

RESEARCH ARTICLE

# Comparing Physical Activity Behavior of Children During School Between Balanced and Traditional School Day Schedules

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## ABSTRACT

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**BACKGROUND:** Some Canadian schools have modified their daily schedules from the traditional school day (TSD) schedule (two 15-minute breaks and one 60-minute break) to a balanced school day (BSD) schedule (two 40-minute breaks). While this change increases daily planning and instructional time, it also changes the amount of time available for moderate-vigorous physical activity (MVPA).

**METHODS:** This study uses a case-control design to examine differences in objectively measured MVPA between children in 3 schools using a BSD schedule and 3 schools using a TSD schedule. Study participants (aged 10-12 years) were recruited from schools in Ontario, Canada.

**RESULTS:** Regardless of schedule type, girls had lower MVPA than boys, and as both boys and girls got older their MVPA significantly decreased. The findings indicate there was no statistically significant difference in the total minutes of in-school MVPA between children from BSD schools and children from TSD schools. MVPA was significantly higher for older girls attending BSD schools than older girls attending TSD schools, suggesting that implementing a BSD may help curb declining MVPA as girls enter adolescence.

**CONCLUSION:** Despite encouraging findings, more rigorous studies (ie, pre-post experiments with control) are needed to better understand how changing schedules impacts children's health.

**Keywords:** school schedule; elementary school; physical activity; accelerometer; case-control.

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Over the last decade, many schools in Ontario have altered their daily schedules to better fit the needs of students and staff. School boards have done this through the implementation of the balanced school day (BSD), which was first implemented by the Peel District School Board in Ontario.<sup>1,2</sup> The BSD divides the daily schedule into 3 blocks of 100 minutes separated by two 40-minute nutrition and activity

breaks, rather than the traditional school day (TSD) schedule of two 15-minute recesses with one longer 60-minute break for lunch.<sup>3</sup> Advocates for the BSD believe that the BSD schedule provides more classroom time as there is less interruption in the day for students to get ready to go outside, improves student concentration and academic success due to increased planning and instructional time, and provides more

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opportunity for participating in continuous physical activity (PA) because the breaks are longer.<sup>3-5</sup> While these assertions sound like a good reason for moving to a BSD schedule, there is very little research evaluating whether they are true.<sup>6</sup>

Despite the lack of research evaluating the benefits of BSD, more schools are moving to this model, mostly due to financial issues. According to Dorman et al,<sup>4</sup> benefits of the BSD are 2-fold: (1) school boards are required to provide teachers with a 40-minute lunch break by the collective bargaining agreement and the BSD schedule provides this opportunity without paying for additional staff for lunch supervisions<sup>7</sup>; and (2) fewer breaks decreases supervision time, improves school cleanliness, and reduces incidences of playground aggression.<sup>2</sup> Because the financial benefits of the BSD are appealing to school boards, it appears that this model of scheduling will continue to be implemented in more schools throughout the province. This trend increases the importance of understanding the impact that the BSD has on children's learning, nutrition, and PA during the school day.

Whereas there has been some recent work focusing on how children's nutrition<sup>8,9</sup> is impacted by the BSD schedule, there is still little rigorous evidence evaluating the effect of the BSD schedule on children's PA during the school day.<sup>10</sup> Understanding the impact of the BSD on moderate-vigorous physical activity (MVPA) is necessary considering that children spend about a third of their day in school,<sup>11,12</sup> which means children need to be active during school hours to have the best chance of obtaining the recommended 60 minutes of daily MVPA.<sup>13</sup> Ridgers et al<sup>14</sup> found that MVPA during school recess time accounted for 17.9% of boys' and 15.5% of girls' (grades 3-6) daily MVPA. Considering that only 9% of Canadian children aged 5 to 17 years are achieving the recommended amount of daily MVPA,<sup>15</sup> maximizing in-school MVPA is a viable way to increase children's PA levels.

Beyond a few unpublished reports, a review of the academic literature revealed only 2 published studies that empirically evaluated the impact of the BSD on children's PA. The unpublished reports were primarily conducted on behalf of school boards, subjective in nature, and unable to quantify the impact of the BSD on PA behavior.<sup>1,2</sup> The first report was commissioned by the Halton District School Board, and provided very limited results in terms of PA.<sup>1,2</sup> The key finding was that 47% of students in BSD schools felt their school had more clubs, sports, and school activities for students compared to when they had a TSD schedule. The second report was carried out by the Hamilton-Wentworth District School Board to examine key differences in schools where the BSD was introduced between 2002 and 2004.<sup>1,2</sup> The most relevant finding from this study was that primary and junior students

(kindergarten to grade 6) perceived a decrease in the time to play, while intermediate students (grades 7 and 8) perceived an increase in the time to play, after their schools moved to the BSD schedule.

