DOI: 10.1590/1413-81232020254.12912018

Consumption of sugar-sweetened beverages in patients with established atherosclerosis disease

Bruna Luiza Paulina Ribas (https://orcid.org/0000-0003-4503-0441) [1]
Aline Longo (https://orcid.org/0000-0002-6600-8975) [1]
Fernanda Vighi Dobke (https://orcid.org/0000-0001-8698-1628) [1]
Bernardete Weber (https://orcid.org/0000-0003-1912-652X) [2]
Eduardo Gehling Bertoldi (https://orcid.org/0000-0001-7290-0348) [3]
Lúcia Rota Borges (https://orcid.org/0000-0001-8978-4048) [4]
Renata Torres Abib (https://orcid.org/0000-0003-4793-0566) [4]

Abstract *This study investigated the association between consumption of sugar-sweetened beverages and anthropometric and biochemical variables in a cross-sectional study conducted with secondary data from the first visit of the randomized clinical trial of the Brazilian Cardioprotective Nutritional Program (BALANCE Program) (2013-2014). Weight, height, waist circumference, lipid profile and fasting glycemia and a 24-hour diet recall were collected. Differences between consumption and non-consumption of sugar-sweetened beverages were evaluated by Student's t-test. The Chi-square test was employed to analyze the association between consumption and non-consumption of sugar-sweetened beverages and biochemical and anthropometric factors. The sample consisted of 2,172 individuals, mostly men (58.5%), elderly (63.6%), C-rated economic class (57.3%), and overweight (62.7%). A statistically significant difference was found between the consumption of sugar-sweetened beverages and higher BMI values (p=0.029), waist circumference (p=0.004) and triglycerides (p=0.023). These results emphasize the need for nutritional intervention regarding the consumption of sugar-sweetened beverages as part of the dietary treatment of this population.*

Key words *Cardiovascular diseases, Body mass index, Waist circumference*

[1] Programa de Pós-Graduação em Nutrição e Alimentos, Universidade Federal de Pelotas. R. Gomes Carneiro 1, Centro. 96010-610 Pelotas RS Brasil. bruna.luiza.ribas89@gmail.com
[2] Instituo de Pesquisa Hospital do Coração. São Paulo SP Brasil.
[3] Departamento de Medicina, Universidade Federal de Pelotas. Pelotas RS Brasil.
[4] Departamento de Nutrição, Universidade Federal de Pelotas. Pelotas RS Brasil.

Introduction

Data published by the World Health Organization (WHO) show that cardiovascular diseases (CVD) are the leading cause of death in the world[1]. Identifying and treating modifiable risk factors such as inadequate diet is crucial in preventing mortality from these pathologies[1,2].

Scientific evidence on high sugar consumption in the form of sugar-sweetened beverages, such as soft drinks, juices and processed teas, has been associated with a calorie-rich, unhealthy diet, favoring the occurrence of overweight, high triglyceride (TG) levels, low-density lipoprotein (LDL), hyperglycemia, systemic arterial hypertension (SAH), increased diastolic blood pressure (DBP), visceral adiposity, insulin resistance (IR), metabolic syndrome and CVD[3-9]. For a healthy and balanced diet, the consumption of free sugars should not exceed 10% of the daily caloric value[2].

According to the latest National Survey of Household Budgets, conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 2008/2009, approximately 20% of Brazilians consume soft drinks and almost 40% processed juices, which is of concern, because they provide many calories and no specific nutrient[10]. In a recent publication by the Ministry of Health, the percentage of Brazilians who consume sugar-sweetened drinks regularly is around 16% and over half of the population is overweight[11].

The analysis of the intake of sugar-sweetened beverages in heart disease patients is relevant since studies have found a positive association between sugar consumption and an increased risk of CVD mortality[6,7,9]. Given the above, this study aimed to investigate the association between the consumption of sugar-sweetened beverages and anthropometric and biochemical variables in patients with manifest atherosclerosis, participating in the Brazilian Cardioprotective Diet (DICA BR) Project.

