessons that resulted from 24 classes were monitored. The types of physical education activities that participants were engaged in were hula-hoop (n = 1), soccer (n = 2), ball games (n = 1), free play (n = 2), swimming (n = 1), jogging/walking (n = 2), foot-soft ball (n = 1), dodge ball (n = 13), table-tennis (n = 2), badminton (n = 2), basketball (n = 4), aerobic dance (n = 1), jump rope (n = 3), gymnastics (n = 2), and high jump (n = 1). Physical education classes were taught by 50.0% (n = 12) of classroom teachers and 50.0% (n = 12) by physical education specialists, and 78.9% (n = 30) of sessions occurred outdoors and 21.2% (n = 8) occurred indoors.

Instrumentation

The accelerometer (GT1M ActiGraph, Computer Science Applications Ins., Shalimar, FL) was used as an objective measure of daily physical activity. It is a small (5.1 × 4.1 × 1.5 cm), lightweight (42.5 g), single-channel accelerometer designed to measure and record acceleration ranging in magnitude from 0.05 to 2.00 g with a frequency response from 0.25 to 2.50 Hz. The filtered acceleration signal is digitized and the magnitude is summed over a user-specified period of time. At the end of each epoch, the summed value is stored in memory and the numerical integrator is reset. A large signal or count represents high levels of physical activity. At the end of data collection, physical activity data were downloaded from the accelerometers and organized using associated software. The uniaxial ActiGraph (formerly known as CSA) accelerometer has been used extensively and reported as an effective objective measure of physical activity in
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It has also been used in children with ASD (Rosser-Sandt & Frey, 2005) and other cultural context of youth with and without intellectual disability (Pan, 2006) and found that these students can tolerate the instrument.

For the current study, the accelerometers were programmed to collect data in one minute intervals and the output was expressed as counts per minute (activity counts divided by minutes of monitored activity), and used to determine the intensity of each physical activity. The daily time spent in MVPA (> 3 MET) was calculated by summing the minutes of moderate, vigorous, and very vigorous physical activity for each day. The age-specific count cutoffs corresponding to each specified intensity level were derived from the energy expenditure prediction equation developed by Freedson et al. (1997). This equation accounted for 90% of the variance in observed MET levels and predicted energy expenditure during treadmill running and walking within +1.1 METs, and the procedure has previously been used in other populations (Trost, Pate, Freedson, Sallis, & Taylor, 2000; Trost et al., 2002).

Procedure

Physical activity was monitored in school on 5 consecutive school days (Monday to Friday) between April and June 2006. Data for each participant were collected within the school time period because most parents of children with and without ASD or the child refused to wear it after school. Measurements of body mass and stature (to the nearest 0.1 kg and 0.1 cm, respectively) were recorded using classroom teacher reports. These measurements were collected in the school health center with all youth dressed in light clothing and shoes removed at the beginning of the Spring semester 2006. Consistent with previous studies, the accelerometer was placed in a small nylon pouch and worn over the right hip with an elastic belt at the start of each school day. The participants were then asked to follow their regular daily routine, and the monitors were then removed at the end of each school day. A diary was given to the research assistants, who were trained and instructed to record the time when the monitor was attached in the morning and detached in the evening as well as physical education and recess time. Monitors were then downloaded and initialized each day and the same participant wore the same monitor every day. Each participant was informally observed at least one time in recess each day and all physical education sessions to note if the monitor was firmly placed over the participant’s right hip.