These subjective results do not sufficiently answer the question as to whether the BSD impacts children's PA levels. A more recent study by Gauthier et al<sup>11</sup> examined the differences in step count, as measured by a pedometer, for grades 3 to 6 students over 4 school days for a BSD school compared to a TSD school. Their results indicated that there were lower average step counts in the BSD school over the course of the day, suggesting that children in BSD schools are less active than those in TSD schools. Another recent study by Vanderloo and Tucker<sup>10</sup> compared objectively measured PA, as measured by an accelerometer, of kindergarten children who attended BSD schools compared to TSD schools. This study concluded that there was no significant difference across school schedule type for overall daily PA and overall sedentary time during school hours, but there was significantly more PA during periods of outdoor play for children in TSD schools.

Overall, these findings are not conclusive, although they do suggest that the BSD may decrease PA levels of children during the school day compared to the TSD. Nonetheless, both had methodological limitations. The work by Gauthier et al<sup>11</sup> provides some evidence that the BSD may decrease PA, but the use of pedometers is a limited measure of PA.<sup>16</sup> Moreover, as the study only compares 2 schools, there is high possibility that other factors, such as the weather, special school events, and school environment,<sup>17</sup> may have confounded the relationship between number of steps and the type of schedule. Vanderloo and Tucker's<sup>10</sup> research builds upon Gauthier's work by providing an overview of how the BSD impacts PA for kindergarten students, there is still very little known about how the BSD impacts the PA of older children, especially pre-teens who are most at risk of declining PA outside of school.<sup>18</sup> Their study also fails to account for confounding factors related to weather, school events, and school environment. The purpose of this study is to build upon this previous research to gain a better understanding of how the BSD can influence PA behavior of children ages 10 to 12 across 6 schools—3 BSD and 3 TSD schools—using a case-control study design. Specifically, this study addresses the following 2 research questions: (1) Does MVPA differ between case-controlled matching schools with BSD and TSD schedules? (2) Is the effect of scheduling different for boys and girls and for younger and older children?

## METHODS

### Participants

This study utilizes a subsample of data from the Spatial Temporal Environment and Activity

Monitoring (STEAM) project that were collected between 2010 and 2013 with 932 students (recruitment rate of 66.9%) aged 10 to 13 years old from 34 schools across Southwestern Ontario, Canada. The STEAM project used an innovative suite of data collection tools and analytical techniques to help gain a better understanding of the causal influences of children's environments on their health-related behaviors. All children received parental/guardian consent and provided assent before participating in the study. Full details of the protocol are available elsewhere (<http://steamproject.ca>).<sup>19-23</sup>

The subsample utilized for this study includes 272 children from 6 schools, 3 schools with the BSD schedule and 3 paired schools with the TSD schedule. Based on geographic location (ie, urban, suburban, rural) and neighborhood characteristics, each of the BSD schools was matched with a school that uses a TSD schedule and was measured on the exact same day. Using case-control matched schools by date provides the ability to control for weather, seasonality, and year (the data collection occurred in spring of 2012 and 2013).<sup>17</sup>

The characteristics of the 3 pairings of schools used for this study are as follows. The pairings of BSD and TSD schools were selected based on data being collected on overlapping days and having similar socioeconomic and physical environmental characteristics, as environmental factors can influence children's PA.<sup>17,21</sup> The first pair of case-control-matched schools (BSD1 and TSD1) are located in the same small town in Middlesex County with students from middle- to high-income families. The second case-control-matched schools (BSD2 and TSD2) are French first language schools located in London, Ontario that have catchment areas that include both urban and rural students from middle- to high-income families. The final 2 case-control-matched schools (BSD3 and TSD3) are rural schools from contiguous counties (Middlesex and Elgin) with students from middle- to low-income families. Unusual school days, such as days with field trips, indoor recesses, and sports competitions, were identified and removed from both BSD and TSD schools to ensure that the comparison was based on activities that occur during a normal school day. There were no known planned PAs at any of the schools during the breaks, and the facilities available within the school yards were relatively similar between school pairings.

### Instruments

The instruments from the STEAM protocol that are used for this paper include Actical™ accelerometers (Bio-Lynx Inc., Montreal, Quebec, Canada) and the Healthy Neighborhood Survey for Youth.

