Original Article (short paper)

Differences in physical activity levels of school domains between high- and low-active adolescents

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Abstract — Aim: To compare high active (HA) and low active (LA) adolescent’s physical activity (PA) levels in three different domains: commuting to school, physical education (PE) class and recess time at school. Method: This is a cross-sectional study, with a quantitative approach and random sample of 176 (105 girls) adolescents aged 14 - 18 years old from 10 urban public high schools in southern from Brazil. PA levels were measured using a pedometer. The average number of steps was recorded on the way to school, during PE classes and during school recess time. Participants were classified as HA and LA according to Tudor-Locke’s cut-off points. Data were analyzed using descriptive statistics and One-Way ANOVA stratified by sex. Results: Data showed differences of mean values between school commuting PA for girls (LA: 1057.60; HA: 1624.54; Δ: 566.94; p<0.001), during PE class (LA: 1401.75, HA: 1701.10; Δ: 308.53; p<0.05) and in recess time (LA: 443.09, HA: 611.98; Δ: 168.89; p=0.001), whereas for boys, differences only found between the mean values of PA during PE class (LA: 1787.91, HA: 2511.20; Δ: 723.29; p<0.01). Conclusion: HA girls are consistently more active in each domain analyzed compared to LA counterparts, while for boys PE class was the domain that differentiated the HA vs. LA adolescents. This study highlights some potential settings to be included in the policies focused in enhance PA levels among adolescents namely in the context of school PE.

Keywords: youth; health; physical education; active commuting.

Introduction

Low levels of physical activity (PA) are associated with increasing risk of several chronic diseases and premature mortality¹,². Therefore, the detection of insufficient levels of physical activity seems to be essential for identifying children and adolescents with increased risk of developing health problems early in life, such as metabolic syndrome, diabetes, obesity and other cardiometabolic risk factors³,⁴.

There are several determinants associated with regular engagement in PA, including parental support, school environment, active commuting, leisure activity and available places for PA practice⁵,⁶. For evidence-based planning of public health interventions it is important to understand these determinants of PA behavior as well as the context in which they occur⁷. One of the more important settings for interventions to enhance PA levels in the school, particularly through developing and applying programs related to health promotion and also curriculum physical education (PE) classes⁸, active recess time and even commuting to school. However, the contribution of these different domains to total daily PA is not well established. This is especially the case for high active (HA) and low active (LA) adolescents. Understanding if there are differences in the use of different domains for PA between HA and LA adolescents is an important first step for effective targeting of interventions to enhance PA and improve health status.

Thus, we hypothesized that HA adolescents are more active in commuting to school, PE class and recess time at school. In addition, we emphasize that the present study add new information, since no investigation has been developed, regarding difference between PA levels in these contexts among Brazilian adolescents. The purpose of the current study was to compare HA and LA adolescent’s PA levels in three different domains: commuting to school, PE class and recess time at school.

Methods

Participants

This study uses a cross-sectional, quantitative, study design. The population of the study comprises adolescents drawn from 15 public high schools from Passo Fundo, RS, Brazil. Approximately 4,599 students were enrolled in the public high school education network, according to the 7th Regional Education Coordinator. All data were collected between August and December 2014. The sample size was calculated considering a sampling error of 5%, a proportion of 10% and a significance level of 95%.
PA level was evaluated using pedometer with the number of steps accumulated during the following four periods being used for subsequent analysis: during PE class, during school recess period, during commuting to school and to school and total daily PA. PA was assessed using a pedometer (Yamax® Digi-Walker CW 700, Tokyo, Japan) worn for three consecutive days (Monday to Wednesday). During PE classes, students wore a pedometer at certain times, such as: when they left home to go to school, when they arrived at school, beginning and end of PE class and school recess, and when they returned home or work; and a researcher was present at school in all activity shifts to solve any problems and remind them to take notes of their steps in the logbook. These data were collected in the spring of 2014.

Among the 176 adolescents, 114 provided recorded complete data for number of steps during PE class, 161 for recess time and 162 for commuting to school. Some sample losses occurred due to recording errors in pedometers and also due to students’ absence on data collection days.

