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ORIGINAL

Healthy and Safe School Cafeteria Program: a randomized controlled study

Programa Cantinas Escolares Saudáveis e Seguras: um estudo controlado randomizado

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ABSTRACT

Objective

To assess the effect of an educational intervention program focused on health risk conditions, based on an assessment of the hygiene and quality of food sold in school cafeterias.

Methods

This is a controlled, parallel, randomized, two-arm, community study. Public and private schools with cafeterias were invited to participate. This study was conducted in 27 school cafeterias in northern and northwestern *Rio Grande do Sul*, a state in southern Brazil. Representatives of the school communities in the intervention group received an educational program consisting of 160-hour distance training. The most relevant outcomes were the assessment of the hygienic conditions and composition of the menus sold in school cafeterias. All outcomes were analyzed as intention-to-treat and per-protocol. For the analysis of continuous data with normal distribution, an analysis of covariance and the Generalized Linear Model were used. The level of statistical significance considered was $p<0.05$ for a 95% CI.

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Results

No statistically significant difference was observed between the intervention group and the control group in the studied outcomes. There was a reduction of 76.2 points in the score for hygienic handling conditions (95% CI: -205 to 357; *p*=0.581). Regarding menu composition, the difference between groups was 0.48% (95% CI: -2.69 to 3.64; *p*=0.760) for ultra-processed foods, 0.23% (95% CI: -1.13 to 1.60; *p*=0.740) for processed foods, and 1.02% (95% CI: -2.59 to 4.64; *p*=0.581) for fresh foods.

Conclusion

There is not enough evidence to conclude that the intervention had a positive impact on any of the outcomes studied.

Keywords: Food and nutrition education. Nutrition policy. School feeding. School health services. Snacks.

RESUMO

Objetivo

Avaliar o efeito de um programa de intervenção educacional nas condições de risco à saúde com base na avaliação das condições higiênicas e na qualidade dos alimentos comercializados em cantinas escolares.

Métodos

Este é um estudo comunitário, controlado, paralelo, randomizado, dois braços. As escolas de Ensino Fundamental e Médio, públicas e privadas, que possuíam cantinas, foram convidadas a participar. Este estudo foi realizado em 27 cantinas escolares do norte e noroeste do Rio Grande do Sul, sul do Brasil. Representantes da comunidade escolar das cantinas do grupo intervenção receberam um programa educacional composto por um treinamento a distância de 160 horas. Os principais desfechos avaliados foram avaliação das condições higiênicas e composição dos alimentos vendidos nas cantinas escolares. Todos os resultados foram analisados como intenção de tratar e per protocolo. Para análise dos dados contínuos, com distribuição normal, utilizou-se a análise de covariância e o Modelo Linear Generalizado. O nível de significância estatística considerado foi p<0,05 para um intervalo de confiança de 95%.

Resultados

Não foi observada diferença estatisticamente significativa entre o grupo intervenção e o grupo controle nos desfechos estudados. Houve redução de 76,2 pontos no escore das condições higiênicas de manipulação (IC 95%: -205 a 357; p=0,581). Em relação à composição dos cardápios, a diferença entre os grupos foi de 0,48% (IC 95%: -2,69 a 3,64; p=0,760) para os alimentos ultraprocessados, 0,23% (IC 95%: -1,13 a 1,60; p=0,740) para os alimentos processados e 1,02% (IC 95%: -2,59 a 4,64; p=0,581) para os alimentos in natura.

Conclusão

Não há evidências suficientes para concluir que a intervenção teve impacto positivo em nenhum dos desfechos estudados.

***Palavras-chave**: Educação alimentar e nutricional. Política nutricional. Alimentação escolar. Serviços de saúde escolar. Lanches.*

INTRODUCTION

According to data from the Global Burden of Disease Study, the prevalence of obesity doubled in more than 70 countries between 1980 and 2015, with a 112 million increase in overweight children [1]. Likewise, in Brazil, evidence from a systematic review indicates that the prevalence of overweight and obesity in children is concerning [2]. According to studies analyzed between 2018 and 2019, the incidence of overweight in children and adolescents grew from 8.8% to 22.2%, while obesity ranged from 3.8% to 24% [2]. Moreover, children's eating patterns tend to be rooted in diets that are dense in calories and low in nutrients, causing a positive energy imbalance and directly contributing to weight gain [3-5].

