

## SUGARY DRINK CONSUMPTION AND NUTRITIONAL STATUS IN ADULTS: AN INTERVENTION STUDY

### Haysla Xavier Martins

Master's student in Public Health. Postgraduate Program in Public Health. Health Sciences Center. Universidade Federal do Espírito Santo - UFES, Vitória (ES), Brazil.

### Hellen Xavier Araujo de Assis

Graduation in Nutrition. Department of Education Integrated in Health. Health Sciences Center. Universidade Federal do Espírito Santo - UFES, Vitória (ES), Brazil.

### Jordana Herzog Siqueira

PhD student in Public Health. Postgraduate Program in Public Health. Health Sciences Center. Universidade Federal do Espírito Santo - UFES, Vitória (ES), Brazil.

### Oscar Geovanny Enriquez Martinez

PhD student in Public Health. Postgraduate Program in Public Health. Health Sciences Center. Universidade Federal do Espírito Santo - UFES, Vitória (ES), Brazil.

### Carla Moronari de Oliveira Aprelini

Master in Public Health. Postgraduate Program in Public Health. Health Science Center. Universidade Federal do Espírito Santo - UFES, Vitória (ES), Brazil.

### Aline Silva Porto

Master in Nutrition and Health. Postgraduate Program in Nutrition and Health. Health Science Center. Universidade Federal do Espírito Santo - UFES, Vitória (ES), Brazil.

### Maria del Carmen Bisi Molina

Professor at the Federal University of Espírito Santo. Department of Integrated Health Education. Health Sciences Center. Universidade Federal do Espírito Santo - UFES, Vitória (ES), Brazil.

### Corresponding author:

Maria del Carmen Bisi Molina  
mdcarmen2007@gmail.com

**ABSTRACT:** This study aimed to evaluate changes in the consumption of sugar sweetened soft drinks and nutritional status of adults linked to a federal educational institution located in Vitória (ES), after an intervention program. Anthropometric measurements and sugary drink intake data were collected from all participants, who were randomized and allocated into two groups, intervention (*mHealth* actions) and control. After that, a reevaluation was performed. The outcomes were evaluated in relation to the groups and the initial and final moments, using SPSS version 21.0, adopting  $p < 0.05$ . We evaluated 200 individuals with a mean age of  $33.8 \pm 11.3$  years. The means for waist circumference and body mass index at each moment, for the control group, were statistically different, with an increase in measurements. Regarding the consumption of sugary drinks, there were no statistically significant differences in the two groups.

**KEY WORDS:** Carbonated Beverages; Food and nutrition education; Fruit juice; Nutritional status; Obesity.

## CONSUMO DE BEBIDAS AÇUCARADAS E ESTADO NUTRICIONAL EM ADULTOS: UM ESTUDO DE INTERVENÇÃO

**RESUMO:** Objetivou-se avaliar mudanças no consumo de bebidas açucaradas e estado nutricional de adultos vinculados a uma instituição federal de ensino localizada em Vitória (ES), após um programa de intervenção. Foram coletadas medidas antropométricas e dados de consumo de bebidas açucaradas de todos os participantes, os quais foram randomizados e alocados em dois grupos, intervenção (ações *mHealth*) e controle. Posteriormente, foi realizada uma reavaliação. Os desfechos foram avaliados em relação aos grupos e aos momentos inicial e final com auxílio do *software* SPSS versão 21.0, adotando-se valor de  $p < 0,05$ . Foram avaliados 200 indivíduos com média de idade de  $33,8 \pm 11,3$  anos. As médias de circunferência da cintura e índice de massa corporal em cada momento do grupo controle foram estatisticamente diferentes, havendo aumento das medidas. A respeito do consumo de bebidas açucaradas, não foram observadas diferenças estatisticamente significativas em ambos os grupos.

**PALAVRAS-CHAVE:** Bebidas gaseificadas; Educação alimentar e nutricional; Estado nutricional; Obesidade; Suco de fruta.

Received in: 17/12/2019

Accepted on: 16/03/2020

## INTRODUCTION

Changes in diet, such as increased consumption of foods with a high degree of industrial processing<sup>1</sup>, constitute an important contribution to chronic noncommunicable diseases (NCDs)<sup>2</sup>. Soft drinks, fruit drinks, energy and sports drinks and bottled waters sweetened with sugar are products that fall under the term “sugary drinks”<sup>3</sup>.

Sugary drinks are considered as ultra-processed products with greater energy contribution in the diet, not only of Brazilians, but of other populations, and have high amounts of sodium and sugar<sup>1,4</sup>. Studies have shown a positive relationship between high consumption of sugary drinks and the incidence or increased risk of developing NCDs, such as type 2 diabetes, obesity and high blood pressure<sup>5,6,7</sup>.

