

Effectiveness on physical activity indicators of an intervention delivered to high school students

Efetividade em indicadores de atividade física de uma intervenção com estudantes do ensino médio

Giovani Firpo Del Duca¹
Mauro Virgilio Gomes de Barros²
Kelly Samara Silva¹
Leandro Martin Totaro Garcia³
Jorge Bezerra¹
Markus Vinicius Nahas¹

Abstract – High schools represent a favorable environment for the development of interventions to increase physical activity because they reach a large number of teenagers. The goal of the study was to determine the effectiveness of an intervention to promote physical activity among high school students (through the ‘Saúde na Boa’ project) through assessing the stages of behavior change and the practices of muscle-strengthening exercise and active commuting. The present study comprised a randomized and controlled intervention conducted in Recife and Florianópolis, Brazil, during 2006. Dependent variables included active commuting (cutoff values: ≥ 1 and ≥ 5 days per week), the practice of muscle-strengthening exercises (cutoff values: ≥ 1 day per week and the recommended level of physical activity), and behavioral changes regarding physical activity. Of the 2,155 students included in the baseline data, 989 were evaluated in the post-intervention period (45.9%). In comparison with the control group, the intervention group significantly increased the practice of active commuting to school on ≥ 1 day per week (80.5% vs. 86.8%, $p < 0.001$) and ≥ 5 days per week (64.3% vs. 71.9%, $p < 0.001$), the practice of muscle-strengthening exercises on ≥ 1 day per week (41.4% vs. 46.0%, $p = 0.017$), and the achievement of the recommended levels of exercise (28.9% vs. 35.0%, $p = 0.002$). The intervention group reached higher stages of change in physical activity behavior compared with controls ($p = 0.004$). The ‘Saúde na Boa’ project effectively enhanced the practices of active commuting to school and muscle-strengthening exercises and resulted in an increased physical activity status.

Key words: Adolescent; Intervention studies; Motor activity; Muscle Strength; Transport.

Resumo – A escola é um local favorável ao desenvolvimento de intervenções para o aumento da atividade física devido à possibilidade de alcançar simultaneamente grande número de indivíduos. O objetivo do estudo foi verificar a efetividade de uma intervenção para promoção da atividade física (projeto Saúde na Boa) em relação aos estágios de mudança do comportamento, prática de exercícios de força e do deslocamento ativo em estudantes do ensino médio. Trata-se de uma intervenção randomizada e controlada, realizada em Florianópolis e Recife durante o ano letivo de 2006. Foram investigados o deslocamento ativo (pontos de corte: ≥ 1 e ≥ 5 dias/semana), a prática de exercícios de força (pontos de corte: ≥ 1 dia/semana e alcance às recomendações relacionadas à saúde) e a mudança de comportamento para a prática de atividade física. Dos 2.155 participantes da linha de base, 989 foram avaliados no período pós-intervenção (45,9%). Comparado ao grupo controle, o grupo intervenção aumentou significativamente a prática de deslocamento ativo em ≥ 1 dia/semana (80,5% vs. 86,8%; $p < 0,001$) e em ≥ 5 dias/semana (64,3% vs. 71,9%; $p < 0,001$), a prática de exercícios de força em ≥ 1 dia/semana (41,4% vs. 46,0%; $p = 0,017$) e o alcance das recomendações de sua prática relacionada à saúde (28,9% vs. 35,0%; $p = 0,002$). O grupo intervenção alcançou maiores proporções em estágios fisicamente ativos de mudança do comportamento para a atividade física, comparado ao controle ($p = 0,004$). Conclui-se que o projeto Saúde na Boa contribuiu de forma efetiva para o aumento da prática do deslocamento ativo, de exercícios de força e do status de atividade física.

Palavras-chave: Adolescente; Atividade motora; Estudos de intervenção; Força Muscular; Transportes.