Methods

This is a cross-sectional study based on the Brazilian Cardioprotective Diet (DICA BR) project, a randomized, multicenter national trial conducted by the Heart Hospital (HCor) in partnership with the Unified Health System (SUS) (PROADI-SUS) of the Ministry of Health, which aims to reduce risk factors and cardiovascular events as a secondary prevention of these pathologies[12,13]. Secondary data collected at the first visit of all study participants in the 2013-2014 period were used in this study. The Research Ethics Committee of the Heart Hospital of São Paulo (SP) approved the research and all patients signed the Informed Consent Form (ICF) before inclusion.

The inclusion criteria of the DICA BR project were: age 45 years or older with evidence of manifest atherosclerosis (coronary artery disease, cerebrovascular disease or peripheral arterial disease) in the last ten years. Individuals with any of the following characteristics were excluded: psychiatric or neurocognitive condition that hindered the collection of reliable clinical data; life expectancy of less than six months; pregnancy or breastfeeding; hepatic failure with previous history of encephalopathy or anasarca; renal failure with indication of dialysis; congestive heart failure; previous organ transplantation; gastroplasty; be wheelchair-bound or who have difficulty feeding themselves orally.

The data obtained for this study were gender, age, weight, height, body mass index, waist circumference, schooling, socioeconomic data, physical activity, use of medications (antithrombotics, antihypertensives, antilipidemics and hypoglycemic agents), lipid and glycemic profile, besides the intake of sugar-sweetened drinks.

Body weight (kilograms) was obtained with a mechanical or digital platform scale (as per availability of each center) with a minimum precision of 100g, with suggested Filizola® PL200 and Plenna® brands. Height (meters) was measured using an anthropometric stadiometer coupled with a fixed, handheld tape-like stadiometer, with a precision of 0.50cm. The BMI was calculated by dividing the weight (kg) by height squared (m^2). Then, the nutritional status of the sample was classified according to WHO recommendations for adults (underweight, BMI < 18.49 kg/m², eutrophy, BMI 18.50-24.99 kg/m², overweight, BMI ≥ 25.00 kg/m²)[14]. The criteria for the classification of the nutritional status of the Pan American Health Organization (underweight, BMI < 23 kg/m², eutrophy, BMI 23.00-27.99 kg/m², overweight, BMI ≥ 28.00 kg/m²)[15] were used for elderly patients (aged 60 years or over).

Waist circumference (WC) was measured with an inelastic and flexible resistant tape with a precision of 0.1cm, at the midpoint between the lower border of the costal arch and the iliac crest, and classified according to WHO (2008), at risk of increased metabolic complications when WC ≥ 94cm for men and WC ≥ 80cm in women; substantially increasing risk WC ≥ 102cm for men and WC ≥ 88cm for women[16].

Schooling was classified as illiterate (no formal education), self-reported complete or incomplete primary school, complete or incomplete secondary school, and complete or incomplete higher education. The socioeconomic profile was classified as proposed by the Brazilian Association of Research Companies (ABEP) in five classes, ranging from higher purchasing power (A) to lower purchasing power (E)[17].

Concerning physical activity, the criteria provided by the National Academy of Sciences (NAS) of the Institute of Medicine (IOM), called Dietary Recommended Intakes (DRIs) were used to classify the activity level into four categories: sedentary, mild activity, moderate activity and intense activity[18].

The values of total cholesterol (TC), high-density lipoprotein (HDL), low- density lipoprotein (LDL) and triglycerides were analyzed for lipid profile evaluation. The glycemic profile was evaluated by fasting glycemia. All patients were instructed to perform a minimum 12-hour and a maximum 14-hour fasting, to avoid the consumption of alcoholic beverages in the last 72 hours and not to perform physical effort before collection.