The *outcome measure* is defined as the number of minutes a child participates in MVPA during the entire

school day as objectively measured by the Actical accelerometer. The Actical accelerometers provide valid measures of PA and active energy expenditure for children.<sup>24-26</sup> Each accelerometer records PA in 30-second epochs and is calibrated for date, sex, and objectively measured height and weight using a stadiometer and validated scale. Participants wore the accelerometers on their right hips for up to 8 consecutive days (ie, 6 weekdays and 2 weekend days), during waking hours only, except for water activities (eg, baths, swimming). School days were defined by the official start and end time as provided by each school. A valid day was defined as an entire school day of wear time, as children with nonwear time during the school day were excluded from the analysis. Nonwear time was classified as 60 consecutive minutes of zero activity with allowance for 1 to 2 minutes of counts between 0 and 100.<sup>27</sup> Cut points for MVPA were defined following the methodology of past research, where accelerometer activity counts are greater than 1500 counts per minute.<sup>26,28</sup>

The Healthy Neighborhood Survey for Youth<sup>19-22</sup> was used to collect information about age and sex of each participant. The *control variables* used for this study are age and sex, as the literature has found that MVPA levels decrease as children get older,<sup>29-31</sup> and, on average, boys are more active than girls during school breaks.<sup>14,32</sup> Schedule type was measured by a binary indicator with the BSD (0) serving as the reference group compared to the TSD (1).

### Data Analysis

Two analyses were conducted in this study to address the research questions. First, a *t*-test was computed to assess the overall effect of scheduling type on MVPA behavior. Second, multivariable regression was used to assess whether scheduling type affect younger and older children differently. To control for the expected effect of sex, the regression model was run separately for girls and boys. All estimates were assessed at the  $p = .05$  level of statistical significance. IBM SPSS Statistics (version 24, IBM, Markham, Ontario, Canada) was used for all analyses.

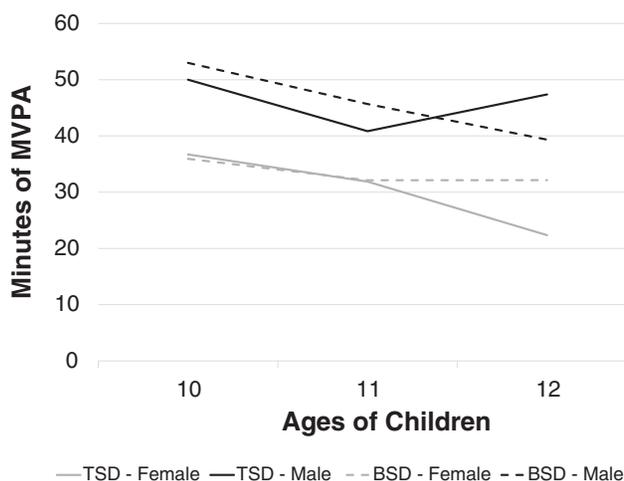
### RESULTS

A total of 272 children from the 6 case-matched schools were used in the current analysis, providing data on their MVPA for 1005 days. After applying the accelerometer quality control measures (ie, PA counts for the entire school day), 163 children with 507 valid days were retained for analyses (266 valid days for children from BSD schools and 241 valid days for children from TSD schools). There were 10 days of observations available, 3 days for 2 pairs of schools (BSD1-TSD1 and BSD2-TSD2) and 4 days

**Table 1. Results of Multivariable Regression Analysis Assessing How Boys' and Girls' Physical Activity in Schools With a Balanced School Day Schedule (the Reference Group) and School With a Traditional School Day Schedule Differ by Age**

| Estimate                     | B      | Std. Error | Chi-Square | p-Value | 95% Confidence Interval |        |
|------------------------------|--------|------------|------------|---------|-------------------------|--------|
| Girls                        |        |            |            |         |                         |        |
| Intercept                    | 34.811 | 2.322      | 14.993     | .000    | 30.241                  | 39.381 |
| Traditional school day       | 2.821  | 3.025      | 0.932      | .352    | -3.134                  | 8.776  |
| Age                          | -1.851 | 1.903      | -0.973     | .332    | -5.596                  | 1.895  |
| Traditional school day × age | -5.219 | 2.496      | -2.091     | .037    | -10.133                 | -.306  |
| Boys                         |        |            |            |         |                         |        |
| Intercept                    | 52.524 | 4.167      | 12.605     | .000    | 44.307                  | 60.741 |
| Traditional school day       | -8.387 | 6.342      | -1.322     | .188    | -20.894                 | 4.120  |
| Age                          | -6.681 | 3.130      | -2.135     | .034    | -12.854                 | -.509  |
| Traditional school day × age | 7.089  | 4.639      | 1.528      | .128    | -2.059                  | 16.238 |