1 Federal University of Santa Catarina. Graduate Program in Physical Education. Florianópolis, SC, Brazil.

2 University of Pernambuco. Graduate Program in Physical Education. Recife, PE, Brazil.

3 University of Sao Paulo. Graduate Program in Public Health Nutrition, São Paulo, SP, Brazil.

Received: 23 January 2014
Accepted: 22 March 2014



Licence
Creative Commons

INTRODUCTION

The practice of physical activity in adolescence can improve several health indicators, stimulate physical growth and development, and prevent important chronic diseases, such as obesity and depression¹. In addition, a physically active lifestyle at this developmental stage may increase the probability of maintaining this habit throughout adulthood². Nonetheless, a considerable number of Brazilian teenagers do not perform the recommended levels of physical activity³. In addition, the prevalence of obesity has increased significantly in the last 20 years and, at present, one out of every five Brazilian teenagers exhibits this health risk condition⁴.

Research on physical activity has devoted special attention to aerobic activities, particularly when practiced in leisure. Other forms of physical activity that are equally important to adolescent health, such as the practices of active commuting and muscle-strengthening exercises, have been less explored in the literature. In this respect, active commuting is known to significantly contribute to daily physical activity and to decrease the propensity towards obesity⁵, while muscle-strengthening exercises build muscle and elicit an increase in lean body mass¹.

Social support measures throughout adolescence are clearly associated with smaller declines in physical activity⁶. In this sense, the school is recognized as an important place for the development of interventions to promote regular physical activity⁷, and the achievement of adequate levels of physical activity can be facilitated by integrating the entire school system, including teachers, students, families, administrators, and public policies.

Although schools can enhance physical activity in adolescents, relevant studies on this topic are still lacking, particularly in countries with low and average income. Thus, the aim of this study was to assess the effectiveness of an intervention to promote physical activity (through the Saúde na Boa project) on the stages of behavior change and the practices of muscle-strengthening exercises and active commuting by high school students.

METHODS

The study consisted of a randomized, controlled, and cross-cultural intervention implemented during the school year (March to December) of 2006. The Saúde na Boa project to stimulate physical activity and healthy eating habits was conducted with students who were undertaking public high school evening courses in two Brazilian cities – Recife and Florianópolis. These cities were selected based on the environmental and sociocultural contrasts between the two at the time of the study. Indeed, these contrasts are still evident to date: considering the 26 state capitals and the Federal District, Florianópolis ranks first in the Human Development Index, whereas Recife is in position thirteen⁸.

The intervention focused on three major components: (a) education regarding physical activity and healthy eating, (b) environmental and organizational changes, and (c) training and engagement of human re-

sources. Strategic actions developed during the intervention included the dissemination of educational information via a website, the preparation of thematic posters and newsletters for classroom discussion, the creation of bicycle racks, the distribution of seasonal fruits, the delivery of physical activity kits, the organization of special weekend activities, such as hiking and cycling, and the presentation of lectures for teachers, technicians, students, and parents/guardians. The logic model and a complete description of the activities provided by the project have been previously reported⁹.

Twenty schools were randomly selected (10 in each city) and paired according to size and geographical location. Half of the schools were assigned to each group (control and experimental). Students aged 15-24 years who were enrolled in high school evening courses at the selected schools were invited to participate. Detailed information about the sampling process has been previously described⁹.

For data collection, a specific and previously validated questionnaire, designated *Saúde na Boa*, was used¹⁰. The instrument was collectively applied in the classroom by a team of graduate students in Physical Education, who were adequately trained by the study supervisors.

The outcomes of the study involved three physical activity indicators: active commuting to and from school, the practice of muscle-strengthening exercises, and the stage of physical activity behavior change. Active commuting was assessed with the following question: "During a typical week, how many days do you walk or pedal to and from school or work?" This outcome was evaluated using cutoff values of ≥ 1 and ≥ 5 days per week. The practice of muscle-strengthening exercises was evaluated with the question: "During a typical week, how many days do you perform exercises to improve muscle tone and strength, such as weight lifting or gymnastics (e.g., support on the ground or hanging on the bar)?" Similarly, two cutoff values were used for this activity: the practice of muscle-strengthening exercises on ≥ 1 day per week and adherence to the recommended practice of resistance exercises on two or more days per week for individuals under 17 years of age or on three or more days per week for those aged 18 years or older¹¹. The stages of behavior change arising from the trans-theoretical model were used to define the effects on physical activity¹². For this outcome, we used the following question: "Young people who perform at least 60 min of daily physical activity on five or more days per week are considered physically active. In relation to your physical activity habits, would you say that: (A) you have been physically active for over six months, (B) you have been physically active for less than six months, (C) you are not active at present but intend to become physically active in the next 30 days, (D) you are not active at present but intend to become physically active in the next six months, and (E) you are not active at present and have no intention to become physically active in the next six months." The responses were used to classify participants into five distinct stages of behavior change as follows: answer (A) - maintenance stage, answer (B) - action stage, answer (C) - preparation stage, answer (D) - contemplation stage, and answer (E) - precontemplation stage.