It is a consensus that schools are the ideal environment to promote healthy eating behaviors and prevent or reduce weight gain [6-8]. Considering this appropriate scenario, the World Health Organization

(WHO) recommends implementing policies and programs that promote a healthy environment at school, with control of the food sold in school cafeterias [6,9].

In Brazil, access to food in schools can occur through school meals provided by the *Programa Nacional de Alimentação Escolar* (PNAE, Brazilian National School Feeding Program) as well as through school cafeterias, facilities within schools that aim at providing food upon payment. Despite the internationally documented constitution of government policies to reduce unhealthy food in school cafeterias [10-12], their implementation in schools is limited [12-17].

Even after laws regulating the unhealthy food trade in schools have been approved, cafeterias continue to sell large amounts of ultra-processed foods rich in fat, sugar, and salt, offering fewer options for healthy food [15,16,18,19]. Ultra-processed foods are very profitable and based on sophisticated marketing strategies designed for ready-to-eat products [20]. Financial resources seem to limit the implementation of a healthy cafeteria, as owners report that the sale of healthy food items is low and generates little profit [16]. This is particularly concerning given that for each increase in the availability of unhealthy foods in school cafeterias by 1%, their purchase by schoolchildren increases by 1.67% [21]. Furthermore, a direct association is observed between the proximity of facilities that sell unhealthy food items to schools and overweight and obesity in children and adolescents [22].

Food marketing in school cafeterias also requires control and monitoring for good handling practices in food production and sale. According to the Brazilian Ministry of Health, daycare centers and schools rank fifth in terms of the highest occurrence of foodborne disease outbreaks, compromising the safety of marketed food and limiting the potential impact of the implementation of healthy cafeterias [23,12].

Observational studies have shown an association between overweight children and adolescents and the presence of school cafeterias that promote unhealthy eating practices [1,6,24]. Additionally, school cafeterias seem to facilitate access to industrialized/ultra-processed foods [15,25,26]. Other research indicates that the sale of ultra-processed foods is more frequent in private school cafeterias [27,28], where the most commercialized items were candies, sweets, and the like (76.2%), followed by sweetened beverages (68.0%) and packaged snacks (57.7%) [27]. Contributing to these studies, Australian research reinforces that the price of food sold in school cafeterias favors the purchase of less healthy foods, which are usually cheaper [29]. Given these findings and the potential contribution of educational intervention programs in school cafeterias for promoting healthy and safe eating habits, this research is justified.

Faced with international calls for the prevention of overweight and the promotion of a healthy environment at schools [6,9], a review presented by WHO found positive effects for nutrition education interventions using various components and approaches, such as diets, physical activity, education on nutrition, and environmental change. There are also positive results related to actions raising awareness of the entire school community and involving parents. The research also reports that many of the studies are based on cross-sectional data and are unable to measure the effect of the studies [30].

As the first randomized controlled trial conducted in Brazilian school cafeterias, this trial presents a new contribution to scientific literature. In this context, we aimed to assess the effect of an educational intervention program on health risks and the quality of food sold in school cafeterias.

METHODS

This is a controlled, parallel, randomized, [1: 1 ratio], two-arm study, conducted in accordance with the recommendations of the Consolidated Standards of Reporting Trials (CONSORT) [31] and the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) [32]. The protocol details were published in the JMIR Research Protocols [33].

The study was carried out at school cafeterias in cities in the northern and northwestern regions of *Rio Grande do Sul*, a state in southern Brazil. The regions comprise 36 municipalities, 17 of which have less than 5,000 inhabitants and are in a situation of social vulnerability [34-36].

The calculation of the sample size was based on primary outcomes. For a significance level of 5% and statistical power of 80% in detecting an effect magnitude (d) of 1.1, 27 cafeterias were estimated (14 for the intervention group and 13 for the control group). The estimated sample needed to achieve the study objectives was based on the study by Nathan *et al.* [37]. The sample size was calculated with the program Power and Sample Size Calculations, version 3.1.

The definition of the sample was carried out through the website of the Education Department of *Rio Grande do Sul* and standardized telephone calls. Public and private schools with cafeterias that accepted to participate in the research by signing the Informed Consent Form were included.

After collecting data at baseline, randomization was performed by minimization in the 1:1 ratio. To maintain a balance between the groups and avoid the occurrence of disproportionate distribution, four predictors of interest for allocation were considered: city; cafeteria administration (self-managed vs. outsourced); scope (public vs. private;) and number of students (less than 500 students vs. greater than or equal to 500 students).