The consumption of sugar-sweetened drinks was evaluated by the 24-hour recall (R24H), applied by previously trained nutritionists, based on the day before the visit. Sugar-sweetened drinks referred to soft drinks, ready-to-drink, powder-diluted or processed juices and teas. Information collection was supported by a photographic album with food and their respective home-based measurements[19]. Reminders were entered and analyzed in Nutriquanti®[20] diet analysis software.

The data were entered in Excel and the statistical analyses were performed in the GraphPad® Prism 5 program. Data normality was verified by the Kolmogorov-Smirnov test. Continuous numerical variables were expressed as means ± standard deviation, and categorical variables in absolute number and relative frequency. The differences between consumption and non-consumption of sugar-sweetened drinks were evaluated through the Student's t-test. The chi-square test was used to analyze the association between consumption and non-consumption of sugar-sweetened drinks and biochemical and anthropometric factors. The significance level used was 5%.

Results

The DICA BR study included 2,468 patients in the study. However, in this study, 296 were excluded because they had incomplete data regarding non-completion of the R24H and no biochemical or anthropometric data, leaving out 2,172 patients. The sample had a mean age of 63.1 ± 8.9 years, a BMI of 29.0 ± 5.0 kg/m², and WC was 101.0 ± 11.4cm for men and 97.8 ± 13, 4cm for women.

Table 1 shows the characteristics of the sample, according to the consumption or non-consumption of sugar-sweetened drinks. Most were men (58.5%), elderly (63.6%), "C" economic level (57.3%), studied until primary school (45.8%), were overweight (62.7%), sedentary (65.8%) and used antithrombotics, antihypertensives and antilipidemics. Significant differences were observed between gender (p = 0.029), economic level (p = 0.001), schooling (p = 0.004) and nutritional status (p = 0.014) among individuals consuming sugar-sweetened drinks.

Of the 2,172 patients in the study, only 28.3%, that is, 383 men and 233 women consumed sugar-sweetened drinks. The mean consumption among those who ingested these beverages was 360.3±268.0ml/day for men and 273.4±198.5ml/day for women.

The sweetened beverages consumed by men were soft drinks (51.7%), artificial powder juice (30.0%), ready-to-drink artificial juice (17.8%) and tea (0.5%). Women consumed soft drinks (43.4%), artificial powder juice (29.6%), ready-to-drink artificial juice (26.6%) and tea (0.4%).

Regarding the association between the consumption of sugar-sweetened drinks and anthropometric and biochemical variables, the results showed a statistically significant difference between the intake of sugar-sweetened drinks and higher values of BMI (p = 0.029), WC (p = 0.004) and TG (p = 0.023). No significant differences were observed for TC (p = 0.137), LDL (p = 0.277), HDL (p = 0.132) and fasting glycaemia (p = 0.147) between consumption and non-consumption of these beverages (Table 2).

Discussion

This study evaluated the association between the consumption of sugar-sweetened drinks and BMI, WC, lipid and glycemic profile. It is known that sugar-sweetened drinks contain high caloric concentration, favoring weight gain and their in-

Table 1. Characterization of the sample of patients with manifest atherosclerosis participating in the DICA BR at the initial visit, 2017, Brazil (n = 2,172).