Descriptive statistics included absolute frequencies (n) and relative frequencies (%). The effectiveness of the Saúde na Boa project was assessed considering the intention-to-treat principle (data input using the Last Observation Carried Forward imputation method) considering only the data collected (i.e., data from students who finished the survey). Fisher's exact test was used for comparisons between the control and intervention groups. The comparisons among the control group (baseline vs. postintervention) and the intervention group (baseline vs. postintervention) were performed using the McNemar test and the Stuart-Maxwell test for marginal homogeneity, for dichotomous and polytomous variables, respectively.

Data were adjusted with binary logistic regression (for the dichotomous variables) and multinomial logistic regression (for the polytomous variables). Multinomial regression was performed because the stages of behavior change did not meet all conditions of the ordinal regression and violated the assumption of the proportional odds ratio. In view of the sociodemographic differences between the two groups in the baseline, other indicators, such as gender, age, ethnicity, occupation, and school location (classified as shown in Table 1) were included as potential confounders. For statistical modeling, we adopted the strategy of backward selection with the inclusion of all sociodemographic variables. In addition, we adopted a critical level of $p \leq 0.20$ for permanence in the model. The results were expressed as odds ratios (OR) and confidence intervals of 95% (95% CI).

The study was approved by the Ethics Committee of the Federal University of Santa Catarina (Universidade Federal de Santa Catarina - Protocol N. 031/2005) and by the Mother and Child Institute of Pernambuco (Instituto Materno Infantil de Pernambuco - Protocol N. 587/2005).

RESULTS

The baseline data of the Saúde na Boa project included 2,155 students, the majority of whom comprised non-Caucasian, unemployed, female high school students in Florianópolis. There were significant differences between the control and intervention groups of this sample. Of these 2,155 students, 989 participated in the postintervention period (45.9%). Except for occupation, most of these students exhibited a sociodemographic profile similar to that of the baseline group, without significant differences between the control and intervention groups. Detailed information about the sociodemographic profiles of the students is shown in Table 1.

Considering an error probability α of 0.05, a power of 80%, and the percentage of young people who participated in the entire study, it was possible to observe a significant difference of 6.7% for active commuting on ≥ 1 day per week, 8.5% for active commuting on ≥ 5 days per week, 9.9% for the practice of muscle-strengthening exercises on ≥ 1 day per week, and 8.3% for the achievement of the recommended levels of muscle-strengthening exercises. With regard to the stages of change in physical activity behavior, it was not possible to calculate the statistical power due to the type of variables present (ordinal polytomous).

Table 1. Sociodemographic profile of public high-school students enrolled in the Saúde na Boa project in Florianópolis (State of Santa Catarina) and Recife (State of Pernambuco), 2006.

Variables	Baseline (n = 2155)					Postintervention (n = 989)				
	Control		Intervention		p-value	Control		Intervention		p-value
	n	%	n	%		n	%	n	%	
Gender										
Female	576	52.8	619	58.6	0.007	295	57.5	295	62.6	0.104
Male	515	47.2	437	41.4		218	42.5	176	37.4	
Age (years)										
14-16	314	28.7	228	21.5	0.001	66	12.8	43	9.1	0.083
17-19	494	45.0	527	49.8		269	52.2	241	50.8	
20-24	288	26.3	304	28.7		180	35.0	190	40.1	
Ethnicity (auto reported)										
Caucasian	488	44.7	423	40.2	0.036	211	41.1	174	37.1	0.213
Other	605	55.3	630	59.8		302	58.9	295	62.9	
Employed^a (auto reported)										
No	565	51.8	573	54.4	0.243	237	46.7	193	40.8	0.071
Yes	525	48.2	480	45.6		271	53.4	280	59.2	
School location										
Florianópolis	564	51.5	592	55.9	0.042	268	52.1	262	55.3	0.338
Recife	532	48.5	467	44.1		247	47.9	212	44.7	

Notes: p-values derived from the Fisher's exact test (control vs. intervention groups). a Variable with the greatest amount of missed data in the baseline (N = 12) and in the postintervention period (N = 8).