Minimization was performed by an independent researcher with the statistical software IBM®SPSS® Statistics for Windows version 26.0 (IBM Corp., Armonk, NY, USA). The cafeterias were randomly assigned to an intervention group and a control group.

As this is an educational intervention, the researchers responsible for administering the interventions and assessing the outcomes could not be blinded. Thus, to avoid contamination between groups, blinding was performed by a statistician responsible for the data analysis.

The schools in the intervention group were invited to participate in the program *Cantina Saudável*: *a gente apoia essa ideia!* (Healthy cafeteria: we support this idea!) in Brazilian Portuguese), which consisted of a 160-hour distance-learning training course. The intervention lasted ten weeks, with a weekly workload of 16 hours. The course was made available on Moodle, with access provided by the *Universidade Federal de Santa Maria* (Federal University of Santa Maria), and through exclusive groups on WhatsApp®.

The course was prepared in 8 units (Table 1), each with expository classes, texts, videos, practical activities, and discussion forums. The material was based on the *Healthy Cafeterias School Manual*: promoting healthy eating, developed by the Brazilian Ministry of Health [38], updated according to new nutritional recommendations and guiding resolutions for food marketing in school cafeterias [39-41]. Details on the components of each unit can be viewed in the study protocol [33].

This intervention targeted cafeteria owners and managers, food handlers, principals, vice-principals, teachers, pedagogical coordinators, nutritionists, students' parents, and students over 16 years old. The units became available in stages so that the weekly workload was scheduled as previously planned. In addition, the modules were available until the end of the course, and most course activities did not require meeting fixed hours and deadlines. The flexibility of distance learning allowed participants to adapt their studies according to their routines. No payments or refunds were made for cafeterias and schools to participate in the study, as local law does not allow individuals to participate in research for remuneration.

To minimize the sample's segment loss, maintain consistency in implementation, and assist in the execution of the agreed actions, the intervention group received two telephone calls (in the 4th and 7th weeks), periodic incentives with weekly motivational messages, and access to a tutor throughout the intervention via Moodle and WhatsApp®.

Table 1 – Components of the course Healthy cafeteria: we support this idea! *Rio Grande do Sul* (RS), Brazil, 2019.

Module	Goals
Unit 1 - Starting healthy schools	Present relevant information about children's and adolescents' health Study how schools and cafeterias can promote healthy and proper eating Understand the importance of implementing healthy school cafeterias and reasons to change Know the current laws that regulate food supply in school cafeterias
Unit 2 - What is healthy eating?	Know the concept of adequate and healthy eating Learn what is healthy eating based on the Brazilian Population Food Guide
Unit 3 - Cafeteria and industrialized foods	Know the effects of industrialized food consumption on students' health Learn how to choose foods by reading labels and nutritional information
Unit 4 - Healthy snacks	Provide suggestions for healthy and creative snacks to be offered in school cafeterias
Unit 5 - Food hygiene	Learn about the importance of adopting good practices in food handling to ensure the health quality and safety of the food sold in school cafeterias
Unit 6 - Food and nutrition education	Present educational strategies and activities to promote adequate and healthy eating in the school setting
Unit 7 - How to profit from healthy school cafeterias and successful experiences	Present strategies on how to profit from healthy food marketing and show successful experiences in planning and implementing healthy school cafeterias
Unit 8 - Schedule of activities and how to keep school cafeterias healthy	Propose a schedule of actions that must be carried out for schools to implement and maintain a healthy school cafeteria

The control group did not receive the intervention. However, the intervention and control group schools received a printed copy of the *Healthy Cafeteria School Manual*: *promoting healthy* eating after collecting baseline data [38].

The two groups received feedback two times via email about the results found in data collection (initial and final), with specific details about the cafeterias' compliance with legislation [39].

The research was developed in three phases. Phase 1 comprised baseline data collection; Phase 2 was the conduction of the program *Healthy Cafeteria*: *we support this idea!*, lasting ten weeks; Phase 3 was the final data collection immediately after the end of the intervention. The study took place from March to December 2019.

Baseline data related to school and cafeteria characteristics were collected before randomization. A face-to-face interview, with the aid of a questionnaire with structured questions, was applied to the school principal and/or cafeteria owner. The instrument was elaborated based on studies conducted by Giacomelli (2014) [42] and Porto (2011) [43].

