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Assessing the Influence of Season and Time of Day on Physical Activity Levels During Recess

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Abstract

Background: Recess time may significantly contribute to a child's daily opportunity to attain the recommended 60 minutes of physical activity per day. This study assesses the impact of block scheduling and season on physical activity levels during recess for children in Grades 3 and 6.
Methods: Data were collected over 5 consecutive days during fall and winter in a school from a northern Ontario community. Children wore the Yamax SW-200 pedometer, and data were collected using a segmented data approach to assess class time and recess time step counts.
Results: Seventy-eight students participated in this study. Average daily steps were higher in the fall compared to the winter. No meaningful differences were found in the number of steps taken considering time of day. Steps accumulated during fall recess were significantly higher than during winter recess. Boys accumulated significantly more steps than girls for total recess steps regardless of season. Grade 3 students experienced the greatest decrease in steps seasonally.
Conclusions: These results suggest that differences in recess step counts are impacted by season; this may be particularly true for younger children. Strategies to mitigate these declines should be implemented.

Keywords

physical activity; children; time of day; season; recess; balanced school day

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Human Subjects Approval Statement. The study protocol was approved by the Laurentian University Research Ethics Board and the school board of the participating school.

Review of Literature

The Canadian Physical Activity Guidelines recommend a minimum of 60 minutes of moderate to vigorous physical activity each day for children aged 5 to 11 (Canadian Society for Exercise Physiology, 2011). Canadian researchers have also estimated that 12,000 steps per day is roughly equal to 60 minutes of moderate to vigorous daily physical activity (Colley, Janssen, & Tremblay, 2012). Given that children spend roughly one third of their waking hours in school, this setting offers important opportunities for children to achieve recommended levels of physical activity. During the school day, students divide their time between classroom and recess time. Each time provides the children opportunities to accumulate the recommended daily physical activity. However, the levels and patterns of physical activity achieved during school hours are rarely explored in isolation from activity levels achieved outside the school setting. Given the current emphasis placed on schools to increase children's daily physical activity levels, further research is needed to fill this knowledge gap.

Students who experience inadequate amounts of physical activity face serious health risks (Boreham & Riddoch, 2001; Boyle, Jones, & Walters, 2010; Janssen & LeBlanc, 2010), and children who do not participate in physical activity throughout the day exhibit higher excess energy levels and poorer concentration in the classroom (Taras, 2005). In this context, scheduled recess is important for health and academic success. In Ontario, almost all school boards have adopted the balanced school day (BSD) schedule. The BSD is block scheduling wherein the school day is divided into three 100-minute teaching blocks separated by two 40-minute nutrition/activity breaks. A consequence of block scheduling, such as the BSD schedule, is the fundamental alterations in the number, length, and time of day that recesses are scheduled; specifically, schools now plan for two recesses, each 20 minutes in length, with the first being offered midmorning and the second midafternoon. The cumulative 40 minutes of outdoor playtime are believed to be fundamental for students to attain a significant portion of the recommended 60 or more minutes of daily exercise.

To maximize the amount of physical activity children achieve during school hours, close consideration of recess scheduling is warranted. For example, McWilliams et al. (2009) reported that children are more active when provided with shorter but more frequent bouts of physical activity compared to longer and less frequent opportunities to be active. More specifically, McKenzie et al. (1997) observed that children are most active for the first ten minutes of active play regardless of the length of playtime. This finding suggests that more frequent, shorter recesses would be more beneficial to maximize levels of physical activity at school. Also, according to Garriguet and Colley (2012), children aged 6 to 10 are most active from 11:00 a.m. to 1:00 p.m. In the context

of the BSD, children are in class during this time frame. This suggests that time of day during which recess time is scheduled may impact the amount of physical activity in which children engage.

