TAILORED NUTRITIONAL INTERVENTION THROUGH DIGITAL TECHNOLOGY FOR BRAZILIAN ADOLESCENTS

INTERVENÇÃO NUTRICIONAL DIRECIONADA VIA TECNOLOGIA DIGITAL PARA ADOLESCENTES BRASILEIROS

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Abstract. The study aimed to compare the effects of a stage-tailored nutritional intervention to a non-tailored one and a control group, through digital technology, for adolescents. Eight schools were randomly selected, and a total of 347 students (18.04 ±0.75 years-old) participated in the study. A WhatsApp-based intervention was implemented in three groups: stage-tailored nutritional educational group, a non-tailored nutritional educational one, and a control group. Daily messages were sent to students for 42 days, one per day. Control group received messages on another theme. Food consumption, stage of change, nutritional knowledge, and self-efficacy for adopting healthy eating behaviors were measured. Wilcoxon test, Kruskal-Wallis rank test, the pair-wise comparison method, and Pearson's chi-square test were performed. Intra-group analyzes revealed the tailored group showed a statistically significant increase in the scores of knowledge and self-efficacy and a decrease in the score of unhealthy eating. Comparing the groups, the stage-tailored intervention showed a significant increase on items of the self-efficacy' scale. The tailored group seems to be the most suitable format for nutritional interventions via WhatsApp for adolescents.

Keywords: adolescent nutrition; Transtheoretical Model; Internet-based intervention; food and nutrition education; healthy diet.

Resumo. O estudo teve como objetivo comparar os efeitos de uma intervenção nutricional direcionada aos estágios de mudança com uma intervenção nutricional não direcionada e um grupo controle, via tecnologia digital, entre adolescentes. Oito escolas foram selecionadas aleatoriamente e um total de 347 alunos (18,04 ± 0,75 anos) participaram do estudo. Uma intervenção baseada no WhatsApp foi implementada em três grupos: grupo nutricional direcionado aos estágios de mudança, grupo nutricional não direcionado e um grupo controle. Mensagens diárias foram enviadas aos alunos durante 42 dias, uma por dia. O grupo controle recebeu mensagens sobre outro tema. Foram avaliados o consumo alimentar, o estágio de mudança, o conhecimento nutricional e a autoeficácia para a adoção de hábitos alimentares saudáveis. Foram realizados o teste de Wilcoxon, o teste de classificação de Kruskal-Wallis, o método de comparação *pairwise* e o teste do qui-quadrado de Pearson. As análises intragrupo revelaram que o grupo nutricional direcionado mostrou um aumento estatisticamente significativo nos escores de conhecimento e autoeficácia e uma diminuição no escore de alimentação não saudável. Comparando os grupos, a intervenção nutricional direcionada aos estágios mostrou um aumento significativo em itens da escala de autoeficácia. Portanto, a intervenção nutricional direcionada parece ser o formato mais adequado para intervenções nutricionais via WhatsApp.

Palavras-chave: nutrição do adolescente; Modelo Transteórico; Intervenção baseada em internet; educação alimentar e nutricional; alimentação saudável.

INTRODUCTION

It is highlighted that, since eating habits in adolescence are still developing, the implementation of health interventions for this population can result in investment in current and future public health (WHO, 2017). Systematic reviews have shown the potential of using digital technologies to health promotion in adolescents (Alcântara, Silva, Pinheiro & Queiroz, 2019; Oh, Carducci, Vaivada & Butta, 2022). Racey et al. (2016) have systematically reviewed 105 interventions aimed at adolescents to promote behavior and/or food consumption changes, and 82% were found to be effective. Nonetheless, the tailored

interventions, the ones that deliver content based on the participant's needs and interests and in a context that is significant for the individual, seem to have a better result (Enwald & Huotari, 2010).

The stages of change of the Transtheoretical Model (TTM) is one of the best-known ways to develop tailored interventions (Racey et al.,2016; Enwald & Huotari, 2010). The content of the intervention received by the participants is based on their stage of change, that is a representation of the degree of the individual's motivation to modify some behavior (Racey et al.,2016; Enwald & Huotari, 2010).

Precontemplation stage is when there is no intention to change one's diet in the near future; in *contemplation* stage, dietary change begins to considered, but also many barriers are identified; *decision* is determined by the preparedness and confidence to change; *action* is presented by visible and concrete diet changes, although recent; and *maintenanc*e, the last stage, corresponds to a dietary change mainteined for a more significant period of time, usually more than six months (Racey et al.,2016; Enwald & Huotari, 2010).