Variables	n (%)	Sugar-sweetened beverages n (%)		*p
		Yes	No	
Gender				
Men	1,271 (58.5)	383 (17.6)	888 (40.9)	0.029*
Women	901 (41.5)	233 (10.7)	668 (30.8)	
Age				
Adults (<60 years)	790 (36.4)	232 (37.7)	558 (35.9)	0.432
Elderly (≥ 60 years)	1,382 (63.6)	384 (62.3)	998 (64.1)	
Economic class[1], n=1,889				
A/B	555 (29.4)	187 (34.9)	368 (27.2)	0.001*
C	1,083 (57.3)	292 (54.6)	791 (58.4)	
D/E	251 (13.3)	56 (10.5)	195 (14.4)	
Schooling, n=1,892				
Illiterate	535 (28.3)	123 (22.9)	412 (30.4)	0.004*
Primary school	866 (45.8)	262 (48.9)	604 (44.5)	
Secondary school	342 (18.0)	98 (18.3)	244 (18.0)	
Higher education	149 (7.9)	53 (9.9)	96 (7.1)	
Nutritional status*				
Underweight	134 (6.2)	30 (4.9)	104 (6.7)	0.014*
Eutrophy	676 (31.1)	171 (27.7)	505 (32.4)	
Overweight	1,362 (62.7)	415 (67.4)	947 (60.9)	
Physical activity[2], n=2,137				
Sedentary	1,406 (65.8)	403 (66.0)	1003 (65.7)	0.919
Active	731 (34.2)	208 (34.0)	523 (34.3)	
Medication Antithrombotics				
Yes	1,971 (90.7)	558 (90.6)	1,413 (90.8)	0.870
No	201 (9.3)	58 (9.4)	143 (9.2)	
Antihypertensives				
Yes	2,071 (95.3)	587 (95.3)	1,484 (95.4)	0.936
No	101 (4.7)	29 (4.7)	72 (4.6)	
Antilipidemics				
Yes	1,873 (86.2)	544 (88.3)	1,329 (85.4)	0.077
No	299 (13.8)	72 (11.7)	227 (14.6)	
Antidiabetics				
Yes	882 (40.6)	249 (40.4)	633 (40.7)	0.912
No	1,290 (59.4)	367 (59.6)	923 (59.3)	

* Chi-square test $p < 0.05$. [1] WHO Criteria, 1995 for adults and PAHO, 2002 for the elderly; [2] As proposed by the National Academy of Sciences (NAS), Institute of Medicine (IOM), 2002.

take in liquid form favors the quick absorption of these calories without providing satiety[3,5].

As observed in a previous study[21], the higher the schooling the lower the consumption of sugar-sweetened drinks, evidencing the role of education in the choice of healthy eating and eating behavior. The results found regarding the association of sugar-sweetened drinks consumption and nutritional status in this study corroborate the previous findings[22-25], which suggested that frequent consumption of sugar-sweetened drinks has been related to the increased risk of weight gain and obesity due to the large quantity of added sugar, which, when consumed in the liquid form, causes less satiety. This study identified a lower consumption of sugar-sweetened beverages among women, which may be justified by their greater concern about health and the adoption of healthy eating habits.

Sugar-sweetened beverages increase the CVD risk factors not only because of weight gain, but also because of the effect of sugar added in these beverages on the metabolism of insulin resistance (IR) and inflammation[3]. The high consumption of these sugar-rich beverages has been associated with increased appetite due to the occurrence of

Table 2. Comparison of anthropometric, biochemical and dietary variables in the initial visit of the patients of DICA BR consumers and non-consumers of sugar-sweetened beverages, Brazil, 2017 (n = 2,172).

Variables	Consumers (> 0 g/d)		Non-consumers		p*
	Mean	SD	Mean	SD	
BMI**	29.3	4.9	28.9	4.9	0.029*
Waist circumference	100.8	11.9	99.2	12.5	0.004*
Total Cholesterol	171.1	43.6	168.9	44.9	0.137
LDL***	96.0	37.4	94.9	38.9	0.277
HDL****	42.5	11.7	43.3	12.7	0.132
Triglycerides	168.6	116.4	153.5	80.2	0.023*
Fasting glycaemia	119.1	49.3	116.6	46.3	0.147

* Student's t-test $p < 0.05$; ** BMI: Body Mass Index; ***LDL: Low-Density Lipoproteins; **** HDL: High-Density Lipoproteins; SD: Standard Deviation.

glucose and blood pressure peaks, and this postprandial insulin response may lead to insulin resistance[26]. Furthermore, it can promote the hepatic lipogenesis again, increase the levels of very low-density lipoprotein (VLDL), TG, favoring overweight and visceral adiposity[3,6]. These metabolic changes contribute to the atherosclerosis process, which is the pathophysiological basis for most CVDs[3].