According to the World Health Organization (WHO) (2015)<sup>8</sup>, per capita sales of ultra-processed products, which include soft drinks and artificial juices, increased 23.7% in Latin America. In Brazil, household soft drink availability in metropolitan areas increased by 500% between 1974-75 and 2002-03, remaining stable in the most recent 2008-09 survey. The consumption of these beverages in Brazil follows the trend of increasing excess weight, since the percentage of Brazilian adults with excess weight increased from 24% (1974-75) to 49% (2008-09)<sup>9</sup>. A recent study using data from the National Food Survey (NFS), in a probabilistic sample from the Family Budget Survey (2008-2009) showed that the consumption of larger portions of soft drinks was associated with being overweight<sup>10</sup>.

Popkin and Hawkes (2016)<sup>11</sup> showed that political actions, most of which are intended to reduce the intake of sugar, fat and salt, have also had an impact on the consumption of sugary drinks. According to the authors, among the most frequently implemented actions are the increase in taxes on the sale of products with a high content of these substances, reducing the availability of ultra-processed foods in schools, restrictions on marketing to children, public awareness campaigns and labeling of industrialized products.

Behavioral interventions through nutritional guidelines have also been shown to be effective in

reducing the consumption of sugary drinks in adult Americans, according to a study by Zoellner et al. (2016)<sup>12</sup>. In addition, an extension of that same clinical trial demonstrated significant changes in the quality of the diet of individuals who received the intervention<sup>13</sup>. In adolescents, interventions with the same objective were associated not only with better diet quality, but with changes in body weight<sup>14</sup>.

The WHO has encouraged online communication to support the reduction of NCDs and in the context of health promotion. The Mobile Health (mHealth) technology is based on tools such as smartphones, emails, videos and phone calls and is being used today due to its low cost, fast application and easy access<sup>15,16</sup>.

Taking into account the impact of high consumption of sugary drinks on health, the easy access for the population to acquire them<sup>4</sup>, in addition to the scarcity of intervention studies using mHealth technology with the Brazilian population, it is imperative to apply awareness strategies to reduce the intake of these products. Thus, the objective of the present project was to verify if there were any changes in the consumption of sugary drinks and in nutritional status after an intervention program using mHealth.

## METHODOLOGY

This is a longitudinal study belonging to a larger study whose objective was to assess the impact of actions to reduce sodium consumption in adults, called “Evaluation of the Impact of Actions to Reduce Sodium Consumption in Adults - *AvaliaSal*”. It has two aspects, an observational one to assess the impact of the protection measures established by the Ministry of Health, and an intervention study to assess the impact of incentive measures for reducing sodium in the usual diet<sup>17,18</sup>. Therefore, this study used the data collected in two moments to evaluate changes in the consumption of sugary drinks and in nutritional status.

This work was developed at a federal educational institution in Espírito Santo, Brazil, with students and public servants, of both sexes, in the age group from 20 to 59 years. Data collection was carried out by undergraduate

students in Nutrition at the Federal University of Espírito Santo who were previously trained for this purpose and supervised by a nutritionist.

#### POPULATION AND SAMPLE

Participants were recruited based on the Brazilian Platform Nilo Peçanha, which provides statistical data and indicators for the federal education network, with an estimate of 4,112 individuals linked to the institution in 2017. Recruitment for the research was carried out by displaying an informational banner in the courtyard of the educational institution, face-to-face invitation during busy times and through the marketing team of the educational institution, who sent e-mail to students and public servants. A media campaign was also carried out through the institution's social network (Facebook®).

The sample size was calculated according to the objectives and design of the larger study. Therefore, according to a systematic review conducted with individuals undergoing Mobile Health (mHealth) interventions, the sample ranges from 28 to 372 participants<sup>19</sup>.

The studied population comprised 200 volunteer individuals who signed the Informed Consent Form (ICF) and participated in the data collection. The disclosure and collection of baseline data took place between March, 2017 and June, 2017 at the educational institution. Pregnant women and individuals with cognitive and physical limitations that compromised data collection did not participate in the study.

#### INCLUSION CRITERIA

Public servants and students linked to a teaching institution in Espírito Santo, 20 to 59 years of age, who have complete anthropometric, sociodemographic, lifestyle and self-reported health data, and who agreed to participate in this study by signing the Free and Informed Consent Form (ICF).

#### DATA COLLECTION

After contacting potential participants electronically, those who showed interest in participating in the research were contacted by telephone to schedule data collection at the workplace/study. Upon signing the informed consent form, anthropometric, hemodynamic, health, socioeconomic, food and lifestyle data were collected from all survey participants (moment 1), which lasted 4 months (March to June, 2017). Between July and August, 2017, intervention activities were planned. From September to December, 2017, educational actions were carried out in the intervention group (the same were applied in the control group at the end of the research, from May to June, 2018). These actions consisted of sending educational messages about healthy eating via email and WhatsApp. After this period of nutritional interventions, all participants were again called for another data collection (moment 2), which took place from January to April, 2018. For this study, data were used regarding the consumption of sugary drinks and nutritional status at both times.

#### ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurements were taken at the institution, following the WHO standard protocol<sup>20</sup>. Height was measured with a CardioMed® stadiometer, with a capacity of up to 2.13 m and subdivided into millimeters. The individual was in a standing position, barefoot, looking fixedly at the horizon. Height was checked during the inspiratory period of the respiratory cycle. Body weight was measured with the participant still barefoot, wearing light clothing on a Tanita® brand portable electronic scale with a capacity of 200 kg and precision of 50 g.