Health programs that compared a tailored-intervention group to a control one for adolescents obtained satisfactory post-intervention results. However, it is noteworthy that not all studies that compared a tailored intervention group to a non-tailored intervention group achieved the expected results, and most of these programs did not deliver similar contents for all groups, making it difficult to compare the results (Enwald & Huotari, 2010; Noar, Benac & Harris, 2007; Eyles & Mhurchu, 2009; Hoelscher, Evans & Kelder, 2002; Kipping, Campbell, MacArthur, Gunnell & Hickman, 2012; Kroeze, Werkman & Brug, 2006) . Therefore, this study aimed to compare the effects of a stage-tailored nutritional intervention to a non-tailored one and a control group, via digital technology, for adolescents.

MATERIAL AND METHODS

Study Design, Data Collection and Participants

This is a randomized community trial of a school-based healthy eating program among adolescents. The current analysis examined the effects on food consumption, stages of change, nutritional knowledge, and self-efficacy in adopting healthy eating behaviors, comparing the stage-tailored intervention group (TG) to the non-tailored one (NTG) and a control group (CG). The intervention's methods with details have been reported elsewhere (Melo, Correa Lima, Santos Chagas, Nakano & Toral, 2020). In summary, the protocol describes a WhatsApp-based nutritional educational intervention, based on the Dietary Guidelines for the Brazilian population (Brasil, 2015).

This study was conducted following the guidelines laid down in the Declaration of Helsinki. Moreover, the University of Brasilia's Research Ethics Committee (no. 2839.510) has approved the study. Written informed consent was obtained from school principals, parents and assent from participants. The study is registered in the Brazilian Clinical Trials Registry (no. RBR-5b9jk7) (trial URL: http://www.ensaiosclinicos.gov.br/rg/RBR-5b9jk7/). Finally, the study was conducted and reported according to the Consolidated Standards of Reporting Trials (CONSORT) guidelines (Campbell, Piaggio, Elbourne & Altman, 2012).

Senior students were recruited from eight public high schools that were linked with the Health in School Program of Brazil, which is a national program aimed at promoting health to children and adolescents from public schools (Brasil, Silva, Silva, Rodrigues & Queiroz, 2017). The schools were randomly selected by group, so there were no control and intervention groups in the same school and study shift. The use of WhatsApp on their own smartphone was an inclusion criterion, and participants could withdraw from the study anytime by requesting through the app.

Intervention

All participants completed a self-reported questionnaire on a regular school day pre and post-intervention. Data were collected at baseline and two to three weeks after the end of the intervention. During the intervention, the participants received one message per day, at lunchtime, via WhatsApp. There was no interaction between students and researchers. A total of 42 messages were sent to each student, lasting 6 weeks. The intervention for both nutritional groups was identical in frequency, delivery platform, and content, which was based on the Dietary Guidelines for the Brazilian population (Brasil,

2015); the only difference was the tailoring mode given to the TG, according to the stages of change of the TTM. The intervention for the control group had the same characteristics, except the content, which was on the prevention of dating violence, according to the Attachment Theory (Bretherton, 1992), specially designed for adolescents by psychology experts. This subject had no relation to any healthy eating content for counteracting the Hawthorne effect (Mccarney et al., 2007).

For all groups, among the text messages, three of them were orientation messages indicating the beginning, halfway complete, and the conclusion of the study. For the nutritional groups, among the remaining messages, five showed concepts related to NOVA food classification (Brasil, 2015), as unprocessed, minimally processed, processed, and ultra-processed foods. The other 34 messages were about healthy eating. These messages were short, straight-forward, suggestive, and designed for youths. For NTG, these 34 messages were general and for TG they were tailored to each stage of change of the TTM, considering the process of change necessary to promote the progress to the next stage or maintenance in the last stages (Dinoia, Contento, & Prochaska, 2008; Prochaska et al., 1994). By logistical aspects of the study and based on a model used in previous nutritional interventions (Menezes, Mendonça, Ferreira, Guimarães & Lopes, 2018), the participants of TG were divided into three subgroups, according to their stage classification at baseline: (1) precontemplation and contemplation, (2) decision, and (3) action and maintenance. Therefore, each non-tailored message was adapted into three tailored messages, one for each subgroup. Table 1 shows examples of the messages and more details can be found in the protocol of the study (Melo, Correa Lima, Santos Chagas, Nakano & Toral, 2020).

