

Effects of a family interdisciplinary intervention on food processing and the stage of eating behavior change in overweight or obese adolescents

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ABSTRACT

Introduction: Due to the increasing prevalence of obesity in recent years, the treatment of excess weight has become necessary and a global public health problem, especially in childhood and adolescence.

Objective: The present study aimed to analyze the effects of an interdisciplinary intervention on the processing and food consumption behavior of overweight and obese adolescents.

Methods: This is a pre-experimental, analytical, and interventional study. Sixty-four adolescents (65% females and 35% males), with a mean age of 13.72 ± 2.46 years, who were overweight or obese, were included in the study. The interdisciplinary interventions took place over 12 weeks, three times a week, with the participation of an interdisciplinary team composed of physical education professionals (three times a week), nutritionists (twice a week), and psychologists (twice a week). To analyze the level of food processing, a 3-day food record was applied before and after the 12 weeks of intervention. Foods were calculated in grams, calories, and % of total energy value (TEI). Data were expressed as mean and standard deviation. Subsequently, the normality of the data was tested using the Kolmogorov-Smirnov test. After this

confirmation, a paired t-test was performed to compare the pre- and post-intervention moments.

Results: significant reduction in processed and ultra-processed foods and increased consumption of fresh foods in grams and calories ($p < 0.05$). However, no significant differences were observed for consuming minimally processed foods ($p > 0.05$). In addition, there were significant results in the domain portion size and quantity ($p < 0.01$) and consumption of fruits and vegetables ($p < 0.05$).

Conclusion: 12 weeks of interdisciplinary interventions provided positive impacts on the level of food processing and consumption behavior of overweight and obese adolescents, contributing to the fight against obesity in adolescence.

KEYWORDS

Lifestyle modifications; Obesity in Adolescence; Adolescent Health; Interdisciplinarity.

INTRODUCTION

Obesity is a multifactorial disease resulting from the interaction between environmental and genetic aspects¹. Environments that provide ample supply and encouragement of sugary, fatty, and sodium-rich foods tend to promote unhealthy eating habits, resulting in negative individual food preferences and, consequently, in the prevalence of diseases associated with poor food quality, such as chronic non-communicable diseases (NCDs)².

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The scenario increased the prevalence of overweight and decreased malnutrition in children and adolescents, which is why obesity is considered a global public health problem³. It is a chronic non-communicable disease (NCD) detected by excess weight or body fat. In 2020, according to data from the National Health Survey conducted with adolescents, 31.8% were overweight, and 11.9% were obese³.

Therefore, to prevent it, it is necessary to identify the causes and contexts related to weight gain and the development of diseases⁴. The condition encompasses multiple factors, and it is necessary to highlight excessive food consumption, sedentary lifestyle, and, in short, intra-family relationships⁵. Eating habits can be influenced by psychological, family, cultural, environmental, and social factors and are directly related to food choices, which can impair health in adulthood⁵.

However, to implement the intervention, assessing the stages of behavior change readiness (CHR)⁶ is necessary. It is important to emphasize that identification through the CRIC, also known as the transtheoretical model, is essential for the choice of intervention methods and the implementation of effective strategies according to the motivation and responsibility of adolescents. Thus, the determination of stages is essential for the adoption of effective strategies and behavior change⁷.

Therefore, including guardians can contribute to behavior change and help adolescents adopt healthy habits (through access to fruits and vegetables), promoting a non-obesogenic environment⁸. Family meals teach children about behaviors, habits, and food choices⁹. However, due to overwork and daily stress, caregivers give their children a different view, such as easy access to ready-to-eat and fast food, negatively influencing the food choices and lifestyle of adolescents⁹. The literature shows that interdisciplinary interventions are the most effective for treating obesity¹⁰.

It is critical to highlight the importance of addressing the growing problem of overweight and obesity among adolescents. This condition has been associated with many adverse health consequences, including chronic diseases such as type 2 diabetes and cardiovascular disease³. Understanding and intervening in food processing and consumption behaviors can effectively prevent and control overweight and obesity in this population. In addition, an interdisciplinary approach can be more comprehensive and practical by considering different aspects of adolescents' lifestyles, such as diet, physical activity, mental health, and socioeconomic factors¹¹.

In addition, it is believed that the family could also participate in the fight against obesity, with the adolescent intending to improve their health status and aspects of nutritional education¹². Therefore, this study aimed to analyze the effects of an interdisciplinary family intervention on the level of food processing and consumption behavior of overweight adolescents.

METHODS

Experimental Design: This is a pre-experimental, analytical, and interventional study¹³. Data were collected at the University, on the premises of the Interdisciplinary Laboratory of Intervention in Health Promotion, over 12 weeks of interdisciplinary interventions. The Research Ethics Committee of the site approved the study through opinion No. 4,913,453/2021. The procedures followed the standards required in Resolution 466/2012 of the National Health Council on research involving human beings.

