

The effect of an intervention on physical activity of moderate-and-vigorous intensity, and sedentary behavior during adolescents' time at school

Efeito de uma intervenção sobre atividade física moderada a vigorosa e comportamento sedentário no tempo escolar de adolescentes

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ABSTRACT: *Introduction:* This study evaluated the effect of an intervention on the engagement in physical activity (PA) and sedentary behavior (SB) of sixth to ninth grade students during school-time, physical education (PE) classes, and recesses at two public schools in Florianópolis, SC, Brazil. *Method:* Schools were divided into control and experimental groups. Participants wore accelerometers during school-time, and PA and SB were estimated for school-time, PE classes and recesses at the baseline and after the intervention. The intervention was composed of four components: changes were made in the PE classes, including giving instruction to teachers; sports equipment was made available for use during recesses; educational sessions on the format of classes were conducted; folders and posters were distributed. Data was analyzed using an Analysis of Covariance for repeated measures comparing baseline data with post intervention data, and for independent samples when comparing control and intervention groups. *Results:* A low proportion of engagement in PA and a large engagement in SB was observed on the baseline. PA decreased in the intervention group during PE classes, while it increased in the control group with regard to school-time, PE classes, and recess. The intervention group accumulated more SB during school-time and PE classes after the intervention, while a decrease in the control group's SB during school-time was observed. *Conclusion:* The intervention was not effective in increasing PA or decreasing SB. Environmental and school's organizational factors impact how interventions are conducted, and should be considered beforehand.

Keywords: Motor activity. Students. Physical education. Health promotion.

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RESUMO: *Introdução:* Este estudo objetivou avaliar o efeito de uma intervenção sobre o engajamento em atividade física (AF) e comportamento sedentário (CS) no período escolar, em aulas de educação física (EF) e nos recreios em estudantes do sexto ao nono ano de escolas públicas de Florianópolis, Santa Catarina. *Métodos:* Duas escolas foram alocadas em grupo experimental e controle. Os participantes utilizaram acelerômetros no período escolar e o tempo em AF e CS foram estimados no período escolar, aulas de EF e recreios antes e após a intervenção. A intervenção foi composta de quatro componentes: mudanças nas aulas de EF, com formação dos professores; disponibilização de materiais esportivos no recreio; sessões educativas no formato de aulas; e distribuição de folders e cartazes com informações sobre os desfechos da intervenção. Foram empregadas análises de covariância para medidas repetidas comparando a linha de base e pós-intervenção e para amostras independentes, comparando o grupo controle com o grupo intervenção. *Resultados:* Observou-se uma baixa proporção de AF na escola na linha de base e um elevado volume de CS. O grupo intervenção diminuiu a AF em aulas de EF, enquanto o grupo controle aumentou em todos os períodos. O grupo intervenção também acumulou mais o CS no período escolar e em aulas de EF após a intervenção, enquanto o controle diminuiu o CS no período escolar. *Conclusão:* A intervenção proposta não foi efetiva em aumentar a AF e diminuir o CS. Fatores ambientais e de organização escolar podem ter impactado os resultados e devem ser considerados no planejamento de intervenções.

Palavras-chave: Atividade motora. Estudantes. Educação física. Promoção da saúde.

INTRODUCTION

Regular physical activity (PA) offers protection against cardiometabolic diseases and promotes the healthy development of children and adolescents^{1,2}. Even though the benefits of PA for children and adolescents are well established in the scientific literature, most adolescents do not practice PA at levels recommended for maintaining good health in Brazil³ and worldwide⁴. Evidence suggests that adolescents' habit of practicing PA, or not, is carried into adulthood^{5,6}, which can severely impact mortality⁷ and the number of times an individual visits the hospital, which can overload health systems⁸⁻¹⁰. Given the benefits of PA and the low involvement of adolescents in PA, interventions to change this reality are necessary.

Schools are positive places to intervene, as they can contribute to engaging adolescents in PA, offering them opportunities to be physically active in both physical education (PE) classes and recess^{11,12}. However, the school environment is also characterized by sedentary academic activities, where students attend classes and perform the majority of their activities in sitting positions¹³. Spending long periods of time in sedentary positions has been shown to be a risk factor for cardiometabolic diseases in this population¹⁴⁻¹⁶.