The impact of inclement weather is a co-consideration when examining time-of-day effects and number of recesses to offer during school hours. According to Chan, Ryan, and Tudor-Locke (2006), inclement weather may have a negative impact on physical activity, yet this factor is commonly overlooked in research (Duncan, Hopkins, Schofield, & Duncan, 2008). A study by Duncan et al. (2008) has shown that low temperatures, strong winds, and heavy rainfall have a negative effect on outdoor physical activity and therefore may result in lower overall energy expenditure levels. Given that different geographical locations experience different climates, it is reasonable that school location will also impact children's physical activity (Duncan et al., 2008). More specifically, children attending schools located in climates that experience more dramatic seasonal variations in temperature are likely to experience greater fluctuations in physical activity levels, potentially impacting their health. It is also reasonable to envisage that physical activity levels may differ between morning and afternoon play periods, particularly during the winter season when cold temperatures may prohibit outdoor play in the morning. Given that the BSD schedule provides opportunities for recess in the morning and the afternoon, daily inclement weather could result in the cancellation of one or both of these recesses. Additionally, repeated extreme cold temperatures, particularly during the winter, would hypothetically impact total physical activity more dramatically in winter compared to summer, spring, or fall. This concept has not received considerable attention and merits further investigation.

Given the broad spectrum of physical capabilities and activity levels among elementary school–aged children from kindergarten to Grade 8, age-related differences in physical activity levels during recess should also be considered when examining school recess schedules. Although the physical activity levels of children of all ages are reportedly impacted by inclement weather (Chan et al., 2006; Tucker & Gilliland, 2007), more detailed studies comparing recess physical activity levels of children from different age groups are lacking and therefore merit consideration.

The purpose of this study was therefore to compare (a) total daily step counts accumulated during class time and recess time, (b) block scheduling effects on variations in step counts accumulated during morning and afternoon recess, and (c) seasonal variations in step counts accumulated during recess for children in Grades 3 and 6.

Methods

Study Design

Data were collected for 5 consecutive days during the fall (October) and winter (February) from an elementary school in northern Ontario. Students in Grades 3 and 6 at this school were asked to participate in the study. Parental/guardian information and consent forms were provided to each child's family prior to data collection. Student assent was obtained only from students who had received parental/guardian consent. This study was approved by the research ethics boards from the authors' academic institution and the school board of the participating school.

Participants

Seventy-eight children (49 boys, 29 girls) from Grades 3 ($n = 37$) and 6 ($n = 41$) from the identified school agreed to participate. The response rate was 63%.

Instruments

The Yamax SW-200 pedometer was used in this study as it has been shown to be the most consistent and accurate pedometer (Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002). Multiple tests have demonstrated the lowest absolute value of percent error under free-living conditions (Le Masurier, Lee, & Tudor-Locke, 2004). Yamax guidelines were followed when using the devices.

Procedure

Students were assigned a labeled pedometer prior to data collection and wore it throughout both data collection periods. During these data collection periods, students were exposed to their regular BSD schedule, which included a 100-minute classroom block, 40-minute nutrition and recess break (20 minutes each), another 100-minutes classroom block, a second 40-minute nutrition and recess break (20 minutes each), and a final 100-minute classroom block. Researchers attached pedometers to participants' waistbands each morning and removed them at the end of the school day. Each device was reset to 0 upon attachment in the morning, and researchers collected step counts from the devices before and after the morning and afternoon recesses and at the end of each day, allowing for total daily step counts to be segmented into class time and recess time. Students were instructed not to touch their pedometers and were monitored throughout the day.

Data Analyses

Data were expressed as mean values and standard deviation. Mean scores were computed for continuous variables and compared using independent sample *t* tests and paired sample *t* tests. Independent sample *t* tests were computed when step counts for two groups were being compared (e.g., Grade 3 and Grade 6 total recess steps for the fall). Paired sample *t* tests were used when comparing the same group of participants over two periods (e.g., Grade 3 total recess steps for the fall compared to Grade 3 total recess steps for the winter). For all analyses, statistical significance is reported at the < 0.05, < 0.01, and < 0.001 levels.

Results

Average Daily Step Counts Accumulated During Class and Recess Time

Total daily steps. Students accumulated an average of 5,899 (SD = 1,444.0) steps.

Recess. Students accumulated an average of 2,767 steps (SD = 804.5) during recess, representing 47% of the average daily steps being accumulated during school hours.

Class. Students accumulated an average of 3,132 steps (SD = 762.9) during class, representing 53% of the average daily steps being accumulated during school hours.