Table 1. Examples of messages with health's content used in the study. Federal District. Brazil. 2019.

Control Group	General Nutrition Group	Tailored Nutrition Group 1	Tailored Nutrition Group 2	Tailored Nutrition Group 3
People who feel insecure in emotional relationships disbelieve that they deserve to be loved. They may fear abandonment and become jealous. Or they may avoid intimacy and become closed off.	*Attention! Ultra-processed seasonings, such as ready-made broths (meat, chicken or vegetables) in tablets or powder, contain a lot of sodium and fat! Choose natural seasonings: garlic, onion, coriander, parsley, bay leaf, pepper, cumin, saffron...*	*Attention! Ultra-processed seasonings, such as ready-made broths (meat, chicken or vegetables) in tablets or powder, contain a lot of sodium and fat. They can increase your chance of having heart disease in the future, and, believe me, many teenagers in Brazil already go through this!*	*Do you use natural seasonings, such as garlic, onion, coriander, parsley, bay leaves, pepper, cumin, saffron...? How about making combinations using them instead of ultra-processed seasonings?*	*Try swapping the ultra-processed seasonings you still use for natural seasonings such as garlic, onion, coriander, parsley, bay leaf, pepper, cumin, saffron...*

Measures

Variables investigated were: age, gender, maternal education level, food consumption, stage of change, nutritional knowledge, and self-efficacy for adopting healthy eating behaviors. Maternal education was assessed through a multiple-choice question, with four response options. To assess food consumption, a food frequency questionnaire was applied, including 13 and 10 markers of healthy and unhealthy eating, respectively. Participants had to mark if those particular food group items were eaten the day before (Brasil, 2021; Costa et al., 2021).To evaluate the stages of change, an algorithm used in a previous study with Spanish adolescents was translated to Portuguese. The instrument is based on a general diet and in accordance with the participant's own perception (López-azpiazu et al., 2000).

To assess nutritional knowledge and self-efficacy, an instrument developed and validated for a nutritional intervention with Brazilian adolescents was used (Cronbach's alpha (α) for nutritional knowledge and self-efficacy of 0.808 and 0.875, respectively) (Chagas, Melo, Botelho & Toral, 2020). For the nutritional knowledge module, the adolescents had to evaluate 15 statements about healthy eating on a Likert scale ranging from 1 ("I don't agree at all") to 5 ("I totally agree"). For the self-efficacy module, the adolescents had to answer 19 questions about how much they intend to take different actions to

adopt healthy eating behaviors, with a Likert scale ranging from 1 ("Definitely no") to 5 ("Definitely yes"). The final version of the self-administered questionnaire can be found in the supplementary material (S1).

Sample Size and Recruitment

Sample size calculation was based on expected self-efficacy in the adoption of healthy practices during the intervention period, considering a 15% increase in self-efficacy scores clinically significant, a standard deviation of 4.79 (Wall, Least, Gromis, & Lohse, 2012), a significance level of 5% and a power of 80%. The distribution of stages of change previously observed among Brazilian adolescents (Cunha, Souza, Veiga, Pereira & Sichieri, 2015) was also considered: 68%, 12% and 20% in precontemplation/contemplation, decision, and action/maintenance stages, respectively; thus, the minimum sample in the smallest intervention subgroup (decision) was 26 individuals. Moreover, an estimated loss of 31.8% was added between pre- and post-intervention based on a previous study with a population with similar characteristics (Fonseca, Bertolin, Gubert, & Silva, 2019). Therefore, the minimum sample was 390 individuals: 38 in the CG, 38 in the NTG and 314 in the TG.

A computer-generated randomization method was used to allocate schools in each intervention group, with new schools drawn from the pool, in the following order: CG, NTG and TG, until the minimum sample was reached.

Data Analysis

KoBoToolbox software was used to enter the survey questionnaires (Kobotoolbox, 2012). There were limited response options, to minimize typing errors. Test of normality was performed using the Shapiro-Wilk test. Statistical analysis was performed using SPSS version 23.0, with a significance level of 5%.