Waist circumference (WC) was measured with the participant in an upright position and normal breathing, with the feet together, the upper garment part raised and the arms crossed in front of the chest. The measurement was taken with an inextensible measuring tape at the point two fingers above the umbilical scar<sup>20</sup>.

## DIETARY ASSESSMENT

At the beginning, the reduced Food Frequency Questionnaire (FFQ) was developed, based on the FFQ ELSA-Brasil<sup>21</sup>. This instrument was adapted for use in our study, as regional items such as stroganoff and chimarrão were excluded, as well as the item, butter, at the discretion of the researchers. The questionnaire was applied in order to verify habitual consumption in the 12 months preceding the interview. Food items are divided into seven groups: 1) breads, cereals and tubers; 2) fruits; 3) vegetables and legumes; 4) eggs, meat, milk and dairy products; 5) pasta and other preparations; 6) sweets and 7) drinks. At the end, part of this questionnaire was reapplied in order to investigate only the usual consumption of sugary drinks.

For this study, the analyses were done based on the three items in the drinks group of the FFQ, these being: soft drinks, industrialized juices and powdered artificial juice. As for the consumption of beverages, the participants were asked whether they consumed or not, how often and how much they consumed at a time (portion adopted equivalent to 240ml). Thus, the frequency was multiplied by the reported quantity and divided by seven in order to obtain the information in ml/day.

## SOCIOECONOMIC AND HEALTH ASSESSMENT

A structured questionnaire with 46 questions was applied, containing socioeconomic information, collected according to the Brazilian Association of Research Companies (ABEP)<sup>22</sup>, as well as health and lifestyle information.

## MOBILE HEALTH EDUCATIONAL ACTIONS

The educational actions consisted of sending electronic messages and videos to participants via mHealth. For the elaboration of messages/videos, two tools of food and nutrition education were used as the theoretical basis, which are the Food Guide<sup>23</sup> and the Food and Nutrition Education Framework for Public Policies<sup>24</sup>.

Prior to sending the messages, two meetings were held with a specialist in the area to discuss the strategies and formats for educational actions. The topics worked on were aimed at improving quality of diet by reducing the consumption of ultra-processed foods/drinks.

The messages and videos were sent to the participants weekly through the WhatsApp® application or email, according to the participant's preference. In all, 21 messages and 3 videos were sent during a 3-month intervention period (October to December, 2017).

## DATA ANALYSIS

For this study, the intention-to-treat analysis was performed, which consists of including in the analyses all individuals who are randomized, ignoring non-compliance, protocol deviations, withdrawal and/or anything that happens after randomization<sup>25</sup>. It is based on the principle that the therapeutic strategy can be evaluated according to the treatment originally planned and not on what was effectively administered<sup>26</sup>. Thus, the sample size is preserved, understanding that if non-adherent individuals and dropouts are excluded from the final analysis, this may interfere with the statistical power of the study<sup>27</sup>.

The results were presented in measures of central tendency and dispersion. The sociodemographic variables considered in this study were grouped into: age (<40 years and ≥ 40 years); schooling (primary, secondary and higher education). Race / color was declared by the participant and categorized as white and non-white (brown, black, Asian-descendant and indigenous). Self-perceived health status was classified as: Very good; Good; Regular, Bad and Very bad (the last three were grouped). The socioeconomic classification was described in class "A" (equivalent to the average monthly income of R \$ 20,800), "B" (average income of R \$ 9,254) and "C and others" (average income from R \$ 768 to R \$ 2,705)<sup>22</sup>.

From the weight and height data, BMI was calculated by dividing weight (Kg) by height (m) raised to the second power. The cutoff points recommended by the WHO for classification of nutritional status were adopted. The participants in the present study were classified as underweight (<18.5 kg / m<sup>2</sup>), eutrophy

( $\geq 18.5$  and  $< 25.0$  kg / m<sup>2</sup>), overweight ( $\geq 25.0$  and  $< 30.0$  kg / m<sup>2</sup>) and obesity ( $\geq 30.0$  kg / m<sup>2</sup>)<sup>29</sup>. The WHO cutoff points were also used to classify WC, in which the inadequate classification is  $\geq 94$ cm for men and  $\geq 80$  cm for women<sup>28</sup>. BMI and WC data were also expressed as mean  $\pm$  standard deviation (SD).

After a previous analysis of the data extracted from the FFQ regarding the sugary drinks evaluated in this study, implausible values were replaced by those corresponding to the 99th percentile of distribution of these items. Consumption was presented as means  $\pm$  SD, as well as categorized as “consume” and “not consume”.

The normality of the data was verified using the Kolmogorov-Smirnov test. The Chi-square test or Fisher's Exact test was used to compare the proportions between the groups. Student's *t* and Mann Whitney tests were used to compare the means of independent samples. Paired *t*-test and Wilcoxon test were applied to compare means of dependent samples. The data were analyzed using SPSS software version 21.0, adopting a significance value of  $p < 0.05$ . The research protocol was approved by the Research Ethics Committee (1.789.812/2016) and registered with the World Health Organization (RBR-9s6jpc).