Block Scheduling Effects (Morning vs. Afternoon Recess)

A comparison of step counts achieved during the morning (AM) and afternoon (PM) recesses are displayed in Table 1. For the average 10-day AM and PM recess step counts for all students, boys, girls, Grade 3, and Grade 6, no difference was found in the number of steps taken, as assessed with the paired *t* test. Similarly, no differences were observed in the number of steps students took during the AM and PM recesses for the fall or winter seasons for all groups, with the exception of Grade 6 students in the winter (see Table 1).

Group Comparisons

Combined seasonal averages.

Gender. Compared to girls, boys accumulated significantly more steps in AM recess (boys: M = 1,547, SD = 342.4; girls: M = 1,121, SD = 378.0; $p < 0.001$) and PM recess (boys: M = 1,549, SD = 361.1; girls: M = 1091, SD = 341.5; $p < 0.001$). See Table 1.

Grade. No difference was found in the number of steps accumulated for the AM or PM recesses for Grades 3 and 6 (see Table 1).

Table 1

Time of Day Comparison for Step Counts During Recess: Mean (Standard Deviation)

	10-day mean step count			5-day fall mean step count			5-day winter mean step count		
	AM	PM	*p*	AM	PM	*p*	AM	PM	*p*
All (N = 78)	1,388 (409.8)	1,379 (416.2)	0.65	1,527 (473.9)	1,476 (496.3)	0.12	1,230 (472.8)	1,258 (449.7)	0.31
Boys (N = 49)	1,547 (342.4)	1,549 (361.1)	0.93	1,684 (392.8)	1,656 (439.4)	0.39	1,383 (469.1)	1,411 (447.5)	0.46
Girls (N = 29)	1,121 (378.0)	1,091 (341.5)	0.46	1,262 (486.7)	1,172 (440.8)	0.19	971 (356.7)	999 (319.5)	0.46
Grade 3 (N = 37)	1,468 (396.4)	1,423 (396.1)	0.08	1,686 (465.3)	1,624 (509.5)	0.11	1,226 (451.9)	1,185 (338.2)	0.35
Grade 6 (N = 41)	1,316 (413.1)	1,339 (434.5)	0.50	1,384 (439.6)	1,342 (449.0)	0.42	1,234 (496.6)	1,323 (526.4)	**0.01**

Note. AM = morning recess; PM = afternoon recess.

Fall step counts.

Gender. Boys accumulated significantly more steps than girls in AM (boys: M = 1,684, SD = 392.8; girls: M = 1,262, SD = 486.7; $p < 0.001$) and PM (boys: M = 1656, SD = 439.4; girls: M = 1172, SD = 440.8; $p < 0.001$) recesses.

Grade. Grade 3 students accumulated significantly more steps than Grade 6 students in the AM (Grade 3: M = 1,686, SD = 465.3; Grade 6: M = 1,384, SD = 439.6; $p < 0.01$) and PM (Grade 3: M = 1,624, SD = 509.5; Grade 6: M = 1,342, SD = 499.0; $p < 0.01$) recesses.

Winter step counts.

Gender. Boys accumulated significantly more steps compared to girls in the AM (boys: M = 1,383, SD = 469.1; girls: M = 971, SD = 356.7; $p < 0.001$) and PM (boys: M =1,411, SD = 447.5; girls: M = 999, SD = 319.5; $p < 0.001$) recesses.

Grade. No differences were found in the AM or PM recesses for Grades 3 and 6.

Seasonal effects (fall vs. winter).

Total daily steps. Overall, students accumulated significantly more steps in the fall (M = 6,267, SD = 1,652.7) than in the winter (M = 5,487, SD = 1,575.9, $p < 0.001$). See Table 2.

Recess. Students accumulated significantly more steps during recess in the fall (M = 3,003, SD = 927.1) compared to the winter (M = 2,488, SD = 890.4, $p < 0.001$). See Table 2.

Class time. Students accumulated significantly more steps during in-class time in the fall (M = 3,264, SD = 891.2) compared to the winter (M = 2,999, SD = 853.5, $p < 0.01$). See Table 2.