Effective interventions to improve PA levels in adolescents have been conducted in the school setting as opposed to in other settings¹⁷⁻¹⁹. However, a limited number of studies are being conducted in low- and middle-income countries. Evidence of the effects of interventions on these realities is scarce, especially in studies with objective measurements of PA and sedentary behavior (SB)¹⁸. The aim of the present study was to evaluate the effect of

the school-based intervention program entitled *Mexa-se* (Get Moving) on moderate to vigorous PA and SB during school time, PE classes, and school recess.

METHODS

The present study conducted a secondary analysis of data from the *Mexa-se – De mãos dadas com a saúde* intervention study, conducted with students from the sixth to ninth grades of two elementary schools in Florianópolis, in the months from April to July 2015. The study was approved by the Carmela Dutra Hospital Research Ethics Committee under Report No. 780.303 and is registered with the National Institutes of Health (NCT02719704).

For the sample calculation, the G*Power 3.0 software was used. The following parameters were inserted: 80% statistical power, 5% significance level and a 30% increase for losses and refusals. As the intervention involved a multiplicity of outcomes, a minimum sample size was adopted to meet the outcome with the largest number of observations required, resulting in a number of 295 participants per group (intervention and control). For behavior change analysis for PA, it has been observed that in interventions in low- and middle-income countries¹⁸, the smallest effect size observed was 0.22, resulting in a minimum value of 229 individuals per group.

Among the 26 schools available in the school system that had classes from sixth to ninth grade, 5 had a number of students equal to or greater than 295 and a gymnasium or indoor court. Two were in the southern region and three were in the northern region of Florianópolis. The Florianópolis Municipal Secretary of Education appointed the two schools with the largest number of students. After being invited, one of the principals refused to participate in the study and the third school on the list was invited (third in terms of the largest number of students). It is worth noting that these three schools belong to the same geographical region. The allocation of the schools into intervention and control groups was also conducted intentionally by the Department of Education. All students from sixth to ninth grade enrolled in the selected schools were invited to participate in the study. The invitation was made by the researchers, in the classroom, in the presence of a school teacher. On this occasion, the researchers explained the objectives of the study and all stages of the research (evaluations and intervention), as well as clarified the students' questions and gave them Informed Consent Forms to be given to their parents. The exclusion criteria were: students who attended classes full-time (two classes in the control school), because their school time and workload were not comparable to those of their peers in part-time classes; and students who had injuries or limitations when doing PA.

Participants received Actigraph GT3X + accelerometers during the school term (8 am to 12 pm or 1 pm to 5 pm) during week one, at the baseline (April 6-10, 2015 at the intervention school and April 13-17 at the control school) and after the intervention (from July 6-10 at the intervention school and July 13-17 at the control school). The accelerometers were delivered and collected in the classroom by trained researchers. Students were instructed

to use the accelerometer positioned on the right side of the hip, held on by an elastic belt. Data were analyzed in three periods: total school time, PE classes and recess. To be included in each analysis, participants had to use the accelerometer for at least 180 minutes of class (> 65% of the school term) for 3 days, 15 minutes of recess (100% of the length of recess) for 3 days and 23 minutes of a PE class (> 50% of the length of the class). The proportions of time spent in moderate to vigorous intensity PA and SB were estimated using validated cutoff points for this population²⁰ at 15-second epochs.

The intervention was conducted between April and July 2015, with a total duration of 11 weeks. The proposed actions were based on the document of health promoting schools²¹, socio-cognitive theories,²² social-ecological theories,²³ and other models of interventions described in systematic reviews,^{19,24} which address the research questions of the macroproject.

To make the necessary changes in target behaviors, actions were implemented in four components.

The first component was the modification of PE classes to promote greater practice of moderate to vigorous PA, strength exercises, and flexibility. The guidelines for the classes were that they should follow a 10-minute structure of stretching exercises, 10 minutes of muscle strength exercises, and 20 minutes of aerobic exercises. The teachers were free to decide the content to be given. They were free to follow the suggestions of exercises and activities proposed in the intervention, or not, and they had full responsibility for conducting each of the three weekly PE classes.

As a second component, changes were made to the school environment so that students became more engaged in PA during recess. This component took place by providing balls (handballs, basketballs, volleyballs, soccer and futsal balls) and ropes, which were loaned by the researchers for four days a week. Each day, a selected class would play with them, and each week a different class would play with them. Students were informed of the materials' availability by the researchers and this information was reinforced by the PE teachers. All of the students in the school could use these materials, regardless of whether they agreed to participate or not. Control of the material was carried out by means of a loan form, in which students were to identify the material taken and be responsible for returning it at the end of the break.