Descriptive and exploratory analysis were performed. Differences in baseline characteristics were assessed using Pearson's chi-square test. Participants lost to follow-up were compared to study participants in terms of maternal education level and age (up to 17 years; 18 or more) using Pearson's chi-square test, and food consumption, self-efficacy and knowledge were compared between the three groups using the Kruskal-Wallis rank test and the pair-wise comparison method.

The intra-group comparisons pre- and post-intervention were assessed through the Wilcoxon test. The intervention's effects on the variables between groups was assessed through the Kruskal-Wallis rank test. Post-hoc analyzes were also performed using the pair-wise comparison method.

Regarding the stage of change, the movement between the stages was assessed through Pearson's chi-square test, and for this, three categories were created: regressed, remained or advanced. It was considered successful for subgroup 3 (action and maintenance) to remain in the same stage, since the intervention did not last longer than 6 months and it is also expected for individuals in the maintenance group to remain in the group.

For each item of food consumption, the participant received one point if there was a consumption of that group of foods in the previous day, and from that, final scores for healthy (maximum score of 13 points) and unhealthy foods (maximum score of 10 points) were calculated. In addition, the items were analyzed in groups of fruits/vegetables and sugary drinks (soda, industrialized juices and dairy sugary drinks), also by creating scores. For the knowledge and self-efficacy scale, a final score was calculated with a maximum score of 75 and 95 points, respectively; and each item was also analyzed separately, with a maximum score of 5 points.

RESULTS

From the 474 participants at baseline, 347 senior students completed the study (Fig 1). The mean age of participants was 18.04 ±0.75 years-old. Comparison of baseline demographic characteristics shows that participants were only statistically different for gender ($p = 0.022$) (Table 2). Study completers were not different from participants who dropped out of the study or were lost to follow-up, regarding sex,

maternal education level, age, healthy eating, unhealthy eating, self-efficacy and knowledge scores (data not shown).

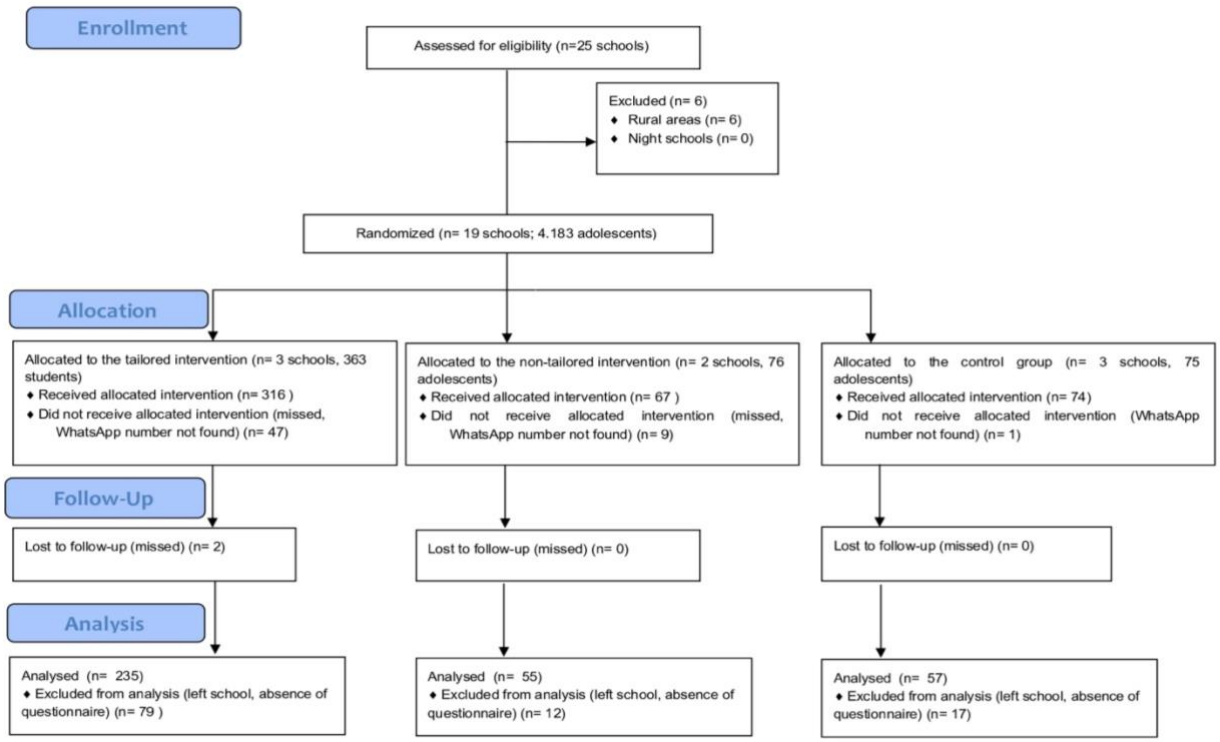

Figure 1. Study flow diagram based on the CONSORT s model. Source: own authorship (2023).