**Figure 1. Minutes of MVPA as a Function of Age for Boys and Girls.**



for third pair of schools (BSD3-TSD3). Each child provided, on average, 3 days of accelerometer data. When comparing the rates of MVPA between boys and girls, as expected, boys (44.9 minutes/school day) were found to be much more active than girls (31.9 minutes/school day) in both BSD and TSD schools. Trends in age were also as expected with the minutes/school day decreasing as age increases (ie, 40.2 minutes/school day for 10 years old, 37.3 for 11 years old, and 34.6 for 12 years old).

In terms of the results related to the research questions, there was no statistically significant difference ( $t = -1.159$ ;  $p = .247$ ) in the total minutes of in-school MVPA when comparing children from 3 BSD schools (38.0 minutes/school day) and children from 3 TSD schools (36.0 minutes/school day). While the overall effect of schedule type was not statistically or substantially significant, there were some important differences between boys and girls. The results from the multivariable regression analysis, depicted in Table 1, indicate that there was a statistically significant interaction effect ( $p = .034$ ) between schedule type and age

among girls, suggesting that the effect of schedule type on girls' MVPA depends on their age. The nature of this relationship is depicted in Figure 1. These results suggest that, among girls from TSD schools, MVPA decreases as girls get older; yet for girls from BSD schools, the level of MVPA tends to remain constant between the ages of 10 and 12. The results for boys indicate that there was no statistically significant interaction between schedule type and age ( $p = .128$ ).

## DISCUSSION

The current study builds upon previous research<sup>10</sup> by using a case-control design to better understand the impact that the BSD has on children's MVPA during the school day. The results of this study indicate that children in both BSD and TSD schools, on average, get approximately half of the recommended MVPA during school time. Maintaining high levels of MVPA during the school day, regardless of schedule, is very important for children's health, as they spend up to 8 hours of their day at school. Previous research also shows that high levels of MVPA within school can help

children in obtaining the recommended 60 minutes of MVPA per day.<sup>21</sup>

The results of this study also suggest that schedule type does not contradict the age and sex differences in MVPA consistently reported in the literature. Boys attending schools in both schedule types, on average, are found to participate in more MVPA per day<sup>10</sup> or have higher daily step counts<sup>11</sup> than girls. Similarly, as children in both schedule types get older, regardless of sex, they participate in less MVPA during the school day.<sup>21</sup> These results suggest that schools need to find ways to increase PA levels, especially among girls and older children during the school day to help them attain the recommended 60 minutes of daily MVPA, which is especially true with the decrease in the frequency of physical education classes as children enter secondary school. To increase MVPA within the schools, policies, such as daily PA,<sup>33,34</sup> and school-based interventions<sup>35,36</sup> should be developed and implemented in both types of schools regardless of schedule type to try to mitigate the trend of declining MVPA.

Although the norms about in-school PA across age and sex held true in this study, the assumptions that BSD schedules will improve children's ability to be physically active are mixed. Our findings do not indicate a significant difference in the average minutes of MVPA per day, which is consistent with previous studies.<sup>10</sup> Furthermore, Gauthier et al<sup>11</sup> found a significant difference in step counts between those attending schools with TSD schedules, suggesting BSD schedule types may lead to a reduced level of PA. One of the findings from this study is that as girls get older, their level of PA declines less if they are attending a school with a BSD schedule compared to a TSD schedule. The finding that older girls are more active in BSD settings than in TSD settings coincides with previous work by Woerhle,<sup>2</sup> who found that older children perceive that they have more time to play in BSD schedule schools.

### Limitations

Although this study has greatly improved upon the study designs used in previous studies, there are still some limitations that could be addressed in future work. Using a case-control study design by day improves upon past work by controlling for issues that arise from comparing temporally mismatched data, such as weather, seasonality, and special days (eg, holidays, field trips). This study also has accounted for unusual days in the school schedule, such as indoor recesses, field trips, and other such activities, by removing them from the analysis entirely to ensure that the same calendar days are compared across schools with different schedule types. Despite these attempts to control for as many between-school factors

as possible, there are others that cannot be controlled for, such as the quality of the school playground children can access, physical education schedules, and any organized activities that occur during a lunch/recess period that may provide additional barriers or opportunities for PA.