Table 2 presents the effectiveness of the intervention on physical activity indicators using the intention-to-treat analysis. Except for the practice of active commuting ≥ 1 day per week, no significant difference was found for these indicators when the control and intervention groups were compared at baseline. Following the intervention, the intervention group exhibited the greatest number of students practicing active commuting ≥ 1 day per week and ≥ 5 days per week, in comparison with the control group; the intervention group also practiced more muscle-strengthening exercises on ≥ 1 day per week and a higher number achieved the recommended levels of muscle-strengthening exercises. In addition, we observed a significant increase in the number of students at advanced stages of change in physical activity behavior following intervention, in comparison with the control group.

For the control group, the comparison between the baseline and the postintervention period (Table 2) revealed a decrease in the number of students who practiced active commuting on ≥ 5 days per week and an increase in the number of those belonging to more advanced stages of behavior change.

For the intervention group, the comparison between the baseline and the postintervention period indicated that the intervention significantly increased the practice of muscle-strengthening exercises on ≥ 1 day per week and enabled the achievement of the muscle-strengthening exercise amounts recommended for a healthy lifestyle. In addition, the effectiveness determined using the collected data (Table 3) was very similar to that observed using the intention-to-treat principle (Table 2).

Table 2. Effectiveness analysis of the Saúde na Boa project using the intention-to-treat analysis of physical activity indicators among public high-school students in Florianópolis (State of Santa Catarina) and Recife (State of Pernambuco) in 2006.

Variables	Baseline		Postintervention				p-value					
	Control		Intervention		Control		Intervention		Control vs. Intervention (Baseline)	Control vs. Intervention (Postintervention)	Control vs. Control (Baseline vs. Postintervention)	Intervention vs. Intervention (Baseline vs. Postintervention)
	n	%	n	%	n	%	n	%				
Active commuting												
≥ 1 day/week	873	81.1	888	85.5	877	80.5	909	86.8	0.003	< 0,001	0.654	0.182
Active commuting												
≥ 5 days/week	731	67.9	727	70.0	700	64.3	753	71.9	0.152	< 0,001	0.005	0.113
Practice of muscle-strengthening exercises												
≥ 1 day/week	427	39.4	427	41.0	451	41.4	483	46.0	0.230	0.017	0.103	< 0,001
Achievement of the recommended levels of muscle-strengthening exercises												
Yes	299	27.6	308	29.6	315	28.9	367	35.0	0.162	0.002	0.315	< 0,001
Stages of change in physical activity behavior												
Pre-contemplation	77	7.1	60	5.8	102	9.4	65	6.2	0.114	0.004	0.045	0.138
Contemplation	196	18.2	156	15.1	205	18.8	162	15.4				
Preparation	227	21.0	222	21.5	223	20.4	208	19.8				
Action	199	18.4	186	17.9	198	18.2	212	20.2				
Maintenance	380	35.2	411	39.7	363	33.2	402	38.3				

Notes: p-values for the comparisons between the control and intervention groups were derived from the Fisher's exact test. p-values for the comparisons among the control and intervention groups were derived from the McNemar test (dichotomous variables) and the Stuart-Maxwell test for marginal homogeneity (polytomous variables).

Table 3. Effectiveness of the intervention considering only data collected from the Saúde na Boa project on the physical activity indicators of public high-school students in Florianópolis (State of Santa Catarina) and Recife (State of Pernambuco) in 2006.