### Statistical analysis

A sample descriptive statistical analysis characteristic was presented, through absolute and relative frequencies stratified by gender according to these variables: age in years; city region; PA level. The students were classified in HA or LA according steps number recommendation, using cut-off points proposed by Tudor-Locke13. The mean variance of PA level (steps-number) was compared between the two groups (HA x LA). The number of steps accrued during commuting to school, PE and in recess time were considered as dependent variables. The One-Way ANOVA test was performed for each sex. Inferential analysis was conducted with statistical significance set at \( P = .05 \). \( \eta^2 \) was calculated as a measure of Effect Size. All data was analyzed in SPSS for Windows software version 22.0 (IBM Corp, Armonk, New York, USA).

### Results

A total of 176 students (71 boys and 105 girls) aged 14 to 18 years (mean: 15.83 standard deviation: 0.85) were evaluated. Approximately 65% of adolescents were classified as LA, 64% girls and 65% boys (Table 1).

### Table 1. Characteristics of participants stratified by sex.

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Male (n=71)</th>
<th>Female (n=105)</th>
<th>Total (n=176)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>2 (2.8)</td>
<td>4 (3.8)</td>
<td>6 (3.4)</td>
</tr>
<tr>
<td>15</td>
<td>21 (29.6)</td>
<td>38 (36.2)</td>
<td>59 (33.5)</td>
</tr>
<tr>
<td>16</td>
<td>29 (40.8)</td>
<td>45 (42.9)</td>
<td>74 (42.0)</td>
</tr>
<tr>
<td>17</td>
<td>17 (23.9)</td>
<td>16 (15.2)</td>
<td>33 (18.8)</td>
</tr>
<tr>
<td>18</td>
<td>2 (2.8)</td>
<td>2 (1.9)</td>
<td>4 (2.3)</td>
</tr>
<tr>
<td>Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downtown</td>
<td>18 (25.4)</td>
<td>14 (13.3)</td>
<td>32 (18.2)</td>
</tr>
<tr>
<td>Northern</td>
<td>17 (23.9)</td>
<td>23 (21.9)</td>
<td>40 (22.7)</td>
</tr>
<tr>
<td>Southern</td>
<td>11 (15.5)</td>
<td>26 (24.8)</td>
<td>37 (21.0)</td>
</tr>
<tr>
<td>Eastern</td>
<td>13 (18.3)</td>
<td>20 (19.0)</td>
<td>33 (18.8)</td>
</tr>
<tr>
<td>Western</td>
<td>12 (16.9)</td>
<td>22 (21.0)</td>
<td>34 (19.3)</td>
</tr>
<tr>
<td>Level of PA*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High active</td>
<td>24 (34.8)</td>
<td>38 (36.2)</td>
<td>62 (35.6)</td>
</tr>
<tr>
<td>Low active</td>
<td>45 (65.2)</td>
<td>67 (63.8)</td>
<td>112 (64.4)</td>
</tr>
</tbody>
</table>

n: absolute sample value; %: proportional sample value. *PA: Physical Activity (male n=69; total n=174), through Tudor-Locke cut-off points.
Table 2 shows the results for HA and LA boys in relation to commuting to school, PE class and recess time. There was a difference between PA accrued during PE classes, equivalent to a difference of 11% between HA and LA boys PE. No differences were found either for commuting or recess time.

Table 3 shows PA for HA and LA girls according to the different domains studied. HA girls where significantly more active in each domain analyzed. Commuting to school was the domain which showed the greatest differences in PA between LA and HA girls.

Additionally, considering all adolescents in the analysis, there was difference between HA and LA in commuting to school (LA: 1146.84, HA: 1581.49; Δ: 434.65; p<0.001), recess time (LA: 503.42, HA: 672.80; Δ: 269.38; p=0.002) and PE class (LA: 1589.52, HA: 2050.57; Δ: 461.05; p=0.006).

Discussion

The current study sought to examine differences in PA between high active and low active adolescents in three different but key settings for accruing PA for health benefit. To the best of our knowledge this is the first study addressing the different levels of PA in different settings and domains in Brazilian youth. Our results identified that: I) 65% of adolescents did not achieve the recommended steps/day threshold for health; II) HA girls were significantly more active in all the domains analyzed while HA boys only were significantly more active during PE at school. Also for all adolescents, there was difference between HA and LA in commuting to school, recess time and PE class.

