Association between heart failure and consumption of ultra-processed foods in older adults: a cross-sectional study

Guilherme José Silva Ribeiro[1]
Luciana Neri Nobre[2]
Gabriela Rocha dos Santos[3]
Emilio Hideyuki Moriguchi[4]
André de Araújo Pinto[5]

Abstract

Objective: To estimate the prevalence of heart failure (HF) and explore its potential association with the consumption of ultra-processed foods (UPF) in older adults. *Method*: This cross-sectional study utilized medical records of 1,322 older adults (55% women; mean age of 70.4 years) treated in primary health care facilities in the state of Roraima, Brazil. A cardiologist diagnosed HF based on diagnostic tests such as echocardiography, clinical evaluation, and analysis of medical history. Nutritionists assessed UPF consumption using a nationally standardized form commonly employed in Brazilian primary health care units. *Results:* The findings revealed that 15.4% of older adults had HF. Significant associations were observed between UPF groups and HF, with the probability of HF ranging from OR=1.97 (95% CI=1.36–2.84) for the consumption of hamburgers and/or sausages to OR=2.59 (95% CI=1.73–3.74) for the consumption of filled biscuits, sweets, and treats. *Conclusion*: The consumption of UPF was associated with a high prevalence of HF in this sample of Brazilian older adults. Policymakers and healthcare professionals directly involved with this population should collaborate on targeted interventions and guidelines to reduce UPF consumption and increase the intake of unprocessed foods.

Keywords: Nutrition. Heart Diseases. Aging. Risk Factors. Prevalence.

[1] Universidade Federal de Viçosa (UFV), Programa de Pós-graduação em Ciências da Nutrição. Viçosa, MG, Brasil.

[2] Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM), Programa de Pós-graduação em Ciências da Nutrição. Diamantina, MG, Brasil.

[3] Universidade Federal do Rio Grande do Sul (UFRGS), Programa de Pós-graduação em Psiquiatria e Ciências do Comportamento. Porto Alegre, RS, Brasil.

[4] Universidade Federal do Rio Grande do Sul (UFRGS), Programa de Pós-graduação em Cardiologia e Ciências Cardiovasculares. Porto Alegre, RS, Brasil.

[5] Universidade Estadual de Roraima (UERR), Departamento de Educação Física. Boa Vista, RR, Brasil.

Funding: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES). Código de financiamento: 001.

The authors declare that there is no conflict in the conception of this work.

Correspondence
André de Araújo Pinto
andre.pinto@uerr.edu.br

Received: February 10, 2024
Approved: May 06, 2024

http://dx.doi.org/10.1590/1981-22562024027.240020en

INTRODUCTION

Globally, heart failure (HF) burdens healthcare systems with high morbidity, mortality, and immense costs[1]. Estimates suggest that 64.3 million people worldwide are living with HF[2], although accuracy may falter in middle-income nations like Brazil, where epidemiological data remain scarce[3]. Notably, the Brazilian Mortality Information System reported over 567,000 deaths related to HF in adults aged 50 and older between 1998 and 2019, highlighting a concerning 45% increase in HF mortality with advancing age[4]. These findings underscore the urgent need for ongoing surveillance and research in older adults.

With a rapidly aging global population, the global prevalence of HF is expected to increase over the coming years[3], which will significantly impact Brazil, projected to rank sixth in the number of older adults by 2025[5]. Additionally, a growing burden of chronic diseases is anticipated as a result of this phenomenon[6]. The rise in age-related cardiovascular risk factors such as hypertension, diabetes, obesity, and coronary artery disease further increases the chances of HF[7]. Unhealthy lifestyles, particularly a nutrient-poor diet, significantly contribute to these risks and are key modifiable factors in cardiovascular disease prevention[8].

Of particular concern is the consumption of ultra-processed foods (UPF) within the context of the Western diet, as these products have been associated with a heightened risk of cardiovascular diseases and their risk factors[9]. Several studies have demonstrated the detrimental impact of UPF on cardiometabolic health outcomes[10-12]. In countries such as the United States and Canada, UPF can represent an impressive 80% of total calorie consumption[13]. In Brazil, although data from the Household Budget Survey show that the proportion of this food group is significantly lower (19.7%)[14], increasing trends over the years have been reported[15].

