

Effectiveness of intervention programs in schools to reduce health risk factors in adolescents: a systematic review

Efetividade de programas de intervenção escolar para reduzir fatores de risco à saúde em adolescentes: uma revisão sistemática

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Abstract – The aim of this study was to systematically review studies on intervention programs involving physical activity promotion and/or nutritional education to reduce health-related risk factors (overweight/obesity and metabolic profile alterations) in Brazilian adolescent students. A search was performed in the following electronic databases: Medline (PubMed), Lilacs, Embase, Scielo and Capes Thesis Database. A total of 1,568 studies were identified, of which 21 full papers were analyzed and 5 were included in the systematic review. The majority of the studies involved physical activity practice combined with nutritional education in Brazilian adolescent students and all interventions showed positive effect on reducing health-related risk factors among Brazilian adolescents. It was concluded that all studies included in this review showed positive alterations in health-related risk factors after interventions, reinforcing the importance of intervention programs to promote a healthier lifestyle and reduce health-related risk factors in adolescents.

Key words: Adolescents; Eating behavior; Intervention studies, Motor activity; Students' health.

Resumo – O objetivo do estudo foi realizar uma revisão sistemática sobre os programas de intervenção, com ações de atividades físicas e/ou educação nutricional, na redução de fatores de risco à saúde (sobrepeso/obesidade e alterações no perfil metabólico), em adolescentes escolares brasileiros. Foi realizada busca nas bases de dados eletrônicas Medline (PubMed), Lilacs, Embase, Scielo e Banco de Teses da Capes. Identificaram-se 1.568 estudos e 21 textos completos foram analisados, dos quais, cinco foram incluídos na revisão. A maioria dos estudos envolveu a prática de atividades físicas combinada à educação nutricional em diferentes regiões do país e todas as intervenções mostraram efeitos positivos na redução de fatores de risco à saúde. Concluiu-se que todos os estudos nesta revisão demonstraram alterações positivas após as intervenções, mesmo que não significativas estatisticamente, reforçando a importância de programas de intervenção para a promoção de uma vida mais saudável e para reduzir os fatores de risco à saúde, em adolescentes.

Palavras-chave: Adolescentes; Atividade motora; Comportamento alimentar; Estudos de intervenção; Saúde escolar.

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INTRODUCTION

Population studies have demonstrated an increased prevalence of obesity among adolescents¹⁻⁵, as well as the early appearance of a series of risk factors for the development of cardiovascular and metabolic diseases such as type-2 diabetes, hypertension and dyslipidemia^{3,6,7}. Studies conducted in Brazil also showed the same results in the last decade, a high percentage of individuals in adolescence presenting several health risk factors such as abdominal obesity (32%), hypertension (15%), metabolic syndrome (7, 7%)⁸⁻¹⁰.

Childhood and adolescence are important stages for the development of a healthy lifestyle, since most habits acquired during this period of life are perpetuated into adulthood¹¹. However, decreased levels of physical activity and increased sedentary behavior have been observed at this stage, both national and internationally¹²⁻¹⁵. Acquiring healthy habits in this age group should be a priority for the educational and social sectors, particularly schools, because they are privileged spaces for the development of interventions towards health, since they gather most adolescents in the country, which are over 30 million students enrolled in the Elementary and High-School public school system¹⁶.

There is evidence that physical activity interventions performed in schools are capable of promoting increased levels of physical activity and combat sedentary behavior¹¹, but the beneficial effects of these actions on cardiometabolic risk factors remain inconsistent. Recent review studies have shown that interventions in schools in different countries, with different models of physical activity practices were effective in reducing cardiometabolic risk factors^{17,18}, increase the level of physical activity and cardiorespiratory fitness, increase the active time during Physical Education classes and active transport to school¹⁹, and indicate that these interventions should focus both on promoting physical activity and nutrition education¹¹.

In Brazil, few school interventions on physical and / or nutritional activities have been performed in order to reduce health risk factors²⁰⁻²⁴, moreover, little is known about the methodology of the studies, types of intervention, evidence of effects and results on the health of adolescents. Thus, this review study will assist in explaining the differences among studies, being useful for the systematization, planning and implementation of school intervention programs in order to define a favorable health policy in this environment.

In this context, the aim of the study was to conduct a systematic review of intervention programs with planned physical activity and / or nutrition education actions to reduce health-related risk factors (overweight / obesity and metabolic profile alterations) in Brazilian adolescent students aged 10-19 years.