Overweight in the Brazilian population has increased over the last decade, from 42.6% in 2006 to 53.8% in 2016[11]. This is a very worrying fact given the overweight risk on the entire population concerning CVD[27]. In this study, more than 60% of the patients were overweight and those who consumed sugar-sweetened beverages showed significantly higher BMI when compared to those who did not consume ($p = 0.029$). These results corroborate the findings of Larsson et al.[22], in a study that used data from two Swedish cohorts with 68,459 men and women with no history of CVD, diabetes and cancer, and found that those individuals who consumed sugar-sweetened drinks were significantly more overweight[22].

Regarding WC, the data showed high values in this measure in both genders and a significant association between the consumption of sugar-sweetened drinks and fat accumulation in the abdominal region ($p = 0.004$). Duffey et al.[23] analyzed data from 2,774 healthy adults participating in a cohort study in the U.S. that aimed to evaluate the consumption of fruit juice and sugar-sweetened drinks and its association with cardiometabolic risk factors, and showed that patients with higher consumption of sugar-sweetened beverages had significantly higher WC[23], which reinforces the results found in this study.

Regarding the lipid profile, patients who consumed sugar-sweetened beverages had significantly higher values of triglycerides ($p = 0.023$), but no association was found with total cholesterol, LDL and HDL. It is important to emphasize that the patients evaluated were under drug treatment, and most (86.2%) used antilipidemics, which may have masked the results of this study. An intervention study that sought to investigate the dose-response effect of sugar-sweetened beverage consumption providing 10%, 17.5% or 25% of the energy requirement during two weeks, under the change in the lipid profile of 85 healthy adults, evidenced increased postprandial triglyceride concentrations and also in fasting LDL in the three doses when compared with 0%[6]. Similarly, Ferreira-Pêgo et al.[24] evaluated the consumption of sugar-sweetened beverages in 1,868 participants in the Mediterranean Diet Prevention (PREDIMED) study of individuals with high cardiovascular risk, and showed that those who consumed sugar-sweetened beverages had higher values of triglycerides at the onset of the study[24].

No significant differences were found for fasting glycemia and consumption of sugar-sweetened beverages, a result that may have been influenced by the treatment received by the patients, in which 40% were using oral hypoglycemics or insulin. A cross-sectional analysis of 2,596 adults with data from two cohorts who sought to identify CVD risk factors (Framingham Heart Study Offspring and Third Generation) also found no significant differences for fasting glycemia and consumption of sugar-sweetened drinks[25].

Some limitations of the study are worth considering, such as cross-sectional analysis, which does not provide evidence on the causality of the

effect of sugary drinks consumption. Also, the use of R24H to assess dietary intake, even when applied by trained researchers, carries the bias inherent to the method, which may underestimate the actual portions and fail to estimate the usual diet of the patients.

The absence of some of the proposed associations, such as the association between the biochemical variables and the consumption of sugar-sweetened drinks, can be attributed to the fact that the sample consists of individuals undergoing drug treatment and may be considered an additional limitation. However, because it is a population of patients with manifest atherosclerotic disease, the use of drugs for secondary prevention is an indispensable part of the treatment.

The consumption of sugar-sweetened beverages was associated with higher BMI, WC and triglyceride values in Brazilian patients with manifest atherosclerosis. These results reinforce the need for nutritional intervention regarding the consumption of sugar-sweetened drinks as part of the dietary treatment of this population.

Collaborations

BLP Ribas participated in data collection in Pelotas, data analysis and interpretation, literature review and drafting of the initial version of the manuscript. A Longo and FV Dobke participated in data collection in Pelotas, data analysis and interpretation. EG Bertoldi, LR Borges and RT Abib participated in the coordination of data collection in Pelotas and critical review of the manuscript. B Weber is the lead researcher and participated in the design and overall coordination of the study and critical review of the manuscript. All authors participated in the drafting and approved the final version of the manuscript.

