

Effect of intervention on total and central obesity in students: The Saúde na Boa project

Efeitos de uma intervenção sobre a obesidade geral e abdominal em escolares: projeto Saúde na Boa

Thiago Ferreira de Sousa¹
Markus Vinicius Nahas¹
Carla Meneses Hardman¹
Leandro Martin Totaro Garcia²
Giovâni Firpo Del Duca¹
Maria Alice Altenburg de Assis¹

Abstract – Although studies have shown that the school setting is favorable for preventing obesity, relatively few studies have examined weight-gain prevention in youths. To assess the effectiveness of a nine-month intervention to reduce total and central obesity in youths attending night secondary school in two Brazilian state capitals (Florianópolis and Recife). This was a randomized controlled intervention study conducted from March to December 2006. The indicators of obesity assessed were the body mass index (BMI), waist circumference (WC) and waist-to-height ratio (WHtR). Statistical analysis was performed using the chi-square and McNemar's tests. A total of 2,155 participants were assessed at baseline, and 989 participants were assessed after the end of the intervention. In the intervention group, the frequency of total obesity, as assessed by the BMI (baseline: 3.8%; after intervention: 4.3%), and of central obesity, as assessed by the WHtR (baseline: 9.5%; after intervention: 10.4%), stabilized after nine months. However, the frequency of central obesity, as assessed by the WC, increased in the intention-to-treat analysis (baseline: 5.4%; after intervention: 7.9%). In the control group, the frequency of total obesity (baseline: 3.8%; after intervention: 4.7%) and central obesity, as assessed by both WHtR (baseline: 8.1%; after intervention: 9.7%) and WC (baseline: 6.1%; after intervention: 8.2%), increased. The intervention implemented by the *Saúde na Boa* project helped to stabilize the prevalence of total and central obesity in the investigated population.

Key words: Adolescents; Central obesity; Intervention studies; Obesity.

Resumo – Embora os estudos demonstrem que o ambiente escolar seja um contexto favorável para a prevenção da obesidade, há ainda relativa escassez de pesquisas relacionadas à prevenção do ganho de peso em jovens. O objetivo do estudo foi avaliar a efetividade de uma intervenção sobre a obesidade geral e abdominal em escolares do Ensino Médio do período noturno de duas capitais brasileiras: Florianópolis e Recife. Trata-se de um estudo de intervenção randomizado e controlado, desenvolvido de março a dezembro de 2006. Os indicadores de obesidade selecionados foram o índice de massa corporal (IMC), perímetro da cintura (PC) e a razão cintura-estatura (RCE). As análises foram conduzidas mediante utilização dos testes qui-quadrado e McNemar. Na linha de base, foram incluídos 2.155 escolares e 989 foram reavaliados no período pós-intervenção. No grupo intervenção, após nove meses se constatou estabilização da frequência de obesidade geral pelo IMC (linha de base: 3,8%; pós-intervenção: 4,3%) e abdominal pelo RCE (linha de base: 9,5%; pós-intervenção: 10,4%). Contudo, houve aumento da obesidade abdominal pelo PC ao considerar a intenção de tratar (linha de base: 5,4%; pós-intervenção: 7,9%). No grupo controle, foram verificados incrementos na frequência de obesidade geral (linha de base: 3,8%; pós-intervenção: 4,7%) e abdominal, tanto pela RCE (linha de base: 8,1%; pós-intervenção: 9,7%) como pelo PC (linha de base: 6,1%; pós-intervenção: 8,2%). A intervenção do estudo Saúde na Boa contribuiu para a estabilização da prevalência de obesidade geral e abdominal.

Palavras-chave: Adolescente; Estudos de Intervenção; Obesidade; Obesidade central.

1 Federal University of Santa Catarina. Graduate Program in Physical Education. Center for Research on Physical Activity and Health Florianópolis, SC. Brazil.

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

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INTRODUCTION

The prevalence of obesity in various populations and age ranges has been the subject of several studies¹. An increase in the prevalence of excess weight among children and adolescents²⁻⁴ has led to the formulation of strategies aimed to prevent and treat obesity. According to the available evidence, educational interventions are effective for treating childhood obesity and its consequences⁵.