## RESULTS

The final sample consisted of 200 participants, 90 (45.0%) men and 110 (55.0%) women, with a mean age of  $33.8 \pm 11.3$  years. Regarding sociodemographic and health characteristics, there were no differences between the allocation groups at the baseline, therefore, the socioeconomic profile, nutritional status and consumption of sugary drinks were similar at the beginning of the study (Table 1).

There was no difference when comparing the mean consumption of sugary drinks, WC and BMI of the control and intervention group at moment 1 (Table

2). At moment 2, the groups remained similar as to the analyzed variables.

When comparing the average consumption of sugary drinks, WC and BMI between the moments of each allocation group, it is observed that the average WC and BMI in the control group increased significantly (Table 3).

**Table 1.** Sociodemographic and health characteristics according to the baseline allocation group. AVALIASAL Study, Vitória (ES), 2018

Variables	Group		p-Value
	Control (n=50) n (%)	Intervention (n=50) n (%)	
<b>Age</b>			0.881
Mean ± sd	33.5 ± 11.2	34.1 ± 11.5	
< 40 years	67 (50.4)	66 (49.6)	
≥ 40 years	33 (49.3)	34 (50.7)	
<b>Sex</b>			0.776
Male	46 (51.1)	44 (48.9)	
Female	54 (49.1)	56 (50.9)	
<b>Race/Color</b>			0.479
White	45 (47.4)	50 (52.6)	
Non-white	55 (52.4)	50 (47.6)	
<b>Functional Category</b>			0.571
Student	55 (51.9)	51 (48.1)	
Public servant	45 (47.9)	49 (52.1)	
<b>Education</b>			0.326
Complete primary education	16 (64.0)	9 (36.0)	
Complete high school	39 (48.1)	42 (51.9)	
University education	45 (47.9)	49 (52.1)	
<b>Socioeconomic class</b>			0.264
A	34 (47.9)	37 (52.1)	
B	48 (47.5)	53 (52.5)	
C	18 (64.3)	10 (35.7)	
<b>Self-perceived health status</b>			0.872
Very good	26 (52.0)	24 (48.0)	
Good	51 (50.5)	50 (49.5)	
Regular, bad and very bad	23 (46.9)	26 (53.1)	
<b>Nutritional status</b>			0.452*
Underweight	4 (50.0)	4 (50.0)	
Eutrophy	45 (45.0)	55 (55.0)	
Overweight	37 (57.8)	27 (42.2)	
Obesity	14 (50.0)	14 (50.0)	
<b>Waist circumference**</b>			0.648
Adequate	70 (51.1)	67 (48.9)	
Inadequate	30 (47.6)	33 (52.4)	
<b>Consumption of sugary drinks</b>			0.157
Consume	76 (47.5)	84 (52.5)	
Not consume	24 (60.0)	16 (40.0)	

Chi-square test; \* Fisher's Exact Test; \*\* Adequacy of waist circumference (WC) using different cutoff point by sex.

**Table 2.** Average consumption of sugary drinks, waist circumference and BMI in each allocation group at the baseline and final moment. AvaliaSal Study, Vitória (ES), 2018

Variables	Moment 1		p-Value	Moment 2		p-Value
	Intervention	Control		Intervention	Control	
<b>Consumption of sugary drinks (ml/day)</b>	<i>Mean ± sd</i>	<i>Mean ± sd</i>		<i>Mean ± sd</i>	<i>Mean ± sd</i>	
Soda	149±473	126±357	0.701	132±442	151±421	0.757
Industrialized juice	64±180	46±143	0.435	68±186	62±177	0.811
Powdered artificial juice	57±206	32±154	0.333	31±140	33±171	0.898
<b>Anthropometry</b>	<i>Mean ± sd</i>	<i>Mean ± sd</i>		<i>Mean ± sd</i>	<i>Mean ± sd</i>	
WC (cm)	82±13	81±14	0.468*	83±13	82±13	0.822
BMI (kg/m <sup>2</sup> )	25±4	24±4	0.611*	25±5	25±4	0.830*

Student's *t*-test; \*Mann-Whitney test; WC=Waist circumference; BMI= Body Mass Index.

**Table 3.** Average consumption of sugary drinks, waist circumference and BMI at baseline and final moment according to allocation group. AvaliaSal Study, Vitória (ES), 2017-2018

Variables	Intervention		p-Value	Control		p-Value
	Moment 1	Moment 2		Moment 1	Moment 2	
<b>Consumption of sugary drinks (ml/day)</b>	<i>Mean ± sd</i>	<i>Mean ± sd</i>		<i>Mean ± sd</i>	<i>Mean ± sd</i>	
Soda	149±473	132±442	0.316	126±357	151±421	0.252
Industrialized juice	64±180	68±186	0.746	46±143	62±177	0.437
Powdered artificial juice	57±206	31±140	0.107	32±154	33±171	0.886
<b>Anthropometry</b>	<i>Mean ± sd</i>	<i>Mean ± sd</i>		<i>Mean ± sd</i>	<i>Mean ± sd</i>	
WC (cm)	82±13	83±13	0.241*	81±14	82±13	0.002*
BMI (kg/m <sup>2</sup> )	25±4	25±5	0.102*	24±4	25±4	0.002*

Paired *t*-test; \*Wilcoxon test; WC=Waist circumference; BMI= Body Mass Index.

