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Effects of an intervention on adolescents with overweight / obesity

Abstract

Promoting healthy lifestyles is one way to be and keep healthy. When the individual itself recognizes strengths in its self-management, this can be identified as an approach to change or improve eating behaviors and physical activity in adolescents. The objective of this research is to determine the effect of a multi-component intervention, "Promoting health in Adolescents", in the BMI and the cognitions related to specific conducts: perception of barriers, benefits and self-efficacy, related to nutrition and physical activity in enrolled adolescents with overweight / obesity in Colombia. This is a quasi-experimental study with an intervention (n= 48) and a control group (n=50), pre-trial, post-trial and follow-up (at 2 and 4 months) measurements. The intervention "Promoting health in Adolescents" was offered to the intervention group. The control group received the annual education activity. The study has the endorsement of the ethics committee of the Universidad Nacional de Colombia and the school rectors, and consent and informed assent forms were signed. When comparing the groups after the intervention, there is a difference in the variables Body Mass Index (p=0,000), physical activity (p=0,042) and nutrition (p=0,010). After the intervention, the BMI decreased in the intervention group: 43,8% passed from overweight to normal and obesity decreased from 10,4% to 8,3%. The size of the effect was moderate with a value of 0,571 and were not sustained over time. These results support the approach of the healthy habit modification program in schools.

Keywords: adolescent, overweight, pediatric obesity, controlled studies before and after, healthy conducts, infirmary, adolescent, adolescent nutrition, exercise. (Source: DeCS, BIREME)

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Claudia Patricia Bonilla Ibáñez,[1] Luz Patricia Diaz Heredia[2]

[1]Nurse, Teacher University of Tolima-Ibagué-Colombia, Colombia

[2]Nurse, Teacher National University of Colombia-Bogota-Colombia, Colombia

Correspondence: Claudia Patricia Bonilla Ibáñez, Nurse, Magister and PhD of Nursing, Docente Universidad del Tolima-Ibagué-Colombia, Carrera 4 B # 43-162 block 18 apt 202 Villa Arkadia-Ibagué, Colombia, Email cbonilla@ut.edu.co

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Introduction

Overweight and obesity are states which are present in a high percentage of adolescents, not only worldwide,[1–3] but also nationally (National Health and Nutrition Survey - ENSIN, 2015). In Latin-American adolescents of both sexes, between 12 and 19 years old, available data indicate that, in general, 20% to 25% of them suffer from overweight and obesity.[1]

The ENSIN 2015 in Colombia reports that, at the national level, 17,9% of children and youth between 13 y 17 years have overweight, almost one in five adolescents in Colombia presented overweight, with higher percentage of women over men.[4]

The efficacy of interventions to promote healthy behaviors in adolescents with overweight and obesity is presented considering the expected outcome after the intervention: reaching goals and objectives and modifying or changing unhealthy behaviors in adolescents, and is reflected in measurement parameters (BMI and instruments). According to some authors, efficacy is the relationship between objectives and outcomes under ideal conditions. Hence, if the intervention is effective, the proposed objectives have been reached.[5]

The development of this study strengthens and consolidates the construction of settings to adopt healthy behaviors regarding physical activity and nutrition, while also contributing conceptual elements to addressing health promotion in adolescents with overweight / obesity. The health promotion model of nurse Nola Pender (basis for this study) identifies cognitive and perceptive factors in people, which have changed given situational, personal, and interpersonal characteristics that translate into the person's and the community's involvement in health care.[6]

The outcomes of the meta-analysis and systematic revisions indicate that more than 75% of the programs resulted in significant improvement in knowledge, self-efficacy perception and health behavior (physical activity, sedentary lifestyle, and food ingestion).[7,8] However, there is no clear impact on BMI.[9,10] Therefore, this study's objective was to determine the effect of the multi-component intervention called "Promoting health in Adolescents" in the Body Mass Index (BMI) and the cognitions related to specific conducts (perception of barriers, benefits, and self-efficacy), and in health-promoting behaviors related to nutrition and physical activity in enrolled adolescents with overweight / obesity.

Materials and methods

The present study has a quantitative approach, quasi-experimental type and longitudinal,[11] with a multi-component (cognitive, motivational, and behavioral) intervention to promote healthy behaviors regarding physical activity and nutrition.