Boys. Boys accumulated significantly more steps in the fall compared to the winter for total daily steps (fall: M = 6,754, SD = 1,450.2; winter: M = 5,914, SD = 1,581.9; $p < 0.001$), total recess steps (fall: M = 3,340, SD = 799.9; winter: M = 2,794, SD = 877.1; $p < 0.001$), and total in-class steps (fall: M = 3,414, SD = 820.8; winter: M = 3,120, SD = 847.7; $p < 0.01$). See Table 2.

Girls. Girls accumulated significantly more steps in the fall compared to the winter for total daily steps (fall: M = 5,445, SD = 1,670.6; winter: M = 4,764, SD = 1,295.8; $p < 0.01$) and total recess steps (fall: M = 2,434, SD = 855.8; winter: M = 1,970, SD = 647.7; $p < 0.01$). No significant difference was found between seasons for total in-class steps. See Table 2.

Grade 3. Children in Grade 3 accumulated significantly more steps in the fall compared to the winter for total daily steps (fall: M = 6755, SD = 1794.3; winter: M = 5664, SD = 1402.8; p < 0.001), total recess steps (fall: M = 3310, SD = 949.0; winter: M = 2411, SD = 755.2; p < 0.001). No significant difference was found between seasons for total in-class steps. See Table 2.

Grade 6. Children in Grade 3 accumulated significantly more steps in the fall compared to the winter for total daily steps (fall: M = 5,827, SD = 1,393.3; winter: M = 5,327, SD = 1,718.8; $p < 0.05$) and total in-class steps (fall: M =

3,101, *SD* = 770.8; winter: *M* = 2,770, *SD* = 865.9; $p < 0.01$). No significant difference was found between seasons for total recess steps. See Table 2.

Table 2
Daily Step Counts by Season: Mean (Standard Deviation)

		Season		*p*
Sample		Fall	Winter	
All				
(100%, *N* = 78)	Total	6,267 (1652.7)	5,487 (1575.9)	**0.001**
	Recess	3,003 (927.1)	2,488 (890.4)	**0.001**
	Class Time	3,264 (891.2)	2,999 (853.5)	**0.01**
Boys				
(62.8%, *N* = 49)	Total	6,754 (1450.2)	5,914 (1581.9)	**0.001**
	Recess	3,340 (799.9)	2,794 (877.1)	**0.001**
	Class Time	3,414 (820.8)	3,120 (847.7)	**0.01**
Girls				
(37.2%, *N* = 29)	Total	5,445 (1670.6)	4,764 (1295.8)	**0.01**
	Recess	2,434 (855.8)	1,970 (647.7)	**0.01**
	Class Time	3,011 (960.9)	2,794 (838.0)	0.22
Grade 3				
(47.4%, *N* = 37)	Total	6,755 (1794.3)	5,664 (1402.8)	**0.001**
	Recess	3,310 (949.0)	2,411 (755.2)	**0.001**
	Class Time	3,445 (987.2)	3,253 (773.9)	0.19
Grade 6				
(52.6%, *N* = 41)	Total	5,827 (1393.3)	5,327 (1718.8)	**0.05**
	Recess	2,726 (823.4)	2,557 (1001.3)	0.14
	Class Time	3,101 (770.8)	2,770 (865.9)	**0.01**

Group Comparisons: Fall Step Counts

Gender. Boys accumulated significantly more steps than girls for total daily steps (boys: *M* = 6,754, *SD* = 1,450.2; girls: *M* = 5,445, *SD* = 1,670.6; $p < 0.001$), total recess steps (boys: *M* = 3,340, *SD* = 799.9; girls: *M* = 2,434, *SD* = 855.8; $p < 0.001$) and total in-class steps (boys: *M* = 3,414, *SD* = 820.8; girls: *M* = 3011, *SD* = 960.9; $p < 0.05$).

Grade. Grade 3 students accumulated significantly more steps than Grade 6 students for total daily steps (Grade 3: *M* = 6,755, *SD* = 1794.3; Grade 6: *M* = 5,827, *SD* = 1,393.3; $p < 0.01$) and total recess steps (Grade 3: *M* = 3,310, *SD* =

949.0; Grade 6: $M = 2{,}726$, $SD = 823.4$; $p < 0.01$). No significant differences were found between Grades 3 and 6 for total in-class steps.