No significant differences were found between the consumption of sugary drinks, by nutritional status and waist circumference, according to the time of collection and allocation group (Tables 4 and 5).

**Table 4.** Consumption of sugary drinks, by nutritional status and waist circumference of each group, according to the time of collection. AvaliaSal Study, Vitória (ES), 2017-2018

Variables	(Continua)					
	Soda (ml/day)					
	Moment 1		p-Value	Moment 2		p-Value
Intervention	Control	Intervention		Control		
<b>Nutritional status</b>						
Eutrophy	213±618	86±210	0.141	171±574	94±209	0.340
Overweight	87±260	184±496	0.233	94±261	233±604	0.143
<b>Waist circumference</b>						
Adequate	161±524	121±395	0.618	133±485	142±437	0.910
Inadequate	121±330	136±272	0.842	129±330	169±393	0.669
	Industrialized juice (ml/day)					
<b>Nutritional status</b>						
Eutrophy	71±188	47±102	0.408	85±243	87±223	0.973
Overweight	56±174	43±188	0.726	51±108	26±56	0.175

Variables	Industrialized juice (ml/day)					
	Moment 1		p-Value	Moment 2		p-Value
	Intervention	Control		Intervention	Control	
<b>Waist circumference</b>						
Adequate	70±210	60±169	0.750	74±211	81±211	0.850
Inadequate	48±76	16±52	0.060	53±108	22±53	0.155
	Powdered artificial juice (ml/day)					
<b>Nutritional status</b>						
Eutrophy	85±279	13±51	0.056	47±190	23±156	0.471
Overweight	30±91	59±232	0.425	15±63	49±191	0.236
<b>Waist circumference</b>						
Adequate	71±239	31±180	0.268	39±165	36±205	0.933
Inadequate	24±88	35±83	0.627	11±44	28±62	0.231

Data were presented as mean ± SD.

**Table 5.** Consumption of sugary drinks, by nutritional status and waist circumference for each moment, according to allocation group. AvaliaSal Study, Vitória (ES), 2017-2018

Variables	Soda (ml/day)					
	Intervention		p-Value	Control		p-Value
	Moment 1	Moment 2		Moment 1	Moment 2	
<b>Nutritional status</b>						
Eutrophy	213±618	171±574	0.196	86±210	94±209	0.604
Overweight	87±250	94±261	0.547	184±496	233±604	0.311
<b>Waist circumference</b>						
Adequate	161±524	133±485	0.225	121±395	142±437	0.214
Inadequate	121±330	129±330	0.688	136±272	169±393	0.567
	Industrialized juice (ml/day)					
<b>Nutritional status</b>						
Eutrophy	71±188	85±242	0.510	47±102	87±223	0.169
Overweight	56±174	51±108	0.753	43±188	26±56	0.563
<b>Waist circumference</b>						
Adequate	70±210	74±211	0.833	60±169	81±211	0.493
Inadequate	48±76	53±108	0.668	16±52	22±53	0.556
	Powdered artificial juice (ml/day)					
<b>Nutritional status</b>						
Eutrophy	85±279	47±190	0.225	13±51	23±156	0.589
Overweight	30±91	15±63	0.193	59±232	49±191	0.203
<b>Waist circumference</b>						
Adequate	71±239	39±165	0.148	31±180	36±205	0.713
Inadequate	24±88	11±44	0.465	35±83	28±62	0.236

Data were presented as mean ± SD.

## DISCUSSION

The means of WC and BMI at each moment, in the control group, were statistically different, observing an increase in measurements after the intervention. Regarding the consumption of sugary drinks, there were no statistically significant differences in the two groups.

Changes in anthropometric parameters after a nutritional intervention program have been shown in other studies with adults. Systematic review and meta-analysis of 11 studies (adults ages 18 to 65) showed that health interventions using digital tools were effective in short-term weight loss in overweight or obese individuals<sup>29</sup>. While an investigation by Bello et al. (2019)<sup>30</sup> with HIV-infected adults from Nigeria found a significant improvement in quality of life, but not in the weight of participants after a 12-week intervention. It is observed that studies involving this theme are often performed on individuals with some pre-existing disease, making it difficult to compare the results.

In Brazil, studies of nutritional intervention with adults are also mostly performed on those with some pre-established pathology or on specific population groups<sup>31,32</sup>. However, studies are also carried out involving healthy and unhealthy individuals, which often have a small sample size. As an example, the study by Castro-Almeida et al. (2018)<sup>33</sup>, evaluating 35 individuals attended at the Nutritional Care Center of the State University of Minas Gerais, showed significant improvement in abdominal circumference and percentage of body fat of the participants after nutritional intervention.

