

Original article

# Sociodemographic, biological, and psychosocial correlates of light- and moderate-to-vigorous-intensity physical activity during school time, recesses, and physical education classes

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## Abstract

**Background:** Identifying factors associated with physical activity (PA) is useful in planning interventions and policies. The aim of this study was to identify sociodemographic, biological, and psychosocial factors associated with PA performed in school settings.

**Methods:** Data collected for the present study included gender, age, socioeconomic status, body fat percentage, aerobic fitness, self-efficacy, attitudes, peer and parental support, and perception of school environment. Dependent variables were light-intensity PA (LPA) and moderate-to-vigorous-intensity PA (MVPA) performed during school time, recesses, and physical education (PE) classes. Multiple regression analyses were performed.

**Results:** Participating adolescents ( $n = 567$ , 53% female,  $12.9 \pm 5.3$  years) spent 5% of school time in MVPA and 27% in LPA, 15% of recesses in MVPA and 44% in LPA, and 16% of PE classes in MVPA and 41% in LPA. Boys engaged in more MVPA in all categories. Age was inversely related with MVPA and LPA in all periods, whereas body fat percentage was inversely related with MVPA in school time and PE classes. Attitude was inversely related with MVPA in all periods and with LPA in recesses. Considering PA to be good and enjoyable was positively associated with MVPA in school time.

**Conclusion:** Adolescents spent little time in PA during school. Future interventions should implement enjoyable activities at school.

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**Keywords:** Accelerometer; Adolescents; Attitude; Physical education; Public health; Self-efficacy

## 1. Introduction

Engaging in regular moderate-to-vigorous-intensity physical activity (MVPA) can be beneficial to children and adolescents and contribute to the development of healthy individuals by benefitting cardiorespiratory and musculoskeletal<sup>1</sup> systems as well as being associated with better body composition<sup>1</sup> and academic achievement.<sup>2</sup> Recent evidence suggests that physical activity (PA) explains about 10% of the variation in aerobic fitness throughout life<sup>3</sup> and even light-intensity physical activity (LPA) may provide benefits for young people's cardiorespiratory systems<sup>4</sup> and body composition.<sup>5</sup> Although the benefits of

regular PA are well known and often described in the scientific literature, the level of this behavior among adolescents is low across many countries,<sup>6,7</sup> and the level is even decreasing in some countries, such as Brazil.<sup>8,9</sup> Verifying targetable psychosocial factors related to PA behavior, such as self-efficacy, attitude, and peer support, as well as identifying at-risk groups for physical inactivity, can help in the development of strategies and policies that promote active lifestyles. Correlating these factors with PA practices in the school context is important because school is the environment where young people spend most of their time<sup>10,11</sup> and where most successful interventions with this target population have occurred.<sup>12,13</sup> Additionally, indicators of Brazilian adolescents' engagement in PA are limited, with inconclusive information regarding school-based PA.<sup>7</sup>

Adolescents engage in many types of PA (e.g., sports, recreational games) during a typical week, and the school setting

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plays an important role in providing opportunities for adolescents to be physically active.<sup>10,11</sup> Studies in France<sup>10</sup> and the UK<sup>11</sup> have found that adolescents perform most of their daily MVPA during the time they spend at school. The school setting provides infrastructure for PA (courtyards and open spaces) and times, such as recesses and physical education (PE) classes, when there are opportunities to engage in PA.<sup>14</sup> However, even with opportunities to be active, such as PE classes and recess time, low levels of MVPA in schools have been observed.<sup>15–17</sup> Some subgroups, such as female adolescents,<sup>18,19</sup> older students,<sup>18,19</sup> and students with higher body mass index,<sup>18</sup> are less active than their peers in relation to PA performed both at school<sup>16</sup> and away from school.<sup>18</sup> Other factors, such as self-efficacy,<sup>19</sup> attitude,<sup>19</sup> peer support,<sup>20</sup> parental support,<sup>20</sup> perception of the environment,<sup>14</sup> and physical fitness levels,<sup>21</sup> may also play a role in the engagement in PA,<sup>18,22</sup> but little is known about these relationships in the school setting.

In addition, most studies that report patterns of PA in school settings were conducted in high-income countries,<sup>17</sup> resulting in a lack of information regarding students in low- and middle-income countries and countries having different school schedules. The aim of this study was to identify sociodemographic, biological, and psychosocial factors associated with LPA and MVPA performed in total school time, recesses, and PE classes using a sample of Brazilian middle-school adolescents.