Variables	Baseline		Postintervention				p-value					
	Control		Intervention		Control		Intervention		Control vs. Intervention (Baseline)	Control vs. Intervention (Postintervention)	Control vs. Control (Baseline vs. Postintervention)	Intervention vs. Intervention (Baseline vs. Postintervention)
	n	%	n	%	n	%	n	%				
Active commuting												
≥1 day/week	873	81.1	888	85.5	407	80.0	415	88.5	0.003	< 0,001	0.654	0.182
Active commuting												
≥5 days/week	731	67.9	727	70.0	311	61.1	341	72.7	0.152	< 0,001	0.005	0.113
Practice of muscle-strengthening exercises												
≥1 day/week	427	39.4	427	41.0	206	40.5	215	45.6	0.230	0.058	0.103	< 0,001
Achievement of the recommended levels of muscle-strengthening exercises												
Yes	299	27.6	308	29.6	143	28.1	170	36.1	0.162	0.005	0.315	< 0,001
Stages of change in physical activity behavior												
Pre-contemplation	77	7.1	60	5.8	56	11.0	32	6.9	0.114	0.003	0.045	0.138
Contemplation	196	18.2	156	15.1	95	18.7	77	16.5				
Preparation	227	21.0	222	21.5	119	23.4	83	17.8				
Action	199	18.4	186	17.9	87	17.1	106	22.8				
Maintenance	380	35.2	411	39.7	151	29.7	168	36.1				

Note: p-values for the comparisons between the control and intervention groups were derived from the Fisher's exact test. p-values for the comparisons among the control and intervention groups were derived from the McNemar test (dichotomous variables) and the Stuart-Maxwell test for marginal homogeneity (polytomous variables).

Tables 4 and 5 show the effects of the Saúde na Boa project on physical activity indicators. In Table 4, the effectiveness results using the intention-to-treat principle revealed that the participants who received intervention practiced more active commuting on ≥ 1 day per week and ≥ 5 days per week than those students in the control group. In addition, these postintervention students exhibited a significantly higher odds ratio for the performance of muscle-strengthening exercises on at least one day per week and for the achievement of the recommended levels of this practice. However, more pronounced effects were observed only when the effectiveness results using data collected from the students who had participated in the entire study were analyzed.

Table 4. Postintervention effects of the Saúde na Boa project on the physical activity indicators of public high-school students in Florianópolis (State of Santa Catarina) and Recife (State of Pernambuco) in 2006.

Variables	Active commuting (≥ 1 day/week)			Active commuting (≥ 5 days/week)			Muscle-strengthening exercises (≥ 1 day/week)			Achievement of the recommended levels of muscle-strengthening exercises		
	OR	CI 95%	p-value	OR	CI 95%	p-value	OR	CI 95%	p-value	OR	CI 95%	p-value
Effectiveness (intention-to-treat)												
Control	1.00		0.005	1.00		0.005	1.00		0.001	1.00		0.001
Intervention	1.55	1.14; 2.10		1.69	1.29; 2.22		1.37	1.04; 1.79		1.62	1.21; 2.17	
Effectiveness (collected data)												
Control	1.00		< 0,001	1.00		< 0,001	1.00		0.01	1.00		0.001
Intervention	1.97	1.38; 2.82		1.74	1.32; 2.29		1.42	1.08; 1.87		1.71	1.28; 2.29	

Notes: Odds ratios (OR) and respective 95% confidence intervals (95% CI) were adjusted for gender, age, ethnicity, employment status, and school location. For active commuting (≥ 1 day/week), the analysis was baseline-adjusted due to the significant difference between the control and intervention groups.

In Table 5, considering the intention-to-treat results and the collected data, the effectiveness was assessed by comparing the effects of the intervention on the stages of behavior change in the control and intervention groups. For the intention-to-treat results, students who participated in the project exhibited a greater probability of achieving the stages of action and maintenance, compared with students in the precontemplation stage. Similar results were observed when data only from students who had completed the study were analyzed.

Table 5. Postintervention effects of the Saúde na Boa project on the stages of change in physical activity behavior among public high-school students in Florianópolis (State of Santa Catarina) and Recife (State of Pernambuco) in 2006.