A systematic literature review showed that one in three school-based interventions induced changes in the prevalence of obesity or in the body mass index (BMI)⁶. However, the effects found in meta-analyses were modest. The review authors also found that the most efficient interventions lasted at least three months, did not focus solely on environmental changes, were implemented in the general population and benefited females and younger participants the most.

Assessments of various anthropometric parameters may be relevant for establishing the effectiveness of interventions for body fat reduction⁷. The BMI is the anthropometric indicator of overweight/obesity that is most widely used in studies of children and adolescents. BMI assessment is inexpensive and easy to perform, and it allows for comparisons within a group, among studies and over time⁸. Central obesity, estimated based on the waist circumference (WC) and other indicators of central adiposity, such as the waist-to-height ratio (WHtR), have been associated with risk factors for cardiovascular and metabolic diseases^{9,10}.

Although the school setting has been shown to be favorable for interventions to prevent obesity, particularly because of the opportunity to include a large number of participants and the significant amount of time children and youths spend at school every day¹¹, relatively few studies have focused on preventing weight gain in this population^{12,13}. For that reason, the aim of the present study was to assess the effectiveness of an intervention targeting total and central obesity in youths attending night secondary school in two Brazilian state capital cities: Florianópolis and Recife. The results of the present study may provide information about changes in the indicators of obesity in the investigated population and about the anthropometric indicators that were most affected by the assessed intervention.

METHODS

The *Saúde na Boa* Project consisted of a randomized controlled school intervention conducted over one school year (March to December) in 2006. The target-population comprised youths aged 15 to 24 years old attending public night secondary schools in Florianópolis and Recife. These cities were selected because of the environmental and sociocultural contrasts they presented at the time of the study, which allowed the effectiveness of the assessed intervention in disparate Brazilian contexts to be analyzed. The methods used in the *Saúde na Boa* project are summarized below, and further detail is available in the study by Nahas et al.¹⁴.

Ten schools from each city were randomly selected and were matched by size and geographic localization. The schools in each pair were allocated to either the control or intervention group via lottery. The intervention included a set of actions focusing on three categories: healthy nutrition and physical activity education, environmental and organizational changes in the school setting and personnel training. Among the actions that were implemented, the following stood out: disseminating educational information through a website; creating thematic posters and newsletters to discuss in the classroom; creating bicycle parking lots; distributing seasonal fruits; distributing physical activity kits; organizing special weekend activities (e.g., hiking, cycling); and offering lectures for teachers, staff and students and their legal guardians. No changes were introduced over the study period in the schools allocated to the control group.

Body mass (kg), height (cm) and WC (cm) were assessed in the present study. Measurements were performed at baseline and after intervention by trained staff following the procedures recommended by Lohman et al.¹⁵. These data were used to calculate the BMI (kg/m²) and WHtR. Total obesity, assessed via BMI, was classified following the criteria formulated by Cole et al.¹⁶ for youths up to 17 years old; the World Health Organization classification¹⁷ was used for the remainder of the sample (i.e., those aged ≥ 18 years). To define the presence of central obesity according to the WHtR, a value ≥ 0.50 was established; when assessment was based on the WC measurement, the values suggested by Taylor et al.¹⁹ were used.

Descriptive statistics included absolute and relative frequencies. The assessment of the intervention effectiveness included intention-to-treat analysis (data were imputed using the last observation carried forward method) and the data for the participants who completed the study. Intergroup comparisons at each time-point were performed using the chi-square test. McNemar's test was used for intragroup comparisons of proportions before and after the intervention. The analyses were also stratified according to city and gender. The significance level was set as $p \leq 0.05$.

The *Saúde na Boa* project was approved by the ethics committees of the Federal University of Santa Catarina (no. 031/2005) and the Mother and Child Institute of Pernambuco (no. 587/2005).

RESULTS

At baseline, the *Saúde na Boa* project included 2,155 participants; 1,156 (53.6%) were from Florianópolis. Most of the participants were female (55.7%), aged 17 to 19 years old (47.4%), nonwhite (57.5%) and unemployed (53.1%). A total of 989 participants remained until the end of the study, corresponding to 45.9% of the initial sample; the sociodemographic characteristics were similar for the participants who remained until the end of the study and the dropouts²⁰.