### Conclusions

The BSD school schedule is an increasingly popular method of scheduling the school day for elementary schools in Ontario, Canada. While there are proven financial benefits for the Ministry of Education and regional school boards to implement the BSD,<sup>7</sup> much of the academic and health benefits advocated for the BSD are assumptions rather than supported by empirical research findings. In a review of this scheduling policy, Wu et al<sup>6</sup> put forward that the evidence pertaining to the effects of the implementation of the BSD on children's eating and PA behaviors has been inconclusive. The current study aimed to fill this gap to better understand how the BSD schedule impacts children's MVPA levels compared to the TSD schedule.

The findings show that using the BSD schedule provides no PA benefit to children ages 10 to 12 compared to the TSD schedule, with the exception that older girls who had increased levels of PA. While these findings on their own are not enough to decide as to whether the BSD should be implemented across the Province of Ontario and other jurisdictions, they are encouraging as older girls are the most vulnerable to experience the lowest levels of MVPA among the study group. This study offers an important start to better understanding the PA benefits of the BSD, but there is still work to be done using more rigorous study designs. For instance, a longitudinal pre-post design with control group could be used to see how changing the school schedule impacts PA from the TSD schedule (pre) to the BSD schedule (post). More rigorous experimental studies on the impacts of changing schedules are possible, if researchers work in close collaboration with school board administrators early in the decision-making process, so that they are afforded enough time to properly plan, resource and undertake evaluations in schools before the interventions take place. Furthermore, qualitative research (ie, focus groups, interviews) is necessary with children, parents, and school staff to help identify the specific elements of the school environment (eg, schedule, PA equipment, programming, social factors) that influence PA levels.

### IMPLICATIONS FOR SCHOOL HEALTH

Most school-aged children and youth in Canada are not getting enough daily PA to achieve the associated health benefits.<sup>15</sup> To increase the likelihood of children

accumulating the recommended amount of MVPA during school hours, children need to be provided with opportunities to be active throughout the day.<sup>21</sup> This study found that as children get older they are less likely to be physically active and girls are less likely to be active than boys. To help increase MVPA of girls and older children, schools can implement comprehensive school PA programs that establish strong physical literacy and sound activity practices in kindergarten and continue to reinforce these habits throughout their school years.<sup>37</sup> A comprehensive school program includes a few key components:

1. Government and school board leadership should develop Comprehensive School PA Programs that include recess, intramurals, interschool sports, classroom PA breaks, and walk and bicycle to school initiatives<sup>38</sup>
2. Government should find ways to alter curriculum to require daily physical education and/or PA opportunities (eg, daily PA).<sup>33</sup>
3. Schools promote PA in schools by providing opportunities for intramurals and interschool sports, incorporating PA and outdoor education into different subjects (eg, walks outside for science), and participation in PA-related activities and festivals (eg, active and safe routes to school, international walk to school day, bike rodeos).<sup>39-41</sup>
4. Schools can also work with community organizations to support and promote in and out of school PA activities and interventions that can help change behavior,<sup>23,42-44</sup> especially those targeting older children and girls.<sup>36</sup>

Using this Comprehensive School PA Program can provide schools an opportunity to purposefully increase PA opportunities across the entire school without adding much financial burden to the schools, although teachers will be required to do some work to find opportunities within the curriculum to incorporate PA into the daily routine of a classroom.

Another key result of this study is that MVPA is not significantly different between schools with TSD and BSD schedules; although older girls were found to have significantly higher MVPA when on a BSD schedule. Further research is warranted to see if this trend continues after employing a more experimental design, and if it does continue, the findings may implicate that adopting a BSD schedule in schools could improve the PA levels and overall health of children within those schools. Despite a growing body of encouraging findings to date, we recommend that school board administrators and principals who are interested in switching to a BSD should proceed cautiously and work collaboratively with researchers, teachers, support staff, parents, and students to track and evaluate

potential impacts on multiple outcomes within their school (eg, PA levels, student academic achievement, behavioral issues, eating habits, teacher planning, supervision time). Adopting a collaborative evidence-based approach, such as running a school-wide pre-post with control group intervention evaluation, can help remove concerns that stakeholders may have about implementing or continuing with the BSD, and help generate more rigorous research evidence about its overall effectiveness.

### Human Subjects Approval Statement

The STEAM project data used in this study was approved by Western University's Non-Medical Research Ethics Board (NMREB#: 17918S), by the research ethics officers of 4 school boards. All children who participated in this study received informed parental consent and provided their own informed assent before participating.

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