METHODOLOGICAL PROCEDURES

A systematic review was conducted in August and September 2014 that aimed to identify articles published in the last 10 years in order to highlight

the scope of the most recent studies in Medline (PubMed), Lilacs, Embase, Scielolectronic databases and also the portal of dissertations and theses of the Coordination for the Improvement of Higher Education Personnel - CAPES (<http://capesdw.capes.gov.br/capesdw/>), using keywords and combinations in Portuguese and English with Boolean operators “and” and “or”: Intervention, Students, Adolescents, Physical Activity, Sedentary Lifestyle, Sedentary Behavior, Eating Behavior, Nutrition, Risk Factors, Overweight and Obesity. A search through the reference lists of relevant studies and systematic reviews that addressed the topic of interest was also conducted. Consultation to journals to ensure that there was peer review and conference of methods described by the authors through the search and reading of articles to verify their methodological quality were used as strategies to reduce bias.

The following inclusion criteria for the selection of studies were used: (i) studies published in journals, dissertations and theses available in selected databases, as well as in the references of the selected studies; (ii) samples that include adolescents aged 10-19 years; and (iii) programmed physical activity and / or nutrition interventions conducted in public and / or private schools in order to reduce health risk factors (overweight / obesity and metabolic profile alterations) regardless of duration; (iv) interventions conducted in Brazil; (v) articles containing pre- and post-test data.

The review study excluded articles with sample of adolescents in specific health conditions (hypertension, diabetes, hyperlipidemia or other chronic diseases); sample with children (<10 years) or adults only (> 19 years); interventions performed totally outside the school environment (clubs, communities, clinics, hospitals, laboratories) or actions involving families or community; interventions carried out only with teachers / school staff; articles with exclusive description of the methodological design of intervention programs and / or transversal studies; Brazilian articles with international data; systematic review articles or meta-analysis.

After the search for studies in electronic databases, the selection started from the analysis of titles and abstracts by two independent reviewers in accordance with the inclusion and exclusion criteria. In the case of lack of information in the abstract, the study was evaluated by the full text. The results were crossed to verify agreements, and disagreements were resolved by consensus and with the presence of a third appraiser, and at the end of the search, and data extracted were checked. The assessment by reviewers was unmasked as for the authors and the study results.

The methodological quality of studies selected was evaluated by the scale proposed by Downs & Black²⁵. This scale aims to evaluate both studies that have randomized clinical trial design and those who are not random, including five sub-items related to: the way results are reported (if the information presented in the study allows the reader to interpret data and results without bias), external validity, biases, confounding factors and study power. The maximum score to be achieved through the 27 items is 31 points²⁵. From this, the evaluators classified the articles with scores greater

than 20 points as high methodological quality, 10 to 20 points, moderate, and below 10 points low methodological quality.

The articles selected are shown in the tables in increasing order of year of publication and, when in the same year, in alphabetical order considering the first author. This study followed the PRISMA recommendations for systematic reviews²⁶.

RESULTS

Figure 1 shows the flowchart of the study selection process. Overall, 1,568 studies were found and of these, 1,515 were excluded after thorough analysis of titles and then 32 by reading the abstracts for not meeting the inclusion criteria. After the first stage, 21 original articles were selected for reading the full text, of these, 16 were excluded for not meeting the inclusion criteria. A search in the reference list of articles read in full was also performed and 1 article was selected. Finally, five studies were chosen for the quality verification step according to the scale proposed by Downs & Black²⁵.