Based on the probability of a Type I error (α) of 0.05, 80% power and the relative frequency of the outcomes corresponding to the participants who remained until the end of the study, the following differences were considered statistically significant: differences of 4.8 percentage points (pp)

relative to total obesity; 5.9 pp relative to central obesity, as established by the WC; and 6.2 pp relative to central obesity, as established by the WHtR.

Table 1 describes the effectiveness of the *Saúde na Boa* project relative to total obesity, in relation intention-to-treat analysis and data corresponding only to the participants who remained until the end of the study. According to both analyses, there were no differences between the groups (control and intervention) at baseline and after intervention; however, was observed a significant increase to total obesity in the control group after intervention.

Table 1. Intention-to-treat and data collected analysis of the effectiveness of the *Saúde na Boa* project relative to total obesity in youths attending public secondary schools in Florianópolis (SC) and Recife (PE) in 2006.

Variables	Baseline		After intervention		p-value			
	Control %(n)	Intervention %(n)	Control %(n)	Intervention %(n)	1	2	3	4
Intention-to-treat								
Total	3.8(39)	3.8(36)	4.7(49)	4.3(42)	1.00	0.67	0.04	0.51
City								
Florianópolis	3.6(20)	3.5(20)	4.7(26)	4.3(25)	0.89	0.76	0.15	0.12
Recife	4.0(19)	4.3(16)	4.8(23)	4.4(17)	0.82	0.78	0.29	0.50
Gender								
Male	4.3(21)	4.4(17)	5.1(25)	5.6(22)	0.98	0.77	0.34	0.12
Female	3.3(18)	3.4(19)	4.4(24)	3.5(20)	0.94	0.44	0.11	1.00
Data collected								
Total	3.8(39)	3.8(36)	5.4(27)	5.2(24)	1.00	0.87	0.04	0.51
City								
Florianópolis	3.6(20)	3.5(20)	5.9(15)	5.5(14)	0.89	0.86	0.15	0.12
Recife	4.0(19)	4.3(16)	4.9(12)	4.7(10)	0.82	0.94	0.29	0.50
Gender								
Male	4.3(21)	4.4(17)	6.0(13)	6.4(11)	0.98	0.89	0.34	0.12
Female	3.3(18)	3.4(19)	4.9(14)	4.4(13)	0.94	0.78	0.11	1.00

P-values 1 and 2: Chi-square test; 3 and 4: McNemar's test. 1: Intervention at baseline vs. control at baseline. 2: Intervention after intervention vs. control after intervention. 3: Control at baseline vs. control after intervention. 4: Intervention at baseline vs. intervention after intervention.

There were no differences between the groups at baseline and after the end of intervention for central obesity, as assessed by the WC (Table 2). For the intention-to-treat analysis, the frequency of central obesity was higher after intervention in both groups. However, when only the data of the participants who remained until the end of the study were analyzed, the increase in frequency was statistically significant only among the students in the control group.

Table 3 describes the results of the analysis of effectiveness relative to central obesity, as assessed by the WHtR. Once again, no difference was found between the groups at baseline and after intervention. Nevertheless, there was an increase in the central obesity proportion of youth with higher WHtR before nine months in the control group (total sample and boys only) after the intervention according to both the intention-to-treat analysis and the analysis of the data of only the participants who remained until the end of the intervention.

Table 2. Intention-to-treat and data collected analysis of the effectiveness of the *Saúde na Boa* project relative to central obesity assessed by waist circumference in youths attending public secondary schools in Florianópolis (SC) and Recife (PE) in 2006.