We worked with an intervention and a control group. All members of the intervention group received the same intervention. The members of the control group received the annual education activity offered in school for healthy habits. The selection for each group was controlled by applying inclusion and exclusion criteria on all participants.[12]

To calculate the sample, aspects related to the statistical significance of the sample were regarded: the minimum relevant clinical difference (in standard deviations) which was 2,11, with a 0.7 factor to reduce the standard deviation; the standard deviations of both groups in the pilot trial which was 3,01 for BMI, standardized significant value of 19,6 with α=5%, 90% output 1.28 with β=10% and 90% output, which gave us a total of 43 students. With 10% attrition, the total sample was of 47 adolescents per group.[13–15]

The sampling type was random probabilistic by classroom (903, 1001, 1101, 902, 1003), not by individual in the Microsoft Excel program.[16] All students were offered the same chance to participate,

which meant taking a larger sample, to avoid a decrease in number which would affect the study in both groups. All students from the chosen classrooms of the two schools participated until the necessary sample was completed, without accounting for the initial results from the instruments. The environmental conditions in which the intervention was performed were similar for each group.[12]

Regarding the instruments used, it was necessary to translate, adapt and validate them to the Spanish language. These instruments showed similar validity and reliability to those of the original language. They were applied to all adolescents who participated in the study. (Source removed for blind review).

The instruments used to collect the information were: perceived self-efficacy inventory for weight control (P-CP) (men and women), Mexican version Perceived Benefits and Barriers of Increased Fruit and Vegetable Consumption: Validation of a Decisional Balance Scale,[17] Perceived Benefits to Exercise - Adolescent (Version Adolescent),[18] Perceived Barriers to Exercise - Adolescent (Version Adolescent).[18] The Adolescent Lifestyle Profile (ALP) (Hendricks, Murdaugh, Pender, 2007). All instruments were subjected to procedures such as permits, translation, retro-translation, facial validity tests for content and construct, according to the request from authors or specific literature for these procedures.[19–22]

The intervention was designed considering three elements: cognitive, motivational, and behavioral, for each of the theoretic elements of the Health Promotion Model of Nola Pender (barrier, benefit and self-efficacy perception).[23–25]

The study was catalogued as research with minimum risk, considering Resolution 8430 of 1993.[26] The nurse promoted an environment in which the person's dignity, human rights, values, customs, and spiritual beliefs were respected.[27] The approval for the adolescents' participation in the intervention was documented by consent and informed assent forms signed by the students and their parents or legal guardians.

Universal ethic research aspects in human being were contemplated, according to the international regulations and recommendations of the Council for International Organizations of Medical Science, CIOMS, and the International Council of Nurses (ICN). Articles 29 and 30 of chapter IV of the Infirmary Ethics Code (Ministry of Social Protection, Law 911, 2004) were considered, as well as the principles included in Law 266 of 1996 (Ministry of Health, Law 266 of 1996). The Ethics Committee of the Faculty of Infirmary of the Universidad Nacional de Colombia gave its endorsement through official statement B. DIEFE-571-16, as did the two schools, approving the study to be conducted in their premises.

Outcomes

When comparing the distribution of each of these variables between both groups, perceived self-efficacy, Perceived Benefits and Barriers of Increased Fruit and Vegetable Consumption, Perceived Benefits to Exercise - Adolescent, Perceived Barriers to Exercise – Adolescent; you can observe a statistically significant difference between both groups regarding gender. In the initial measurements we find that 89,6% of the adolescents in the intervention group have overweight and 10,4% have obesity. In the control group, 92% of adolescents had overweight and 8% had obesity (Table 1).

Table 1 Comparison between the control and the intervention group after the intervention

Variables	Group	Descriptive measures					Value p
		Mean	Standard deviation	Median	Quartile 1 (25)	Quartile 3 (75)	
	Intervention			25,20	24,29	27,88	,000*
	Control			27,42	25,77	28,98	
Cognitions related to a specific conduct							
Perception of Benefits of Fruit and Vegetable Consumption	Intervention			28,50	22,75	32,75	,881*
	Control			28,00	24,00	33,00	
Perception of Benefits of Exercise	Intervention			36,50	27,00	43,00	,820*
	Control			37,00	31,50	42,00	
Perception of Self-Efficacy	Intervention	113,04	19,54				,240**
	Control	118,10	22,62				
Perception of Barriers of Fruit and Vegetable Consumption	Intervention	22,15	7,11				,120**
	Control	19,96	6,67				
Perception of Barriers for Exercise	Intervention	27,63	10,15				,780**
	Control	27,08	9,07				
Health-promoting conducts							
Physical Activity	Intervention	18,23	4,03				, 042**
	Control	15,98	4,44				
Nutrition	Intervention	20,52	3,80				,010**
	Control	18,92	3,80				