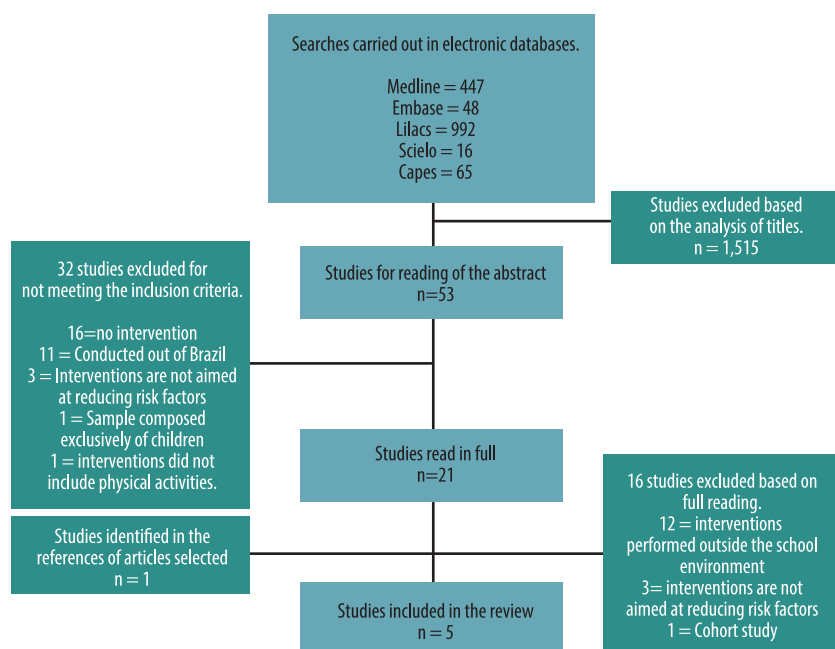


Figure 1. Selection process.

Two studies were conducted in the southeastern^{21,22}, one in the mid-western²³, one in the northern²⁰ in one in the southern regions of Brazil²⁴. All interventions were conducted with boys and girls at the same time, and the age group ranged from 7 to 17 years, the sample size from 34 to 416 students and the duration of interventions from 10 weeks to 1 academic year. It was observed that all interventions, with the exception of only one study²⁰ occurred in public schools.

As for the sample selection, all studies²⁰⁻²⁴ showed selection of participants for convenience. It was found that all studies used body mass index

(BMI) as the dependent variable, as well as some skin folds to estimate body fat percentage (% BF)^{20,21,24}, anthropometric girth^{20,21,23}, body composition through bioelectrical impedance (BIA)²², blood variables^{21,23}, blood pressure measurement²³ and physical fitness control^{23,24} (Table 1).

Table 1. Characteristics of the intervention studies included in the systematic review.

Reference	n	Age	Nutritional Status	Dependent variables	Main results after intervention	Effect size observed in IG compared to CG	Downs & Black scale
Farias et al. ²⁰	383 CG: 186 IG: 197	10-15 years	32% of the sample were overweight and obese	BMI, %BF (triceps and subscapular skin folds), arm, waist, abdomen and calf girth.	Changes in body composition and decrease in body fat.	BMI: Males: -0.33 Females: -0.83 %BF: Males: -0.82 Females: -0.85	19
Martelo ²¹ .	82 G _{Diet} : 20 IG ₁ : 46 IG ₂ : 16	10-17 years	All with overweight and obesity	BMI, arm circumference, %BF (triceps and subscapular skin folds). Blood concentrations of GLU, TC and TG.	Aerobic exercise + anaerobic + diet group: Positive Changes in body composition between pre and post intervention (decrease BMI, subscapular skinfold, %BF, and increased lean mass). Aerobic Group: Positive result on reducing GLU between pre and post intervention. All groups: Improvement in TC and TG values, between pre and post-intervention.	Total sample BMI: 0.49 %BF: 1.65 GLU: 5.12 TC: -1.55 TG: 3.09	19
Feferbaum et al. ²²	416 CG: 203 IG: 213	7-14 years	31% of the sample showed overweight and obesity	Weight/age, height/age, weight/height ratios and BMI. Lean Mass and Fat Mass (FM), estimated by BIA.	There was a significant reduction in BMI (z score) of body proportions. No increased fat mass in the control group was observed. There was no difference between GI and GC.	Total sample BMI: 0.08 FM: 0.30	17
Militão et al. ²³	34 CG: 17 IG: 17	9-11 years	All showed overweight and obesity	Weight, height, waist circumference, VO ₂ max, BP, GLU, TC, LDL, HDL and TG and skin folds.	There were no significant differences between control and intervention groups in all parameters, but in the intervention group there was a significant improvement in body composition, BP, VO ₂ max and metabolic parameters.	Total sample BMI: -0.20 WC: -0.84 %BF: -0.93 BP: -0.99 VO _{2max} : 0.48 TC: 0.02 LDL: 0.79 TG: -4.5	21
Silva et al. ²⁴	238 CG: 130 IG: 108	6-11 years	60% of the sample were overweight and obese	BMI, %BF (triceps fold and medial leg), physical fitness (endurance race, abdominal tests, arm flexion and flexibility).	Intervention group: Significant improvement in BMI and %BF. Improvement in physical fitness, with the exception of flexibility in the intervention group.	Total sample BMI -0.155 %G: -0.697 Endurance running: 4.79	19

n: number of subjects; CG: control group; IG: Intervention Group; F: Female; M: Male; BMI: Body Mass Index; % BF: Body Fat Percentage; GLI: glucose; CT: total cholesterol; TG: Triglycerides; LDL-C: low density lipoprotein; HDL-C: high density lipoprotein; BIA: bioelectrical impedance; VO₂max: Maximal oxygen uptake; BP: Blood Pressure.