Variables	Baseline		After intervention		p-value			
	Control %(n)	Intervention %(n)	Control %(n)	Intervention %(n)	1	2	3	4
Intention-to-treat								
Total	6.1(63)	5.4(51)	8.2(85)	7.9(76)	0.48	0.77	<0.01	<0.01
City								
Florianópolis	7.6(42)	5.7(33)	9.0(50)	8.0(46)	0.20	0.51	0.04	<0.01
Recife	4.4(21)	4.8(18)	7.3(35)	7.8(30)	0.76	0.80	<0.01	0.29
Gender								
Male	7.6(37)	5.6(22)	8.4(41)	7.8(31)	0.25	0.76	0.45	0.04
Female	4.8(26)	5.2(29)	8.1(44)	7.9(45)	0.76	0.91	<0.01	0.04
Data collected								
Total	6.1(63)	5.4(51)	8.9(44)	10.0(46)	0.48	0.56	<0.01	0.08
City								
Florianópolis	7.6(42)	5.7(33)	9.2(23)	10.0(25)	0.20	0.76	0.06	0.12
Recife	4.4(21)	4.8(18)	8.5(21)	10.0(21)	0.76	0.60	<0.01	0.69
Gender								
Male	7.6(37)	5.6(22)	8.4(18)	9.4(16)	0.25	0.73	0.45	0.37
Female	4.8(26)	5.2(29)	9.3(26)	10.3(30)	0.76	0.66	<0.01	0.21

P-values 1 and 2: Chi-square test; 3 and 4: McNemar's test. 1: Intervention at baseline vs. control at baseline. 2: Intervention after intervention vs. control after intervention. 3: Control at baseline vs. control after intervention. 4: Intervention at baseline vs. intervention after intervention.

Table 3. Intention-to-treat and data collected analysis of the effectiveness of the *Saúde na Boa* project relative to central obesity assessed by the waist-to-height ratio in youths attending public secondary schools in Florianópolis (SC) and Recife (PE) in 2006.

Variables	Baseline		After intervention		p-value			
	Control %(n)	Intervention %(n)	Control %(n)	Intervention %(n)	1	2	3	4
Intention-to-treat								
Total	8.1(84)	9.5(90)	9.7(100)	10.4(100)	0.29	0.60	<0.01	0.57
City								
Florianópolis	7.2(40)	9.2(53)	8.4(47)	10.3(60)	0.23	0.27	0.09	0.17
Recife	9.2(44)	9.9(37)	11.1(53)	10.4(40)	0.71	0.74	0.06	0.51
Gender								
Male	8.4(41)	9.2(36)	10.1(49)	9.9(39)	0.68	0.93	0.04	0.75
Female	7.9(43)	9.7(54)	9.4(51)	10.7(61)	0.30	0.46	0.10	0.81
Data collected								
Total	8.1(84)	9.5(90)	10.6(53)	12.1(56)	0.29	0.46	<0.01	0.57
City								
Florianópolis	7.2(40)	9.2(53)	9.6(24)	12.4(31)	0.23	0.31	0.09	0.16
Recife	9.2(44)	9.9(37)	11.7(29)	11.8(25)	0.71	0.97	0.06	0.51
Gender								
Male	8.4(41)	9.2(36)	11.2(24)	11.1(19)	0.68	0.99	0.04	0.75
Female	7.9(43)	9.7(54)	10.3(129)	12.8(37)	0.30	0.36	0.10	0.81

P-values 1 and 2: Chi-square test; 3 and 4: McNemar's test. 1: Intervention at baseline vs. control at baseline. 2: Intervention after intervention vs. control after intervention. 3: Control at baseline vs. after intervention. 4: Intervention at baseline vs. after intervention.

DISCUSSION

The results of the present study show that the prevalence of total (BMI) and central (WHtR) obesity remained stable in the intervention group. In contrast, the percentage of participants with total and central obesity significantly increased in the control group after the nine-month study period, based on the indicators selected to assess obesity¹⁶⁻¹⁸. To the best of the authors' knowledge, no results relative to this set of anthropometric measures have been reported to date in any experimental randomized controlled study of Brazilian youths attending school. It is worth emphasizing the specificity of the intervention implemented by the *Saúde na Boa* project, which was designed to test effectiveness via indicators related to physical activity and nutrition; changes in indicators of nutritional status were not the main focus of interest¹⁴.

The prevalence of total obesity did not decrease in the intervention group; however, it increased in the control group when the full sample was analyzed. A school-based study using an intervention that targeted individuals (educational program) and the environment (encouragement to increase the number of physical education classes and to change the food provided by school cafeterias) did not find BMI differences in males or females in the intervention group after eight, 12 and 20 months of follow up²¹. However, clear differences were observed in other indicators of nutritional status, such as skinfold thickness in both males and females and WC in the males²¹.