Source: the author

Outcomes from the present study show that in the variable gender, perception of benefits of fruit and vegetable consumption is higher in women from the intervention group (Me=31,50), while in the control group this perception was higher in men (Me=31,00). Regarding the benefits of exercise, in the intervention group the behavior was the same between men and women, and in the control group in men (Me=39) it was less than in women. The socioeconomic level in this study is social strata 2.

Perception of barriers of fruit and vegetable consumption was higher in women ($\bar{x}$=19,59) than in men in the intervention group ($\bar{x}$=18,42), contrary to the control group, where it is higher in men ($\bar{x}$=27,00) than in women ($\bar{x}$=19,42)

The mean in self-efficacy perception was higher in women of the intervention group ($\bar{x}$=119,45) than of the control group ($\bar{x}$=118,82) than in men in both groups.

To findings in the present study, in which barriers to exercise are higher in men than in women ($\bar{x}$=28,42 in the intervention group and $\bar{x}$=36,00 in the control group).

When comparing the groups after the intervention, we find a difference in the variables BMI (p= 0,000), physical activity (p=

,042) and nutrition (p= ,010). However were found to be statistically similar at the beginning of the study (self-efficacy perception 0,803, perception of barriers for fruit and vegetable consumption 0,381, perception of benefits of fruit and vegetable consumption 0,434, perception of barriers for exercise 0,603 and perception of benefits of exercise 0,616).

In the follow-up measurements we found that two months after the intervention ended, the weight of the adolescents in the intervention group increased 26,74% and decreased again 37,32% after 4 months. In the control group, taking the same measurement times, adolescents gained weight in 67,46% and the final decrease was -0,40% (Table 2).

When comparing gender after the intervention (Table 3), results show there is a statistically significant difference between men and women in the variable BMI (men p= 0,031, women p= 0,004).

The estimation of the effect size between the intervention and control group after the intervention ended was 0,571, with a correlation index of r=,680 and an effect size of d=0,577, g of Hedges = 0,571 (Table 4).

Efficacy indexes of the intervention Health Promotion in Adolescents: the relative risk (RR) 6,25 indicates that the intervention had six times better outcomes than the intervention given to the control group. The absolute benefit increase (RAR) indicates that the intervention given to the experimental group increased 32% the chances of reducing weight in those who received it. The relative risk difference (RRD) refers to the intervention benefit increase, which was 5,25 or 525% to reduce weight opposite the control group.

When comparing the groups after two months of having ended the intervention (Table 5), we found a statistically significant difference in the BMI (p= ,000) and in physical activity (p= ,008).

The analysis by gender made two months after the intervention ended shows us there is a statistically significant difference in the BMI in men (p= ,029) and women (p= ,006) and in physical activity in women (p=, 024).

4 months after the intervention ended, statistical data show that there is a statistically significant difference in BMI (p= .000) and perception of barriers for consuming fruit and vegetables (p= ,025) (Table 6).

Table 2 Changes in adolescents in all measures

Group	Between after and before		Between after and 2 months after finishing intervention		Between after and 4 months after finishing intervention	
	Kg	%	Kg	%	Kg	%
Intervention	-27	34,26	19	26,74%	-28	37,32
Control	0	0	57	67,46	-1	-0,40

Source: the author

Table 3 Comparison body mass index and main variables adjusted to gender after the intervention. Ibague, 2018