Some results should be highlighted such as the significant body fat reduction observed in all studies, positive changes in blood parameters^{21,23}, improvement in physical abilities^{23,24} and blood pressure²³. The effect size was calculated from the results obtained after the intervention

programs of the main variables that showed significant pre- and post-test differences according to the equation of Cohen²⁷. According to Cohen²⁷, values greater than or equal to 0.8 represent large effect size; values between 0.8 to 0.2 are considered intermediate effect size and less than 0.2 small effect size, and positive values correspond to a higher average in the intervention group and negative values to a higher average in the control group (Table 1).

Table 2. Characteristics of intervention programs

Authors	Location	Intervention type	Duration of sessions	Weekly Frequency	Duration	Actions IG	Actions CG
Farias et al. ²⁰	Porto Velho (RO)	Physical Activities	60'	2	1 academic year	2 lessons per week in PE (60' each) with control of HR, involving aerobic activities (30'), games (20') and stretching (10'). ^x	Usual physical activities at school. Pre- and post-assessments.
Martelo. ²¹	Lins (SP)	Physical Activities/ Nutritional education	50'	3	12 weeks	Group 1: aerobic + anaerobic exercise + diet; Group 2: predominantly aerobic exercise + diet; Group 3: Diet. Exercise: Three times a week, with 50-minute sessions. ^x	Six individual consultations, at intervals of 15 days between each visit to food plan.
Feferbaum et al. ²²	São Paulo (SP)	Nutritional education.	N/A	5	10 months	"Alimente-se Bem" program - SESI-SP with monitoring of students in meal times. Culinary preparations with greater variety of vegetables and fruits. ^x	Presence of a specialized team in nutrition education with meetings, lectures, cooking classes, practical classes and recreational activities on healthy eating.
Militão et al. ²³	Brasília (DF)	Physical Activities	60'	2	10 weeks	Recreational physical activities from moderate to vigorous (with HR control) and guidance on healthy habits (daily). ^x	Usual activities.
Silva et al. ²⁴	Criciúma (SC)	Nutritional education/ Physical Activities.	50'	1: Nutri. 2: P.A.	28 weeks	Curricular and extracurricular activities on Nutrition Education (50') and Physical Activities (50'). ^x	Received no intervention, only continued curricular activities.

IG: Intervention Group; CG: control group; N / A: Not applicable; P.A. : Physical Activity; Nutri: Nutrition. PE: Physical Education; HR: heart rate; ' : Symbol for minutes. ^x Own intervention model - developed by the author (s).

When observing the aims, all studies focused on the effects of programmed physical activity and / or nutrition education in school about health risk factors such as changes in body composition²⁰⁻²⁴ and / or metabolic profile^{21,23} in adolescents.

After assessing the methodological quality of studies, it was found that only one article²³ had excellent methodological quality and the others had moderate. The items that most studies have not achieved refer to the sample randomization or the intervention groups, as well as the control of confounding variables²⁵.

DISCUSSION

The first fact that drew attention in this systematic review was the limited number of available studies who developed intervention programs in Brazil promoting physical activity and / or nutrition education aiming to reduce health-related risk factors among adolescent students²⁰⁻²⁴. Another highlight is the occurrence of positive effects in all studies found, regardless of type of intervention (physical activity, nutrition or both), duration (10 weeks to 1 academic year) or nutritional status of participants (overweight / obesity or normal weight; overweight and obese included in the same sample).

The inclusion criteria of this study were selected due to the high prevalence of overweight and obesity, as well as to the poor health-related habits in this phase, as we believe that this phase is of utmost importance for the development of a healthy lifestyle. Thus, there are gaps in this area of study, making it possible for future investigations using a reliable methodology using methods of better accuracy and validity.

Improvement in the body composition of participants was observed after intervention²⁰⁻²⁴; however, all studies used BMI or methods for assessing body composition considered doubly indirect (developed from an indirect assessment method) as skinfold thickness^{20,22-24} or bioelectrical impedance²¹. Despite being correlated with cardiometabolic risk factors in adolescents^{28,29} and easy to be used in the field with a high number of individuals, as in the school environment, these methods may have some limitations related to the lack of accuracy, especially in individuals with higher body fat³⁰.