Table 2. Characteristics of participating schools by intervention condition at baseline. Federal District. Brazil. 2019.

	Total n=347 n (%)	CG n= 57 n (%)	NTG n=55 n (%)	TG n=235 n (%)	*p*-value [1]
Gender					**0.022**
Male	79 (27.2)	26 (45.6) [a,b]	15 (27.3) [b]	64 (27.2) [a]	
Female	211 (72.8)	31 (54.4)	40 (72.7)	171 (72.8)	
Maternal education					0.937
Incomplete primary education	87 (25.1)	14 (24.6)	12 (21.8)	61 (26)	
Complete primary education/ incomplete high school	47 (13.5)	8 (14)	10 (18.2)	29 (12.3)	
Complete high school/ Incomplete college	153 (44.1)	26 (45.6)	24 (43.6)	103 (43.8)	
Complete college/ Postgraduate	43 (12.4)	8 (14)	6 (10.9)	29 (12.3)	
Not declared	17 (4.9)	1 (1.8)	3 (5.5)	13 (5.5)	
Stages of change					0.317[2]
Precontemplation	78 (22.5)	10 (17.5)	14 (25.5)	54 (23.0)	
Contemplation	136 (39.2)	27 (47.4)	25 (45.5)	84 (35.7)	

Decision	35 (10.1)	4 (7.0)	5 (9.1)	26 (11.2)
Action	62 (17.9)	11 (19.3)	10 (18.2)	41 (17.4)
Maintenance	36 (10.4)	5 (8.8)	1 (1.8)	30 (12.8)

CG;Control group NTG. Non-tailored group; TG. Tailored group

[1] Pearson's chi-square test

[2] Fisher's exact test for cells below five expected values.

Groups with the different letters are significantly different

Source: own authorship (2019)

In the intra-group comparisons, TG showed a statistically significant increase in the scores of nutritional knowledge and self-efficacy and a decrease in unhealthy eating, more specifically in the score of sugar-sweetened beverages, comparing the pre and post-intervention time (Table 3). No significant effects were found in the NTG and CG.

Table 3. Intra-group comparisons between pre and post-intervention and comparison between intervention groups regarding total scores of food consumption, groups of food items, nutritional knowledge and self-efficacy for adopting healthy eating behaviors. Federal District. Brazil, 2019.

		Pre-intervention mean (SD)	Post-intervention mean (SD)	p-value[1]	*dif* mean (SD)	*Dif* p-value[2]
Food Consumption						
Unhealthy Eating (Total score)	CG n=57	3.98 (2.18)	3.61 (2.12)	0.133	-0.37 (1.79)	0.899
	NTG n=55	3.75 (2.03)	3.69 (2.59)	0.675	-0.05 (2.72)	
	TG n=235	3.49 (2.11)	3.05 (1.89)	**0.025**	-0.44 (2.31)	
Food grouping items						
Sugar-sweetened beverages	CG n=57	1.32 (0.98)	1.23 (0.92)	0.429	0.09 (0.83)	0.850
	NTG n=55	1.18 (0.98)	1.13 (0.86)	0.556	0.05 (1.11)	
	TG n=235	1.09 (0.89)	0.93 (0.86)	**0.028**	0.16 (1.04)	
Knowledge						
Natural (non-processed) foods should be prioritized in healthy meals.	CG n=57	4.58 (0.94)	4.63 (0.87)	0.744	0.05 (1.31)	0.631
	NTG n=55	4.64 (0.72)	4.56 (0.91)	0.786	-0.07 (.99)	
	TG n=235	4.57 (1.02)	4.60 (0.99)	**0.000**	0.03 (1.30)	
I would have more energy if I ate fruits and vegetables.	CG n=57	4.42 (0.96)	4.47 (1.03)	0.603	0.05 (1.24)	0.865
	NTG n=55	4.47 (0.69)	4.60 (0.78)	0.182	0.13 (0.84)	
	TG	4.46	4.59	**0.004**	0.13	