It is noteworthy that our findings showed an increase in some anthropometric measurements in the group that did not receive nutritional guidelines. Bernardes and Marín-Léon (2018)<sup>32</sup>, in a study with obese women, identified an increase in the BMI of those in the control group, while those who received the nutritional intervention (1 meeting / month for 7 months) had a significant reduction in weight and BMI. Thus, it is believed that greater knowledge about food and nutrition helps not only in reducing anthropometric measures but also prevents worsening of nutritional status.

Changes in eating behavior involve more than just knowledge about the relationship between nutrition,

health and food. Thus there is a need for greater opportunities to incorporate such changes into one's lifestyle, factors that may explain the difficulty of finding investigations with adults in which the reduced consumption of sugary drinks is statistically significant<sup>34</sup>.

As previously described, no statistical difference was found between the groups regarding the consumption of sugary drinks in the present study. We believe that this result is due to the various aspects of healthy eating addressed in the interventions, not being limited only to the consumption of beverages and their health consequences. Thus, the intervention time may have been insufficient for the participants to adopt a new stage of motivation for changes<sup>35</sup>. Additionally, they were educational messages sent by email and WhatsApp, not guaranteeing that the individual had read the messages in full. Thus, other strategies must be verified in epidemiological studies, such as long-term face-to-face meetings, for example. There is little evidence to prove the effectiveness of mHealth actions related to food and nutritional status. Systematic reviews and meta-analyses show that most studies using this strategy focus on treatment and adherence to drug therapies<sup>19,36</sup>.

There is evidence of the impact of nutritional interventions not only to reduce the consumption of sugary drinks, but to improve quality of diet and anthropometric parameters<sup>13,14</sup>. However, much has been discussed about the importance of public health actions in addition to these interventions, in order to make their reach more comprehensive and effective<sup>11,37</sup>. It is known that the environment is a conditioning factor in food choices, but not only that, price and advertising also contribute considerably. Therefore, having actions that regulate and promote a healthy environment and limit access to purchase is extremely important<sup>38,39</sup>.

As limitations of the present study, the sample size that is not representative of the population is pointed out, and thus, the findings cannot be extrapolated to the general population<sup>40</sup>. Another important limitation is the instrument used (FFQ) to assess food consumption, since underestimation/overestimation can occur. This may be related to the possibility of memory errors, inaccurate estimate of portion sizes and frequency of consumption<sup>40</sup>. As a way of mitigating the effects of the

limitations indicated, priority was given to standardizing consolidated routines and procedures for conducting the interview and measuring anthropometric measures, thus ensuring their quality.

Studies of nutritional interventions on the consumption of sugary drinks are still scarce in adult populations, both nationally and internationally. According to a systematic review and meta-analysis by Vargas-Garcia et al. (2017)<sup>37</sup>, no significant results were found in this population group. In addition, it is understood that these studies are carried out more frequently in children and adolescents, and are shown to be more effective<sup>37,41,42</sup>. This type of health intervention is recent and, therefore, it is understood that the findings of the present work can contribute to broaden the discussions involving this topic so pertinent today.

## CONCLUSION

We emphasize that no statistically significant differences were found regarding the consumption of sugary drinks and nutritional status between the intervention and control groups. However, the control group showed an increase in WC and BMI between moments 1 and 2 (statistically significant).

The use of the strategy is feasible and important for public health, but its effectiveness needs to be tested in other epidemiological studies. It is understood that it is necessary to combine the application of incentive measures to reduce the consumption of these products with the implementation of public policies in order to increase the impact of these actions, thus promoting health and disease prevention.

## REFERENCES

1. Martins APB, Levy RB, Claro RM, Moubarac JC, & Monteiro CA. Participação crescente de produtos ultraprocessados na dieta brasileira (1987-2009). *Revista de Saúde Pública*. 2013; 47(4):656–65.
2. Monteiro CA, Cannon G. The impact of transnational “big food” companies on the South: a view from Brazil. *PLoS Med*. 2012; 9(7):e1001252.
3. US National Cancer Institute. Sources of Beverage Intakes Among the US Population, 2005–2006, 2014. Disponível em: <https://epi.grants.cancer.gov/diet/foodsources/beverages/>. Acesso em: 28 abr. 2017.
4. An R, Maurer G. Consumption of sugar-sweetened beverages and discretionary foods among US adults by purchase location. *European Journal of Clinical Nutrition*. 2016: 1–5.
5. Imamura F, O'Connor I, Ye Z, Mursu J, Hayashino Y, Hupathiraju SN, Forouhi NG. Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: systematic review, meta-analysis, and estimation of population attributable fraction. *The British Medical Journal*. 2015; 50(8): 496-504.
6. Ma J, Jacques PF, Meigs JB, Fox CS, Rogers GT, Smith CE, Hruby A, Saltzman E, Mckeown NM. Sugar-Sweetened Beverage but Not Diet Soda Consumption Is Positively Associated with Progression of Insulin Resistance and. *The Journal of Nutrition*. 2016; 146(12): 2544-2550.
7. Velasquez-Meléndez JG, Molina MCB. Sweetened Soft Drinks Consumption Is Associated with Metabolic Syndrome: Cross-sectional Analysis from the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *Journal of the American College of Nutrition*. 2016; 36:1-9.
8. WHO. World Health Organization. Ultra-processed food and drink products in Latin America: Trends, impact on obesity, policy implications: Washington: World Health Organization, 2015. Disponível em: [http://iris.paho.org/xmlui/bitstream/handle/123456789/7699/9789275118641\\_eng.pdf?se](http://iris.paho.org/xmlui/bitstream/handle/123456789/7699/9789275118641_eng.pdf?se)