## 2. Materials and methods

Baseline data from the MEXA-SE—De mãos dadas pela saúde study, which included a school-based, non-randomized controlled intervention carried out in 2015 in 2 public schools in Florianópolis, a city in southern Brazil, were analyzed in the present study. In the MEXA-SE study the schools were selected by the board of education of the municipality and were assigned as control and intervention groups. All adolescents in the 6th, 7th, 8th, and 9th years were invited to participate. Out of a total of 1011 students, 567 (56%) provided written informed consent from their parents. The study was approved by the Ethics Committee on Human Research of the Carmela Dutra Maternity Hospital (process 780.303). This study is registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) (Identifier NCT02719704).

The schools operate in two 4 h shifts (8:00 a.m.–12:00 p.m. and 1:00 p.m.–5:00 p.m.). Children attend 1 of those 2 shifts, where they have five 45-min classes and a 15-min recess between the 3rd and 4th classes. Adolescents wore ActiGraph GT3X+ accelerometers (ActiGraph LLC, Fort Walton Beach, FL, USA) on the right hip during their time in school, and the wear time was determined by subtracting the time they received the accelerometer (at the beginning of class) from the time it was retrieved (at the end of class). Adolescents wore accelerometers for 5 days, and those who wore them for at least 3 days with 180 min (75% of school time) of valid data on each day were included in the school-time analysis ( $n = 344$ ). Students who wore accelerometers at least 3 days with 15 min (100% of total recess time) of valid recess data were included in the recess analysis ( $n = 369$ ), and those who wore them for at least 23 min of 1 PE class (50% of total PE class time) were included in the PE class analysis ( $n = 406$ ). Minutes performing LPA (101 to 2295 counts per

minute (cpm)) and MVPA (2296 cpm and above) were estimated using cut-off points for the adolescents,<sup>23</sup> with 15 s epoch length, and the proportion of time spent on each of those activities was calculated for PE classes, recesses, and total school time.

Participants also answered a structured questionnaire, where information was collected regarding gender (male or female); age (completed years); economic status (scores calculated for family ownership of items like cars, televisions, computers, washing machines, and refrigerators; range: 0–46 points); psychosocial correlates of attitude (5–20 points, related to students' attitudes toward PA as unimportant or important, unsafe or safe, bad or good, boring or fun); self-efficacy (8–32 points, related to students' ability to engage in PA even when not motivated, when lacking company, when feeling lazy, or when lacking skills); perception of school environment (3–12 points, related to the students' sense of availability of facilities for PA, the appearance and enjoyability of said facilities, and PA practice of peers); support from peers (5–20 points, related to students' sense of encouragement, invitation, and conversation with friends about PA); and support from parents (6–24 points, related to the students' sense of encouragement, invitation, and conversation with parents about PA). The psychosocial variables scales were previously validated for this population; further information can be found elsewhere.<sup>22</sup> Additionally, aerobic fitness was assessed by the 20-m shuttle run,<sup>24</sup> and students had their triceps and subscapular skinfolds measured by researchers trained by International Society for the Advancement of Kineanthropometry, with an intra-evaluator technical error of 3.5% and inter-evaluator technical error of 7.0%. Maximum aerobic capacity (mLO<sub>2</sub>/kg) and percentage of body fat were estimated using the equations of Léger et al.<sup>24</sup> and Slaughter et al.,<sup>25</sup> respectively.

Multiple linear regression analyses were conducted to test the association of each independent variable with minutes and proportion of time spent on LPA and MVPA in PE classes, recesses, and school time. All covariates were inserted simultaneously into each regression model. The dependent variables were tested for normality using the Shapiro-Wilk test, and if normality was not observed but the number of observations was higher than 100, the analysis was conducted. If a significant association between MVPA and a psychosocial variable was found, the association of each item that composed that scale was tested with MVPA using linear regression analysis. Analyses were performed in Stata, Version 13.0 (StataCorp., College Station, TX, USA). Statistical significance was set at a  $p$  value <0.05.

## 3. Results

A total of 567 adolescents (53% female,  $12.9 \pm 5.3$  years) participated in this study. The sociodemographic, behavioral, biological, and psychosocial characteristics of these participants are shown in [Table 1](#).