	n=235	(0.84)	(0.82)		(.93)	
Eating ultra-processed foods often is bad for your health.	CG n=57	4.46 (0.98)	4.72 (0.55)	**0.045**	0.26 (.95)	0.256
	NTG n=55	4.58 (0.83)	4.51 (0.96)	0.649	-.07 (1.13)	
	TG n=235	4.65 (0.78)	4.66 (0.70)	**0.004**	0.01 (.85)	
Having a colorful meal is a healthy habit.	CG n=57	4.23 (1.06)	4.39 (0.92)	0.411	0.16 (1.16)	0.870
	NTG n=55	4.25 (1.29)	4.47 (0.76)	0.313	0.22 (1.32)	
	TG n=235	4.35 (0.94)	4.48 (0.88)	**0.048**	0.12 (.99)	
Fruits and vegetables from farmers' markets or produce markets are usually fresher and healthier.	CG n=57	4.02 (0.93)	4.23 (0.84)	0.159	0.21 (1.09)	0.613
	NTG n=55	4.15 (0.97)	4.25 (0.98)	0.435	0.11 (1.14)	
	TG n=235	4.02 (1.06)	4.33 (0.05)	**0.000**	0.30 (1.10)	
Eating with friends and/or colleagues is a healthy habit.	CG n=57	3.70 (1.29)	3.88 (1.01)	0.246	0.18 (1.13)	0.700
	NTG n=55	3.82 (1.15)	4.20 (0.98)	0.054	0.38 (1.43)	
	TG n=235	3.73 (1.10)	4.10 (1.02)	**0.000**	0.36 (1.27)	
Reading food labels is a healthy habit because they show the ingredients in each food product.	CG n=57	4.16 (1.08)	4.12 (1.01)	0.817	-0.04 (1.23)	0.116
	NTG n=55	4.38 (0.82)	4.38 (0.75)	0.948	0.00 (1.01)	
	TG n=235	4.31 (0.90)	4.51 (0.78)	**0.002**	0.21 (.91)	
Cooking your own food is a healthy habit.	CG n=57	4.21 (0.97)	4.25 (0.93)	0.561	0.04 (1.03)	0.392
	NTG n=55	4.35 (0.88)	4.38 (0.75)	0.800	0.04 (1.13)	
	TG n=235	4.31 (0.51)	4.50 (0.89)	**0.003**	0.18 (1.05)	

Total score	CG n=57	65.30 (7.52)	66.81 (5.48)	0.176	0.05 (1.31)	0.700
	NTG n=55	66.13 (5.62)	67.38 (6.40)	0.084	-0.07 (0.99)	
	TG n=235	66.09 (8.93)	68.17 (6.90)	**0.000**	0.03 (1.30)	
Self-efficacy						
Do you intend to replace quick snacks with full meals?	CG n=57	3.37 (1.19)	3.71 (0.92)	**0.044**	0.38 (1.34)	0.209
	NTG n=55	3.49 (1.31)	3.49 (1.24)	0.940	0.00 (1.91)	
	TG n=235	3.39 (1.24)	3.32 (1.28)	0.492	-0.07 (1.51)	
Do you intend to have a diet low in sweets and sugar?	CG n=57	3.54 (1.41)	3.59 (1.18)	0.818	0.05 (1.38)	0.823
	NTG n=55	3.44 (1.25)	3.51 (1.26)	0.737	0.07 (1.42)	
	TG n=235	3.50 (1.28)	3.64 (1.16)	**0.044**	0.14 (1.25)	
Do you intend to avoid eating "junk food" (e.g., chocolate, lollipops, snacks, soft drinks, sandwich cookies)?	CG n=57	3.61 (1.29)	3.45 (1.12)	0.466	-0.14 (1.25)	0.157
	NTG n=55	3.18 (1.42)	3.44 (1.33)	0.200	0.25 (1.65)	
	TG n=235	3.22 (1.38)	3.46 (1.28)	**0.004**	0.24 (1.39)	
Do you intend to have your meals calmly, attentively, and at regular times?	CG n=57	3.88 (1.28)	4.00 (0.97)	0.533	0.13 (1.46) [a,b]	**0.040**
	NTG n=55	4.05 (1.25)	3.84 (1.08)	0.209	-0.22 (1.58) [b]	
	TG n=235	3.76 (1.25)	4.00 (1.08)	**0.007**	0.24 (1.32) [a]	
Do you intend to sita at the table to have meals of the day (breakfast, lunch, and dinner)?	CG n=57	3.54 (1.40)	3.63 (1.34)	0.697	0.11 (1.42)	0.459
	NTG n=55	3.51 (1.38)	3.75 (1.23)	0.417	0.24 (1.66)	
	TG n=235	3.51 (1.37)	3.83 (1.24)	**0.000**	0.32 (1.47)	
	CG n=57	2.91 (1.36)	3.18 (1.25)	0.147	0.29 (1.34) [a,b]	**0.043**