Statistical Analysis

Daily physical activity variable was examined separately at each group for the fit between distributions and assumptions of normality and homoscedasticity. All cases remained for further analysis because assumptions were met and no multivariate outliers were identified. Of the 48 students monitored in this study, all provided complete data sets and were retained for analysis. The dependent variables used for analysis were percentage of time spent in MVPA. For physical education and recess, the percentage of time spent in MVPA was calculated by summing the MVPA minutes for all physical education and recess sessions,
respectively, and dividing the minutes of total monitoring time. Intraclass correlation coefficients and 95% confidence intervals were calculated to investigate the intra- and interindividual variation in activity scores across different days of assessment. Values above 0.70 were considered as demonstrating acceptable reliability (Vincent, 1999). Group and setting differences were analyzed using a two-way ANOVA (group × setting) with repeated measures on one factor (setting: physical education vs. recess). Independent t tests were used to analyze the group differences on the contribution of physical activity during physical education and recess to total physical education and recess time available, health-related guidelines, and daily school time total MVPA. The statistical power and effect sizes were computed and reported as observed power and partial $\eta^2$, respectively. SPSS version 13.0 was used to analyze the data and the alpha level was set at $p < .05$. Data are reported as percentages rather than minutes to accommodate inconsistencies in time allotted for recess and physical education among individuals.

**Results**

Intraclass reliability coefficients and 95% confidence interval (CI) across days for the percentage of time spent in MVPA was $R = 0.80$ (CI 0.64–0.90) and $R = 0.76$ (CI 0.57–0.89) for students with ASD and those without disabilities, respectively. There were no differences between days, so the five school days were combined for future analysis.

Preliminary data analyses were conducted to determine the possibility of grade level, gender, specialist, and/or school day effects on the percentage of time spent in MVPA. No effect was found, and therefore, gender, specialist, school day, and grade level were not used in subsequent analyses.

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The physical education time available was 40 min for the first and the second graders, and 80 min for the third graders and above. A total of 38 lessons, 40 min each, which resulted from 24 classes were monitored. The daily recess time available was $99.75 \pm 15.53$ min and $99.00 \pm 15.62$ min for students with and without ASD, respectively. Students with ASD ($46.25% \pm 19.25$) and students without disabilities ($46.77% \pm 25.43$) seemed to engage in relatively similar amounts of MVPA during physical education, while students with ASD ($27.70% \pm 8.80$) seemed to be less active than students without disabilities ($36.15% \pm 11.98$) during recess.

There was a significant difference for the percentage of time spent in MVPA between physical education and recess settings, $F(1, 46) = 15.94, p < .01$, partial $\eta^2 = 0.26$, observed power = 0.97; Table 1). The MVPA for the physical education ($46.51\%$) was higher than for the recess ($31.93\%$). There was no main effect for group ($p = .21$). Students with ($36.97\%$) and without ($41.46\%$) ASD engaged in relatively similar percentages of time in MVPA. The group by setting interaction was not significant ($p = .28$).

Figure 1 shows the percentage of recess and physical education time spent in MVPA according to total recess and physical education time, health-related physical activity guidelines, and daily total school time MVPA observed. The
proportion of time that students with ASD spent in MVPA during recess (27.70%) was significantly lower (t46 = 2.79, p < .01) than their peers without disabilities (36.15%). Participation in MVPA during recess contributes significantly more (t46 = 2.60, p < .05) for students without disabilities (58.40%) than those with ASD (45.96%) to the total amount of physical activity suggested by international health-related physical activity guidelines. The percentage of time engaged in MVPA during recess at school accounts for a large amount for students with ASD (59.03%) and those without disabilities (60.55%) of the daily total school time MVPA.

Table 1 Two-Way ANOVA With Repeated Measures on One Factor (Setting)

<table>
<thead>
<tr>
<th>Variables</th>
<th>F</th>
<th>p</th>
<th>Partial $\eta^2$</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group (G)</td>
<td>1.62</td>
<td>0.21</td>
<td>0.03</td>
<td>0.24</td>
</tr>
<tr>
<td>Setting (s)**</td>
<td>15.94</td>
<td>0.00</td>
<td>0.26</td>
<td>0.97</td>
</tr>
<tr>
<td>G $\times$ S</td>
<td>1.18</td>
<td>0.28</td>
<td>0.03</td>
<td>0.19</td>
</tr>
</tbody>
</table>