The third component of the intervention took the form of educational sessions, in which topics of PA and health, nutrition and body image were addressed. The sessions on PA and health took place in the format of meetings, developed by the school PE teachers, on two occasions, lasting 45 minutes each. The meetings addressed the theme of health and lifestyle, PA, physical exercise and sedentary behavior. These themes were approached in a dialogical way, using a video, an educational game and making posters.

The nutritional sessions aimed to promote reflection and positive changes in eating habits and health care of adolescents. In the sessions the following themes were developed: "healthy eating as a way of health promotion and disease prevention", "general recommendations on the choice of fresh and minimally processed food in the composition of meals", "consumption of a wide variety of source foods from organic farming", "guidelines on

how to combine food in the form of meals, with incentives to use regional foods”, “guidelines on the act of eating and sharing the table with others, addressing the circumstances - time and focus, space and company” and “culinary skills”. These themes were developed in accordance with the recommendations of national governmental documents dealing with food²⁵. The content of the nutritional sessions was addressed through films, conversational lectures, poster workshops and contests, music workshops and cooking workshops. Six sessions were held, with an average duration of 1 hour and 40 minutes, and all meetings were conducted by a nutritionist. Parents were also invited to attend a meeting on dietary recommendations for the Brazilian population²⁵, in order to inform and raise awareness about the importance of healthy eating.

Themes related to body image were addressed in three sessions, which were held once a week, mediated by a researcher, and were during students’ class hours (with the responsible teacher’s permission). The sessions included information on the media’s imposition of beauty standards, changes in beauty standards throughout history and between cultures, image manipulation, health damage caused by the search for the “perfect” body (anorexia, bulimia and anabolic steroids) and individual qualities.

The fourth component was the use of educational materials in the formats of folders and posters, based on the *Fortaleça sua saúde* (Strengthen your health) intervention²⁶, which addressed topics on PA and SB. Two folders were given to students and two were given to parents. Posters were hung up in the classrooms, the school yard, and the neighborhood’s basic health unit. Nutrition and body image posters that were prepared by students in educational activities were also posted at the school.

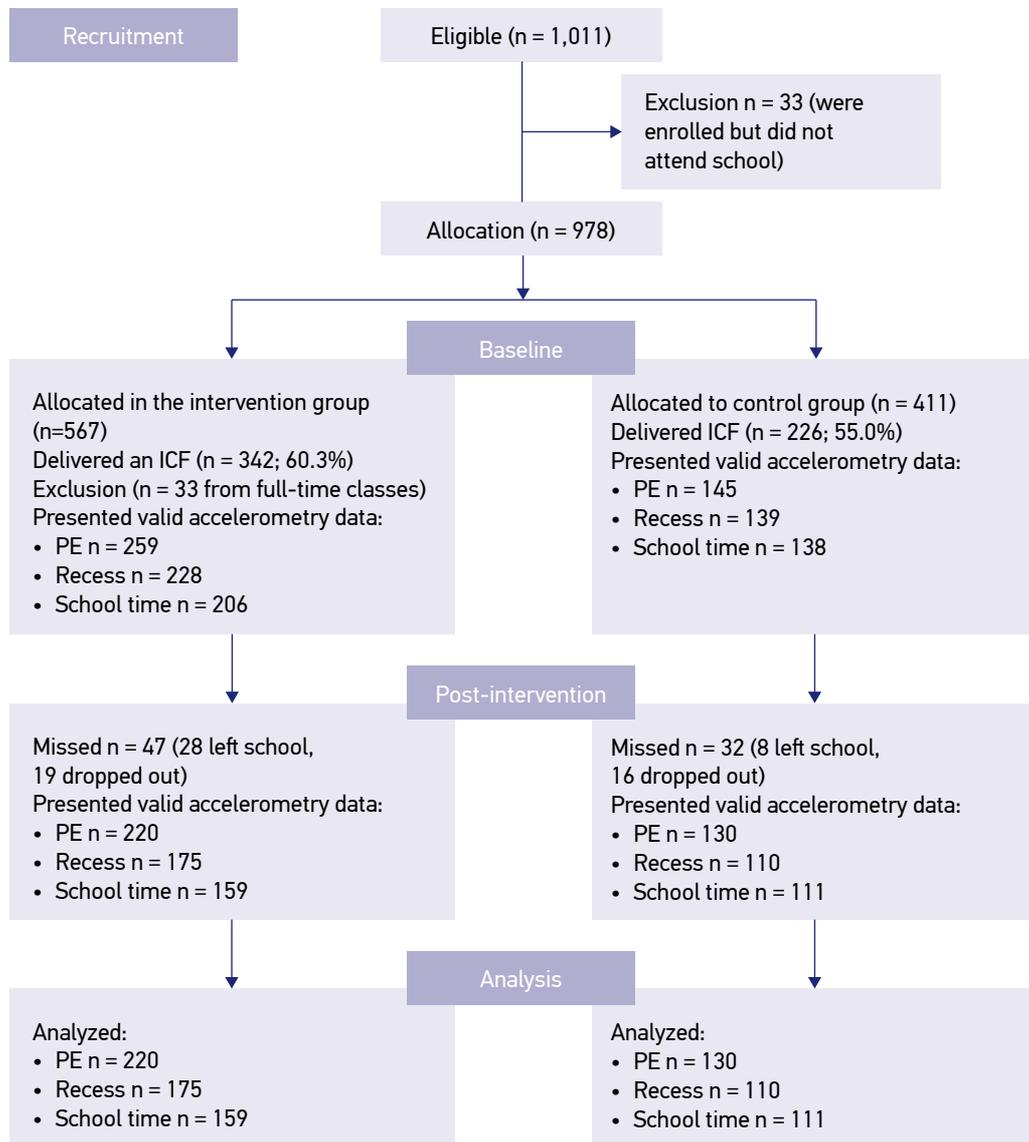
To conduct the first and third components of the intervention, PE teachers received training and didactic material related to the topics covered. These materials contained suggested activities to work on different components of physical fitness in the context of the PE classroom.

