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Consumption of foods according to their degree of processing in patients with established atherosclerosis disease

Consumo de alimentos según su grado de procesamiento en pacientes con enfermedad aterosclerótica establecida

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ABSTRACT

The aim of the present study was to analyze the consumption of foods according to their degree of processing in patients with established atherosclerosis disease. A cross-sectional study was performed with 74 patients of the BALANCE Program trial, a randomized, multicenter and national clinical trial occurring in Brazil. Body weight, height, waist circumference, blood pressure, lipid profile and fasting glucose were collected. Food intake was assessed with 24-h dietary recall. Consumption of nutrients was analyzed in quartiles of consumption of ultra-processed foods and their differences were obtained by one-way ANOVA with Tukey's post hoc test. Half of consumed calories came from natural or minimally processed foods (50.9%), followed by ultra-processed food products (35.1%). The largest contribution in calories came from meats, cereals/roots/tubers, breads, and sweets. No significant difference was found in quartiles of consumption of ultra-processed foods. In this sample, consumption of processed/ultra-processed food was almost the same as natural/minimally processed foods. Preferential consumption of unprocessed/minimally processed foods should be more widely advocated by health professionals.

Keywords: Cardiovascular diseases; Diet; Eating; Food; Food consumption.

RESUMEN

El objetivo del presente estudio fue analizar el consumo de alimentos, de acuerdo con su grado de procesamiento, en pacientes con enfermedad arterioesclerótica establecida. Estudio transversal, en 74 pacientes del BALANCE Program trial que es un ensayo clínico randomizado, multicéntrico y nacional que se realiza en Brasil. Se midió el peso corporal, la talla, la circunferencia de la cintura, la presión arterial, el perfil lipídico y la glucosa en ayunas. La ingesta de alimentos se evaluó con un recordatorio de 24 horas. El consumo de nutrientes se analizó en cuartiles de consumo de alimentos ultraprocesados y sus diferencias se pusieron a prueba mediante ANOVA de una vía. La mitad de las calorías consumidas provino de alimentos naturales o mínimamente procesados (50.9%), seguidos por productos alimenticios ultraprocesados (35.1%). La mayor contribución en calorías provino de carnes, cereales/raíces/tubérculos, panes y dulces. No se encontraron diferencias significativas en los cuartiles de consumo de alimentos ultraprocesados. En esta muestra, el consumo de alimentos procesados/ultraprocesados fue casi el mismo que de los alimentos naturales/mínimamente procesados. El consumo preferencial de alimentos no procesados/mínimamente procesados debería ser defendido más ampliamente por profesionales de la salud.

Palabras clave: Alimentos; Consumo de alimentos; Dieta; Enfermedades cardiovasculares; Ingestión de alimentos.

INTRODUCTION

Cardiovascular diseases (CVDs) are a major cause of death worldwide. In 2012, more than 17 million people died from CVDs, which represented 31% of all deaths[1]. The prevention of this group of pathologies must include proper control of risk factors such as improper eating, obesity, physical inactivity and harmful consumption of alcohol[1,2].

Dietary factors, such as consumption of high amounts of salt and fat (particularly saturated and trans fatty acids), and an inadequate intake of fruits and vegetables, increase the risk of CVDs[1,2]. Therefore, governmental concern has increased in recent years, resulting in regulatory policies that aim to reduce fats and sodium use by the food industry, potentially contributing to a decrease in the consumption of these nutrients in the population[2].

In 2014, new Dietary Guidelines were published in Brazil[3]. This edition contains a novel food classification, which evaluates the extent and purpose of the industrial processing applied to foodstuffs and divides foods into four groups: natural or minimally processed, processed culinary ingredients, processed foods and ultra-processed food products[3]. The ultra-processed group stands out for its unfavorable nutritional profile, due to high energy density and high levels of total fat, saturated fat, trans fat, free sugars and sodium[4,5]. Nevertheless, these products frequently have attributes that stimulate their consumption, such as high palatability, large portion sizes, durability, easy transport, being "ready-to-eat" and wide marketing and advertising[3].

According to the Brazilian Ministry of Health[6], in 2017, approximately 27% of deaths in Brazil were due to CVD. However, Moreira et al[7] estimated that 29% of CVD deaths could be avoidead if saturated fat, trans-fat, salt and added sugar were reduced from processed culinary ingredients and ultra-processed foods in the Brazilian diet.