The researchers responsible for the data collection were trained and received a standardized guidance manual on data collection. Data entry was performed using the Cafeterias Survey mobile application, developed for research, which assisted in information collection, analysis, interpretation, and follow-up. Through the application, data were stored in a database exported to Microsoft Excel®. The National Institute of Industrial Property granted software registration under number BR512019002503-2.

For the data collection regarding hygienic conditions of food handling in school cafeterias, a validated instrument developed from Ordinance 817 of May 10, 2013, was used [44-46]. The questionnaire scores items based on risk criteria to identify those that directly impact food quality and consumers' health [47,48].

This legislation is composed of 51 items from 9 categories, namely: water supply; building structure; cleaning of facilities, equipment, furniture, and utensils; control of vectors and urban pests; food handlers; raw material, ingredients, and packaging; food preparation; storage, transport, and display of prepared food; liability, documentation, and registration.

The score is attributed when the assessed facility does not fulfill some of the requested requirements, representing the importance of foodborne diseases prevention. Health risk assessment concerning good handling practices consists of a continuous scoring system ranging from zero (least severe) to 2,498.89 (most severe). The score is awarded when the assessed facility does not meet one or more of the requested requirements. Thus, the higher the score, the greater the number of non-conformities verified and the worse the facility's performance [44]. The assessment was carried out by a trained nutritionist through on-site observation [47,49].

The assessment of menu composition in school cafeterias was determined by the frequency of all items available for sale, which were grouped according to the NOVA food classification [40,50]. The frequency of foods was assessed according to the NOVA classification (Table 2). Afterward, the percentage of each group was calculated concerning the total foods items in each school cafeteria.

Table 2 – Classification of menu items according to the NOVA classification. *Rio Grande do Sul* (RS), Brazil, 2019.

Group	Descrption	Exemples
Fresh (green)	Fresh, minimally processed foods, and culinary preparations without the addition of culinary ingredients.	Water, fruit, sweet potato, corn, fruit salad, unsweetened natural juice
Processed food (yellow)	Processed foods and culinary preparations with added culinary ingredients*	Coconut water, peanuts, coffee with sugar, homemade tea, *rapadura* (a sweet of Azorean or Canarian origin in the form of small bricks, with a flavor and composition similar to brown sugar), sweet and salty popcorn, brown sugar, natural juice with sugar. Preparations with less than five ingredients
Ultra-processed food (red)	Ultra-processed food	Chocolate milk, candy, cereal bar, biscuit, isotonic drinks, industrialized cakes, fudge, hot dog, machine coffee, industrialized teas, chocolate, donuts, gummies, jelly, ice cream, hamburger, bread, popsicles, lollipops, ice cream, sandwich, snacks and toast with sausages, snacks, industrialized juices. Preparations with five or more ingredients

Note: *The culinary ingredients group was incorporated into this group, as cafeterias do not sell these foods in isolation.

An adapted version of these references was used for this research, as can be seen in Table 2. The assessment was based on similar Australian studies that evaluated menu composition based on the frequency of available items, classified according to food traffic light colors [51,52].

The assessment was carried out by two properly trained nutritionists; in case of divergence, a third nutritionist was consulted. To assist in item classification, for each food or drink present, information such as the name, brand of food or drink sold, production (homemade or industrial), and list of ingredients was also collected.

To assess the impact of the intervention on the quality of the food in school cafeterias, a score was developed for each cafeteria, calculated based on the frequency of each type of food available for sale, according to the NOVA food classification, proposed by Brasil (2014) [40] and Monteiro *et al.* (2010) [50]. The score details were published in the JMIR Research Protocols [33].

An equation (1) was used to calculate the score regarding food quality in school cafeterias. In It, F*innat* means the frequency of fresh foods, minimally processed foods, and culinary preparations without the addition of culinary ingredients; F*process* means the frequency of processed foods and culinary preparations with culinary ingredients; F*ultra* means the frequency of ultra-processed foods; N means the total number of items sold in the cafeteria. The score ranges from zero to 100 points. Higher scores reflect superior food quality in facilities.

$$Escore = 50 \times [Finnat \times 1 + Fprocess \times 0 + Fultra \times (-1)]/N + 50 \quad (1)$$

All outcomes were assessed as Intention-To-Treat (ITT) and Per Protocol (PP). The missing results were included in an analysis using the Last Observation Carried Forward approach [31]. For the analysis of continuous data with normal distribution, covariance analysis (ANCOVA) and the Generalized Linear Model with gamma function for variables with asymmetric distribution were used.