Ciência & Saúde Coletiva, 25(4):1499-1506, 2020

Main Researchers of the Brazilian Cardioprotective Diet Project

Cristiane Kovacs (Instituto Dante Pazzanese de Cardiologia, São Paulo-SP, Brazil), Annie Seixas Bello Moreira (Hospital Universitário Pedro Ernesto, Rio de Janeiro-RJ, Brazil e Instituto Nacional de Cardiologia, Rio de Janeiro-RJ, Brazil), Rosileide de Souza Torres (Hospital das Clínicas Gaspar Viana, Belém-PA, Brazil), Helyde Marinho (HU Francisca Mendes, Manaus- AM, Brazil), Cristina Henschel de Matos (Universidade Vale do Itajaí, Itajaí-SC, Brazil), Renata Torres Abib (Universidade Federal de Pelotas, Pelotas-RS, Brazil), Gabriela Correa Souza (Hospital de Clínicas de Porto Alegre, Porto Alegre-RS, Brazil), Gabriela da Silva Shirmann (Universidade da Região da Campanha, Bagé-RS, Brazil), Francisca Eugenia Zaina Nagano (Hospital de Clínicas da Universidade Federal do Paraná, Curitiba-PR, Brazil), Maria Estela Monserrat Ramos (Hospital Universitário Associação Educadora São Carlos, Canoas-RS, Brazil), Soraia Poloni (Instituto de Cardiologia do Rio Grande do Sul, Porto Alegre-RS, Brazil), Raquel Milani El Kik (Hospital São Lucas da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre-RS, Brazil), Naoel Hassan Feres (Universidade Federal do Mato Grosso, Cuiabá-MT, Brazil), Eliane Said Dutra (Hospital Universitário de Brasília, Brasília-DF, Brazil), Ana Paula Perillo Ferreira Carvalho (Hospital das Clínicas de Goiânia, Goiânia-GO, Brazil), Marta Marques David (Hospital Universitário Maria Aparecida Pedrossian, Campo Grande- MS, Brazil), Isa Galvão Rodrigues (Pronto Socorro Cardiológico Universitário de Pernambuco, Recife-PE, Brazil), Antonio Carlos Sobral Sousa (Hospital São Lucas, Aracaju-SE, Brazil), Amanda Lopes Gonçalves Coura (Hospital Universitário Alcides Carneiro, Campina Grande-PB, Brazil), Josilene Maria Ferreira Pinheiro (Hospital Universitário Ana Bezerra, Santa Cruz-RN, Brazil), Sandra Mary Lima Vasconcelos (Universidade Federal de Alagoas, Maceió-AL, Brazil), Andreza de Matos Penafort (Universidade de Fortaleza, Fortaleza-CE, Brazil), Daniele Maria de Oliveira Carlos (Hospital de Messejana, Fortaleza-CE, Brazil), Viviane Saha de Souza (Hospital Universitário Professor Edgard Santos, Salvador-BA, Brazil), Adriana Barros Luna (Hospital Universitário da Universidade Federal de Sergipe, Aracaju-SE, Brazil), José Albuquerque de Figueiredo Neto (Hospital Universitário da Universidade Federal do Maranhão, São Luís-MA, Brazil), Emilio Hideyuki Moriguchi (Associação Veranense de Assistência em Saúde, Veranópolis-RS , Brazil), Camila Ragne Torreglosa (Hospital do Coração, São Paulo-SP, Brazil), Maria Cristina de Oliveira Izar (Universidade Federal de São Paulo, São Paulo-SP, Brazil), Sônia Lopes Pinto (Universidade Federal de Tocantins, Palmas-TO, Brazil), Luciano Marcelo Backes (Bioserv, Passo Fundo-RS, Brazil), Josefina Bressan (Universidade Federal de Viçosa, Viçosa-MG, Brazil), Simone Raimondi (Instituto Estadual de Cardiologia Aloysio de Castro, Rio de Janeiro-RJ, Brazil), Magali Kumbier (COTENUT, Porto Alegre-RS, Brazil).