In regard to the recommended levels of PA, our data is in agreement with several other reports. Indeed, several studies have shown that a high prevalence of adolescents do not reach PA recommendations evaluated either by questionnaires, pedometers or accelerometers\textsuperscript{14,15}. Within the Brazilian context, our findings show that 64.4% of southern Brazilian adolescents did not achieve the recommended number of steps/day for health as suggested by Tudor-Locke et al\textsuperscript{13}. This outcome is in agreement with a study conducted in southeast of Brazil, using the same approach\textsuperscript{16}. The aforementioned study reported that 74.1% of their sample did achieve the recommended steps/day for health\textsuperscript{16}. As such the low level of PA found among our participants is not unusual but also emphasizes the need to understand the amount of PA accrued among different school contexts. The level of PA among Brazilian adolescents in the current study is congruent with other studies around the world\textsuperscript{12,13}. Such results also highlights the necessity of approaches aimed to increase PA in the different contexts of an adolescent’s day.

Active commuting as a domain of PA appears to be one important and promising strategy for increasing PA levels and improving adolescent health\textsuperscript{17–19}. Our data identified that HA girls were significantly more active than their LA counterparts; while in boys the difference was not statistically significant. Some studies have demonstrated associations between active commuting to school with a favorable body composition, improvement in the cardiorespiratory and muscular condition, in addition to increased levels of PA\textsuperscript{20,21}. However, these studies did not examine whether the level of PA during active commuting differed between HA and LA adolescents. Furthermore, a study conducted in a sample of Colombian children and adolescents indicated that girls who usually go cycling to school showed a lower association with incidence of metabolic syndrome and better physical fitness, when compared to those who travelled using passive transport\textsuperscript{22}. Our results are also congruent with a systematic review of 68 studies conducted by Larouche, Saunders, Faulkner, Colley, Tremblay\textsuperscript{23} who found that commuting to and from school...
among adolescents should be promoted to increase PA levels in children and adolescents and that cycling to/from school is associated with increased cardiovascular fitness.

Given the fact that girls usually have lower levels of daily PA compared to boys\(^9\), the results of our study indicate that commuting to school is an important domain, contributing for PA levels. In fact, our data showed that physical activity during commuting to school has contributed for increment of physical activity in HA girls compared to LA. Thus, health promotion actions should consider some factors related to environment, such availability of bicycle path, walking track and safety of neighborhood to increase PA levels of adolescents.

An important outcome from our study was the fact that there were differences in PA between LA and HA in both boys and girls in PE class. However, for boys this was the only domain where significant differences in PA were observed between HA and LA adolescents. This finding may be because competition and sports are preferences and these kind of PA is commonly offered in PE classes in Brazil\(^24\). Adolescents might also have greater motivation to participate in PA during PE which might translate to higher PA than their low active peers, despite the fact that the PE lessons are the same. Such motivational differences have been demonstrated previously in the context of PE classes\(^25\). In the context of school PA and also from a public health perspective the results of the present study are worthy of comment. Indeed, PE classes seem to play an important role on overall human development but specifically in enhancing the PA levels in adolescents\(^29\). The importance of enjoyment in PE classes has been described, indicating that nearly 37% of boys and 61% of girls met the recommended steps/day guidelines when PE was offered\(^27\). In addition, during PE classes, students are engaged in moderate to vigorous PA during 20% to 50% of the time\(^18,28\). In school class time about 30% of adolescents spend moderate to vigorous PA\(^19\).

In regard to recess time, a significant difference in the number of steps between HA and LA adolescents was observed but only for girls. It is important to emphasize that we are not aware of any study that has examined differences in PA during recess time between HA and LA adolescents. On the other hand, researches have been indicating that there is a difference between sexes in recess time. Mota, Silva, Santos, Ribeiro, Oliveira, Duarte\(^26\) showed that girls were more involved in moderate to vigorous PA during recess time than boys. While other studies indicated that boys were more active in recess time, compared to girls\(^30–32\). Therefore, our findings also highlight that school recess time is an important setting for promoting PA.

Our study has some limitations. First, the cross-sectional design impairs cause-effect inferences. Second, the use of pedometers does not allow measurement of PA intensity. Finally, the adolescents were not drawn in their respective classes, but the class as a whole. Despite these issues, a considerable strength of this investigation was the originality of research topic, as no study has examined the difference between PA levels in these contexts among Brazilian adolescents. As practical implications we highlight that parents, professors and school principals should develop strategies to promote a more active recess time, as well as PE classes structured with high intensity activities and to encourage active commuting to school.

**Conclusion**

HA girls are consistently more active in each domain analyzed compared to LA counterparts, while for boys PE class was the domain that differentiate the HA vs. LA adolescents. This study highlights some potential settings to be included in the policies focused in enhance PA levels among adolescents namely in the context of school PE.

**References**

Physical activity levels' domains in adolescents


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