Considering the potential association between the consumption of ultra-processed foods and CVDs, and the fundamental role of lifestyle adjustments, including a healthy diet for secondary prevention of atherothrombotic events, the objective of the present study was to analyze the consumption of foods, according to their degree of processing, in a sample of patients with established atherosclerosis disease, participants the Brazilian Cardioprotective Nutritional Program Trial (BALANCE Program Trial).

MATERIALS AND METHODS

A cross-sectional study was conducted. This work represents a subanalysis of the BALANCE Program Trial, a randomized, multicenter and national clinical trial, conducted by the Hospital do Coração (HCor) in partnership with the Unified Health System (SUS) (PROADI-SUS) of the Ministry of Health, to reduce events and risk factors inn secondary prevention for CVD. The pilot and protocol studies have been published previously[8,9]. The data presented were collected from patients in one of the participating centers, Pelotas-RS, at baseline. The study included patients aged 45 years or older, with evidence of established atherosclerosis disease in the preceding 10 years. a) coronary disease (defined by previous myocardial infarction, stable or unstable angina, history of atherosclerotic stenosis ≥70% of the diameter of any coronary artery on conventional or computed tomographic (CT) coronary angiography, or history of angioplasty, stenting, or coronary artery bypass surgery); (b) previous stroke; (c) peripheral vascular disease (ankle/arm ratio <0.9 of systolic blood pressure in either leg at rest, angiography or Doppler demonstrating >70% stenosis in a cardiac artery, intermittent claudication, vascular surgery for atherosclerotic disease, amputation due to atherosclerotic disease, or aortic aneurysm). The exclusion criteria were: neurocognitive or psychiatric conditions; life expectancy less than 6 months; pregnancy or lactation; liver failure with a history of encephalopathy or anasarca; renal failure with indication for dialysis; congestive heart failure; previous organ transplantation; wheelchair use; or any restrictions to receiving an oral diet. Eligible subjects were selected from cardiology outpatient clinic and teaching hospital, in the period of August 2013 to December 2014. The study was approved by the local ethics committee (nº 287.722) and all participants provided written informed consent prior to inclusion.

Body weight and height were measured using a digital calibrated scale with a coupled stadiometer (Filizola®), with an accuracy of 0.1 kg and 0.1 cm, respectively. Waist circumference was obtained by inelastic tape measure, at midway between the lowest rib and the iliac crest using an anthropometric tape, with an accuracy of 0.1 cm. Body mass index (BMI) was calculated from weight (kg) divided by squared height (m) and categorized in groups according to World Health Organization criteria for subjects under 60 years (underweight, BMI<18.5kg/m²; normal weight, BMI18.5 to 24.9kg/m²; overweight, 25 to 29.9 kg/m²; and obesity, BMI>30 kg/m²) or Pan American Health Organization criteria for the elderly (underweight, BMI<23kg/m²; normal weight, BMI 23 to 27.9 kg/m²; overweight, BMI 28 to 29.9 kg/m²; and obesity, BMI>30 kg/m²)[10,11].

Blood pressure was assessed using the auscultatory method. Total cholesterol, HDL cholesterol, triglycerides and glucose were determined by enzymatic colorimetric dry chemistry method (Ortho-Clinical Diagnostics VITROS 5.1), in venous blood, and LDL cholesterol was estimated using the Friedewald equation[12]. Clinical history was collected from patient records and complemented by interview when necessary.

Food intake was assessed with one 24-h dietary recall per patient, performed by trained dietitians. The subjects described their average portion sizes for food items in terms of household measurements, the standard weights of food items and validated food portion photographs of known weights. To quantify energy intake, data were entered into the Nutriquanti® diet system, an online computer program

that is based on the Brazilian food database. All cited foods in the 24-h dietary recalls were classified according to the new food classification system proposed by Brazilian Dietary Guidelines[3]: natural or minimally processed foods, processed culinary ingredients, processed foods and ultra-processed food products.