Variables	Groups	MEN						WOMEN					
		Mean	SD	Median	Quartile 1	Quartile 3	Value p	Mean	SD	Median	Quartile 1	Quartile 3	Value p
Body Mass Index	Intervention			24,70	24,69	27,99	,031*			25,62	25.18	26,90	,004*
	Control			26,47	31,55	27,72				27,55	26,29	29,22	
Cognitions related to a specific conduct													
Perception of Benefits of Fruit and Vegetable Consumption	Intervention			28,50	24,25	32,00	,697*			28,50	27,75	34,00	,986*
	Control			28,00	35	35,00				28,00	23,50	32,00	
Perception of Benefits of Exercise	Intervention			37,00	26,50	43,00	,930*			39,00	31,50	43,00	,711*
	Control			36,00	45	41,00				37,00	29,00	42,00	
Perception of Self-Efficacy	Intervention	108,77	17,19				,520**	119,45	21,08				,120**
	Control	108,36	15,47					123,12	21,54				
Perception of Barriers of Fruit and Vegetable Consumption	Intervention	18,42	5,70				,320**	19,59	6,07				,395**
	Control	20,59	6,99					19,64	5,73				
Perception of Barriers for Exercise	Intervention	28,42	11,63				,240**	25,91	9,59				,435**
	Control	24,76	9,06					28,27	9,24				
Health-promoting conducts													
Nutrition	Intervention	20,00	3,29				,507**	18,36	3,60				.095**
	Control	20,12	2,88					18,30	3,66				
Physical Activity	Intervention	17,92	3,67				,064**	18,18	3,92				,159**
	Control	16,12	3,84					15,91	4,22				

*Mann Whitney U-Test ** T Test

Source: the author

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Table 4 Estimation of the effect size of the intervention "Promoting Health in Adolescents" regarding BMI in adolescents enrolled in school. Before and after the intervention. Ibagué, 2018

Outcomes	
Effect Size d	0,577
Effect d turned into g	0,571

Source: the author

Table 5 Comparison body mass index and main variables between intervention and control groups 2 months after finishing the intervention

Variables	Group	Descriptive Measures					Value p
		Mean	SD	Median	Quartile 1 (25)	Quartile 3 (75)	
Body Mass Index	Intervention			25,46	24,07	27,56	,000*
	Control			27,44	25,92	29,09	
Cognitions related to a specific conduct							
Perception of Benefits of Fruit and Vegetable Consumption	Intervention			29,00	26,00	32,00	,615*
	Control			28,00	27,00	33,00	
Perception of Benefits of Exercise	Intervention			40,50	27,25	45,00	,225*
	Control			36,00	27,00	41,00	
Perception of Self-Efficacy	Intervention	118,60	19,55				,284**
	Control	119,22	21,69				
Perception of Barriers of Fruit and Vegetable Consumption	Intervention	22,94	6,86				,328**
	Control	21,56	7,30				
Perception of Barriers for Exercise	Intervention	25,19	11,16				,192**
	Control	26,46	8,83				
Health-promoting conducts							
Physical Activity	Intervention	18,06	3,88				,008**
	Control	16,38	3,68				
Nutrition	Intervention	20,44	4,16				,209**
	Control	19,40	3,41				

Source: the author* Mann Whitney U-Test (do not meet statistic normality criteria) ** T Test (meet statistic normality criteria).

Table 6 Comparison between the control and the intervention group 4 months after the intervention. Ibagué 2018

Variables	Group	Descriptive Measures					Value p
		Mean	SD	Median	Quartile 1 (25)	Quartile 3 (75)	
Body Mass Index	Intervention			25,24	24,05	27,63	,000*
	Control			27,20	25,86	28,88	
Cognitions related to a specific conduct							
Perception of Benefits of Fruit and Vegetable Consumption	Intervention			28,00	24,25	32,00	,469*
	Control			28,00	27,00	33,00	
Perception of Benefits of Exercise	Intervention			36,50	27,25	43,75	,347*
	Control			36,00	27,00	41,00	
Perception of Self-Efficacy	Intervention	118,06	26,04				,811**
	Control	119,22	21,69				
Perception of Barriers of Fruit and Vegetable Consumption	Intervention	24,81	6,84				,025**
	Control	21,56	7,30				
Perception of Barriers for Exercise	Intervention	27,92	10,32				,454**
	Control	26,46	8,83				
Health-promoting conducts							
Physical Activity	Intervention	17,56	4,37				,150**
	Control	16,38	3,68				
Nutrition	Intervention	20,81	4,12				,068**
	Control	19,40	3,41				

Source: the author* Mann Whitney U-Test (do not meet statistic normality criteria) ** T Test (meet statistic normality criteria).