Data analysis was conducted using the Stata statistical package, version 13.1 for Windows. To compare the mean proportion of PA and SB between schools, analyzes of covariance (ANCOVAs) were applied to independent samples. For baseline and post-intervention comparisons, ANCOVAs were applied for repeated samples. An effect analysis was conducted with the data collected in the post-intervention period and the intention to treat was also considered (with data imputed to maintain the last observation made). Analyzes were adjusted for participants’ age, which differed between groups at the baseline ($p < 0.05$). The effect size derived from ANCOVA was used. In all tests, a significance level of 5% was adopted.

RESULTS

The flowchart of student participation in the research can be observed in Figure 1, while the characteristics of the study participants can be observed in Table 1. PA and SB observed at baseline did not differ between the intervention and control schools for any of

the time-segments (PE, recess or school time) (Tables 2 and 3, respectively). In the intervention school, students spent less time in PA in PE classes after the intervention, when compared to the baseline ($p = 0.0019$). In the control school, students were more active in total school time ($p = 0.0006$), in PE classes ($p = 0.03987$) and in recess ($p = 0.0170$) in the second assessment, when compared to the baseline. In the post-intervention period, control school students spent more time on PA in total school time ($p = 0.0216$) and PE classes ($p = 0.0005$) compared to intervention school students (Table 2).



ICF: Informed Consent Form; PE: physical education classes.

Figure 1. Flowchart of groups and students participating in the research.

Table 1. Baseline characteristics of participants with valid accelerometry data during school time. Florianópolis, 2015.

	School Control	School intervention	p
Sex [n (%)]			
Boys	49 (44)	75 (47)	0.624 ^a
Girls	62 (56)	84 (53)	
Age (mean ± SD)	12.6 ± 1.4	12.1 ± 1.2	0.003 ^b
ABEP score* (mean ± SD)	17.0 ± 3.9	17.7 ± 3.5	0.142 ^b
BMI (mean ± SD)	20.1 ± 3.7	19.7 ± 3.7	0.496 ^b

SD: Standard Deviation; ABEP: Brazilian Association of Research Companies (*Associação Brasileira de Empresas de Pesquisa*); *variable with loss of respondents (loss of 12% in the control school and 18% in the intervention school); BMI: body mass index; ^atest of χ^2 ; ^bStudent test *t*.

Table 2. Differences between the proportions of moderate to vigorous physical activity during total school time, recess and physical education classes of adolescents at the baseline and after the *Mexa-se* intervention. Florianópolis, 2015.

