Daily Physical Activity Patterns of Children Living in an American Indian Community

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**Background:** Embracing a physically active lifestyle is especially important for American Indian (AI) children who are at a greater risk for hypokinetic diseases, particularly Type 2 diabetes. The purpose of this study was to describe AI children’s pedometer-determined physical activity (PA) segmented into prominent daily activity patterns. **Methods:** Participants included 5th- and 6th-grade children (N = 77) attending school from 1 Southwestern US AI community. Children wore a pedometer (Yamax Digiwalker SW-200) for 7 consecutive days. **Results:** Boys accumulated 12,621 (±5385) steps/weekday and girls accumulated 11,640 (±3695) steps/weekday of which 38% (4,779 ± 1271) and 35% (4,027 ± 1285) were accumulated at school for boys and girls, respectively. Physical education (PE) provided the single largest source of PA during school for both boys (25% or 3117 steps/day) and girls (23% or 2638 steps/day). Lunchtime recess provided 1612 (13%) and 1241 (11%) steps/day for boys and girls, respectively. Children were significantly less active on weekend days, accumulating 8066 ± 1959 (boys) and 6676 ± 1884 (girls). **Conclusions:** Although children accumulate a majority of their steps outside of school, this study highlights the important contribution of PE to the overall PA accumulation of children living in AI communities. Further, PA programming during the weekend appears to be important for this population.

**Keywords:** pedometry, physical education, daily step counts

The need to understand where and how much physical activity (PA) children accumulate has become increasingly important in the development, implementation, and evaluation of interventions targeting PA. This is especially important for AI children who are at a greater risk for hypokinetic diseases, including Type 2 diabetes. When compared with an age- and sex-matched reference population 5 and 10 years of age, American Indian (AI) children were heavier and had a higher percentage of body fat. AI children are 3 times more likely to be obese than other US youth. BMI above the 85th percentile is more prevalent in AI children than in the overall US school-age population. Given the current public health emphasis and guidelines for daily PA, as well as the clear health benefits of PA, objective measurement of PA is a necessity.

Recently, schools have been identified as ideal institutional settings for promoting the health of youth through PA and the prevention and treatment of childhood obesity. It is therefore, essential to examine the PA opportunities children have at school to identify where increases in PA may be possible.

The pedometer has become a popular tool for measuring PA. As a result of its low cost and ease of use, it is used more and more frequently to assess children’s PA in field settings. For example, a recent review of pedometer-determined PA studies assembled over 40 studies that have determined free-living step values. More recently, a review of pedometer determined PA across 13 countries found 43 studies that examined steps/day. In both cases, however, very little attention has been paid to objectively assessing the free-living activity levels of AI children, or to how they accumulate PA over the course of the day segmented into the contributions of physical education (PE), lunchtime recess, and outside of school PA to overall school and daily activity patterns. Two previous studies have explored the typical pedometer-determined PA patterns across various physical activity segments, both of which primarily include non-AI children. Both studies found that children accumulate the greatest number of steps outside of school. Lunchtime recess was the greatest in-school contributor of PA for boys in both studies (13%–16%). Lunchtime recess was also the biggest contributor for 6th-grade girls, however, the 4th-5th grade girls accumulated the greatest amount of school PA during PE (14.3%).

AI children are known to be at risk for physical inactivity and obesity; however, little is known about their activity. Previous studies of non-AI children already exist; therefore, it is important to extend knowledge about children’s PA in this at-risk population. Therefore, the purpose of this study was to describe daily patterns...
pedometer-determined PA patterns (both weekday and weekend day) of AI children as well as to determine the contributions of PE, lunchtime recess, school day (activity accumulated during school hours), and outside of school, to their total day PA.

Methods

Participants
All 5th and 6th grade students (N = 77) from 1 southwestern US AI community were invited to participate in this study. The community school consisted of K–6th-grade students, exclusively of AI descent (> 95%). Approximately 5,000 people live in the community with an average household income well below average.14 Students were informed about the study during school hours and sent home with informed consent forms to request parent/guardian’s written consent (all students were given consent forms) for her/him to participate. Children also provided their own written assent. Participating teachers also provided written consent. University Institutional Review Board personnel, Tribal Council, and administrators at the community school approved all methodologies. A total of 77 students (57% boys and 43% girls) agreed to participate. Children were aged 11.26 (± 0.86) and had an average BMI of 25.0 ± 6.5 kg/m² (boys = 26.7 ± 6.7; girls = 22.6 ± 5.4). Almost all (> 90%) children rode the bus or got a ride to school.