Considering that Brazilians have been increasing their consumption of UPF[15] and that this food group has been associated with cardiovascular diseases[16], a thorough investigation into the prevalence of HF and its potential association with UPF consumption is justified. Identifying the link between UPF and HF is crucial for the development of effective preventive strategies targeting modifiable risk factors. Despite the lack of epidemiological studies on the prevalence of HF and limited evidence on the relationship between food consumption and HF risk in older adults, such research is essential. Therefore, the aim of this study was to estimate the prevalence of HF and explore its potential association with UPF consumption in older adults.

METHOD

This is a cross-sectional epidemiological study based on data from the internal control system of the Epidemiological Surveillance Department of the State of Roraima, Brazil. We collected data from the medical records of older adult patients (aged 60 years or older) residing in the state of Roraima, Brazil, between January and December 2020, who were attended to in Primary Health Care. The research procedures, conducted following Resolution number 466/2012 of the National Health Council, were approved by the Human Research Ethics Committee of the Universidade Estadual de Roraima (protocol number 5385012).

Roraima, the northernmost state of Brazil, covers 223,644 km² but is home to only 636,303 inhabitants, resulting in a density of 2.85/km². Its 14 municipalities (the lowest number in the country) cluster around Boa Vista, the capital, which alone hosts 64.9% of the population. The Human Development Index (HDI) of Roraima (0.707) reflects progress in education, income, and life expectancy (71.8 years). This context sets the stage for the study on the prevalence of HF in older adults in Roraima and its association with UPF consumption.

According to information from the Department of Epidemiological Surveillance, the data from the medical records of 4,194 older adults were entered into the control system and were available for analysis. Based on this information, the following parameters were used to estimate the minimum sample size: a prevalence of 50% (for unknown outcomes), a confidence level of 95%, a tolerable error of 4.0%, and a design effect (deff) defined as 2 (correction

factor). To compensate for potential losses and ensure an adequate sample size, 20% was added to the final number. Based on these parameters, the minimum required sample was 1,260 older adults (60 years or older) with complete data. Despite encountering a significant amount of incomplete information due to reasons such as lack of diagnostic tests, absences from consultations, and lack of clinical history suggestive of HF, the final sample consisted of 1,322 older adults.

To mitigate exposure to the pandemic, the Roraima State Health Department adopted telephone monitoring for older adults in 2020. This aimed to minimize their visits to primary health care units and reduce the risk of COVID-19 infection. Trained healthcare professionals (including doctors and nurses) used a standardized medical record to document sociodemographic and health data during consultations. The information obtained and recorded in these medical records was subsequently entered into the control system of the Department of Epidemiological Surveillance. The health authorities of the state of Roraima provided the data in November 2022, via a spreadsheet generated from the internal control system. The data were provided following confidentiality protocols, with written consent obtained from the health authorities.

The diagnosis of HF (dependent variable) was made by primary care cardiologists, following the Brazilian Heart Failure Guidelines[17]. The clinical history and physical examination were initially evaluated for signs and symptoms of HF, such as dyspnea, nocturnal cough, elevated jugular venous pressure, and tachycardia. Based on these data, a clinical suspicion of HF (mild, moderate, or severe) was established. Subsequently, plasma levels of brain natriuretic peptide (BNP) were measured, confirming moderate or severe suspicion with BNP values >35-50 pg/mL[17]. All patients with a clinical suspicion of HF underwent an echocardiogram to assess cardiac structure, function, and classification of left ventricular ejection fraction (LVEF). HF was classified as reduced ejection fraction (LVEF <40%), intermediate (LVEF between 40% and 50%), or preserved (LVEF >50%)[17]. The presence or absence of HF was recorded in the internal control system, considering older adults as having HF regardless of the type of ejection fraction.

Using the food intake markers from the Food and Nutrition Surveillance System (SISVAN), the consumption of ultra-processed foods (independent variable) from the previous day was assessed[18]. The form contains four items exclusively for evaluating the consumption of UPF, and for each food marker, a healthcare professional would ask: "Did you consume this yesterday?" The markers are: I) Hamburger and/or processed meats (ham, mortadella, salami, sausage, hot dog); II) Sweetened beverages (soda, boxed juice, powdered juice, boxed coconut water, guarana/blackcurrant syrups, fruit juice with added sugar); III) Instant noodles, packaged snacks, or savory crackers; and IV) Filled biscuits, sweets, or treats (candies, lollipops, chewing gum, caramel, gelatin).