Group Comparisons: Winter Step Counts

Gender. Boys accumulated significantly more steps than girls for total daily steps (boys: $M = 5{,}914$, $SD = 1{,}581.9$; girls: $M = 4764$, $SD = 1{,}295.8$; $p < 0.01$) and total recess steps (boys: $M = 2{,}794$, $SD = 877.1$; girls: $M = 1{,}970$, $SD = 647.7$; $p < 0.001$). No significant differences were found in the winter between boys and girls for total in-class steps.

Grade. Grade 3 students accumulated significantly more steps than Grade 6 students for total in-class steps (Grade 3: $M = 3{,}253$, $SD = 773.9$; Grade 6: $M = 2{,}770$, $SD = 865.9$; $p < 0.05$). No significant differences were found between Grades 3 and 6 for total daily steps or total recess steps.

Discussion

The aim of this study was to assess how physical activity levels in children from Grades 3 and 6 from a northern Ontario elementary school are impacted by the recess schedule of the BSD and by season. Our findings show that the levels of physical activity during recesses are significantly reduced during the winter months, particularly for younger students, whereas recess scheduling has no impact. Daily total step counts in the present study are similar to those reported by Gauthier, Laurence, Thirkill, and Dorman (2012), further indicating that the school setting is not likely being fully exploited to help children achieve the recommended daily physical activity levels. Results from our study indicate that throughout the day participants accumulated only 52% (6,267 steps) of the recommended 12,000 steps in the fall and 46% (5,487 steps) in the winter. As data were collected via a segmented approach, we can report that during recess time participants attain only 25% (3,003 steps) of the recommended daily physical activity in the fall and 21% (2,488 steps) in the winter. Therefore, unless children engage in physical activities outside school hours, the 40 minutes of unstructured play provided by recess periods of the BSD appear to not engage students sufficiently in physical activity levels that are conducive to health and wellness.

Our findings also suggest that boys accumulate more recess-based physical activity than girls, which has also been reported in other studies (Beighle, Morgan, Le Masurier, & Pangrazi, 2006; Huberty et al., 2011; Nettlefold et al., 2011; Ridgers, Stratton, & Fairclough, 2005; Ridgers, Tóth, & Uvacsek, 2009; Verstraete, Cardon, Clercq, & De Bourdeaudhuij, 2006). Some researchers have postulated that these gender differences arise due to the behaviors in which each gender engages at recess time. In particular, some researchers have suggested that boys tend to engage in more competitive and sporting behaviors (Blatchford, Baines, & Pellegrini, 2003) and girls participate more in seden-

tary play (Blatchford, Baines, & Pellegrini, 2003; Ridgers, Stratton, & McKenzie 2010). Accordingly, these results suggest that physical activity interventions targeting the interests of girls to increase their participation in recess-based physical activity are warranted; however, boys should also be encouraged to increase their physical activity levels during recess. Furthermore, Grade 3 students accumulated more physical activity than Grade 6 students. These findings are consistent with similar studies that have focused on recess-based physical activity (Gauthier et al., 2012; Ridgers, Saint-Maurice, Welk, Siahpush, & Huberty, 2011). Therefore, strategies to enhance physical activity participation in older students during recess time are also needed.

Although participants did not appear to maximize opportunities for physical activity throughout the day, a fairly balanced amount of steps were accumulated during the AM and PM recess time during fall and winter. In other words, children using the BSD are engaging in equal amounts of physical activity in the AM and PM recesses, but this amount likely remains insufficient to attain healthful levels of physical activity, particularly if children are not engaged in activities outside of school.

The present study is the first to report the impact of season on recess-based physical activity for students using the BSD. Our results clearly demonstrate that season has a strong influence on physical activity levels attained during recess time by children using the BSD schedule. Specifically, step counts are significantly reduced in the winter season. This is particularly worrisome given that previous studies have shown that declines in activity in the winter months persist into overall declines in subsequent seasons as well (Chan & Ryan, 2009).