Variables	Contemplation vs. Precontemplation			Preparation vs. Precontemplation			Action vs. Precontemplation			Maintenance vs. Precontemplation		
	OR ^a	CI 95%	p-value	OR ^a	CI 95%	p-value	OR ^a	CI 95%	p-value	OR ^a	CI 95%	p-value
Effectiveness (intention-to-treat)												
Control	1.00		0.213	1.00		0.519	1.00		0.003	1.00		0.009
Intervention	1.40	0.82; 2.38		1.19	0.70; 2.00		2.18	1.30; 3.68		1.94	1.18; 3.19	
Effectiveness (collected data)												
Control	1.00		0.196	1.00		0.500	1.00		0.005	1.00		0.005
Intervention	1.43	0.83; 2.44		1.20	0.71; 2.03		2.13	1.25; 3.60		2.07	1.25; 3.43	

Note: a Odds ratios (OR) and respective 95% confidence intervals (95% CI) were adjusted for gender, age, ethnicity, employment status, and school location.

DISCUSSION

This study indicated that the Saúde na Boa project was effective in increasing the number of students who actively commuted to and from school and/or work, performed muscle-strengthening exercises, and achieved a more advanced stage of adherence to physical activity practices. To date, the authors are not aware of the existence of other studies on physical activity indicators using randomized and controlled interventions in Brazilian teenagers.

The school is a privileged environment for discussions of health-related topics involving children and adolescents, including discussions concerning physical activity; this is where young people spend most of their week and where the social functions of education in its different domains are assigned. Therefore, it is expected that the school environment effectively helps young people adopt an active and healthy lifestyle¹³. According to Costa et al.¹⁴, this influence occurs mainly through the creation of environments conducive to physical activity and the incorporation of didactic and pedagogical approaches into the school curriculum.

In fact, several reports worldwide have indicated the effectiveness of educational practices aimed at increasing physical activity^{7,15}. A recent systematic review of existing interventions in Latin America has identified four strategies for promoting physical activity at school: curricular changes in physical education classes, adequate infrastructure and training of school staff, provision of adequate equipment and supplies, and directing of actions according to the profile of the target population⁷. Importantly, such strategies were used in the Saúde na Boa project⁹.

Effect on active commuting

Previous research has revealed important effects of active commuting on health^{16,17}, including increased levels of physical activity¹⁸, an improvement in fitness and health,¹⁹ and the minimization of problems such as traffic congestion and the environmental pollution and noise derived from the use of private transportation²⁰. In the present study, the practice of active commuting was increased both on ≥ 1 day per week and on ≥ 5 days per week in the intervention group, compared with the control group. Considering the odds ratio, these values corresponded to an effect of 1.66 and 1.45, respectively. In the analysis separated by groups, there was a decrease in active commuting in the control group on ≥ 5 days per week (-6.8%).

Commuting is considered an essential element of physical activity and has been used in intervention strategies to promote an active lifestyle among children and adolescents. As such, commuting to school is a behavior that enables the adoption of a daily routine among young people. Although the average time spent on active commuting to school/work (15 to 30 min) was below that recommended for physical activity, this practice contributed to an increase in the total amount of physical activity, with a weekly expenditure of 955 kcal (considering a distance of 1.9 km with a travel time of 22 min, 5 days per week), which contributes to better health²¹.

A review study has reported that the physical environment (e.g., the presence of open spaces, parks, and recreational facilities) has a positive effect on active commuting²². Another recent review reported the implementation of several interventions focused on active commuting to school. Most of these interventions used a quasi-experimental design and were conducted with elementary school students in the United States, Australia, and the UK. Other studies created interventions with the participation of schools, parents, and the community, and reported an increase in active commuting in the range of 3% to 64%. However, 6 of the 12 studies reported only small effects²³.

In the present study, the main strategies for active commuting comprised the installation of bicycle racks, bicycle raffles, and the dissemination of informational material to motivate the students to adopt this behavior. Other initiatives that have had some success, including “Walk to School” and “Safe Routes to School”, were based on campaigns, specific actions, and events that adopted incentives to encourage active commuting to school (www.iwalktoschool.org) as their main goal. In fact, changes in the physical environment coupled with incentive campaigns tend to contribute to an increase in active commuting to school.