Do you intend to opt for healthy meals when you are away from home?	NTG n=55	2.96 (1.47)	2.98 (1.29)	0.934	0.02 (1.67) [b]	
	TG n=235	2.83 (1.29)	3.28 (1.29)	**0.000**	0.45 (1.56) [a]	
Do you intend to read food labels to know the ingredients that are included?	CG n=57	2.84 (1.27)	3.05 (1.35)	0.160	0.23 (1.46)	0.547
	NTG n=55	2.98 (1.44)	3.16 (1.41)	0.474	0.18 (1.74)	
	TG n=235	2.95 (1.37)	3.30 (1.38)	**0.000**	0.35 (1.46)	
Do you intend to have a healthy diet (low in salt, sugar, and fat) often?	CG n=57	3.89 (1.14)	3.61 (1.27)	0.089	-0.27 (1.32)[a]	**0.046**
	NTG n=55	3.42 (1.51)	3.67 (1.26)	0.201	0.25 (1.69)[b]	
	TG n=235	3.70 (1.18)	3.83 (1.18)	**0.033**	0.14 (1.19)[a,b]	
Do you intend to cook healthy dishes?	CG n=57	3.82 (1.16)	3.63 (1.35)	0.254	-0.19 (1.18)	0.073
	NTG n=55	3.76 (1.31)	3.80 (1.23)	1.000	0.04 (1.63)	
	TG n=235	3.66 (1.23)	3.86 (1.15)	**0.017**	0.21 (1.26)	
Total score	CG n=57	68.67 (11.96)	68.09 (15.52)	0.575	-0.58 (15.82)	0.605
	NTG n=55	67.51 (13.10)	68.95 (12.96)	0.426	1.44 (15.26)	
	TG n=235	67.74 (13.14)	70.07 (13.73)	**0.000**	2.33 (10.97)	

CG;Control group NTG. Non-tailored group; TG. Tailored group

[1] Wilcoxon matched-pairs test

[2] Kruskal-Wallis rank test with post-hoc analyzes using the pair-wise comparison method

Regarding Kruskal-Wallis rank test, groups with *dif* mean (SD) with different letters are significantly different.

Source: own authorship (2019)

Comparing the groups, no significant effects were found for food consumption and total scores of nutritional knowledge and self-efficacy; however, significant increase was observed for the intention of having the meals calmly, attentively, and at regular times and opting for healthy meals when away from home for TG, in comparison to NTG (Table 5). TG was also found to have a significantly increased score of the intention of having meals with less salt, sugar, and fat, in comparison to CG. The progress between the stages of change did not differ significantly between groups (χ^2= 2.53; df= 3; p= 0.281).

DISCUSSION

This is one of the few studies found in the literature that sought to compare a tailored nutritional educational intervention strategy to a non-tailored one with all factors (content, format and time of message delivery, number of messages, guidance material, and school year) of the intervention being equal, allowing to truly explore the tailoring effect (Lee et al., 2017). It has also not been found published results of any nutritional intervention aimed at sending messages to adolescents exclusively via WhatsApp, which is the first choice of instant messaging application worldwide (WhatsApp, 2020). Among its advantages, there are the ease to download on any digital mobile platform and to use, and no cost for exchanging texts, audio messages, images, and videos (Sharma & Shukla, 2016).