**Denotes significance at $p < .01$

Figure 1 — Percentage of recess and physical education time spent in MVPA according to total recess and physical education time, health-related guidelines and daily total school time MVPA; ** significant differences $p < .01$; * significant differences $p < .05$; Recess %MVPA (1) = Recess time MVPA/Total recess time; Recess %MVPA (2) = Recess time MVPA/Health-related guidelines; Recess %MVPA (3) = Recess time MVPA/Daily total school time MVPA; PE %MVPA (1) = PE time MVPA/PE time; PE %MVPA (2) = PE time MVPA/Health-related guidelines; PE %MVPA (3) = PE time MVPA/Daily total school time MVPA.
For the percentage of MVPA during physical education classes, no significant differences were noted on all percentages of MVPA between students with and without ASD. Students with ASD engaged in a relatively similar proportion of time during physical education (46.25%) as compared with those without disabilities (46.77%), and both groups were not moderately active for at least 50% of the physical education time. Engagement in MVPA during physical education equated to 30.83% and 31.18% of the daily recommended MVPA for students with and without ASD, respectively. The proportion of time engaged in MVPA during physical education accounts for 42.37% of the daily total school time MVPA in students with ASD. This was higher than their peers without disabilities (34.81%), although the differences were not significant.

Discussion

The primary purpose of this investigation was to compare MVPA of elementary school students with and without ASD during inclusive physical education and recess. The secondary purpose was to quantify the contribution physical education and recess makes to the total physical education and recess time available, health-related guidelines, and daily total school time MVPA for Taiwanese student’s physical activity.

Students with and without ASD spent a larger percentage of time in MVPA during physical education compared with recess period, relative to the amount of time spent in those settings. This finding was surprising since Faison-Hodge and Porretta (2004) reported that MVPA of students with and without mental retardation for the recess setting was significantly higher than for the physical education setting, and no difference in group physical activity levels within either setting. Rosser-Sandt and Frey (2005) reported that students without disabilities spent significantly more percentage of time in MVPA during recess than physical education, but students with ASD were similarly active during recess and physical education. One possible explanation may be that participants in the current study respond and perform better in a structured setting as compared with a nonstructured setting. Furthermore, the school environment of the current study, (viz., limited space, equipment, and playground facilities) were not arranged to be conducive for physical activities, which may also explain reasons for lower recess MVPA. These discrepancies also highlight the difficulty in not only comparing studies that have employed different measurement instruments and different disabling conditions, but also studies that have used similar instruments and methods but alternative subgroups and environments for establishing outcome measurements of physical activity.

Activity levels of students with (46.3%) and without ASD (46.8%) under regular conditions were similar during physical education. The accumulated data indicated that 50% of class time in MVPA for both groups is achievable in Taiwanese elementary school physical education classes that are 40 min in length. This finding was slightly higher than a review article (Fairclough & Stratton, 2006), reporting that the mean MVPA value was 34.2% of physical education class time when data from all studies were combined. Participants in the current study spent 18.6 min per lesson in MVPA during physical education, where they
accumulated nearly one-third of the recommended hour. Results highlight the importance of physical education as part of a student’s overall daily MVPA and suggest that increasing student’s active play may be important in enhancing MVPA participation as well as reaching health-related MVPA values.

Evidence of similarities in MVPA during physical education between the two groups may be found in the research assistants’ diaries. First, all children attended physical education classes and no one’s physical education class was reduced or eliminated for the sake of academic time or behavior problems. Second, after verbally explaining something to the class, physical education teachers would demonstrate or physically assist children with ASD. It is likely that children with ASD benefited from these attempts. Third, it was observed that three children with ASD participated in some amount of MVPA in an isolated context during physical education classes when they could not benefit from either demonstration or being physically assisted. For example, alternative forms of physical activities would be given such as running, bouncing a ball, or shooting it into a basket over and over. Based on this data, it can be concluded that structured school physical education provide opportunities for children both with and without ASD to be active.