A recent systematic review found that most school-based interventions did not induce positive effects on the BMI in the intervention group compared with the control group²². Brown and Summerbell²³ found that only nine out of 20 studies included in a systematic review reported significant effects of dietary intake- and physical activity-based interventions on BMI. Although the data in these reviews were inconsistent, their authors suggest that combined diet and physical activity may help prevent children from becoming overweight in the long term. In turn, dietary interventions, such as providing breakfast for adolescents and offering physical activity interventions, may help to prevent these children (particularly girls in primary schools) from becoming overweight in the short term²³.

It is worth noting that the BMI may not be the best measure for investigating the effectiveness of interventions based on promoting physical activity in youths²². This is because physical activity may increase the muscle mass volume, particularly in the intervention group, which may be incorrectly interpreted as an increase in the prevalence of obesity after intervention²⁴. Although widely used as a measure of obesity, the BMI measures excess weight relative to height (overweight) rather than excess adiposity (obesity). The BMI reflects the relative length of the leg, body size and body lean mass in addition to fat; thus, two individuals with the same amount of body fat may exhibit a different BMI value. Furthermore, the BMI does not distinguish between changes in the lean mass and the fat mass because it is a proxy measure for both^{25,26}.

For that reason, the present study included two indicators of central adiposity: the WC and the WHtR. Based on WC measures, the percentage of participants with central obesity increased in both the intervention and control groups after nine months of intervention. However, when only the data for the participants who remained until the end of the intervention were analyzed, only the control groups showed an increase. This finding might be explained by the fact that in most studies that found a significant reduction of obesity, the intervention lasted more than 10 months²².

In the past decade, the WHtR has been used frequently in studies that assessed the nutritional status of children and adolescents, and it is relevant because of its predictive value relative to health-related markers¹⁸. The results of the present study showed an increase in the frequency of central obesity, as assessed by the WHtR, only in the control group, which is similar to the data for BMI. These findings agree with the results of an experimental intervention with Brazilian youths that consisted of the application of a physical activity program over one school year²⁵ and found increases in the nutritional status indicators (the BMI, WC and central circumference) in the control group only at the end of the intervention.

The programs that have relevant effects on obesity in youths characteristically include educational and behavioral components²⁴. Regarding educational components, individual and family counseling have proven efficient; among the behavioral components, participation in physical education classes at school ought to be complemented by physical activity outside of school and a reduction in sedentary behavior²⁴. As a whole, the effectiveness of school-based interventions for the prevention of obesity is satisfactory when the programs address various actions in combination^{23,24}.

The limitations of the present study include the low rate of assessment after the intervention and strikes at both participating schools that required the investigators to perform the assessments at different times. Those limitations notwithstanding, the intervention was applied in a standardized manner at both schools, and the quality of the anthropometric parameter measurement was also standardized. Furthermore, the short length of the intervention may represent a source of bias relative to the lack of difference in nutritional status indicators. In this regard, one should bear in mind that the duration of one school year has paramount importance in school-based interventions. The study's strengths include the application of a randomized intervention in two Brazilian cities with different economic and cultural characteristics and the fact that the study population comprised youths attending night school because that population is more inclined toward physical inactivity compared with youths who attend daytime school¹⁴. Finally, the inclusion of various indicators of nutritional status for analysis also deserves mention.

CONCLUSION

At the end of nine months of intervention, the prevalence of total and central obesity stabilized in the intervention group. The values of all three assessed

indicators of obesity increased in the control group, whereas only the WC increased in the intervention group in the intention-to-treat analysis. The difference in the results of the assessed anthropometric parameters before and after intervention indicates that intervention was more significant on central than on total obesity when considering the BMI. School-based interventions are of paramount importance to reducing the prevalence of obesity. The various strategies may include programs that include moderate-to-vigorous physical activity together with physical education.

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Corresponding author

Thiago Ferreira de Sousa
Universidade Federal de Santa
Catarina
Campus Universitário Reitor João
David Ferreira Lima.
Coordenadoria de Pós-Graduação em
Educação Física, s/n.
Bairro - Trindade,
CEP: 88040-900 - Florianópolis, SC.
Brasil.
E-mail: tfsousa_thiago@yahoo.com.br