In [Table 2](#), the correlates of the investigated factors with LPA in different school settings are presented. Girls performed proportionally less LPA than boys in school time. Age was inversely related with LPA in school time, recesses, and PE

**Table 1**  
Sociodemographic, behavioral, biological, and psychosocial characteristics of adolescents.

	Mean	95%CI	Equivalent (%)*
Socioeconomic score	17.55	17.21–17.88	–
School time (min)			
MVPA	10.5	9.8–11.2	5
LPA	55.9	54.1–57.7	27
Recess time (min)			
MVPA	2.2	2.0–2.4	15
LPA	6.6	6.4–6.7	44
PE class (min)			
MVPA	6.5	6.0–7.0	16
LPA	16.8	16.3–17.2	41
Aerobic fitness (mLO <sub>2</sub> /kg/min)	40.77	40.36–41.18	–
Mean body fat (%)	20.40	9.63–21.18	–
Self-efficacy score	12.54	12.20–12.88	–
Attitudes score	11.02	10.81–11.22	–
Perception			
School environment	4.57	4.41–4.74	–
Peer support	5.66	5.31–6.01	–
Parental support	9.24	8.85–9.62	–

\* The equivalents of MVPA and LPA in school time, recess time, and PE class duration.

Abbreviations: LPA = light-intensity physical activity; MVPA = moderate-to-vigorous-intensity physical activity; PE = physical education.

classes, while socioeconomic status, body fat, and aerobic fitness were not significantly associated with LPA at school. Among psychosocial factors, only attitude was positively associated with LPA in recesses (Table 2).

In Table 3 the correlates of the investigated factors with MVPA in different school settings are presented. Girls spent significantly less time on MVPA than boys in all periods at school. Age was inversely related with MVPA in total school time, PE classes, and recesses. Body fat percentage was inversely related with MVPA in

PE classes and total school time. Attitude was the only psychosocial factor positively associated with MVPA in total school time, PE classes, and recesses (Table 3).

Due to the association of attitude with MVPA in all periods analyzed, the association of each item of the attitude scale (importance of PA, safety in engaging in PA, judgment related to PA being good or not, PA being healthy or not, and PA being enjoyable or not) in relation to MVPA was tested (Fig. 1). The items related to judgment about whether PA was good or bad ( $p = 0.022$ ) and whether engagement in PA was enjoyable were significantly related to MVPA in school time. No other item was associated separately with MVPA in each time ( $p < 0.000$ ) frame.

#### 4. Discussion

This study aimed to identify sociodemographic, biological, and psychosocial factors associated with LPA and MVPA performed at school. Adolescents spent an average of 27% of their school time on LPA and 5% on MVPA, and similar percentages of time spent on MVPA were observed for recesses and PE classes (15% and 16%, respectively). Meanwhile, 44% of recess time and 41% of PE classes were spent in LPA, respectively. Girls performed less MVPA and LPA than boys in all periods analyzed in total school time. Age was inversely related with MVPA and LPA in all periods, and body fat percentage was inversely related with MVPA in PE classes and school time, whereas attitude was positively associated with MVPA in all periods and with LPA during recesses.

The proportion of MVPA in PE classes observed in the present study (16%) was lower than reports from other southern Brazilian cities<sup>26</sup> and Switzerland,<sup>27</sup> where students spent more than 30% of instruction time on intense activities, but was similar to studies conducted in Scotland<sup>28</sup> and England.<sup>29</sup> Many factors influence the intensity of PE classes, including the presence of

**Table 2**  
Association of sociodemographic, biological, and psychosocial factors with LPA in total school time, PE classes, and recesses among adolescents.

Variable	School time LPA <sup>a</sup>		PE classes LPA <sup>b</sup>		Recess LPA <sup>c</sup>	
	$\beta$ (proportion)	$\beta$ (min)	$\beta$ (proportion)	$\beta$ (min)	$\beta$ (proportion)	$\beta$ (min)
<b>Sociodemographic factor</b>						
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	-0.04*	-7.26*	-0.0228	-1.08	-0.017	-0.26
Age (year)	-0.02*	-4.49*	-0.0156*	-0.80*	-0.0201*	-0.30*
Socioeconomic status	-0.002	-0.51	-0.0021	-0.09	-0.0011	-0.02
<b>Biological factor</b>						
Body fat (%)	-0.0010	-0.18	-0.0002	-0.00	0.0001	0.00
Aerobic fitness (mLO <sub>2</sub> /kg/min)	0.0003	0.07	0.0007	-0.02	-0.0018	-0.03
<b>Psychosocial factor</b>						
Self-efficacy	0.001	0.12	0.0005	0.09	0.0009	0.01
Attitudes	0.001	0.32	0.0037	0.17	0.0059*	0.10*
School environment	-0.004	-0.65	-0.0013	-0.02	-0.0037	-0.06
Peer support	0.002	0.52	0.0011	0.03	-0.0009	-0.01
Parental support	0.001	0.24	0.0018	0.09	0.0013	0.02

<sup>a</sup>  $n = 216$ ,  $r^2 = 0.23$ .

<sup>b</sup>  $n = 250$ ,  $r^2 = 0.05$ .