Natural foods are obtained directly from plants or animals and do not undergo any alteration following their removal from nature, and minimally processed are natural foods that have been submitted to cleaning, removal of inedible or unwanted parts, fractioning, grinding, drying, fermentation, pasteurisation, cooling, freezing, or other processes that may subtract part of the food but do not add oils, fats, sugar, salt or other substances (e.g. meat, milk, eggs, grains, legumes, and fruits). Processed culinary ingredients are products extracted from natural foods or from nature by processes such as pressing, grinding, crushing, pulverising, and refining (e.g. vegetable oils, butter, sugar and salt). Processed foods are products manufactured by industry with the use of salt, sugar, oil or other substances added to natural or minimally processed foods (canned vegetables, fruits in sugar, cheeses and breads made of wheat μour, yeast, water, and salt). Ultra-processed foods are industrial formulations made entirely or mostly from substances extracted from foods, derived from food constituents or synthesised in laboratories from food substrates or other organic sources (e.g. biscuits, chocolates, chips and soft drinks)[3].

Economic level were categorized according to the Brazilian Criteria of Economic Classification of the Brazilian Research Institute in A, B, C, D and E[13]. Education was evaluated by years of study in the following way: low education level, elementary school (complete or incomplete), high school (complete or incomplete) and college (complete or incomplete).

Continuous variables were expressed as the mean ± standard error or medians and interquartile ranges, depending on their normality, and categorical data were expressed with frequencies. Consumption of micro and macronutrients was analyzed in quartiles of relative contribution of ultra-processed foods to total energy. Differences between quartiles were obtained by one-way ANOVA with Tukey's HSD post hoc test. All analyses were carried out using GraphPad® Prism 5.

RESULTS

The sample consisted of 74 subjects. As shown in table 1, the majority were male (66.2%), elderly (52.7%), from level C of economic classification (66.6%), studied until elementary school (83.3%), former smokers (54.1%), overweight or obese (74.3%), had family history of CVD (77.0%) and used antihypertensive (98.6%) and hypolypidemic (95.9%) drugs. Most had established coronary heart disease (95.9%), 78.4% hypertension, 60.8% dyslipidemia and 36.5% diabetes.

The mean waist circumference was 100.0±9.7cm and the medians of total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, fasting blood sugar were, respectively, 160.0 mg/dL (95% CI 133.8-184.0), 95.00mg/dL (95% CI 72.7-114.0), 36.0mg/dL (95% CI 32.0-42.2), 116.0mg/dL (95% CI 91.0-165.3) and 110.5mg/dL (95% CI 98.7-137.3) (Table 1).

The mean daily energy consumption was 1,429 kcal. Roughly half of calories came from natural or minimally processed foods (50.9%), followed by ultra-processed food products (35.1%), processed foods (11.1%) and processed culinary ingredients (2.9%). The foods that most contributed in calories can be seen in table 2. The largest contribution in calories came from meats and cereals/roots/tubers, both from the group of minimally processed foods. Next, from the processed food group, came bread, followed by sweets and biscuits, both from the ultra-processed food group.

The consumption of nutrients and biochemical parameters distributed in quartiles of ultra-processed intake are presented in table 3. No significant difference was found.

DISCUSSION

Consumption of ultra-processed products has significantly increased in the Brazilian diet, as seen in metropolitan areas since the 1980s and confirmed at a national level in the 2000s[14]. A similar increase has also been observed in Sweden[15] and Canada[16]. In our sample of patients with established atherosclerotic disease, we found a high contribution of ultra-processed foods to total caloric intake.

Obesity presented a high prevalence and the mean of waist circumference was elevated. Previous studies associated ultra-processed products consumption with the risk of metabolic syndrome in adolescents[17], while a dietary pattern high in fruit and dairy and low in white bread, processed meat, margarine and soft drinks may help prevent abdominal fat accumulation in adults[18]. In addition, people with high consumption of ultra-processed foods had a significantly higher BMI and higher odds of being obese, compared with those with the lowest consumption[19,20].

The majority of our sample (60.8%) presented dyslipidemia with low levels of HDL cholesterol, but this profile was not significantly associated with baseline ultra-processed consumption. Importantly, patients in our sample received guideline-recommended therapy for CVD disease, including statins in 96% of cases, and that may have influenced the results of this study. Corroborating these findings, Stewart et al.[21], evaluated more than 15,000 patients with stable coronary heart disease and did not observe an association between LDL and HDL cholesterol and the Western dietary pattern that includes consumption of refined grains, sweets, fried foods and sugared drinks. Authors also believe that the use of preventive medications may decrease the ability to detect modest effects of diet on these risk factors.

Table 1. Clinical, sociodemographic, anthropometric and biochemical characteristics of patients with established atherosclerosis.