Segmented School Day
A certified PE specialist taught PE to students twice during the week. PE classes were 30 minutes in length and included PA promotion, fitness activities (eg, jump roping and running), and team/individual sport activities (eg, soccer and basketball). The PE curriculum used at the school was Dynamic Physical Education15 (DPE). DPE includes a warm-up game, fitness activity, skill practice, and a culminating game. The daily lunch recess was 40 minutes (approximately 20 minutes to eat and 20 minutes to play) in length and lunch was held in the multipurpose (gym/cafeteria) room. When children completed eating their lunch, they were given unstructured PA time outside on the playground, courts, and fields. The exact amount of activity time varied from child to child depending on how long they took to finish their lunch. Students were free to play or not to play as long as they wanted until the lunch period was over. Very little equipment was provided (most students either played on the playground equipment or played large scale games with 1 ball) for recess. Children had a traditional playground (slides, swings, etc.) and some green space during recess. Students spent the remaining portion of their school day in a classroom for all other subjects.

Procedures
The Yamax Digiwalker SW-200 was chosen for this study, as it has been commonly used and has good reliability and validity for the measurement of children’s PA levels in field settings.16-18 The following pedometer protocol was adopted from previous research.9,12,13 Before data collection, all batteries were changed and a series of shake tests were performed to ensure correct calibration of the pedometers.19 Pedometers failing the shake test were discarded. In addition, all children completed a step test20 to ensure that the pedometer accurately measured their steps (all students with the assistance of a researcher were able to find an attachment site that allowed them to pass the step test). Each student was assigned a pedometer with a number (this number was consistent with their identifying ID for data collection).

Before data collection, the participating PE teacher and administrators were familiarized with pedometers and the assessment procedures. All children had previous experience using pedometers as part of their regular PE curriculum. The PE teacher provided additional practice opportunities with pedometers before data collection to limit potential reactivity or a change in regular activity patterns because they were being monitored. Finally, a brief 5-minute review of procedures was delivered by the research team on the first day of data collection, serving as a reminder for teachers/students. Specifically, as part of the step test (see above), participants were reminded how to locate the ideal location for pedometer attachment (typically attached to their waist band, centered over their right knee). Students were reminded that the only acceptable times to remove their pedometer were during all water activities and sleeping, and were instructed to reattach the pedometer immediately after completing these events. Students were instructed that they should wear their pedometer during all other times and to go about their normal activities.

Data collection took place over 7 consecutive days (5 school days and 2 weekend days) during the fall. A background questionnaire (completed by parents) was used to collect simple demographic information (ie, sex and grade). Weight (to the nearest 0.1kg) and height (to the nearest 0.5cm) were directly measured without shoes using a digital scale (Seca 882 Digital BMI Scale) and stadiometer (Seca 214 Portable Stadiometer).

The research team was present all day during the school portion of data collection to prompt students and provide instructions as needed to record data or comply with the protocol at the school. Each morning (ie, beginning of the school day), students were prompted to record their pedometer step counts and reset the pedometer for the current day. Students were also prompted to record their step counts before and after PE, lunch recess, and when they left school for the day. Research team members actively provided prompts throughout the day about correctly wearing the instrument and to ensure recording compliance. In addition, each day research team members scanned student step counts and questioned children if data appeared unusual (eg, more than 30,000 steps). When unusual data appeared it was typical explained by either accidentally resetting the pedometer or failing to reset after the previous days step totals. Weekend data were recorded by students throughout the weekend. Students
were reminded before going home for the weekend of recording responsibilities and parents were notified via reminder letters to help prompt their children to record step values on their recording sheet before they went to bed and when they woke up (in case they forgot before bed).

Validation checks were also used with each child by having them complete a brief survey about their previous day’s activity. These surveys asked children yes or no questions related to whether they wore their pedometer the entire day and if they removed the pedometer for any reason other than expected times (eg, shower, swimming). Any unusual or extreme responses were checked with the children for clarification (any unverified data were not used). Finally, data were entered each day into a spreadsheet as a means to check for any extreme or unusual values and to ensure the quality and completeness of the data. This entire process was repeated for each of the 5 weekdays and at the end of the weekend.