Baseline means shows total scores of self-efficacy and nutritional knowledge were above 70% of maximum scores, resulting in a possibility of changes of less than 30% post-intervention, thus decreasing the possible impact of the intervention. Similar results for high nutritional knowledge score at baseline among adolescents have already been found in the literature and were expected (Chagas et al., 2020; Sharma & Shukla, 2016; Fraticelli et al., 2016). Fraticelli et al. (2016) describes the results of a game called *Gustavo in Gnam's Planet* to improve healthy nutrition knowledge in Italian adolescents, with baseline scores for nutritional knowledge above 80% for all groups (Fraticelli et al., 2016), while in our study this percentage was around 88%. A study on the development of nutritional interventions for adolescents ' states that the first step in developing an effective program is the needs assessment, which can be obtained through previous data collected from the study population (Kipping et al., 2012). This step was not foreseen in this study, based on epidemiological previous studies that emphasize the actual unhealthy eating habits of Brazilian adolescents; however, it is recognized after the study the need to previously evaluate the specific study population.

There was no significant result from the non-tailored group, leading to questions whether a general intervention based only on delivering messages has the potential to promote eating behavior changes. A program outlined to enhance healthy eating habits among university students found that a strategy of delivering messages plus a web-based nutritional short course significantly increased the likelihood of increasing vegetable intake as well as choosing healthy foods (O'Brien & Palfai, 2016). Pandya (2020) sent completed posts, with text messages, quizzes, videos or images, once a week via WhatsApp for adolescents living with food allergies and found the intervention was effective in enhancing mindful eating behaviors, sense of wellbeing and self-concept. Those studies show that a general intervention through WhatsApp may need additional digital exposure and interaction, such as longer texts, quizzes, and videos.

Results of intra-group analysis showed the intervention tailored at the stages of change promoted satisfactory results for the group. This fact could be attributed to the tailored content of the intervention, which reflects on a content that is adequate to the needs and interests of the participant. It is known that involvement with the content of a health education message is an important determinant of the time and attention that a person will invest in reading the information, which ultimately can be translated into behavior change (Brug, Campbell, & Van Assema, 1999).

However, analysis between intervention groups did not show that the tailored strategy was statistically superior to the other groups, except by some items of self-efficacy. This situation opens questions about whether the intervention had enough time to show a difference on other items of the scale, resulting in a significance in the total scores. According to Hoelsher et al (2002), the dose and duration of interventions are key characteristics that can determine whether the nutritional program will find significant results. The absence of effects on food consumption might be related to the fact that, as proposed by the TTM, an increase in knowledge promotes greater self-efficacy and progression through the stages, which is later reversed in behavior change (Dinoia, Contento, & Prochaska, 2008; Prochaska et al., 1994), in our study reflected as healthy eating. We believe that this benefit could be achieved if the intervention had a longer time of exposure, since the baseline knowledge score was close to 90% and significant items of self-efficacy started to appear.

Yet, regarding the changes observed in relation to self-efficacy, it is considered of great importance that adolescents in TG showed more intention to choose healthy foods outside the home. Especially for this age group, peer relationships impact food-decision making, since belonging to social groups is

considered one of the priorities of life; however, this influence is usually more negative than positive (Rageliéne & Gronhoj, 2020; Nawaz & Gilani, 2011; Huang, Wang, & Shi, 2012). A recent systematic review analyzed 29 studies focused mainly on older adolescents and found that peer influence is associated with the increase in consumption of *junk* food (Rageliéne & Gronhoj, 2020). In the case of Brazil, the latest national data showed adolescents are the age group that most consume outside the home (IBGE, 2020); therefore, the positive results of the intervention can impact not only in the health of the participants of the study but be extended on their social network.

It is important to note some limitations of the current study. Once each student participated in different subgroups, contamination was possible in TG. To address this issue, the messages were sent at lunchtime, when no students were at school, as a way of limiting discussions. Another limitation was the inability to determine whether the messages were read in their entirety. However, the effectiveness of the intervention depends on whether the messages are read, so results can be considered an indication of good participant adherence.

CONCLUSION

Results indicate tailored interventions can be better than a standard nutritional educational intervention for adolescents, since all significant results found were in the direction of the tailored group. Based on the findings, future studies should evaluate the effectiveness of a tailored intervention based on a non-tailored intervention with already proven effectiveness. More long-term studies are necessary to confirm the superiority of a tailored intervention compared to a non-tailored one. Moreover, future studies should have the means to analyze if the messages are being read by the participants.

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