The area in which this study was conducted faces varying weather conditions during the elementary school year. For instance, in October, average temperatures are 5.8°C, whereas in February average temperatures are -11.4°C with extreme temperatures as low as −50 °C with the wind chill (Environment Canada, 2013). According to Chan et al. (2006), weather conditions may have a great influence on outdoor activities, impacting daily steps counts and overall energy expenditure. They postulated that an increase in temperature by 10°C may result in a 2.9% increase in steps per day. In the present study, students accumulated 515 steps fewer during recess in the winter, and Grade 3 students experienced the greatest decrease in steps seasonally, dropping by 899 steps from fall to winter. This suggests that to increase recess-based physical activity levels in colder weather, interventions targeting children, particularly younger students, are warranted. For instance, some winter physical education classes could be held outside, focusing on educating children on how to engage in snow-related activities. This would allow the younger students to become more comfortable and engaged during inclement weather, in turn accumulating more physical activity during recess time. Indoor play could also be implemented. The option of playing in the gymnasium during cold weather spells

may be more conducive to active play; however, this option may be feasible only in schools with a small student population.

Limitations

Pedometers were used in this study because they are commonly used for assessing physical activity levels (Bassett & John, 2010). The frequency of pedometer use has increased for measuring levels of physical activity in children as these devices yield more objective data than traditional self-report instruments such as physical activity logs, diaries, and questionnaires (Bassett & John, 2010). These latter subjective measures are less suitable as they require memory recall, which when used to record physical activity levels are highly prone to self-reported bias specifically in children (Bassett & John, 2010; Welk, Corbin, & Dale, 2000; Sallis & Saelens, 2000) as a child's cognitive development may impair the ability to provide accurate recall (Baranowski, 1988). Although more reliable than certain survey data, pedometers are limited as they do not assess all aspects of physical activity, specifically duration and intensity of movement. Using a more comprehensive tool (e.g., accelerometers) would have allowed for a more detailed understanding of the children's activity patterns (i.e., intensity). Furthermore, despite the strong response rate and sample size, the simultaneous assessment of recess-based physical activity at multiple schools using scheduling variations would have been beneficial. The addition of multiple schools, with various school schedules, would have allowed for a more comprehensive analysis of the impact of season on recess-based physical activity. Additionally, assessing multiple schools at more frequent intervals (not just fall and winter) would have provided a more in-depth analysis of the influence that weather may have on recess-based physical activity. Overall, the inclusion of multiple schools, with varying schedules, over a broader range of weather would allow for a study like this to provide more generalizable results.

Furthermore, the study would have benefited from the collection of additional covariates. For example, the study was focused only on the impact of the general concept of season, yet the addition of daily temperature values may have allowed researchers to control for weather conditions. Additionally, controlling for individual predictors of physical activity, such as body mass index, would also have been beneficial. As such, future studies should consider controlling for additional confounding elements.

Conclusions

As a result of this study, we have reaffirmed that children are not maximizing opportunities for physical activity during the school day. In general, girls have a lower step count than boys. We also conclude that the recess schedule (i.e., AM vs. PM) does not affect physical activity during recess in children using the BSD; however, a seasonal influence exists. All children were less active

in the winter recess compared to the fall, and this was particularly accentuated among the younger participants. Future studies in this area of research would benefit from including schools using the same organizational system for recess time, schools using different scheduling systems, and data collection periods throughout the school year, a strategy that would result in more generalizable results.

Implications for School Health

This study has four main applied findings. First, strategies to enhance active play during recess, irrespective of time of day or season, are warranted as recess time is severely underused. Second, this study reaffirms the need for targeted strategies to enhance active play for girls. Third, strategies to mitigate the declines in physical activity during the winter should be implemented. For example, situations where extreme weather conditions apply may warrant physical activity interventions including more organized, inclusive outdoor play or perhaps indoor gymnasium activities. Finally, despite this study finding no difference in recess step counts at different times of day, and thus confirming that the BSD is a balanced school scheduling system as it relates to comparative physical activity levels, administrators need to consider all aspects affected by modifications of school scheduling. We recommend that administrators work with the research community to properly evaluate the impact of administrative changes on physical activity levels and corresponding health and wellness effects prior to a complete implementation. The adoption of healthful behaviors during childhood that include exercise and physical activity has long-lasting impacts on physical activity behaviors in adulthood. Schools should recognize their important role and contributions in helping children achieve lifelong well-being.

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