Data Analysis

BMI was calculated as kg/m$^2$ and students were categorized using the CDC sex-and-age specific growth charts as obese, overweight, or normal weight. Following established procedures a minimum of 2 days of data were required to be included in analyses. A valid day was defined as a day where the children reported wearing the pedometer the entire time (except for sleep/water activities). Children wore their pedometers for an average of 4.4 days. Means for total steps/day (both week and weekend days) were computed as well as mean steps attributed to PE, school day, lunchtime recess, and outside of school (calculated by subtracting the child’s at school activity from their 24-hour activity) activity. Independent $t$ tests were used to examine sex-specific and grade differences. ANOVA was used to examine BMI differences.

Results

Means and standard deviations for children across each segment of the day appear in Table 1. There were no statistically significant sex differences by BMI or grade. Figure 1 illustrates mean steps/day for each PA segment by BMI classification; Figure 2 illustrates steps/day for each PA segment by grade. $t$ test results showed that boys took significantly more total steps/day than girls during most PA opportunities, that is, weekend days, $t(62) = 2.70, P < .01, \Delta = 1300$; at school, $t(62) = 2.31, P < .05, \Delta = 772$ steps; lunchtime recess, $t(62) = 2.28, P < .05, \Delta = 371$ steps; PE, $t(62) = 2.71, P < .01, \Delta = 479$ steps. Boys and girls took statistically similar steps/day during weekdays, $t(62) = 1.03, P = .30, \Delta = 981$ steps; and outside of school (on weekdays), $t(62) = .21, P = .84, \Delta = 156$ steps. AI children were significantly more active on PE days (vs. non-PE days), $t(38) = 2.65, P < .05, \Delta = 1939$. No differences ($P = .21$) were found between the children with and without weekend data.

Discussion

The 5th- and 6th-grade AI girls (steps = 11,640 ± 3091) accumulated a comparable number of steps/weekday when compared with similar age and sex non-AI populations (10,479–12,332 steps) from the US. The boys (steps = 12,624 ± 4362); however, were less active than their age and sex matched non-AI counterparts (13,082–16,421 steps). Both boys and girls were less active than most of their international (non-American) counterparts. It is important to note that methodological differences (ie, Yamax vs. Walk4Life pedometer) may explain some of these differences.

An examination of weekend steps showed that boys (8066 ± 1959) and girls (6766 ± 1884) accumulated significantly fewer steps/day on the weekend than during the week. These step values are similar (7660 and 7317 for boys and girls, respectively) to a study that examined the weekend steps of 4th- and 5th-grade US children with various ethnic backgrounds. It would appear that children fail to make up for steps accumulated while at school during weekend days (outside of school weekday step counts were similar to weekend steps/day). The relatively low step values on these days highlight the importance of increased PA programming on weekends in this community.

PA accumulated during school hours accounted for 38% (boys) and 35% (girls) of children’s daily steps. More specifically PE class contributed nearly 25% to

### Table 1 Pedometer-Determined Physical Activity of American Indian Children

<table>
<thead>
<tr>
<th>Steps per day (n)</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total weekday (77)</td>
<td>12621 ± 4362</td>
<td>11640 ± 3091</td>
<td>11891 ± 3978</td>
</tr>
<tr>
<td>Total weekend (43)</td>
<td>8066 ± 1959</td>
<td>6766 ± 1884*</td>
<td>7370 ± 1899</td>
</tr>
<tr>
<td>At school (73)</td>
<td>4834 ± 1324</td>
<td>4062 ± 1350*</td>
<td>4404 ± 1350</td>
</tr>
<tr>
<td>Outside of school (73)</td>
<td>8017 ± 3539</td>
<td>7861 ± 2387</td>
<td>7757 ± 3172</td>
</tr>
<tr>
<td>Lunch recess (73)</td>
<td>1612 ± 649</td>
<td>1241 ± 653*</td>
<td>1419 ± 664</td>
</tr>
<tr>
<td>PE (73)</td>
<td>3117 ± 642</td>
<td>2638 ± 771*</td>
<td>2847 ± 754</td>
</tr>
</tbody>
</table>

*Note. Significant sex differences: * $P < .05$. 
children’s daily steps counts. Lunch recess contributed an additional 13% and 11% of the daily weekday steps for boys and girls, respectively. PE and recess represent more than one-third of children’s daily PA, illustrating that these time segments are important to their overall PA. Many schools are eliminating both PE and recess to provide increased academic opportunities, without these PA segments, many children would be losing an important PA opportunity. Previous research has suggested that children typically accumulate more steps during recess than PE. The differences in this study may be related to the lack of equipment, structure, and classroom teacher support during recess time.