References

1. World Health Organization (WHO). *Cardiovascular diseases (CVDs)* [Internet]. 2017 [acessado 2017 Maio 20]. Disponível em: http://www.who.int/mediacentre/factsheets/fs317/en/
2. World Health Organization (WHO). *Ingestão de açúcares por adultos e crianças* [Internet]. Genebra: WHO; 2015. [acessado 2017 Maio 20]. Disponível em: http://www.paho.org/bra/images/stories/GCC/ingestao%20de%20acucares%20por%20adultos%20e%20criancas_portugues.pdf?ua=1
3. Malik VS, Hu FB. Fructose and Cardiometabolic Health: What the Evidence from Sugar-Sweetened Beverages Tells Us. *J Am Coll Cardiol* 2015; 66(14):1615-1624.
4. Hu FB, Malik VS. Sugar-sweetened beverages and risk of obesity and type 2 diabetes: Epidemiologic evidence. *Physiol Behav* 2010; 100(1):47-54.
5. Malik VS, Popkin BM, Bray GA, Després JP, Hu FB. Sugar-Sweetened Beverages, Obesity, Type 2 Diabetes Mellitus, and Cardiovascular Disease Risk. *Circulation* 2010; 121(11):1356-1364.
6. Stanhope KL, Medici V, Bremer AA, Lee V, Lam HD, Nunez MV, Chen GX, Keim NL, Havel PJ. A dose-response study of consuming high-fructose corn syrup–sweetened beverages on lipid/lipoprotein risk factors for cardiovascular disease in young adults. *Am J Clin Nutr* 2015; 101(6):1144-1154.