The response options were "yes," "no," and "don't know". No responses with the option "don't know" were reported. For analysis purposes, UPF were examined both individually and simultaneously. For the combination of UPF, a score was created with the number of UPF consumed the previous day ranging from 0 to 4. Each participant who answered "yes" received a score of "1," and "no" received a score of "0". Thus, simultaneous UPF consumption was classified using an ordinal scale ranging from zero (no foods) to four (four foods)[19]. The food consumption markers from SISVAN[18], integrated into a simple SUS (Unified Health System) form, reflect the overall quality of the diet well[19].

All sociodemographic information available in the internal control system of the Department of Epidemiological Surveillance was considered as covariates for the study. This included the following data: sex (male/female), age in completed years grouped by age range, skin color/race following a national classification (yellow/white/mixed-race/black/indigenous), and place of residence (capital/interior). Education level, measured by the number of years of formal education, was categorized into three groups (illiterate, < 8 years and ≥8 years) due to the diversity of possible responses. Additionally, information on pre-existing cardiovascular risk factors was used, including hypercholesterolemia, hypertension, diabetes, obesity, and smoking.

The data were analyzed using descriptive statistics (mean, standard deviation, absolute and relative

frequency distribution) and inferential statistics. The Kolmogorov-Smirnov test was employed to assess the normality of the age variable, indicating normality of the data (p=0.215). The independent t-test was used to compare the age of older adults with and without HF, and the Pearson chi-square test was used to examine potential interactions between HF and other variables. Binary logistic regression models (both crude and adjusted) were constructed to investigate the associations between UPF consumption and the prevalence of HF, estimating odds ratios (OR) and 95% confidence intervals (CI). In the adjusted analysis, all variables were included in the model to assess the probability of HF within each UPF group, regardless of the observed p-value in the crude analysis. A two-tailed p-value less than 0.05 was considered statistically significant.

DATA AVAILABILITY

The dataset is not publicly available due to containing information that compromises the privacy of research participants.

RESULTS

Table 1 displays the general characteristics and prevalence of heart failure in the participants. Out of the 1,322 older adults assessed, the majority fell within the age range of 60 to 69 years. Most were female (55.0%), of mixed race (45.2%), illiterate (47.2%), residing in the capital (64.1%), and reported consumption of UPF on the day before (71,8%). Although more than half of the participants had hypertension, diabetes mellitus, and hypercholesterolemia, lower prevalences of obesity and smoking were found. Overall, the prevalence of HF among the evaluated older adults was 15.4% (95% CI = 13.6–17.1). HF was associated with most of the covariates, except for sex [$\chi2(1, N = 1322) = 2.062$, $p = 0.151$, $Phi = 0.039$] and smoking [$\chi2(1, N = 1322) = 0.024$, $p = 0.878$, $Phi = 0.004$].

The crude and adjusted association analyses were conducted to examine the development of HF in relation to the consumption of UPF among older adults (Table 2). In the crude analysis, a higher risk of HF was observed in older adults who consumed UPF. In the adjusted model, all food groups maintained a statistically significant association with the development of HF: burgers and/or processed meats (OR = 1.97; 95% CI = 1.36–2.84), sweetened beverages [OR = 2.18; 95% CI = 1.44–3.29], instant noodles, packaged snacks or biscuits [OR = 2.53; 95% CI = 1.75–3.66], filled biscuits, sweets, and treats [OR = 2.59; 95% CI = 1.73–3.74]. Regarding the simultaneous consumption of UPF, the more frequent the consumption of different UPF, the higher the chances of older adults having HF, suggesting a direct dose-response relationship.

Table 1. Prevalence of heart failure and general characteristics of the older adults participating in the study. Roraima, Brazil, 2020.