Variables	Control School		Effect Size	Intervention School		Effect Size
	Baseline	Post-intervention		Baseline	Post-intervention	
	Proportion (95%CI)	Proportion (95%CI)		Proportion (95%CI)	Proportion (95%CI)	
<i>Collected data only</i>						
MVPA in total school time (n = 111/159)	5.15 (4.54 – 5.77) ^a	6.11 (5.44 – 6.78) ^{ab}	0.10	5.17 (4.68 – 5.66)	5.17 (4.69 – 5.66) ^b	< 0.00
MVPA during recess (n = 110/175)	14.14 (11.97 – 16.32) ^a	16.57 (14.35 – 18.79) ^a	0.05	16.78 (14.66 – 18.91)	15.78 (14.04 – 17.52)	0.01
MVPA during PE classes (n = 130/220)	16.73 (14.64 – 18.81) ^a	19.71 (17.14 – 22.28) ^{ab}	0.04	16.17 (14.6 – 17.73) ^a	14.24 (12.66 – 15.81) ^{ab}	0.03
<i>Data with intention to treat</i>						
MVPA in total school time (n = 138/206)	4.99 (4.46 – 5.52) ^a	5.76 (5.18 – 6.34) ^a	0.10	5.1 (4.68 – 5.53)	5.11 (4.68 – 5.53)	< 0.00
MVPA during recess (n = 139/228)	13.64 (11.74 – 15.54) ^a	15.56 (13.61 – 17.51) ^a	0.05	15.78 (13.93 – 17.62)	15.01 (13.42 – 16.6)	0.01
MVPA during PE classes (n = 145/259)	16.34 (14.39 – 18.28) ^a	19.01 (16.63 – 21.39) ^{ab}	0.04	15.74 (14.34 – 17.14) ^a	14.1 (12.7 – 15.49) ^{ab}	0.03

95%CI: 95% confidence interval; MVPA: moderate to vigorous physical activity; PE: physical education; ^adifference between baseline and post-intervention ($p < 0.05$); ^bdifference between control school and intervention school ($p < 0.05$).

Regarding SB (Table 3), in the intervention school the students were more sedentary in the total school time ($p = 0.0249$) and in PE classes ($p < 0.0001$) after the intervention, when compared to the baseline. In the control school, students spent less time in SB in the total school time after intervention when compared to the baseline ($p = 0.0087$). In the comparison between groups, intervention school students spent more time in SB in PE and recess classes when compared to the control school students ($p < 0.0001$ and $p = 0.0217$, respectively).

Comparing the intention-to-treat analysis with the collected data, it was observed that the difference between intervention and control schools in relation to PA and SB in the post-intervention period lost statistical significance (Tables 2 and 3).

Table 3. Differences between the proportions of moderate to vigorous physical activity during total school time, recess and physical education classes of adolescents at the baseline and after the *Mexa-se* intervention. Florianópolis, 2015.

Variables	Control School		Effect Size	Intervention School		Effect Size
	Baseline	Post-intervention		Baseline	Post-intervention	
	Proportion (95%CI)	Proportion (95%CI)		Proportion (95%CI)	Proportion (95%CI)	
<i>Collected data only</i>						
SB in total school time (n = 111/159)	67.29 (65.32 – 69.27) ^a	65.49 (63.63 – 67.34) ^{ab}	0.06	66.57 (64.95 – 68.19) ^a	67.91 (66.4 – 69.42) ^{ab}	0.03
SB during recess (n = 110/175)	41.79 (39.04 – 44.54)	39.66 (36.46 – 42.87)	0.02	38.66 (36.09 – 41.23)	40.52 (38.03 – 43.00)	0.01
SB during PE classes (n = 130/220)	40.84 (37.76 – 43.92)	37.91 (34.59 – 41.23) ^b	0.02	39.71 (37.43 – 42.00) ^a	50.69 (48.3 – 53.08) ^{ab}	0.27
<i>Data with intention to treat</i>						
SB in total school time (n = 138/206)	67.84 (66.17 – 69.51) ^a	66.38 (64.78 – 67.98) ^a	0.06	66.58 (65.12 – 68.05) ^a	67.62 (66.23 – 69.01) ^a	0.03
SB during recess (n = 139/228)	42.55 (40.13 – 44.96)	40.87 (38.11 – 43.63)	0.02	40.15 (37.85 – 52.44)	41.66 (39.42 – 43.91)	0.01
SB during PE classes (n=145/259)	40.59 (37.77 – 43.41)	38.6 (35.45 – 41.75) ^b	0.01	40.29 (38.19 – 42.40) ^a	50.61 (48.33 – 52.90) ^{ab}	0.29

95%CI: 95% confidence interval; MVPA: moderate to vigorous physical activity; PE: physical education; ^adifference between baseline and post-intervention ($p < 0.05$); ^bdifference between control school and intervention school ($p < 0.05$).