Effects of intervention on the practice of muscle-strengthening exercises

The current recommendations for physical activity have devoted a specific section to strengthening exercises. These recommendations specify that activities for the strengthening of muscles and bones should be performed by children and adolescents (5 to 17 years old) on at least three days each week, and by teenagers (18 to 19 years old) and adults at least two days per week.¹¹ The regular performance of muscle-strengthening exercises among young people can reduce cardiovascular risk, promote weight loss, increase bone density, enhance psychological and social well-being, improve motor skills, and reduce the incidence of sports-related injuries²⁴.

The Saúde na Boa project effectively increased the number of physical exercise practitioners and enabled students to achieve the recommended muscle-strengthening exercise levels, in comparison with the control group. However, the authors found no other reports of interventions to encourage physical activity in schools that have analyzed the practice of strength exercises. This indicates that, although this type of exercise is important and strongly recommended, little attention has been devoted to its incentive and monitoring.

Effects on the stages of change in behavior

Monitoring the stages of change in physical activity behavior in teenagers is essential for an assessment of the levels of awareness of the practice. In terms of change in physical activity behavior, the Saúde na Boa project evoked students to transition from the inactive stage to the physically active stages. Moreover, the number of students who achieved the action stage postintervention (20.2%) was higher than that found in a previous survey conducted with students from the State of Pernambuco (16.4%)²⁵.

Specific actions to encourage active commuting, in addition to those cited, may have contributed to the increase in physical activity during leisure time. Among these, we highlight the delivery of physical activity kits, special weekend sports events, such as hiking and cycling, and lectures for teachers, technicians, students, and parents/guardians.

As reported by Dumith et al.²⁶ in a literature review, comparative analyses of findings from similar studies that have investigated the stages of change in physical activity behaviors may not be possible because most of these studies were cross-sectional, which precluded an evaluation of the temporal continuity of these behaviors.

Strengths and weaknesses of the study

Although the applied questionnaire has been evaluated on the basis of its psychometric properties, the collection of data through a self-report study may result in inaccuracy, particularly in behavioral data such as those involving physical activity. However, we believe that the repeatability of the data collection methodology for the control and intervention groups has minimized potential biases in data comparison. In addition, the occurrence of school strikes and protests (over different periods) in both cities during the study led to the application of the school interventions over distinct periods. Nonetheless, the adequate amount of time devoted to each intervention and the adaptation of the study to the peculiarities of each city should have minimized any season-related problems.

The strengths of the study include the performance of randomized and controlled interventions, the selection of students who were enrolled in evening classes and were more exposed to physical inactivity, and the inclusion of physical activity variables that had not been adequately addressed during previous interventions.

CONCLUSION

The Saúde na Boa project effectively increased active commuting, the practice of muscle-strengthening exercises, and the status of physical activity. In addition, our results reinforce the need for the planning of interventions considering sociodemographic characteristics. In this sense, intervention strategies targeted to high school adolescents are attractive targets for the promotion of physical activity.

REFERENCES

1. Malina RM, Bouchard C, Bar-Or O. Crescimento, maturação e atividade física. 2nd ed. São Paulo: Phorte; 2009.
2. Friedman H, Martin L, Tucker J, Criqui M, Kern M, Reynolds C. Stability of Physical Activity across the Lifespan. *J Health Psychol* 2008;13(8):1092-104.
3. Malta D, Sardinha L, Mendes I, Barreto S, Giatti L, Castro I, and al. Prevalência de fatores de risco e proteção de doenças crônicas não transmissíveis em adolescentes: resultados da Pesquisa Nacional de Saúde do Escolar. Brazil, 2009. *Cienc Saude Colet* 2010;15(suppl. 2):3009-19.