- quence=5&isAllowed=y&ua=1&ua=1. Acesso em: 28 abr. 2017.
9. Brasil. Ministério do Planejamento, Orçamento e Gestão, Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008–2009 - Antropometria e estado nutricional de crianças, adolescentes e adultos no Brasil. Rio de Janeiro; 2010. Disponível em: <https://biblioteca.ibge.gov.br/visualizacao/livros/liv45419.pdf>. Acesso em: 28 abr. 2017.
  10. Bezerra IN, de Alencar ES. Associação entre excesso de peso e tamanho das porções de bebidas consumidas no Brasil. *Revista de Saúde Pública* 2018; 52(21):1-11.
  11. Popkin BM & Hawkes C. Sweetening of the global diet, particularly beverages: patterns, trends, and policy responses. *The Lancet Diabetes & Endocrinology*. 2016; 4(2): 174-186.
  12. Zoellner JM, Hedrick VE, You W, Chen Y, Davy BM, Porter KJ et al. Effects of a behavioral and health literacy intervention to reduce sugar-sweetened beverages: a randomized-controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*. 2016; 13(1): 38.
  13. Hedrick VE, Davy BM, You W, Porter KJ, Estabrooks PA, Zoellner JM. Dietary quality changes in response to a sugar-sweetened beverage–reduction intervention: results from the Talking Health randomized controlled clinical trial. *The American Journal of Clinical Nutrition*. 2017;105(4):824-833.
  14. Ebbeling CB, Feldman HA, Chomitz VR, Antonelli TA, Gortmaker SI, Osganian SK, Ludwig DS. A Randomized Trial of Sugar-Sweetened Beverages and Adolescent Body Weight. *The New England Journal of Medicine*. 2012; 367(15): 1407–1416.
  15. Cole-Lewis H, Kershaw T. Text Messaging as a Tool for Behavior Change in Disease Prevention and Management. *Epidemiol Rev*. 2010; 32(1):56-69.
  16. WHO. World Health Organization. *mHealth New horizons for health through mobile Technologies*. Geneva: World Health Organization; 2011. Disponível em: [https://www.who.int/goe/publications/goe\\_mhealth\\_web.pdf?](https://www.who.int/goe/publications/goe_mhealth_web.pdf?). Acesso em: 28 abr. 2017.
  17. Buss PM. Promoção e educação em saúde no âmbito da Escola de Governo em Saúde da Escola Nacional de Saúde Pública. *Cad. Saúde Pública*. 1999; 15(Suppl 2): S177-S185.
  18. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Política Nacional de Alimentação e Nutrição / Ministério da Saúde, Secretaria de Atenção à Saúde. Departamento de Atenção Básica, 1. ed., 1. reimpr. – Brasília: Ministério da Saúde, 2013. Disponível em: [https://bvsms.saude.gov.br/bvs/publicacoes/politica\\_nacional\\_alimentacao\\_nutricao.pdf](https://bvsms.saude.gov.br/bvs/publicacoes/politica_nacional_alimentacao_nutricao.pdf). Acesso em: 10 Jul. 2018.
  19. Lee J, Choi M, Lee SA, Jiang N. Effective behavioral intervention strategies using mobile health applications for chronic disease management: a systematic review. *BMC Med Inform Decis Mak*. 2018;18(1):12.
  20. WHO. World Health Organization. Use and interpretation of anthropometry. Technical report series 854. Geneva: World Health Organization, 1995. Disponível em: [http://www.who.int/childgrowth/publications/physical\\_status/en/](http://www.who.int/childgrowth/publications/physical_status/en/). Acesso em: 10 jul. 2018.
  21. Mannato LW, Pereira TSS, Velasquez-Melendez G, Cardoso LDO, Benseñor IM, & Molina MDCB. Comparison of a short version of the Food Frequency Questionnaire with its long version—a cross-sectional analysis in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *Sao Paulo Medical Journal*. 2015; 133(5): 414-420.
  22. Associação Brasileira de Empresas de Pesquisa. (2016). Critérios de Classificação Econômica no Brasil. Disponível em: <http://www.abep.org/Servicos/Download.aspx?id=09/>. Acesso em: 28 abr. 2017.
  23. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Guia alimentar para a população brasileira. Brasília: Ministério da Saúde, 2014. Disponível em: [https://bvsms.saude.gov.br/bvs/publicacoes/guia\\_alimentar\\_populacao\\_brasileira\\_2ed.pdf](https://bvsms.saude.gov.br/bvs/publicacoes/guia_alimentar_populacao_brasileira_2ed.pdf). Acesso em: 28 abr. 2017.