7. Stanhope KL, Bremer AA, Medici V, Nakajima K, Ito K, Nakano T, Chen G, Fong TH, Lee V, Menorca RI, Keim NL, Havel PJ. Consumption of Fructose and High Fructose Corn Syrup Increase Postprandial Triglycerides, LDL-Cholesterol, and Apolipoprotein-B in Young Men and Women. *J Clin Endocrinol Metab* 2011; 96(10):E1596-E1605.
8. Raben A, Møller BK, Flint A, Vasilaras TH, Møller AC, Holst JJ, Astrup A. Increased postprandial glycaemia, insulinemia, and lipidemia after 10 weeks' sucrose-rich diet compared to an artificially sweetened diet: a randomised controlled trial. *Food Nutr Res* 2011; 55:5961.
9. Micha R, Peñalvo JL, Cudhea F, Imamura F, Rehm CD, Mozaffarian D. Association Between Dietary Factors and Mortality From Heart Disease, Stroke, and Type 2 Diabetes in the United States. *JAMA* 2017; 317(9):912-924.
10. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa de Orçamentos Familiares 2008-2009: análise do consumo alimentar pessoal no Brasil*/IBGE. Rio de Janeiro: IBGE, 2011.
11. Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Vigilância de Doenças e Agravos não Transmissíveis e Promoção da Saúde. *Vigitel Brasil 2016: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2016*. Brasília: MS, 2017.
12. Weber B, Galante AP, Bersch-Ferreira AC, Torreglosa CR, Carvalho VO, Victor ES, do Espírito-Santo JA, Ross-Fernandes MB, Soares RM, Costa RP, Sousa Lara E, Buehler AM, Berwanger O. Effects of Brazilian Cardioprotective Diet Program on risk factors in patients with coronary heart disease: a Brazilian Cardioprotective Diet randomized pilot Trial. *Clin Sci* 2012; 67(12):1407-1414.
13. Weber B, Bersch-Ferreira AC, Torreglosa CR, Ross-Fernandes MB, da Silva JT, Galante AP, Sousa Lara E, Costa RP, Soares RM, Cavalcanti AB, Berwanger O. The Brazilian Cardioprotective Nutritional Program to reduce events and risk factors in secondary prevention for cardiovascular disease: study protocol (The BALANCE Program Trial). *Am Heart J* 2016; 171(1):73-82.
14. World Health Organization (WHO). *Physical status: The use and interpretation of anthropometry*. Genebra: WHO; 1995. (Technical Report Series, nº 854).
15. Organização Pan-Americana de Saúde (OPAS). *XXXVI Reunión Del Comitê Asesor de Investigaciones em Salud – Encuestra Multicêntrica – Salud bienestar y Envejecimiento (SABE) em América Latina e el Caribe – Informe preliminar* [Internet]. 2002 [acessado 2017 Mar 18]. Disponível em: http://www.opas.org/program/sabe.htm
16. World Health Organization (WHO). *Waist circumference and waist-hip ratio: report of a WHO expert consultation*. Genebra: WHO; 2011.
17. Associação Brasileira de Empresas de Pesquisa. *Critério de classificação econômica Brasil* [Internet]. 2014. [acessado 2017 Abr 7]. Disponível em: http://www.abep.org/criterio-brasil
18. Institute of Medicine, Food and Nutrition Board. *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids (Macronutrients)*. Washington: National Academy Press; 2002/2005.
19. Weber B, Berwanger O, Costa RP, Lara EMS, Fernandes MBR, Ferreira ÂCB, *et al*. Álbum fotográfico de medidas e porções de alimentos. São Paulo: Instituto de Ensino e Pesquisa do Hospital do Coração; 2012.
20. Galante AP. *Desenvolvimento e validação de um método computadorizado para avaliação do consumo alimentar, preenchido por indivíduos adultos utilizando a Web*. 2007. [tese] São Paulo: Universidade de São Paulo; 2007.
21. Chen L, Caballero B, Mitchell DC, Loria C, Lin P-H, Champagne CM, Elmer PJ, Ard JD, Batch BC, Anderson CAM, Appel LJ. Reducing Consumption of Sugar-Sweetened Beverages Is Associated with Reduced Blood Pressure: A Prospective Studyamong U.S. Adults. *Circulation* 2010; 121(22): 2398-2406.
22. Larsson SC, Akesson A, Wolk A. Sweetened Beverage Consumption Is Associated with Increased Risk of Stroke in Women and Men. *J Nutr* 2014; 144:856-860.
23. Duffey KJ, Gordon-Larsen P, Steffen LM, Jacobs Jr DR, Popkin BM. Drinking caloric beverages increases the risk of adverse cardiometabolic outcomes in the Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Am J Clin Nutr* 2010; 92:954-959.
24. Ferreira-Pêgo C, Babio N, Bes-Rastrollo M, Corella D, Estruch R, Ros E, Fitó M, Serra-Majem L, Arós F, Fiol M, Santos-Lozano JM, Munõz-Bravo C, Pintó X, Ruiz-Canela M, Salas-Salvad J. Frequent Consumption of Sugar- and Artificially Sweetened Beverages and Natural and Bottled Fruit Juices Is Associated with an Increased Risk of Metabolic Syndrome in a Mediterranean Population at High Cardiovascular Disease Risk. *J Nutr* 2016; 146(8):1528-1536.
25. Ma J, Sloan M, Fox CS, Hoffmann U, Smith CE, Saltzman E, Rogers GT, Jacques PF, McKeown NM. Sugar-Sweetened Beverage Consumption Is Associated with Abdominal Fat Partitioning in Healthy Adults. *J Nutr* 2014; 144:1283-1290.
26. Ludwig DS. The glycemic index: physiological mechanisms relating to obesity, diabetes, and cardiovascular disease. *JAMA* 2002; 287(18):2414-2423.
27. Moraes KD, Araújo AP, Dos Santos AF, Barbosa JMA, Martins MLB. Correlation between body mass index and cardiovascular risk anthropometric indicators in women. *Rev Pesq Saúde* 2015; 16(3):175-181.

Article submitted 23/10/2017
Approved 02/08/2018
Final version submitted 04/08/2018