A study (using a Walk4Life pedometer) examining the at school PA of Pima (AI) youth showed that the children accumulated 4237 (boys) and 4042 (girls) steps at school. These previous findings support the current study’s results that AI girls accumulate similar steps counts at school to other age and grade matched children. Boys, however, lag behind their age and grade matched non-AI peers.

Numerous studies have explored steps counts accumulated during PE classes. Due to various lengths of PE classes, a steps/minute ratio was used to compare studies. These studies suggest that students typically accumulate between 36–68 steps/minute during

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**Figure 1** — Steps/day for each PA segment by BMI classification.

**Figure 2** — Steps/day for each PA segment by grade.
PE depending on the content taught. The current sample accumulated 104 and 88 steps/minute (calculated by dividing PE steps by minutes of the PE class) for boys and girls, respectively. Most students (89%) met the recommended 2000 steps per 30-minute PE class. Assuming 5 minutes of instruction, the steps/minute ratio of 125/ min (boys) and 106/min (girls) suggests that a majority of the PA accumulated during PE was moderate-to-vigorous physical activity (MVPA; using the formula of 122 steps/min and 102 steps/min is equivalent to 1 minute of MVPA). PE appears to be a very important PA opportunity for this sample. The current findings also support previous research that suggested children are more active on PE days, indicating that PE may have a positive impact on children’s daily PA.

Although it is difficult to compare step counts accumulated during lunch recess across studies due to various recess lengths (eg, children can often begin their recess immediately after completing their lunch), the current sample accumulated a similar number of steps to a sample of non-AI Southwestern US children. Boys accumulated 1612 steps and girls accumulated 1241 steps compared with studies of non-AI children; where boys accumulated 1753 and girls accumulated 1289 steps during a similar 20 minute post lunch recess. When presented with free play (recess) opportunities, children, regardless of race or ethnic background appear to accumulate similar steps counts. Furthermore, with additional playground equipment and organized activities, recess may be able to add greater PA opportunity.

For the current study, outside of school activity was the biggest % contributor to children’s overall PA (7757 steps) and also is the largest time segment. Similarly, the current sample accumulated 7370 steps on weekend days, this would suggest that the children do not make up for the PA they accumulate at school (4404 steps) during the weekends. This highlights the importance of school day physical activity opportunities, without these PA opportunities, children may lose up to one-third of their PA.

A couple of limitations are important to note. First, pedometers were used, although great for measuring ambulatory PA, they do not measure water and/or cycling activities; although, these children had limited access in their community to water or cycling activities. Previous day recall indicated that less than 10% of children participated in these activities during data collection. Second, spring levered pedometers underestimate steps in overweight and obese adults, it is important to consider that the current sample consisted of nearly 50% of students considered overweight or obese. Lastly, although almost all of the 5th and 6th grade children in the community participated, the sample size was small, making generalizations difficult, further examination of AI youth with larger samples in various areas of the country may be warranted.

Conclusions

This study is important as it is the first study to explore the daily physical activity patterns of children living in an AI Community. The understanding of PA contributions during various segments and across different days is essential in designing effective PA interventions and programming as it allows researchers and practitioners to target specific times for PA. The school day and more specifically PE appears to be extremely important for this sample of children as nearly 25% of their daily PA is accumulated during this 30-minute time frame. Findings suggest that AI children when provided the resources and opportunity (ie, PE) for activity are just as active (if not more so) than their age and gender matched non-AI children. Children were significantly more active on PE days suggesting that PE is of importance for the sample. Lastly, PA programming on weekends appears to be extremely important for this sample. With very little structured activity opportunity on the weekends, these children are accumulating approximately 33% less steps/day during weekends.

References