Variables	Total (n= 74)
Men, n (%)	49 (66.2)
Age, years, mean (SE)	60.7 (1.1)
Adults, n (%)	35 (47.3)
Elderly (≥60 years), n (%)	39 (52.7)
Economic levels, n= 66, (%)	
A/B	11 (16.7)
C	44 (66.7)
D/E	11 (16.7)
Education, n= 65, (%)	
Low education level	17 (26.2)
Elementary school	40 (61.5)
High school	7 (10.8)
College	1 (1.5)
Coronary heart disease, n (%)	71 (95.9)
Stroke, n (%)	4 (5.4)
Peripheral artery disease, n (%)	7 (9.5)
Smokers, n (%)	11 (14.9)
Former smokers, n (%)	40 (54.1)
Never smoked, n (%)	23 (31.1)
Body mass index, kg/m², mean (SE)	28.7 (0.5)
Underweight, n (%)	3 (4.1)
Normal weight, n (%)	16 (21.6)
Overweight, n (%)	26 (35.1)
Obesity, n (%)	29 (39.2)
Waist circumference, cm, mean (SE)	100 (1.1)
Systolic blood pressure, mmHg, mean (SE)	128 (2.3)
Diastolic blood pressure, mmHg, mean (SE)	81.3 (1.3)
Hypertension, n (%)	58 (78.4)
Diabetes, n (%)	27 (36.5)
Dyslipidemia, n (%)	45 (60.8)
Family history of CVD, n (%)	57 (77.0)
Antihypertensive drugs, n (%)	73 (98.6)
Hypoglycemic drugs, n (%)	23 (31.1)
Hypolipidemic drugs, n (%)	71 (95.9)
Total cholesterol, mg/dL, median (p25-p75)	160 (134-184)
LDL cholesterol, mg/dL, median (p25-p75)	95 (72.7-114)
HDL cholesterol, mg/dL, median (p25-p75)	36 (32-42.3)
Triglycerides, mg/dL, median (p25-p75)	116 (91-165)
Fasting glucose, mg/dL, median (p25-p75)	110 (98.75-137)

Table 2. Caloric contribution of foods consumed by patients with established atherosclerosis disease classified according to industrial processing.

Food groups/Foods	Cal/day/person
Natural or minimally processed foods	727 (37,9)
Meats	273 (21,5)
Cereals/roots/tubers	187 (8,7)
Milk	80,7 (4,5)
Fruits	75,6 (5,3)
Beans	61,3 (5,5)
Vegetables	22,5 (1,7)
Coffee and tea	10,5 (1,1)
Pasta	9,16 (4,4)
Eggs	6,27 (2,9)
Other*	0,562 (0,0)
Processed culinary ingredients	41,5 (7,5)
Sugar	34,0 (3,6)
Butter	4,12 (3,7)
Other†	3,91 (5,2)
Processed foods	158 (17,0)
Breads	132 (7,6)
Culinary preparations	9,81 (6,4)
Cheeses	9,43 (6,0)
Canned foods	6,87 (19,5)
Ultra-processed foods	502 (52,5)
Sweets	94,1 (13,7)
Biscuits	89,5 (16,1)
Snacks and fried foods	75,9 (23,7)
Industrialized breads	59,7 (7,0)
Margarine	48,8 (10,4)
Soft drinks	44,3 (6,0)
Salted/Cured/Smoked meats	42,4 (21,4)
Sauces, creams and condiments	28,2 (9,4)
Yogurts	19,2 (7,5)

*Linseed; † Olive oil, milk cream, honey.

In our study, mean daily energy consumption was 1,430 kcal. About half of calories came from natural or minimally processed foods, followed by ultra-processed food products. Louzada et al.[20], studying more than 30,000 adults and adolescents, found a similar consumption of ultra-processed foods (30%). However, other studies exhibit different results. For example, one study with 32,898 Brazilians (aged 10 years or older) identified that natural or minimally processed foods contributed with approximately 70% of the calories[22], while, a cohort study with 4,202 young adults in the city of Pelotas-Brazil, showed a relatively higher intake of ultra-processed foods (51.2% of total calories)[23]. Patients in our

Table 3. Consumption of nutrients and biochemical parameters by quartile of ultra-processed food products intake in patients with established atherosclerosis disease.