The outcomes were evaluated by comparing the differences in scores between groups in the post-test, adjusted by baseline measure. Data were analyzed using IBM®SPSS® Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). The level of statistical significance considered was $P < 0.05$ for a 95% confidence interval. All the hypotheses and analytic plans were specified before the data collection, the analytic plan was pre-specified, and any data-driven analyses were clearly identified and discussed appropriately.

The Research Ethics Committee of the *Universidade Federal do Rio Grande do Sul* (UFRGS, Federal University of *Rio Grande do Sul*) approved this project, under process nº 89504618.9.0000.5347, which was registered with the Brazilian Platform of Clinical Trials under the code RBR-9rrqhk, on April 30, 2018 (U1111 -1213-1614). To carry out the study, participants authorized their participation by signing the Informed Consent Form.

RESULTS

Between June 2018 and February 2019, 337 schools were assessed for eligibility. Of these, 216 schools reported over the phone that they did not have a cafeteria, 83 schools did not respond to three phone call attempts, seven cafeterias had been shut down, and four did not sign the Informed Consent Form. Thus, of the 27 cafeterias included in the sample, 14 were allocated to the intervention group and 13 to the control group, according to the CONSORT flowchart that describes the progress of the participating schools during the study (Figure 1).

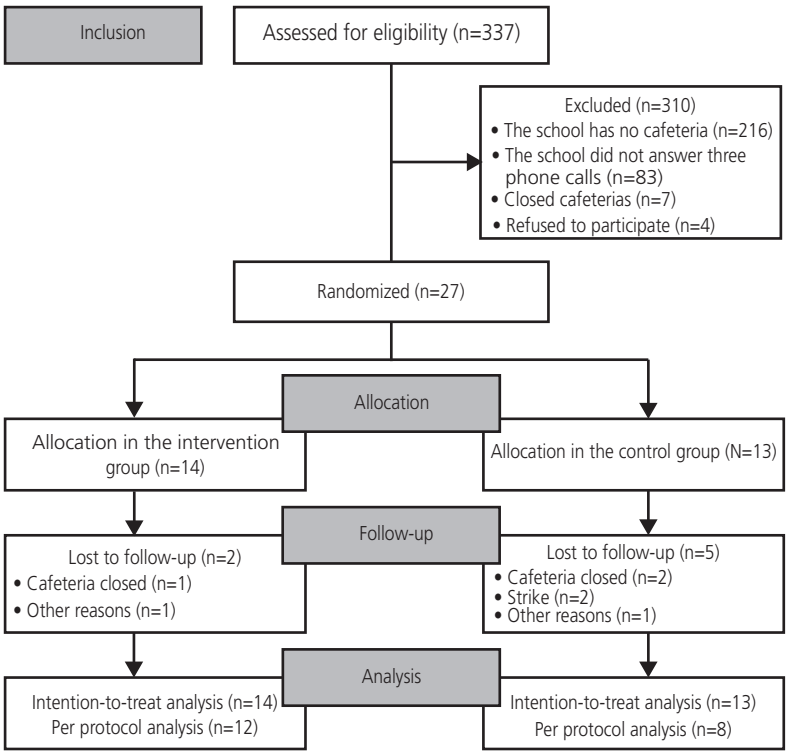

Figure 1 – CONSORT flowchart describing the progress of participating schools. *Rio Grande do Sul* (RS), Brazil, 2019.

There were no differences between baseline characteristics of the participating schools and cafeterias in the intervention group and the control group (Table 3).

The ITT analyses showed that there was no difference between the intervention and the control group regarding any of the studied outcomes. The effect observed in the intervention group was not statistically different from the effect in the control group. Similar results were found in the population that complied with the protocol until the end (PP) (Table 4).

Table 3 – Baseline characteristics of participating schools and cafeterias by group. *Rio Grande do Sul* (RS), Brazil, 2019.

Characteristics	Intervention (n=14)		Control (n=13)		Total (n=27)	
	n	%	n	%	n	%
Public school	9	64	8	62	17	63
Number of students ≥500	7	50	7	54	14	52
Outsourced cafeteria management	10	71	9	69	19	70
Presence of school meals (PNAE)	9	64	10	77	19	70
Presence of a nutritionist	1	7	1	8	2	7

Note: PNAE: *Programa Nacional de Alimentação Escolar* (Brazilian National School Feeding Program).