Variables	Total n (%)	Heart Failure		*p*-value*
		Absent n (%)	Present n (%)	
Overall	1322	1.119 (84,6)	203 (15,4)	
Sex				
Female	727 (55.0)	606 (83.4)	121 (16.6)	0.151
Male	595 (45.0)	513 (86.2)	82 (13.8)	
Age, mean (sd)	70.4 (7.87)	69.4 (7.37)	75.9 (8.27)	<0.001†
Age range				
60-69	712 (53.8)	667 (93.7)	45 (6.3)	<0.001
70-79	416 (31.5)	328 (78.8)	88 (21.2)	
≥80	194 (14.7)	124 (63.9)	70 (36.1)	
Skin color/race				
Yellow	61 (4.6)	38 (62.3)	23 (37.7)	<0.001
White	302 (22.8)	265 (87.7)	37 (12.3)	
Black	222 (16.8)	182 (82.0)	40 (18.0)	
Mixed race	597 (45.2)	524 (87.8)	73 (12.2)	
Indigenous	140 (10.6)	110 (78.6)	30 (21.4)	
Education level in years				
Illiterate	624 (47.2)	496 (79.5)	128 (20.5)	<0.001
< 8	395 (29.9)	349 (88.4)	46 (11.6)	
≥ 8	303 (22.9)	274 (90.4)	29 (9.6)	
Place of residence				
Interior	475 (35.9)	376 (79.2)	99 (20.8)	<0.001
Capital	847 (64.1)	743 (87.7)	104 (12.3)	
Hypercholesterolemia				
Yes	719 (54.4)	549 (76.4)	170 (23.6)	<0.001
No	603 (45.6)	570 (94.5)	33 (5.5)	
Hypertension				
Yes	995 (75.3)	801 (80.5)	194 (19.5)	<0.001
No	327 (24.7)	318 (97.2)	9 (2.8)	
Diabetes Mellitus				
Yes	686 (51.9)	506 (79.8)	180 (26.2)	<0.001
No	636 (48.1)	613 (96.4)	23 (3.6)	
Obesity				
Yes	185 (14.0)	135 (73.0)	50 (27.0)	<0.001
No	1137 (86.0)	984 (86.5)	153 (13.5)	
Smoking				
Yes	154 (11.6)	131 (85.1)	23 (14.9)	0.878
No	1168 (88.4)	988 (84.6)	180 (15.4)	
Consumption of UPF				
Yes	949 (71.8)	767 (80.8)	185 (19.2)	<0.001
No	373 (28.2)	352 (94.4)	21 (5.6)	

n: absolute frequency; %: relative frequency; sd: standard deviation; *chi-square test; †: Independent t-test. **Source**: Authors, 2024.

Table 2. Crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) for heart failure associated with the consumption of ultra-processed foods in older adults Roraima, Brazil, 2020.

Variables	p	Crude		Adjusted*	
		OR (95% CI)	*p*-valor	OR (95% CI)	*p*-value
Burgers/ Processed Meats					
No	10.0	Ref.	<0.001	Ref.	<0.001
Yes	24.8	2.96 (2.18–3.74)		1.97 (1.36–2.84)	
Sweetened Beverages					
No	6.8	Ref.	<0.001	Ref.	<0.001
Yes	22.6	3.32 (2.79–3.85)		2.18 (1.44–3.29)	
Instant Noodles/ Packaged Snacks/ Savory Biscuits					
No	9.8	Ref.	<0.001	Ref.	<0.001
Yes	27.7	2.83 (2.60–3.06)		2.53 (1.75–3.66)	
Filled Biscuits/ Sweets/ Treats					
No	7.3	Ref.	<0.001	Ref.	<0.001
Yes	24.1	3.30 (2.88–3.72)		2.59 (1.73–3.74)	
Simultaneous Consumption of UPF					
None	5.6	Ref.		Ref.	
One	7.9	1.41 (1.31–1.49)		1.40 (1.06–2.77)	
Two	12.6	2.25 (2.17–3.52)	<0.001	2.13 (1.24–3.75)	<0.001
Three	23.4	4.18 (3.11–5.24)		3.53 (1.91–6.54)	
Four	38.8	6.93 (5.77–8.11)		5.25 (3.84–8.72)	

P: prevalence; *adjusted for sex, age, education level, skin color/race, place of residence, hypercholesterolemia, hypertension, diabetes, obesity, and smoking. **Source**: Authors, 2024.

DISCUSSION

Pioneering in Brazil, this study investigated the link between the consumption of ultra-processed foods (UPF) and heart failure (HF) in older adults. The results have significant implications for clinical practice and cardiovascular health in this population. A high prevalence of HF underscores the relevance of the issue and highlights the need for targeted interventions. Furthermore, the results reveal a dose-response relationship between UPF and the risk of HF. Remarkably, foods examined such as filled biscuits, sweets, and treats showed a detrimental impact, nearly tripling the odds of HF. This clarifies the critical role of diet quality, particularly concerning UPF, in the development and progression of HF.