	Q1 (n= 18)	Q2 (n= 19)	Q3 (n= 19)	Q4 (n= 18)	P*
Nutrients					
Total calories, mean (SE)% of energy from:	1.169 (130)	1.442 (116,7)	1.465 (131,7)	1.646 (152,4)	0,188
Carbohydrate, mean (SE)	51,1 (2,8)	53,4 (3,2)	49,8 (2,8)	47,1 (3,5)	0,699
Protein, mean (SE)	18,4 (1,3)	15,0 (1,0)	17,2 (1,1)	15,3 (0,8)	0,158
Total fats, mean (SE)	31,6 (2,0)	32,5 (2,9)	33,4 (2,0)	38,5 (2,9)	0,342
Saturated, mean (SE)	8,75 (0,5)	8,88 (0,8)	10,5 (0,8)	11,3 (0,8)	0,115
Monounsaturated, mean (SE)	8,08 (0,5)	7,24 (0,7)	8,47 (0,6)	8,34 (0,8)	0,726
Polyunsaturated, mean (SE)	8,93 (0,7)	7,86 (0,7)	8,46 (0,9)	9,62 (1,1)	0,676
Cholesterol (mg)	187 (34,4)	177 (31,5)	187 (29,8)	210 (32,3)	0,966
Fiber (g)	16,5 (2,7)	15,8 (1,9)	13,1 (1,3)	13,6 (1,6)	0,704
Sodium (mg)	2.062 (260,7)	2.183 (222,7)	2.469 (245,8)	2.876 (287,2)	0,223
Biochemical parameters mean (SE)					
biochemical parameters					
Total cholesterol, mg/dL	174 (12,88)	156 (8,037)	167 (6,459)	157 (7,093)	0,446
LDL cholesterol, mg/Dl	106 (11,08)	92 (7,292)	101 (6,262)	89,6 (5,214)	0,403
HDL cholesterol, mg/Dl	42,8 (3,771)	39,6 (2,280)	36,4 (1,406)	37,4 (2,189)	0,292
Triglycerides, mg/Dl	128 (11,06)	122 (14,23)	152 (24,80)	153 (23,04)	0,549
Fasting glucose	140 (16,31)	112 (6,392)	131 (12,22)	131 (13,33)	0,444

SE- standard error; *One-way ANOVA, Tukey post-hoc test.

study belong to a different demographic stratum (older and lower socioeconomic status), and already had established CVD, which may explain the different pattern of consumption as compared to the cited studies. These results demonstrate the need for more studies using different age groups, as this may influence food consumption choices.

In Canada, over 60% of dietary energy came from ultra-processed products and the average diet exceeded WHO upper limits for fat, saturated fat, free sugars and sodium density, with less fiber than recommended[5]. Highly processed foods contributed 61% of mean energy intake in Spain, and 78-79% in the Netherlands and Germany[24]. A recent study performed in a Brazilian urban area described factors associated with preferential acquisition of minimally processed foods: the habit of buying fruits and vegetables at farmer´s markets or group-specific markets, walking as the principal means of transportation to buy food, and the perception of availability of fresh fruits and vegetables in the neighborhood[25].

In a previous study, increased consumption of ultra-processed foods was positively correlated with the consumption of fat, cholesterol, sodium, iron, calcium, and calories, and negatively correlated with the consumption of carbohydrates, protein, and dietary fiber; the main source of ultra-processed food were sweets, breads and snacks[23]. In our sample, we evaluated all food processing groups and we analyzed impact on total caloric intake. The major contribution in calories came from natural or minimally processed foods, mainly by meats and cereals/roots/tubers, followed by processed (breads) and ultra-processed foods (sweets). Overall, in the Brazilian diet, rice and beans represent about 25% of the energy consumed throughout the day, followed by red meat (9.3% of total energy), fruits (6.9%), and cereals other than rice (5.9%) and, among ultra-processed foods, the top ones are industrialized breads (9.2%), pizzas, hamburgers and sandwiches (4.7%), and cakes and cookies (3.0%)[20].

Although we did not find a difference between quartiles of ultra processed food intake, patients in the highest quartile did not reach the recommendations for most nutrients, more

than the others quartiles. Compared with the nutrient goals for patients with high cardiovascular risk, they consumed more total fats (38.5%v.25-35%), saturated fat (11.3%v.<7%), sodium (2,876 mg v.<2,000mg), cholesterol (209.8 mg v.<200 mg) and less fiber (13.6g v.14g/1000kcal)[26,27,28,29,30].