Table 4 – Effect of intervention on the hygienic conditions of food handling, menu composition, and food quality of school cafeterias, intention-to-treat and per protocol analysis. *Rio Grande do Sul* (RS), Brazil, 2019.

Variables	Intervention		Control		Adjusted differences (95% CI)*	*p*-value
	Baseline (n=14)	Follow-up (n=14)	Baseline (n=13)	Follow-up (n=13)		
	M±SD	M±SD	M±SD	M±SD		
Intention-to-treat						
Hygienic condition score	1292±417	1165±388	1187±387	1047±370	76.2 (-205–357)	0.58
Menu composition (%)						
Ultra-processed	92.6±8.49	91.6±7.81	87.7±10.27	87.4±8.42	0.48 (-2.69–3.64)	0.76
Processed	1.61±1.91	1.56±1.90	3.87±5.94	3.94±6.04	0.23 (-1.13–1.60)	0.74
Fresh	5.75±7.79	6.92±7.34	8.39±9.81	8.78±8.75	1.02 (-2.59–4.64)	0.58
Food quality score	6.56±8.09	7.66±7.53	10.3±9.59	10.69±8.05	-0.37 (-4.37–3.62)	0.86
Variables	Intervention		Control		Adjusted differences (95% CI)*	p-value
	Baseline (n=12)	Follow-up (n=12)	Baseline (n=8)	Follow-up (n=8)		
	M±SD	M±SD	M±SD	M±SD		
Per protocol						
Hygienic condition score	1348±357	1200±339	1285±434	1056±440	131 (-239–501)	0.47
Menu composition (%)						
Ultra-processed	93.4±7.48	92.1±6.67	87.0±11.7	86.4±8.71	1.45 (-2.89–5.79)	0.49
Processed	1.88±1.94	1.80±1.95	2.19±3.63	2.29±3.98	0.14 (-1.36–1.64)	0.86
Fresh	4.77±6.21	6.10±5.80	10.8±10.5	11.4±8.59	-0.40 (-4.78–3.98)	0.86
Food quality score	5.69±6.81	6.97±6.19	11.9±10.9	12.48±8.42	-2.05 (-6.61–2.50)	0.38

Note: *Adjusted by baseline values, *p* means statistical significance. M: Mean; SD: Standard Deviation.

There was an improvement in the performance of school cafeterias concerning hygienic handling conditions, with a slight reduction in the assessed score. However, there was no statistically significant difference in the change in the score of hygienic conditions between groups.

Despite the lack of significant results, a modest reduction in the score of hygienic handling conditions was observed after the intervention. The absolute changes in the categories were calculated and compared

between the intervention and control groups, and no statistically significant differences were found. The scores concerning the structures, food preparation and storage, transport, and display of prepared food categories had a reduction, but this difference was not statistically significant (p=0.181; p=0.624 and p=0.678, respectively). The categories with the worst results were food handlers and water supply (p=0.999 and p=0.970, respectively).

Likewise, the assessment of menu composition and food quality scores in school cafeterias did not have a statistically significant effect between groups. However, in general, there was an improvement in the outcomes from pre- to post-intervention, both in the intervention group and in the control group. This improvement, regardless of the *Healthy Cafeteria*: *we support this idea!* course, resulted in a non-significant difference.

When assessing food supply according to the type of processing, it was also observed that the two groups had high levels of ultra-processed foods compared to processed and fresh foods, both in baseline assessment and follow-up.

The results show a low quality of the food supply in the assessed school cafeterias, with very high levels of ultra-processed foods compared to processed and fresh foods. There was an improvement in food quality indicators, with a minimal drop in ultra-processed food marketing, a modest increase in fresh food marketing, and a little increase in school cafeterias' food quality scores.

DISCUSSION

This is the first randomized controlled trial carried out in Brazil that assessed the effect of an educational intervention program on improving hygienic handling conditions and the quality of food offered in Brazilian cafeterias. This study was designed to favor the implementation of healthy school cafeterias in southern Brazil [53,54].