24. Brasil. Ministério do Desenvolvimento Social e Combate à Fome. Marco de referência de educação alimentar e nutricional para as políticas públicas. Brasília, DF: MDS; Secretaria Nacional de Segurança Alimentar e Nutricional, 2012. Disponível em: [http://www.mds.gov.br/webarquivos/publicacao/seguranca\\_alimentar/marco\\_EAN.pdf](http://www.mds.gov.br/webarquivos/publicacao/seguranca_alimentar/marco_EAN.pdf). Acesso em: 28 abr. 2017.
25. Gupta, S. K. Intention-to-treat concept: a review. *Perspectives in clinical research*. 2011; 2(3): 109.
26. Heritier SR, Gebski VJ, Keech AC. Inclusion of patients in clinical trial analysis: The intention-to-treat principle. *Med J Aust*. 2003; 179:438–40
27. Wertz RT. Intention to treat: Once randomized, always analyzed. *Clin Aphasiol*. 1995; 23:57–64
28. WHO. World Health Organization. Obesity: Preventing and managing the global epidemic: report of a WHO consultation. Geneva: World Health Organization, 2000. Disponível em: [http://www.who.int/whr/2000/en/whr00\\_en.pdf](http://www.who.int/whr/2000/en/whr00_en.pdf). Acesso em: 10 jul. 2018.
29. Beleigoli AM, Andrade AQ, Cançado AG, Paulo MN, Maria De Fátima HD, Ribeiro AL. Web-based digital health interventions for weight loss and lifestyle habit changes in overweight and obese adults: systematic review and meta-analysis. *Journal of medical Internet research*. 2019; 21(1): e298.
30. Bello TK, Gericke GJ, MacIntyre UE, Becker P. A nutrition education programme improves quality of life but not anthropometric status of adults living with HIV in Abeokuta, Nigeria. *Public Health Nutrition*. 2019; 22(12):1–13.
31. Nascimento M, Silva D, Ribeiro S, Nunes M, Almeida M, Mendes-Netto R. Effect of a nutritional intervention in athlete's body composition, eating behaviour and nutritional knowledge: A comparison between adults and adolescents. *Nutrients*. 2016; 8(9):535.
32. Bernardes MS & Marín-Léon L. Group-based food and nutritional education for the treatment of obesity in adult women using the family health strategy/ Educação alimentar e nutricional em grupo para o tratamento do excesso de peso em mulheres adultas na estratégia de saúde da família. *Revista de Nutrição*. 2018; 31(1):59-70.
33. de Castro Almeida J, de Mendonca AAF, Batista LM. Nutritional intervention through culinary workshops and educational lectures: application and influence in nutritional status of adults/Intervenção nutricional através de oficinas culinárias e palestras educativas: aplicação e influência no estado nutricional de adultos. *Revista Brasileira de Obesidade, Nutrição e Emagrecimento*. 2018;12(69): 126-132.
34. Kaufer-Horwitz M, Villa M, Pedraza J, Domínguez-García J, Vázquez-Velázquez V, Méndez JP, García-García E. Knowledge of appropriate foods and beverages needed for weight loss and diet of patients in an Obesity Clinic. *European Journal of Clinical Nutrition*. 2015; 69(1): 68-72.
35. Vet ED, Nooijer, J, Vries NK, Brug J. The Transtheoretical model for fruit, vegetable and fish consumption: associations between intakes, stages of change and stage transition determinants. *International Journal of Behavioral Nutrition and Physical Activity*. 2006; 19(3):13.
36. Free C, Phillips G, Watson L, Galli L, Felix L, Edwards P, et al. The effectiveness of mobile-health technologies to improve health care service delivery processes: a systematic review and meta-analysis. *PLoS Med*. 2013; 10: e1001363.
37. Vargas-Garcia EJ, Evans CEL, Prestwich A, Sykes-musket BJ, Hooson J, Cade JE. Interventions to reduce consumption of sugar-sweetened beverages or increase water intake: evidence from a systematic review and meta-analysis. *Obesity Reviews*. 2017; 18(11): 1350-1363.
38. Louzada MLC. Nutrição e saúde: O papel do ultra-processamento de alimentos. [tese]. São Paulo: Faculdade de Saúde Pública da USP, 2015.
39. Claro RM, Maia EG, Costa BVL, Diniz DP. Preço dos alimentos no Brasil: prefira preparações culinárias a alimentos processados. *Cadernos de Saúde Pública*. 2016; 32(8):1-13.

40. Fisberg RM, Martini LA, Slater B. Inquéritos Alimentares: Métodos e bases científicas. São Paulo: Editora Manole, p. 1-29, 2005.
41. de Moraes MM, Mediano MFF, de Souza RAG, Moura AS, da Veiga GV et al. Discouraging soft drink consumption reduces blood glucose and cholesterol of Brazilian elementary students: Secondary analysis of a randomized controlled trial. Preventive medicine. 2017; 100: 223-8.
42. Abdel-Rahman A, Jomaa L, Kahale LA, Adair P, Pine C. Effectiveness of behavioral interventions to reduce the intake of sugar-sweetened beverages in children and adolescents: a systematic review and meta-analysis. Nutrition reviews. 2018; 76(2): 88-107.