This inadequacy in the consumption of nutrients involved in the development of CVD shows the importance of controlling the intake of ultra-processed foods for better secondary prevention. The latest edition of the Dietary Guidelines for the Brazilian Population advises that natural or minimally processed foods should be the basis of diet. However, it does not indicate a referential value. Thus, further studies are needed in order to establish an appropriate consumption value of foods according to their degree of processing. In our study, close to half of dietary calories came from natural or minimally processed foods. However, as exposed before, the diet of our sample was not nutritionally adequate.

There are some limitations of our study. The dietary survey was not designed specifically to classify foods according to the characteristics of industrial processing, and this could limit the ability to detect associations and complicate classification of some preparations into groups. In addition, 24h recall can underestimate real portions, a characteristic intrinsic of this instrument. Recall was performed for only one day and thus may not reflect habitual consumption. Furthermore, we do not know if patients in our study had received nutritional recommendations after the cardiovascular event, reflected in a healthier diet, detected in our analysis.

To our knowledge, this is the first study to address the relative contribution of foods according to their degree of processing in patients with atherosclerotic disease. Larger studies with the power to investigate the association of this novel food classification system with cardiovascular events could bring important contributions to our understanding of the role of dietary counseling in the treatment of atherosclerotic diseases.

CONCLUSION

In this sample of patients with established atherosclerotic disease, consumption of processed/ultra-processed food was almost the same as natural/minimally processed. Preferential consumption of natural/minimally processed foods should be advocated by health professionals, as recommended by the Dietary Guidelines for the Brazilian Population. Further experimental and clinical studies are recommended to assess the possible association between these foods and cardiovascular biomarkers and events.

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REFERENCES

1. *World Health Organization. Global Status Report on Noncommunicable Diseases 2014. Geneva: WHO, 2014.*
2. *World Health Organization (in collaboration with the World Heart Federation and World Stroke Organization). Global Atlas on Cardiovascular Disease Prevention and Control. Geneva: WHO, 2011.*
3. *Brazil Ministry of Health. Dietary Guidelines for the Brazilian Population. Brasília, DF: Ministry of Health, 2014.*
4. *Monteiro CA, Levy RB, Claro RM, De Castro IR, Cannon G. Increasing consumption of ultra-processed foods and likely impact on human health: evidence from Brazil. Public Health Nutr. 2011; 14: 5-13.*
5. *Moubarac JC, Martins AP, Claro RM, Levy RB, Cannon G, Monteiro CA. Consumption of ultra-processed foods and likely impact on human health. Evidence from Canada. Public Health Nutr. 2013; 16: 2240-2248.*
6. *Brazil Ministry of Health. Health Unic System (SUS) Department of Informatics (DATASUS). Available in: http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/obt10uf.def Acessed in: 29/04/2020.*
7. *Moreira PVL, Hyseni L, Moubarac J-C, Martins APB, Baraldi LG, Capewell S, O'Flaherty M, Guzman-Castillo M. Effects of reducing processed culinary ingredients and ultra-processed foods in the Brazilian diet: a cardiovascular modelling study. 2018; 21: 181-188.*
8. *Weber B, Galante AP, Bersch-Ferreira AC, Torreglosa CR, Carvalho VO, Victor ES, et al. Effects of Brazilian Cardioprotective Diet Program on risk factors in patients with coronary heart disease: a Brazilian Cardioprotective Diet randomized pilot trial. Clinics (Sao Paulo). 2012; 67: 1407-1414.*
9. *Weber B, Bersch-Ferreira ÂC, Torreglosa CR2 Ross-Fernandes MB, da Silva JT, Galante AP, et al. 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: 73-81.*
10. *World Health Organization. Physical Status: The use and Interpretation of Anthropometry. (Technical Report Series, 854). Geneva: WHO, 1995.*
11. *Peláez M, Palloni A, Albala C, Alfonso JC, Ham-Chande R, Hennis A, et al. SABE - Survey on Health, Well-Being, and Aging in Latin America and the Caribbean. Geneva: Pan American Health Organization (PAHO/WHO), 2000.*
12. *Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem. 1972; 18: 499-502.*
13. *Brazilian Survey Company Association. São Paulo, SP: ABEP. 2012.*
14. *Martins AP, Levy RB, Claro RM, Moubarac JC, Monteiro CA. Increased contribution of ultra-processed food products in the Brazilian diet (1987-2009). Rev Saude Publica. 2013; 47: 656-665.*
15. *Juul F, Hemmingsson E. Trends in consumption of ultra-processed foods and obesity in Sweden between 1960 and 2010. Public Health Nutr. 2015; 18: 3096-3107.*
16. *Moubarac JC, Batal M, Martins AP, Claro R, Levy RB, Cannon G, Monteiro C. Processed and ultra-processed food products: consumption trends in Canada from 1938 to 2011.Can J Diet Pract Res. 2014; 75: 15-21.*
17. *Tavares LF, Fonseca SC, Garcia Rosa ML, Yohoo EM. Relationship between ultra-processed foods and metabolic syndrome in adolescents from a Brazilian Family Doctor Program. Public Health Nutr. 2012; 15(1): 82-87.*
18. *Romaguera D, Ängquist L, Du H, Jakobsen MU, Forouhi NG,*