Adjusting by gender, we found that 4 months after ending the intervention, men (p= 0,35) and women (p= ,012) have statistically significant change in BMI and women in the variables of perception of barriers for consuming fruit and vegetables (p= ,018) and nutrition (p= ,027).

The variables BMI, physical activity, nutrition, and perception of barriers for consuming fruit and vegetables maintained similar levels with respect to measurements after the intervention and measurement 3 (two months after the intervention). Variables BMI, physical activity, and nutrition maintained their level with respect to measurement 2 (two months or after the intervention). On the other hand, perception of barriers for consuming fruit and vegetables do present a change when comparing measurements 2 and 4.

Discussion

In the present study, exploration by gender is necessary, considering the growth process by gender may influence in the obtained outcomes.

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The results obtained before the intervention is that men have a smaller BMI than the women in the intervention group, while in the control group, women have more overweight and obesity than men. After the intervention, women have mor overweight and obesity than men in both groups. This correlates to data found in the health and nutrition survey ENSIN,[4] Whittemore et al.[28] and Maatoug et al.[29] who indicated that girls were more affected by overweight. Other studies don't find differences in overweight and obesity by gender.[30,24] This indicates that there is no consensus regarding the relation of this variable in the response to interventions to lose weight.

Regarding BMI, the present study found that 91,7% of the adolescents in the intervention group had overweight and 8% obesity, while in the control group, 92% had overweight and 8% obesity. This data coincides with the one found in the revised literature with respect to the percentual distribution of overweight and obesity in adolescents. Barco Leme et al., (2015) (Barco-Leme, Tucunduva, 2015) indicates in his clinical trial that more than 20% of girls suffered from overweight (23,5% in the intervention group vs. 19,8% in the control group) or were obese (9,2% vs. 3,6%). On the other hand, Roustsalainen et al., (2015)[31] indicates that in the revised studies, the average adolescent BMI oscilated between 23,2% and 36,6%, without identifying data by groups.

Sociocultural variables may have influenced the study, given that, from the information available, families from social strata 2 do not always have the available economic resources to have healthy nutrition habits. Similarly, relating to physical activity, men at that age are more engaged with exercise than women, which influences changes in BMI and nutrition.[24.30]

In said studies, even though they don't consider the model with these variable names, they do design and implement interventions regarding what adolescents consider important of exercise and health nutrition.[24,25]

Evidence suggests that youth interventions must be differentiated in terms of gender, age and socio-economic level.[32,33] Physical activity and unhealthy eating habits may make themselves more evident during adolescence, especially among girls of low socio-economic levels, corresponding to underprivileged environments, which puts this group at a higher risk of unhealthy weight.[34] Additionally, literature indicates that these variables can be modified through interventions that include perceived benefits, barriers, and self-efficacy, and that have high motivational importance.[35]

In perceptions regarding exercise, there are no differences in the variable gender, which is different than what is found in the literature, where a difference has been established in the perception and level of physical activity in adolescents.[35,29]

As to self-efficacy perception, is consistent with other studies, like the ones from Karimi, Saffari, Sanaeinasab, Hassam[37] in which differences between before and after the intervention were found. Strengthening self-efficacy is considered important to develop healthy habits in adolescents, given that self-efficacy eliminates barriers and improves abilities of persistence and sustaining to confront them (Karimi et al, 2016).

Regarding barriers and benefits of consuming fruits and vegetables in adolescents different studies show no significant differences between groups, but do not establish changes according to gender.[38] In contrast to the present study that found an increase in the perception of Barriers in both men and women (greater in women).

Regarding exercise, the studies found have focused on women.[39] These interventions have been based on strengthening self-efficacy in women, like in the study from Brazil by Barco Leme et al., (2015), in which, using diverse methodologies, he established that there are no significant differences between the intervention and the control group. The percentages found in said study are high, which is opposite to findings in the present study, in which barriers to exercise are higher in men than in women, and benefits from exercise are higher in men than in women. This behavior should be further explored given that, despite this data, initial physical activity in men was higher and may depend also on physical changes in each sex at this stage.[40]

Literature indicates that these variables or concepts (nutrition and physical activity) may be modified through interventions that include perceived benefits and barriers, as well as self-efficacy, and that have high motivational importance, as shown by studies from Acevedo R[38] Wiseman, et al.,[41,42] Mazloomy-Mahmoodabad, Navabi, Ahmadi, Askarishahi.[43,44] Self-efficacy, the perceived benefits of having fun, being close to friends or meeting new people and not being bored, and the perceived barrier of not liking physical activity mediated various associations between parental and peer variables and physical activity of women, with some mediated proportions higher than 60%.[39]

Diverse studies show that change in body weight was not significantly different between intervention and control group,[45] which is contrary to findings in this study, in which BMI decreases in the intervention group but not in the control group.