The results suggest a reduced effect of the distance education intervention involving cafeteria workers and part of the school community, even with the researchers' monitoring through motivational encouragement and phone and text message support. Although not significant enough to characterize a difference between the groups, there was a modest increase in the hygienic quality indicators of good handling practices, the composition of marketed menus, and food quality in the school cafeterias after the intervention.

This improvement trend, observed in both groups, can be explained by the effect of participation in the study. Going to the schools, visiting, talking to the school community about the topic, and providing feedback and printed technical manuals seem to mobilize and motivate the school community to implement healthier school cafeterias.

The study's results also suggest the low quality of Brazilian school cafeterias' food supply, with very high levels of ultra-processed foods compared to processed and fresh foods. Unhealthy food marketing persists in schools in Brazil, and the criteria established in legislation are currently not able to ensure the marketing of adequate and healthy food [55].

Additionally, the study showed low hygienic quality in handling food in the assessed cafeterias. Most facilities were classified as having unacceptable hygiene practices (scores greater than or equal to 1,152.3) pre- and post-intervention. Although training can improve knowledge about the proper procedures, studies show that it does not guarantee a change in practices and behaviors concerning food safety [56,57].

Food handlers' attitudes are discussed from several perspectives: optimistic bias; cognitive illusions; low-risk perception; and lack of managers to measure practices [58-60]. Optimistic bias is directly linked to a feeling of competence that may prevent the correction of an error, which could have been avoided without the conviction of protection of the error itself [61].

The course was made available to the 14 schools in the intervention group, with 71 course participants. In 4 schools, there was no participation of other school community representatives in addition to cafeteria owners/managers (principals, vice-principals, food handlers, teachers, pedagogical coordinators, students' parents, and students over 16 years old), which helps explain the results of the research. The non-standardization of the number of participants per school, which would provide a better understanding of the intervention's effect, is a limitation of the study. This reinforces the relevance of involving the entire school community (cafeteria owners, food handlers, teachers, principals, students, *etc*.) to ensure that food safety-related actions are carried out in food services. To the best of our knowledge, no previous study has assessed the effect of interventions on the hygienic conditions of food handling in school cafeterias.

The results of this research are comparable to those of Yoong *et al.* (2016) [62], which also did not show enough evidence to conclude that the intervention significantly improved compliance in Australian schools with the healthy cafeteria policy. The authors suggest that, in isolation, a 12-month intervention with 72 cafeterias, consisting of menu audits and verbal and written feedback, may not be effective in improving compliance with such a policy. However, for these authors, increasing the intervention dose with more frequent menu audits and feedback could have maximized its effectiveness [62]. Accordingly, these measures are associated with increased compliance with Australian policy, indicating that more frequent feedback is likely to predict the intervention's effectiveness [62]. It is worth noting that such intervention did not provide training for food handlers, only follow-up through audits, feedback with the results, and initial face-to-face meetings with school principals and cafeteria managers to obtain support [62].

Other studies have had a positive impact on the implementation of a healthy school cafeterias policy, increasing the availability of healthier foods [12,37,63-65]. These studies carried out several strategies, including support from the school community, follow-up, feedback training, action plan, recognition, printed and electronic materials [12,14,65], policy consensus meetings [12,65], financial support for purchasing kitchen equipment, marketing [12,14], continuous support [14,65], among others. In particular, financial support for purchasing kitchen equipment for school cafeterias was a promising reason for the interventions' positive effect in improving school cafeterias [12,14]. This reality of developed countries like Australia is very distant from that of the schools participating in the present study, most of which were public and had cafeterias with domestic characteristics.

Despite the success of some of the interventions, authors report that 52% of schools continued to include prohibited items on cafeteria menus [37]. According to Reilly *et al.* (2018b), there were minor changes in the schools' policy adoption when principals and cafeteria managers were interviewed regarding their intention to use the Australian policy Fresh Tastes @ School.

Our results can be explained by the difficulty in maintaining and implementing a healthy cafeteria in Brazil, given the country's present economic situation [16]. Healthier diets with high nutritional value, based on unprocessed or minimally processed foods, usually cost more per unit of energy than less healthy diets, generally based on ultra-processed foods. In Brazil, unprocessed or minimally processed foods, such as fresh meat, milk, fruits, and vegetables, tend to cost more per unit of energy than ultra-processed foods [66].