Halkjaer J, et al. Food composition of the diet in relation to changes in waist circumference adjusted for body mass index. PLoS One. 2011; 6: e23384.

19. *Canella DS, Levy RB, Martins AP, Claro RM, Moubarac JC, Baraldi LG, Cannon G, Monteiro CA. Ultra-processed food products and obesity in Brazilian households (2008-2009). PLoS One. 2014; 9: e92752.*
20. *Louzada ML, Baraldi LG, Steele EM, Martins AP, Canella DS, Moubarac JC, et al. Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. Prev Med. 2015; 8: 9-15.*
21. *Stewart RA, Wallentin L, Benatar J, Danchin N, Hagstrom E, Held C, et al. Dietary Patterns and the Risk of Major Adverse Cardiovascular Events in a Global Study of High-Risk Patients with Stable Coronary Heart Disease. Eur Heart J. 2016; 37: 1993-2001.*
22. *Louzada ML, Martins AP, Canella DS, Baraldi LG, Levy RB, Claro RM, et al. Impact of ultra-processed foods on micronutrient content in the Brazilian diet. Rev Saude Publica. 2015; 49: 45.*
23. *Bielemann RM, Motta JV, Minten GC, Horta BL, Gigante DP. Consumption of ultra-processed foods and their impact on the diet of young adults. Rev Saude Publica. 201; 49: 28.*
24. *Slimani N, Deharveng G, Southgate DA, Biessy C, Chajès V, van Bakel MM, et al. Contribution of highly industrially processed foods to the nutrient intakes and patterns of middle-aged populations in the European Prospective Investigation into Cancer and Nutrition study. Eur J Clin Nutr. 2009; 63 (Suppl 4): S206-225.*
25. *Vedovato GM, Trude AC, Kharmats AY, Martins PA. Degree of food processing of household acquisition patterns in a Brazilian urban area is related to food buying preferences and perceived food environment. Appetite. 2015; 87: 296-302.*
26. *Sociedade Brasileira de Cardiologia. IV guidelines of Sociedade Brasileira de Cardiologia for treatment of acute myocardial infarction with ST-segment elevation. [published correction appears in Arq Bras Cardiol. 2010 Oct;95(4):553]. Arq Bras Cardiol. 2009;93(6 Suppl 2):e179-e264.*
27. *Xavier HT, Izar MC, Faria Neto JR, Assad MH, Rocha VZ, Sposito AC. V Brazilian Guidelines on Dyslipidemias and Prevention of Atherosclerosis. Arq Bras Cardiol. 2013; 101 (4Suppl1): 1-20.*
28. *Malachias MVB, Franco RJ, Forjaz CLM, Pierin AMG, Gowdak MM, Klein MRST, et al. 7th brazilian guideline of arterial hypertension: chapter 6 - non-pharmacological treatment. Arq Bras Cardiol. 2016;107(3 Suppl 3):30-34.*
29. *Sociedade Brasileira de Hipertensão; Sociedade Brasileira de Cardiologia; Sociedade Brasileira de Endocrinologia e Metabologia; Sociedade Brasileira de Diabetes; Sociedade Brasileira de Estudos da Obesidade. I Brazilian guidelines on diagnosis and treatment of metabolic syndrome. Arq Bras Cardiol. 2005; 84 (Suppl 1): 1-28.*
30. *Sociedade Brasileira de Diabetes. Diretrizes da Sociedade Brasileira de Diabetes 2017-2018 / Organização José Egídio Paulo de Oliveira, Renan Magalhães Montenegro Junior, Sérgio Vencio. São Paulo: Editora Clannad, 2017.*