Evidence shows that men show a statistically significant difference in the variable BMI (p=0,031), and in women both in BMI (p=0,004) as well as nutrition (p=0,095). These differences in BMI are corroborated in the meta-analysis of Pearson et al (2015), in which the importance of gender is established in the responses to interventions that promote healthy nutrition and exercise. Adolescence is a delicate stage, reason for which it might be more complex to promote health, existing differences between men and women in terms of physiological, psychological, and cultural dimensions.[46]

It can be established that the data from this study are opposite those of Withermore et al. (2013), in whose research adolescents showed a significant increase in self-efficacy (p<0,001), (d=1,47 to 3,25), (81) (d=1,86-3,16),[47] in healthy eating behavior (p<0,001), fruits and vegetables (p<0,001), in moderate and vigorous exercise (p<0,001), and in stretching exercises (p<0,01), jointly with a significant decrease in sweetened beverages (p<0,001), intake of junk food (p<0,01), sedentary behavior (p<0,001) and in the effect of the intervention in self-efficacy. This differs from findings in this study, where no significant differences were found in the perception of self-efficacy in adolescents with overweight and obesity (T=0,912; p=0,366); however, there is evidence of change after the intervention, increasing in men (108,77 DS 17,198; 112,38 DS 18, 402) and decreases in women (114,62 DS 18150; 113,04 DS 19,54).

Regarding the perception of barriers of fruit and vegetable consumption, in the present study this remained the same in men after the intervention,[8,48] and increased in women (28, 50-31, 50) after the intervention, which differs from the Franco et al. study in which the perception of barriers of fruit and vegetable consumption decreased (p<0,001). The healthy eating behavior (p<0,001) and fruits and vegetables (p<0,001) is expected to increase.[49]

The findings regarding benefits of fruit and vegetable consumption found in this study (U Mann-Whitney=77,000; p=0,706) are related to the ones of the study by Franko et al, in which, among the ethnic minority group, the consumption of five portions a day reported higher perceived benefits of the same consumption – fruits and vegetables - (p<0,001) and perception of benefits of exercise (U Mann-Whitney=39,50; p=0,069).[49]

Chamberlain et al. (2017) identified that nutrition has an effect in time – group and an interaction time – condition for the consumption of fruits and vegetables (F=17,8. P<0,0001. F=12,6. P=0.01). These authors informed of an increased consumption of fruits and vegetables at the end of the intervention, which is related to the present study, in which nutrition showed a significant change.

The intervention and control groups were different at the beginning of the study regarding physical activity relating to gender. This is opposite to what was found in the study of Whittemore et al.[28] where a significant increase in moderate and vigorous exercise (p=<0,001) was evidenced with moderate to big effects (d=0,58), (59,60,82), (d=2,32), (59,83) and perception of barriers for exercise (T=0,334; p=0,740), (59,81). The systematic revision made by Rocha-Da Silva et al.,[50] indicates that physical activity programs increase moderate and intense physical activity practice, the habitual physical activity[51] and increase knowledge regarding physical activity practice and the drafting of exercise programs.[52] However, "Choose Health" studies[53] and "Loozit"[54] the same outcomes than the study that we are presenting here.