4. Brasil. Pesquisa de orçamentos familiares 2008-2009: antropometria e estado nutricional de crianças, adolescentes e adultos no Brasil. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2010.
5. Cooper A, Wedderkopp N, Wang H, Andersen L, Froberg K, Page A. Active travel to school and cardiovascular fitness in Danish children and adolescents. *Med Sci Sports Exerc* 2006;38:1724-31.
6. Craggs C, Corder K, van Sluijs E, Griffin S. Determinants of change in physical activity in children and adolescents: a systematic review. *Am J Prev Med* 2011;40(6):645-58.
7. Ribeiro I, Parra D, Hoehner C, Soares J, Torres A, Pratt M, et al. School-based physical education programs: evidence-based physical activity interventions for youth in Latin America. *Global Health Promotion*. 2010;17(2):5-15.
8. United Nations Program for Development. Atlas of Human Development in Brazil - City ranking in 2010-2013. Available from: <http://www.atlasbrasil.org.br/2013/ranking> [2013 Nov 20].
9. Nahas M, de Barros M, de Assis M, Hallal P, Florindo A, Konrad L. Methods and participant characteristics of a randomized intervention to promote physical activity and healthy eating among Brazilian high school students: the Saude na Boa project. *J Phys Act Health* 2009;6(2):153-62.
10. Nahas M, Barros M, Florindo A, Farias Júnior JC, Hallal PC, Konrad L, et al. Reliability and validity of the Saude na Boa questionnaire to assess physical activity and eating habits of high-school students. *Rev Bras Ativ Fis Saúde* 2007;13:80-5.
11. World Health Organization. Global recommendations on physical activity for health. Geneva: World Health Organization, 2010.
12. Prochaska J, Marcus B. The Transtheoretical model: applications to exercise. Dishman R, editor. Champaign: Human Kinetics, 1994.
13. Ippolito-Shepherd J. Health-promoting schools – strengthening regional initiatives: strategies and lines of action during 2003–2012. Washington: Pan American Health Organization, 2006.
14. Costa F, Garcia L, Nahas M. A Educação Física no Brasil em transição: perspectivas para a promoção da atividade física. *Rev Bras Ativ Fis Saúde* 2012;17(1):14-21.
15. De Bourdeaudhuij I, Van Cauwenberghe E, Spittaels H, Oppert J, Rostami C, Brug J, et al. School-based interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project. *Obes Rev* 2011;12(3):205-16.
16. World Health Organization. A physically active life through everyday transport: with a special focus on children and older people and examples and approaches from Europe. Copenhagen: WHO Regional Office for Europe; 2002.
17. Hamer M, Chida Y. Active commuting and cardiovascular risk: a meta-analytic review. *Prev Med* 2008;46(1):9-13.
18. Lee MC, Orenstein MR, Richardson MJ. Systematic review of active commuting to school and children's physical activity and weight. *J Phys Act Health* 2008;5(6):930-49.
19. Lubans DR, Boreham CA, Kelly P, Foster CE. The relationship between active travel to school and health-related fitness in children and adolescents: a systematic review. *Int J Behav Nutr Phys Act* 2011;8(5).
20. Pooley CG, Turnbull J, Adams M. The journey to school in Britain since the 1940s: continuity and change. *Area* 2005;37(1):43-53.
21. Shephard RJ. Is active commuting the answer to population health? *Sports Med* 2008;38(9):751-8.
22. Pont K, Ziviani J, Wadley D, Bennett S, Abbott R. Environmental correlates of children's active transportation: a systematic literature review. *Health Place* 2009;15(3):827-40.
23. Chillón P, Evenson KR, Vaughn A, Ward DS. A systematic review of interventions for promoting active transportation to school. *Int J Behav Nutr Phys Act* 2011;8(1):10.

24. Faigenbaum A, Kraemer W, Blimkie C, Jeffreys I, Micheli L, Nitka M, et al. Youth resistance training: updated position statement paper from the national strength and conditioning association. *J Strength Cond Res* 2009;23(5 Supl.):S60-79.
25. Oliveira N, Barros M, Reis R, Tassitano R, Tenório M, Bezerra J, et al. Estágios de mudança de comportamento para a atividade física em adolescentes. *Motriz* 2012;18(1):42-54.
26. Dumith S, Domingues M, Gigante D. Stages of behavior change for physical activity: a literature review. *Rev Bras Cineantropom Desemp Hum* 2008;10(3):301-7.

Corresponding author

Giovâni Firpo Del Duca
Universidade Federal de Santa
Catarina
Campus Universitário Reitor João
David Ferreira Lima.
Caixa Postal 6510.
Coordenadoria de Pós-Graduação em
Educação Física.
Bairro Trindade, Florianópolis, Santa
Catarina, Brazil
CEP 88040-900.
E-mail: gfdelduca@gmail.com