Participants: Sixty-two adolescents (65% female and 35% male) aged 13.8 ± 2.4 years agreed to participate in the study. The inclusion criteria were: (i) age between 11 and 19 years; (ii) overweight or obese; (iii) who completed the requested questionnaires and the ICF and FA; (iv) who were available to participate in interdisciplinary interventions twice a week in the evening (6:15 p.m. or 7:15 p.m.) throughout the 12 weeks, and (v) adolescents who attended all baseline intervention assessments. Regarding the exclusion criteria, the following were considered: (i) participating in sports activities outside the intervention; (ii) not reaching 75% of attendance in the interventions offered; (iii) missing the intervention more than twice in a row; (iv) did not complete any of the requested questionnaires; (v) followed a restrictive diet (low carb, low fat or hypocaloric) during the development of the intervention; and (vi) used psychotropic or appetite regulating medications.

Assessment of food intake: Food intake was measured in all adolescents at the beginning and end of the interventions using the food record. Participants were instructed to write down all their meals for three non-consecutive days: two days during the week and one day on the weekend¹⁴. They were instructed to fill in all food items and the appropriate quantities in detail (employing household measurements), using measuring utensils, or to provide the best estimate of portion size if they were away from home. In addition, all participants were instructed to detail each food item, such as brand or restaurant names and labeling of specific items (e.g., low-fat, 1% milk). To this end, support material was provided for information on household measurements and the correct completion of the questionnaire. In addition, to assist, at the beginning of the intervention, in the middle, and the final fulfillment, theoretical classes were held on how to fill in the material and what the home measurements are.

The food records collected were calculated using the Avanutri software (2004® version, Avanutri Equipamentos de Análise Ltda, Três Rios, Rio de Janeiro, Brazil). After tabulation in the software, it was possible to analyze the amount, in grams and kilocalories, of the level of food processing: fresh (in natura), minimally processed, processed, or ultra-processed¹⁵. The results found from the record were tabulated in Excel (version 2013, Microsoft, United States of America).

Stage of Eating Behavior Change: The Stage of Change questionnaire was translated into the Brazilian context by Cattai, Hintze, and Nardo Junior to assess the stages of readiness for eating behavior change¹⁶. This questionnaire was applied to adolescents before and after 12 weeks of intervention, which consisted of 38 statements distributed in four domains: size and number of portions (9 statements); amount of fat in the diet (11 statements); fruit and vegetable consumption (9 statements) and physical activity (9 statements). The answers to each statement ranged on a Likert scale from 1 to 5, with 1 pre-contemplation, 2 contemplation, 3 preparation, 4 action and 5 maintenance. The mean score for the three domains was calculated to obtain the steps related to each. The following classifications have been used: 1 to 1.4 – pre-contemplation; 1.5 to 2.4 – contemplation; 2.5 to 3.4 – preparation; 3.5 to 4.4 – action; 4.5 to 5.0 – maintenance^{17,18}.

Anthropometry: Height was measured using a stadiometer attached to a scale with 0.1 division, and body weight was also calculated on a digital scale with a precision of 0.1 kg (Welmy R-110, Santa Bárbara D'Oeste, São Paulo). All participants were previously instructed on the recommendations. Body mass index (BMI) was calculated for all participants (kg/m^2), and BMI-for-age z-score (BMI/A) was also calculated¹⁹.

Interdisciplinary interventions: The family interdisciplinary interventions followed the methodology previously published by Marques et al.¹². The legal guardians participated in all activities, i.e., physical exercises, dietary re-education, and psychological interventions, including theoretical or practical activities. All activities began with theoretical classes: dietary re-education or psychological interventions (lasting around 30 minutes – twice a week) and practical activities with physical exercises – three times a week. Dietary re-education was theoretically based on the Food Guide for the Brazilian Population¹⁵. Psychological intervention was carried out through theoretical and practical activities, carefully elaborated based on the National Health Promotion Policy (PNPS)²⁰. The physical exercises were performed in a circuit model. Thus, the functional training sessions were developed based on locomotor ability, stabilization, and manipulation skills and performed with em-

phasis on localized muscle groups, muscle strength and endurance work, flexibility, and cardiorespiratory endurance sectioned into 10 minutes of walking, in addition to 45 minutes of functional exercises and 5 minutes of stretching/resting.

Statistical analysis: The data are presented as mean \pm standard deviation (SD). First, normality data was tested using the asymmetry-kurtosis test, and values from 2 to -2 were given to indicate an accurate statistical parametric analysis. The comparison between pre- and post-intervention was performed through paired t-tests. It was accepted at $p < 0.05$ for all analyses. In addition, the effect size using Cohen's d was calculated and classified as < 0.20 – *small*, $> 0.20 < 0.80$ – *medium*, and > 0.80 – *large*. Statistical analyses were performed using SPSS 24 software (IBM, USA).