Among the interventions protocols applied, three studies involved controlled exercise, using heart rate as a parameter for the monitoring physical exercise intensity^{20,22,23}, and this variable is considered valid as an indicator of physical activity intensity in adolescents³¹. Most of them added education programs^{20,23,24} to physical activity intervention nutrition and only one study used nutritional intervention and also demonstrated positive changes in body proportions and effectiveness in reducing BMI²¹, as previously observed in a systematic review³², where most of the studies showed a decrease in the prevalence of overweight and obesity among participants.

Analyzing the intervention period of the selected studies, it was observed that even programs with shorter duration (12 and 10 weeks)^{20,23} demonstrated positive changes in variables. Sun et al.¹⁸ claim that higher intervention periods provide greater health benefits and a high adhesion to physical activity practices in the daily lives of adolescents; in the studies analyzed, it was not possible to verify the influence of intervention duration on the health risk factors of students, because based on the findings, it was found that the effectiveness of interventions was independent of the duration of interventions.

The lack of control of the level of physical activity and nutrition intake of participants is also a point to be considered after the evaluation of the quality

of studies²⁵. Only two studies evaluated physical activity and eating habits, one of them using previously validated questionnaires and classifying adolescents by TEM / week (considering the resting metabolic equivalent of 3.5 mL • kg⁻¹ • min⁻¹) and the frequency of the consumption of different types of food²³, and the other through a recall of time spent in physical and sedentary activities, classifying them according to the intensity of reported activity²⁴.

Physical activity questionnaires and recalls are subjective instruments well accepted and widely used in population studies, and generally present good correlation with objective physical activity measures such as accelerometers, being valid to estimate the level of physical activity in adolescents³³. Furthermore, the lack of criterion-methods to measure physical activity in adolescents can be considered a limitation of these studies, since self-reports can present significant bias associated with the outcomes³⁴⁻³⁶.

Another important aspect to be considered is the fact that the changes do not always occur in a sensitive way due to metabolic adaptations during the intervention process and mainly due to growth changes and body composition of the growth spurt and sexual maturation²², and most interventions included in this review did not control this variable. Therefore, some of the positive results presented by intervention programs can be related to body changes. Another fact observed in most studies was that adolescent males and females are equally compared within groups, but there are differences between them at the end of puberty such as the fact that girls present proportionately twice as much fat than boys, which may cause bias the interpretation of the reported findings³⁷. Similarly to the inclusion of subjects with different nutritional status in the same group, differences in body composition after interventions tend to be higher in overweight and obese adolescents compared to those with normal weight¹⁸.

Furthermore, the limitations of these studies were not clearly described by the authors, except by Silva et al.²⁴, who reported that the design adopted by the authors (quasi-experimental and sample not randomized for convenience) was chosen due to operability reasons and to the presence of complex programs with extracurricular activities twice a week, making it impractical to move participants from the intervention group to places far from their homes to participate in activities. The low score obtained by studies in item related to the intervention design in the assessment of the methodological quality should also be emphasized.

The inclusion of a control group can minimize this limitation, ensuring similarities among gender, age and nutritional status; however, there was a study²⁰ that did not include it, dividing participants only into different intervention groups and presenting a very small number of individuals in the sample. Another limitation is the lack of generalization of results to populations with similar characteristics, because none of them is characterized as randomized clinical trial, considered the gold standard for interventions, and so little representative to the population in question.

The results presented here can assist in the planning of future intervention studies. Thus, even considering that some studies have shown medium

and small effects, it could be inferred that the regular practice of physical activity along with nutrition education contributes to the improvement of health-related risk factors in adolescents. In addition, it is essential to consider that school is critical in the formation and actuation of people in all fields of social life, playing a decisive role in the development of students, the perception and construction of citizenship and access to public policies. Thus, school is the best place to carry out health promotion activities for children, adolescents and young adults^{38,39}.

FINAL COMMENTS

The increased incidence of obesity and the early onset of a number of risk factors for the development of cardiometabolic diseases in adolescents are stimulating factors for carrying out actions to improve health in this population, but there are few intervention studies in Brazil that are often not properly documented and evaluated.

Thus, the few studies involving students and methodological differences between them, as well as the observed biases, made it difficult to assess the effectiveness of these actions. However all studies in this review showed positive changes after intervention, even if some are not statistically significant, reinforcing the importance of intervention programs to promote a healthier lifestyle and reduce health-related risk factors in adolescents.

It is believed that the results and criticisms presented in this systematic review can assist in improving the methodological quality of intervention programs aimed at students, enriching the scientific evidence for improving the quality of life and health in adolescents.

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