Furthermore, although laws that regulate marketing food in the school environment exist, the lack of supervision aggravates, threatens, and hinders their operation and the implementation of healthy school cafeterias in Brazil [16]. In this regard, it is necessary that the city and state executive power, as well as school

managers, are also held accountable for complying with the current legislation. The inertia of a national policy that refrains from implementing tax regulations, marketing restrictions, and nutrition labeling, is also noteworthy [67,68]. Thus, attempts at regulation to reverse this situation and promote healthy eating fall short of creating significant changes [69].

Media literacy can also help children develop defenses against unhealthy food marketing and reduce its effects on eating behaviors and related health outcomes [70,71]. Parents can also shape their children's food preferences and behaviors as they play the role of health promoters, role models, and educators in their children's lives [72].

For public policies promoting adequate and healthy food in schools to achieve their full benefits, Food and Nutrition Education (FNE) must cross over other areas of knowledge, interacting and approaching different knowledge, subjects, and professionals. That will make practices in the area of food and nutrition effective, consistent, and lasting [73].

Schools should focus on building alternatives to increase availability and access to adequate and healthy food, as it seems to be incoherent that the school community, which in theory values healthy eating, provides students with nutritionally inadequate food [73-75].

Given the global challenge of combating obesity in children and adolescents, WHO recommends implementing programs that promote a healthy environment in schools. Among the strategies, they highlight eliminating the supply and marketing of unhealthy food, including knowledge about nutrition and health education in the schools' basic curriculum, promoting physical activity, and reducing sedentary behavior [6].

Likewise, the Food and Agriculture Organization of the United Nations (FAO) recommends different governmental pathways for healthier school environments, such as: defining and applying nutritional standards; making nutritious food more accessible; and restricting the marketing and advertising of foods high in fat, sugar, or salt [76]. The development of FNE and the participation of the entire school community (children, families, school staff, etc.) in the implementation of actions is also essential to promote adequate and healthy food in the school environment [76].

The present study has relevant limitations regarding its population and sample. The lack of statistical significance is justified by the size of the assessed sample. Such a limitation is also reported as a considerable challenge by another study in this field [12]. Another limitation is the loss in the sample's follow-up (25.92%). The data may have been influenced by Decree 54,994, promulgated on January 17, 2019, and sanctioned in the same year of the intervention. This decree regulates the Healthy Cafeterias Law in *Rio Grande do Sul* [53]. However, as our ITT and PP analysis revealed similar results, there is confidence in the study results. Furthermore, the impact of the intervention was examined only in a small sample from southern Brazil, possibly in a situation of social vulnerability [34]. Most of the assessed school cafeterias have the characteristics of domestic kitchens. These conditions can limit the generalization of findings to other contexts.

The size of the intervention effect observed in this study could have been greater if feedback to cafeterias and printed manuals had been provided only to the intervention group during the program. Schools in the control group received these documents after the intervention so as not to interfere with the results. The mechanism explaining certain effects is unclear and this is also an obstacle in other studies [12,37]. Another limitation that may have interfered with the results is the lack of evaluation of participants' compliance with the course. In future works, we recommend the assessment of the target audience compliance for a better understanding of the results. The short period may also have contributed to the reduced effect of the intervention. Also, we call attention to the scarcity of nutritionists in the technical

school cafeterias assessed. The presence of these professionals could have increased the odds of achieving the desired statistical differences.

This research brings new contributions to a scenario of scarce research [12,14,62,65]. It also provides evidence to improve the implementation of healthy cafeterias in schools through randomized testing, one of the most powerful tools in the search for consistent answers to promote adequate and healthy eating in the school environment, facilitating translation into practice in public health [77-80].

CONCLUSION

There is not enough evidence to conclude that the intervention improved the nutritional quality of the food offered in cafeterias and the hygienic aspects of food handling. However, there is a modest improvement in the implementation of healthy cafeterias by decreasing ultra-processed food supply, increasing fresh food supply, and improving the facility's performance concerning hygienic conditions and food quality.

The existing government legislative guidance and training provision documents do not seem sufficient to achieve the objectives intended by policies to implement healthy school cafeterias, as proposed by the Ministry of Health and *Rio Grande do Sul* Healthy School Cafeterias Law. Therefore, it is necessary to rethink the implementation of public policies so that there is greater inspection and accountability for compliance with legal requirements, as well as the need for permanent education in health and education on the subject.

CONTRIBUTORS

M BALESTRIN, VR KIRSTEN, and MB WAGNER were responsible for the conception, design, writing, review, and approval of the final version of this article.

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