RESULTS

The final sample consisted of 64 adolescents, one of whom showed a significant increase in height during the intervention period (12 weeks). There were no significant changes in body weight, BMI, height, and BMI Z-score ($p > 0.05$). Table 1 shows the general characteristics of the sample.

When comparing each level of processing described in Table 2, it is noted that there was a change in the dietary pattern with an increase in the consumption of fresh foods, both in grams and kcal and no significant change was observed in the consumption of minimally processed foods. However, concerning processed foods, there was a reduction in kcal intake but no significant difference in grams. On the other hand, the reduction in their consumption is evident in grams and kcals ($p < 0.05$).

Significant changes were found in the size and quantity of portions consumed by the adolescents, as well as greater adherence to the consumption of fruits and vegetables. Therefore, it is a positive aspect since these are variables related to consumption and food choices. However, no significant differences were observed in the amount of fat in the diet and physical activity between the pre- and post-intervention moments. The results aim to contribute to the gaps in the

Table 1. General Characteristics of the Participants in the pre and post-intervention moments

General Characteristics	Pre-intervention	Post-intervention	p-value	Effect size
Age (years)	13.72 \pm 2,46	13.98 \pm 2,53	$p > 0.05$	0.10 - <i>small</i>
Body Weight (Kg)	1.63 \pm 0,12	1.64 \pm 0,11	$p > 0.05$	0.08 - <i>small</i>
Height (m)	1.55 \pm 0,06	1.56 \pm 0,05	$p > 0.05$	0.16 - <i>small</i>
IMC (kg/m^2)	29.85 \pm 7,97	29.66 \pm 7,46	$p > 0.05$	-0.02 - <i>small</i>
BMI/A Z-score	1.60 \pm 1,11	1.54 \pm 1,03	$p > 0.05$	-0.05 - <i>small</i>

Note: Data are expressed as mean and standard deviation (\pm); BMI = Body Mass Index (kg/m^2); BMI/A = Body Mass Index (kg/m^2) by age.

Table 2. Comparison of food processing levels previous and post-interventions

Food Processing Level	Pre-intervention	Post-intervention	p-value	Effect size
Food Processing Level	118.2 ± 128.1	213.9 ± 192.2	<i>p</i> <0.05	0.74 - <i>medium</i>
Natural food (g)	49.1 ± 60.9	93.0 ± 90.3	<i>p</i> <0.05	0.72 - <i>medium</i>
Natural food (kcal)	680.9 ± 408.7	726.0 ± 451.9	<i>p</i> >0.05	0.11 - <i>small</i>
Minimally processed (g)	860.8 ± 494.2	828.0 ± 434.4	<i>p</i> >0.05	-0.06 - <i>small</i>
Minimally processed (kcal)	315.5 ± 401.7	180.7 ± 218.4	<i>p</i> >0.05	-0.33 - <i>medium</i>
Processed (g)	405.7 ± 406.3	259.5 ± 237.5	<i>p</i> <0.05	-0.35 - <i>medium</i>
Processed (kcal)	327.6 ± 355.6	178.9 ± 204.7	<i>p</i> <0.05	-0.41 - <i>medium</i>
Ultra-processed (g)	661.6 ± 660.1	349.9 ± 388.8	<i>p</i> <0.05	-0.47 - <i>medium</i>

Note: Data are expressed as mean and (±) standard deviation.

Table 3. Comparison of pre and post-intervention using the Stage of Change questionnaire

Domain	Pre-intervention	Post-intervention	p-value	Effect size
Portion Control	2.0 ± 0.9	3.0 ± 0.8*	<i>p</i> <0.001	1.11 - <i>large</i>
Consumption of fruits and vegetables	2.0 ± 1.0	3.0 ± 1.0*	<i>p</i> <0.05	1.00 - <i>large</i>
Control of fat consumption	1.2 ± 4.7	1.8 ± 4.2	<i>p</i> >0.05	0.12 - <i>small</i>
Physical activity	1.0 ± 4.0	1.2 ± 4.0	<i>p</i> >0.05	-0.05 - <i>small</i>

Note: Data are expressed as mean and (±) standard deviation.

literature regarding the best intervention method for changing eating behavior in adolescents and their guardians.

The identification of assertive interventions corroborates health promotion, body weight reduction (although in our study, no significant difference was observed for this variable), and, consequently, diseases related to excess weight. The results found that the study participants were willing to participate in the proposed interventions, especially when involved in nutritional issues, such as portion size, quantity, and consumption of fruits and vegetables. Table 2 shows the comparison of food processing levels in previous and post-interventions.