It is obvious that the activity levels in physical education tend to vary considerably within and between classes, as a result of pedagogical, individual, and environment factors (Stratton, 1996). An examination of the effect of these variables on physical activity in physical education contexts is beyond the scope of this study; however, they do warrant discussion. Studies reported that students spent at least 50% of their time engaged in MVPA during fitness lessons (Cardon, Verstraete, De Clercq, & De Bourdeaudhuij, 2004; Hodges Kulinna, Martin, Lai, Kliber, & Reed, 2003; McKenzie, Sallis, & Nader, 1991; Simons-Morton et al., 1994; van der Mars, Darst, Vogler, & Cusimano, 1998) because they are more active and on-task due to the nature of the activity (e.g., jogging, jumping rope, running, swimming). Unlike nonfitness lessons (e.g., game play, skill drills), students are more likely to be off task, standing, or waiting for a turn. Furthermore, McKenzie et al. (1995) found that students engaged in outdoor physical activities were more active than those engaged in indoor lessons. Therefore, it is reasonable to assume that time spent in MVPA during physical education is higher than recess because participants in the current study received a majority of physical education lessons that focused on fitness, and a majority of sessions occurred outdoors. Within the context of this study, it seems that students with ASD were appropriately placed within the regular physical education class because their activity levels were similar to their peers without disabilities.

The differences in the contribution of physical activity during recess to total recess time available and health-related guidelines between students with and without ASD can be partially described by the self-determination model related to personal characteristics and the environment. In the recess setting, students are allowed to choose the activities to participate. A majority of the participants without disabilities often chose high intensity activities like ball games, wrestling, and running and chasing other students. Participants with ASD, however, were likely to choose play activities like playing alone, playing alongside a peer with no interactions, or watching but not interacting (Wolfberg, 1999). According to research assistants’ diaries, six students with ASD were observed. These activities
that students with ASD engaged in involved less frequent or intense movement, resulting in lower physical activity during recess. Therefore, the lower level of physical activity in students with ASD may be because they require verbal or physical prompts to engage in MVPA during recess, not due to being unable to physically perform since both groups were similarly active during physical education. A previous study has reported that appropriately designed school playgrounds may serve to increase MVPA and promote health in children (Stratton & Mullan, 2005). The lower level of physical activity in students with ASD during recess suggests that unstructured recess time during the school day might be redesigned to provide support and encouragement to be physically active.

The average amount of time spent in MVPA during school was 47 min for students with ASD and 58 min for students without disabilities. In-school MVPA during physical education and recess accounted for 96% of this sample’s daily total school time MVPA and 84% of daily recommended MVPA. Because many of the students are sedentary after school (Huang, 1999), this rigorously scheduled activity time makes opportunities for in-school physical activity of utmost importance if an overall healthy level of physical activity is to be maintained. Unfortunately, a determination of the specific types of activities engaged in school was beyond the scope of this study. Since much of the academic school day is necessarily spent sitting, the wide standard deviations in physical activity observed in these two segments of the school day suggest that interindividual variation was indeed great and warrants further study.

Implications

Findings support the notion that appropriate engagement in MVPA during physical education and recess can make a significant contribution to daily recommended MVPA and has the potential to impact future practice in schools. In addition, the equivalent levels of physical activity during physical education classes is evidence of the important role that physical education plays in providing physical activity for all students. Finally, the lower level of activity in students with ASD during recess periods suggests that unstructured time during the school day might be redesigned and strategies to enhance these students’ physical activity at recess time must be developed.

Limitations of the Study

Physical activity may have been underestimated because of the accelerometers are less accurate when assessing nonweight bearing activities (e.g., swimming and bicycling), but few participants reported significant amounts of these activities. Other limitations of the study were the limited sample size and assessment of only one or two physical education units per student, which may not be representative of the curriculum. It remains possible that the presence of monitors in the school during the monitoring frame may have elicited reactivity. It is also possible that the cultural and educational settings may have produced potential differences from the previous research. Furthermore, even though all attempts were made to obtain a homogenous sample of students with and without ASD, differences in
social skills, behaviors, cognitive abilities, and gross motor skills were also not evaluated and might have influenced findings.

**Recommendations for the Future Study**

This study did not assess the relationships between characteristics of ASD (e.g., social skills, behaviors, cognitive abilities, and gross motor skills) and physical activity. Ongoing research is needed to understand the impact of these variables on physical activity behavior in this population. Future studies should also attempt to develop knowledge and understanding of the determinants of student’s health-promoting physical activities during recess.

**References**


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