<sup>c</sup>  $n = 234$ ,  $r^2 = 0.08$ .

\*  $p < 0.05$ .

Abbreviations: LPA = light-intensity physical activity; PE = physical education; Ref = reference.

Table 3  
Association of demographic, biological, and psychosocial factors with MVPA in total school time, PE classes, and recesses among adolescents, Florianópolis, Brazil, 2015.

Variable	School time MVPA <sup>a</sup>		PE classes MVPA <sup>b</sup>		Recess MVPA <sup>c</sup>	
	$\beta$ (proportion)	$\beta$ (min)	$\beta$ (proportion)	$\beta$ (min)	$\beta$ (proportion)	$\beta$ (min)
<b>Sociodemographic</b>						
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	-0.0270*	-5.51*	-0.0971*	-4.05*	-11.5400*	-1.73*
Age (year)	-0.0048*	-0.96*	-0.0137*	-0.61*	-0.0155*	-0.23*
Socioeconomic scale	-0.0001	-0.03	-0.002	-0.09	0.0015	0.02
<b>Biological factor</b>						
Body fat (%)	-0.0007*	-0.15*	-0.0025*	-0.10*	-0.0013	-0.02
Aerobic fitness (mLO <sub>2</sub> /kg/min)	0.0005	0.11	0.0028	0.12	0.0030	0.05
<b>Psychosocial factor</b>						
Self-efficacy	-0.0005	-0.12	-0.0010	-0.02	-0.0021	-0.03
Attitudes	0.0021*	0.43*	0.0078*	0.29*	0.0071*	0.11*
School environment	0.0005	0.13	0.0050	0.23	0.0017	0.03
Peer support	0.0010	0.21	0.0009	0.04	0.0011	0.02
Parental support	0.0000	-0.01	0.0007	0.03	0.0005	0.01

<sup>a</sup>  $n = 216$ ,  $r^2 = 0.41$ .

<sup>b</sup>  $n = 250$ ,  $r^2 = 0.40$ .

<sup>c</sup>  $n = 234$ ,  $r^2 = 0.31$ .

\*  $p < 0.05$ .

Abbreviations: MVPA = moderate-to-vigorous-intensity physical activity; PE = physical education; Ref = reference.

infrastructure and adequate equipment; school policies;<sup>14</sup> the teacher's expertise, experience, and knowledge;<sup>30</sup> students' individual characteristics;<sup>19</sup> and, but not least, their attitudes, which are highlighted in the present study. Students spent about 15% of recess time on MVPA, which corresponds to approximately 2 out of every 15 min, which may make only a minimal contribution to daily levels of MVPA because students have recess every weekday in contrast to PE classes, which occur 3 times per week.<sup>31</sup> The proportion of time spent on MVPA is lower than that observed for students in the UK, who spend between 20% and 28% of their recess time on such activities.<sup>29</sup>

Based on the frequency of MVPA observed in PE classes and recesses in the present study, the contribution of PE classes to weekly levels of MVPA is more significant than that of recesses, bearing in mind that students have PE classes 3 times a week while they have recesses daily.

In relation to school time MVPA, our study reported a low proportion of time (5%) spent on this behavior. Another study in 5 European countries also reported that students spent 5% of their school time on MVPA.<sup>16</sup> Nettlefold and colleagues<sup>29</sup> found that students in the UK spent 14%–17% of their school time on

MVPA.<sup>29</sup> Differences in MVPA in school time might be attributable to the same issues that exist for PE classes, such as school infrastructures and schedules.<sup>14</sup>

When the sociodemographic variables were analyzed, girls were less active than boys in all periods analyzed in the present study. This finding corroborates the findings in international studies,<sup>16,18,29</sup> which show that girls are less active than boys in overall PA, including in the school setting. Likewise, the inverse relationship between age and MVPA is also found in other studies.<sup>18</sup> In the present study, socioeconomic status was not associated with LPA or MVPA performed at school. Other studies have also found that socioeconomic status is not related to PA performed at school.<sup>16</sup> Perhaps this is because the infrastructure and opportunities for students to be active at school are similar, and differs from opportunities out of school, which might be dependent on access to equipment or payment of club and gym memberships.