DISCUSSION

The present study aimed to analyze the effects of an interdisciplinary intervention on the level of food processing and eating behavior of overweight and obese adolescents. The main results showed significant changes in the improvement of fresh food consumption, reduced processed and ultra-processed foods, improved fruit and vegetable consumption, and portion control. However, no significant differences were

observed between the consumption of minimally processed foods, the amount of fat, and physical activity in the diet and post-intervention periods. Due to the progressive gain of autonomy during adolescence, individuals are susceptible to making food choices of good or poor nutritional quality²¹, which is reflected in the nutritional status of these adolescents, which ends up causing weight gain in this age group. The results showed that the participants were willing to participate in the proposed interventions, especially when involved in nutritional issues such as portion size, quantity, and consumption of fruits and vegetables.

This finding makes it clear that family support can be complex, so that support implies encouragement to participate in activities together and changes in the family's habits at home²². Therefore, the family should be an example in changing eating habits and healthy lifestyles, encouraging physical activity, and monitoring it so that the child feels safe, motivated, and welcomed by his or her family²³. Thus, these changes made throughout the intervention were beneficial for health status and lifestyle, both in adolescence and adulthood, in which the better quality of food choices contributes

to the reduction of energy density, weight loss, and reduces the risk of developing chronic NCDs in the short and long term¹². It is known that food choices are not only determined by the physiological needs of the adolescent, but accessibility, coexistence, environmental factors, media advertising, and the price of food also influence them. In this context, substituting natural and minimally processed foods for processed and ultra-processed foods has become extremely important²⁴.

Several studies state that interdisciplinary interventions can improve the components of body composition, but few use the Likert rating of the stage of readiness for behavior change, so promoting this change is essential^{17,24,25}. Based on the above, with the evaluation of the stage of readiness for behavior change, it becomes possible to identify the level of commitment to change the individuals are at, and thus, professionals can develop more effective strategies based on the level of motivation. Therefore, encouraging interdisciplinary actions and recovering health conditions will help prevent complications associated with excess weight²⁶. In the study, after 12 weeks of intervention, it was possible to verify an improvement in the dietary profile of overweight and obese adolescents. Therefore, modifying the lifestyle in this age group is essential to prevent diseases in adulthood^{17,25}. Some studies have shown that improving dietary patterns and levels of physical activity through fresh foods, such as fruits and vegetables, and practicing physical exercises is associated with better lipid profile values and health status^{26,27}.

The improvement identified after the proposed interventions, through a significant increase in the consumption of fruits and vegetables, corroborates the results found in the literature, confirming that our study was able to give adolescents autonomy in food decisions. Therefore, encouraging adolescents and guardians to make better food choices is essential, especially in the environment in which they live¹⁴. Family members are essential, as food choices are inspired by caregivers and provide availability and accessibility to nutritious food⁸. Therefore, the diet quality can be influenced by the family's diet²⁸. Changes in adolescents' daily living activities concerning their eating habits and physical activity, together with nutrition and psychology education professionals, directly influence their health status and lifestyle.

Consequently, the strength of this study is that it is a framework that can be easily applied elsewhere. The program sought to encourage adolescents and parents to change their sedentary behavior to a healthy lifestyle through an interdisciplinary approach. Therefore, it is considered that the interdisciplinary program can positively influence both groups and modify behaviors by adopting healthy daily habits despite the family's participation in activities. Change is one of the main factors for the success of the treatment, and one of the most considerable difficulties encountered in the process is that these habits are often already ingrained in the family, and changing them requires a joint effort, a point that parents

have a lot of difficulty^{7,28,29}. Families that show greater acceptance and willingness to change their eating habits have greater adherence to treatment³⁰. Thus, multidisciplinary family interventions can contribute to strategies based on family incentives, support for the practice of physical activity, and health education¹⁴.

For a complete understanding of the results of this study, it is essential to consider the following limitations: The study did not assess the impact of family involvement, and this variable may play a significant role in adolescents' eating behavior and lifestyle habits, influencing the study's results. It is also important to emphasize that the effects of interventions may manifest differently over time, and the absence of long-term follow-up assessments may limit some findings. We can gain a fuller and more accurate understanding of future possibilities from these limitations. Future studies may consider the impact of family involvement and the relationship between adolescents and their guardians, which can help in the complete and accurate understanding of the factors that directly influence the most effective actions to control excess weight. By evaluating in the long term, it would be possible to verify the durability of the effects of the interventions.

CONCLUSION

Based on the results obtained, the 12 weeks of multidisciplinary family interventions (theoretical-practical) could positively impact the dietary profile and the level of food processing in overweight and obese adolescents. These results highlight the importance of multidisciplinary approaches in the treatment of overweight adolescents, in addition to the inclusion of the family in the approaches, in order to improve not only lifestyle habits in adolescence but also to improve the family scenario about healthy eating, ensuring health for all in adult life.

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