Additionally, it was considered relevant to include measures of the size of the effect, referring to the effect's magnitude, in other words, if the difference between the intervention group (to which the intervention was applied) and the control group (who only received habitual educational lectures) is because the intervention was applied, or because it is better than the habitual lecture, and to what extent this phenomenon should be expected within the population.[55]

The size of the intervention's effect in school enrolled adolescents is considered moderate, given by the Hedges g statistics (88,89) which was 0,571 in the intervention group. This indicates that the null hypothesis, establishing that the two interventions are equal, is rejected. It implies then that the intervention had an influence in the changes presented in nutrition, and hence the changes in weight and BMI. This coincides with the meta-analysis made by Pearson et al.[56] in which it is indicated that the intervention used showed "moderate benefits", in comparison to the control group.[24,29,57]

The outcomes of the present study in the intervention group were six time more positive, the probability of reducing weight increased in an important percentage (32%) and the benefits of intervention increased 52%, in comparison to the outcomes of the control group. This is corroborated by a study made in Germany[58] in which risk of overweight was reduced in students in 31%, and other studies in which the interventions showed positive changes in eating behaviors[59,60] and physical activity.[60–62]

Regarding permanence of the changes during follow-up, a slight decrease in BMI and an important decrease in physical activity was identified, while an increase in nutrition was observed. On the other hand, barriers to fruit and vegetable consumption seem to persist, which can be assimilated to the outcomes of the "HIPTEENS" study,[57] with food education, exercise and healthy life styles, in which no significant differences in BMI in both groups were found after two years, contrary to the "Bright Bodies" study,[57] which showed efficacy after 12 months of having ended the intervention.

The revised studies do not contain information on the variables of the whole study. However, a primal study[63] with an ANOVA of mixed design indicated that the main effect of time (pre – post) was not significant for fruit consumption F (1,65) = 1,31, p=0,26. The recommended intake of fruits and vegetables improved significantly, from 30% to 33,2% after the intervention (p=0,03) and lessened significantly in the control group from 40,2% to 35% (p=0,001).[29] Regarding physical activity, there was a significant decrease (P<0,001) in students who walked or rode on a bicycle to and from school in the control, but not in the intervention group. There was also a significant decrease (p=0,01) in adolescents that practiced the recommended physical activity in the intervention group.[29]

Outcomes from this study allowed us to identify that the variables BMI (decreased), weight (decreased) and nutrition (increased) changed positively. BMI changed positively because 43,8% of adolescents from the intervention group passed from overweight to normal weight.

The moderate effect of the intervention, plus the evidence of the importance of the changes in the variables BMI and nutrition, must be considered for future research. The findings evidenced here con be used to show the need of an environmental modification in nutrition policies, decisions regarding school cafeterias and the importance of having plenty and safe places to practice practical eating activities and physical activity, preferably directed towards dynamic methodologies that reach this population. By including the previously mentioned variables and doing studies that take gender into account might establish other patterns of behavior in adolescents.

Additionally, to maintain satisfactory outcomes, these interventions must be part of the education of enrolled students, so the health education they need to reach adulthood healthy and with behaviors that keep them well can be consolidated, which decreases the risk of cardiovascular and metabolic diseases, among others.

As limitations of this study, we find that the presented follow-up outcome measurements were taken 2 and 4 months after finishing the intervention, but during this period, sending web messages was difficult because the school computing resources that were used to send them did not allow them to be sustained and continuous. Additionally, part of the follow-up evaluation was made by self-report, which might be a source of information bias. The activities made in the follow-up were not successful at maintaining the changes evidenced after the intervention and the extracurricular activities that were not evidenced or evaluated might have influenced the perception of the study variables.[64–98]

Conclusion

The intervention "Health Promotion in Adolescents" produced statistically significant changes in BMI and eating behaviors, but these do not persist in time. The intervention "Health Promotion in Adolescents" had a moderate effect in BMI (weight) and nutrition. However, changes were not statistically significant, and its effect did not persist in time. For this reason, the elements that did not have a significant change in the intervention must be strengthened. The decrease in the perception of barriers to exercise is relevant. However, even if many activities to improve time dedicated to exercise and implement WHO recommendations are fostered daily, said recommendations are not perceived nor assumed as important to prevent overweight / obesity in adolescents. The Nola Pender Health Promotion theory identifies positive key elements and others that must be studied in-depth to identify causal relations of the phenomenon addressed in this study. The design of the interventions must be strengthened guide the expected outcomes in acquiring healthy behaviors in adolescents with overweight / obesity. The explanatory variables, perception of barriers, benefits and self-efficacy were only related to each other in the dimension of perception of benefits of fruit and vegetable consumption.

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Conflicts of interest

The authors express not having any conflict of interest.

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