Among the biological variables analyzed in the present study, body fat percentage was inversely related to MVPA performed in school time and PE classes. The negative relationship between body composition and PA performed at school was also observed

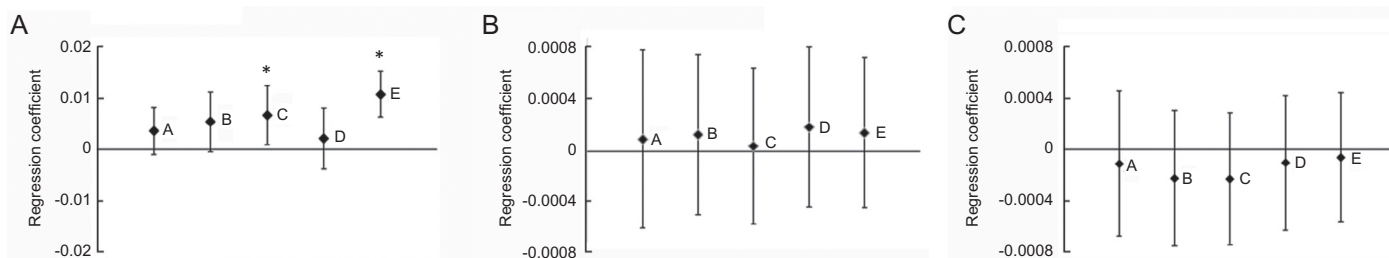


Fig. 1. Linear regression coefficients of each item on the attitude scale with proportion of time in moderate-to-vigorous-intensity physical activity in school time (A), recess time (B), and physical education classes (C). \* $p < 0.05$ . Attitude scale items: A: importance; B: safety; C: judgment; D: health value; E: enjoyment.



in a study across 5 European countries.<sup>16</sup> However, many factors that were not controlled for in our study (e.g., nutrition and sleep behaviors) might influence body composition, and the relationship found suggests that interventions at school could involve more strategies to promote behavior change in the groups that are more susceptible to being overweight.

With regard to the psychosocial variables analyzed in the present study, only attitude was shown to be significantly and positively related to MVPA in all periods and to LPA in recesses. The relationship of psychosocial variables with behaviors is postulated in different theoretical models and frameworks<sup>22</sup> but is not easily measured or observed.<sup>19</sup> Previous studies have shown that social support is relevant for PA-related behaviors, with peers,<sup>19</sup> parents,<sup>18</sup> and teachers<sup>14</sup> influencing adolescents' behavior in diverse settings. Intrinsic characteristics such as attitudes and self-efficacy have been shown to be positively related with PA,<sup>19,22</sup> yet their role in relation to behavior in the school setting still needs to be researched in more depth.

When the items that comprised the attitude scale were analyzed separately, student attitudes that PA was good (as opposed to bad) and enjoyable were significantly associated with more MVPA in total school time. This result, although new, suggests that one way to improve levels of PA in adolescents might be to make activities more fun and enjoyable during school time. In 1 study, an intervention inserting gaming characteristics into active commuting to school proved to be a way to increase the level of students' PA.<sup>32</sup> Another study also found that enjoyment played an important role in PA behavior change.<sup>33</sup>

Although we found some statistically significant associations between PA and correlates, the ones related to biological and psychosocial variables were weak when compared to the ones found for gender and age. The possible contributions to the development of strategies, when based on our findings, still focus on gender and age, as other studies have highlighted before.<sup>18</sup>

The present study has some limitations, such as the number and duration of observed PE classes and the number of participating schools. The period when adolescents used the accelerometers may not represent PE classes across the school year, and seasonal variability was not taken into account. Additionally, differences in the school schedule of Brazil and other countries may limit the comparability of our results, even though the relative percentage of time was reported. The strengths of the present study include the objectively measured PA, which is not as common in studies conducted in middle- and low-income countries; the analysis of different time frames at school; and the inclusion of a wide range of investigated factors that might be related to PA behavior.

## 5. Conclusion

Adolescents were not engaging in PA when at school even in opportunities such as PE classes and recesses. Age and body fat percentage were inversely associated with MVPA and LPA, and girls were even less active than boys. Having positive attitudes toward PA was associated with an increased MVPA at school. In addition, finding PA to be enjoyable and having a good judgement

about PA also were independently associated with MVPA in school time.

More intense activities should be encouraged during recess time and in PE classes, especially for girls, older adolescents, and those who are overweight. Implementing activities that adolescents find enjoyable might be a good strategy for interventions aimed at increasing MVPA at school. Educators should share their knowledge with students regarding the importance, health benefits, safety, and enjoyment related to practicing regular PA in PE classes.

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## Authors' contributions

BGGC and KSS conceived of the research, wrote the draft of the paper, and analyzed the data; JAS reviewed the draft and the statistical analysis; GM, LRAL, and ELP were responsible for the MEXA-SE project, reviewed the analysis and the draft, and were also responsible for the implementation of the intervention in the MEXA-SE project. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of authors.

## Competing interests

The authors declare that they have no competing interests.

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