DISCUSSION

The results suggest that the intervention was not effective in increasing the proportion of PA and decreasing SB in the total school time, PE classes and recess. Contrary to expectations, there was an improvement in the control group profile in relation to SB in the total school time and PA in the three analyzed periods, while the intervention school presented a more sedentary and less active profile in the post-intervention period, when compared to the control.

Some phenomena influenced the performance and evaluation of the intervention, and possibly impacted the results observed in the present study. First, the intervention was purposely designed to last for 14 weeks, enough time to observe changes in PA engagement and a reduction in adolescent SB, according to previous systematic reviews^{19,24,26}. However, in the midst of the intervention, the school staff at the schools went on strike and, as a result, the intervention was stopped for approximately two weeks. These weeks could not be reset or compensated for, due to the school break established in the academic calendar of the schools. This compromised the continuity of the project and the evaluation after the intervention. As a result of this unforeseen event, the intervention had a total effective duration of 11 weeks, with an interruption in the middle, which possibly negatively impacted the process of behavioral change in the adolescents.

Another factor that may have impacted the worsening PA behavior observed in the intervention group is the weather. Due to resource constraints and how the schools were organized, school intervention and control collections were conducted on different weeks, though they were one after the other. The average weekly rainfall in the city of Florianópolis in the intervention school collection week was double the control school collection week in July²⁷, and it is possible that these climatic variations may have influenced PA-related behavior in schools, since on rainy days the use of courts is impaired. The option to conduct post-intervention assessment after the school vacation could have also compromised the relevance of the data as it portrayed a period of time far from the end of the intervention.

Other interventions with educational actions (meetings, posters, folders) and changes in PE classes were effective in improving students' PA level^{18,19}. However, the results presented in other interventions may also help to understand how behavior change may not have happened. A recent review showed that among 898 references of interventions found, only 53% had a significant effect on PA.⁶ An intervention in adolescents in Ecuador, which also adopted educational strategies for teachers, only slowed the decrease in moderate to vigorous PA that is common in early adolescence, but it did not prevent a decrease or increase in students' moderate to vigorous PA²⁸. Another pilot intervention in Chinese adolescents used student leaders, who were trained on how to promote PA, food and SB knowledge among their peers. Although the intervention was well evaluated by teachers and students, it was also not effective in modifying moderate to vigorous PA of the students after three or seven months²⁹. In Trinidad and Tobago, an educational intervention also had no significant effect on adolescents' moderate to vigorous PA, although it was well received by schoolchildren

and faculty³⁰. These examples of interventions involving training and educational measures appear to have no effect on moderate to vigorous PA behavior. Although substantial changes have been observed in the knowledge of the subject in some of them^{30,31}, factors beyond our knowledge, such as the perception of fun and social support for behavior, may not have been identified in these cases, which may be limiting or preventing behavior change among these teenagers. In some ways, these interventions have altered important ways to promote behavior change, but are not enough to achieve behavior change itself.

Environmental covariates (season, climate) are generally not controlled or accounted for in studies, especially intervention studies, and fluctuations in PA practice throughout the year may impact this behavior³², especially in locations with large temperature variations throughout the year, as is the case of southern Brazil. Future interventions are suggested to explore these issues or to control them in their studies. In the present study it is not possible to conclude how much weather impacted the practice of PA during the evaluation week, however the self-report done by the researchers on duty at the school during the collection week shows that there was a considerable change in the activities commonly performed by the students, which was not observed in the control school.

Strengths of this study were its design and the objective measurement of PA and SB, although the use of hip accelerometers may have limited the measurement of SB. Limitations of the study were the small number of schools, the lack of a randomization process (intentionality in the choosing of groups) and representation (the two schools do not represent the number of existing schools), the occurrence of a strike and the limited comparability of data due to fluctuation in the weather during the post-intervention assessment weeks.

CONCLUSION

In conclusion, the actions proposed in the *Mexa-se* intervention were not effective in changing the behavior of these adolescents within 11 weeks. However, uncontrollable factors, such as the weather and the school strike, may have greatly influenced the assessment of the intervention. New strategies should be tested, with a greater control of possible factors that influence the success of interventions.

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