The prevalence of HF found in the older population of this study is consistent with others conducted in Germany[20] and the United States[21]. Considered a major public health issue in the United States, HF affects over 6.2 million people, with an expected rise to 8 million diagnoses by 2030[22]. In Brazil, between 2008 and 2017, HF was the leading cause of cardiovascular hospitalization, resulting in nearly one billion dollars in HF-related admissions[23]. These findings may be a consequence of various factors, such as poorly controlled hypertension, diabetes, unhealthy dietary patterns, and physical inactivity[17].

The results revealed a direct link between the consumption of UPF, particularly filled biscuits, sweets, treats, and sweetened beverages, with HF in older adults. This reinforces previous research demonstrating the detrimental effects of sugar-laden beverages on heart health. For example, one study found that doubling the daily intake of sugary drinks significantly increases the risk of HF[24], while another linked the daily consumption of 250ml of these

beverages to an increased risk of HF[25]. These UPF are packed with various sugars (fructose, high-fructose corn syrup, inverted sugar, maltodextrin, dextrose, and lactose), making them highly palatable, appealing, and unfortunately, profitable[26]. Regular consumption of UPF fuels detrimental cardiometabolic effects such as weight gain and obesity[27], paving the way for diabetes, metabolic syndrome[11], and elevated inflammatory markers like C-reactive protein[28]. The close association of these conditions with cardiovascular diseases, including HF[17], underscores the importance of moderate consumption of sugar-rich UPF and the need to reduce simultaneous consumption of UPF to avoid the dose-response effect with HF. The unfavorable nutritional profile of UPF and its association with adverse health outcomes contribute directly to the development of HF.

The findings indicated that the consumption of burgers and/or processed meats, snacks, and instant noodles is statistically associated with the likelihood of older adults having HF. These foods are high in salt and sodium, and excessive intake of these nutrients has been associated with the development of hypertension – a significant risk factor for HF[8,17]. Previous studies have shown that a 1g increase in sodium intake increases the risk of cardiovascular diseases (CVDs) by 6%29 and that reducing added salt to meals can improve cardiovascular health[30]. Several factors associated with sodium intake (e.g., vascular stiffness, endothelial dysfunction, and hypertension) contribute to the development of HF[31]. It is hypothesized that chronic hypertension, as a consequence of excessive sodium consumption, burdens the heart, increasing its resistance to pumping blood throughout the body, weakening the cardiac muscle, and favoring the development of HF.

As a preventive measure, it is recommended to restrict sodium intake to 1,500 mg/day in patients at risk of HF (stages A and B)[32]. However, it is important for the general population to adopt the recommendation of up to 2g of sodium per day (equivalent to about 5g of salt per day) for the prevention of hypertension[33]. Therefore, it is advisable to follow a healthy dietary pattern that avoids foods high in sodium to reduce the risk of cardiovascular events in older adults. Restricting the consumption of burgers and/or processed meats, snacks, and instant noodles, especially due to their high salt and sodium content, can play a significant role in preventing HF and promoting cardiovascular health[33]. Thus, reducing salt intake is crucial as it will contribute to the reduction in the incidence of HF[34].

There are limitations in the present study that should be acknowledged. Firstly, the cross-sectional design does not allow for causal inferences between UPF and HF. Secondly, as we used data provided by the Department of Epidemiological Surveillance and were not responsible for the data entry into the system, we cannot rule out the possibility of underreporting. Thirdly, the asynchronous timing of UPF consumption and HF diagnosis prevents the exclusion of spurious associations, despite documented links between UPF and cardiovascular risk factors (e.g., hypertension and diabetes). Fourth, we acknowledge that the questionnaire assesses only the consumption of UPF on the previous day, which may not represent habitual food intake. Fifth, the food markers form does not gather detailed information on the quantity and frequency of UPF consumption throughout the day, nor on caloric intake. This could provide valuable insights into the relationship between UPF and HF. Therefore, we encourage future studies to address these limitations.

Despite the limitations, the study has important strengths. The large sample size of 1,322 older adults provided robust estimates, revealing a HF prevalence of 15.4% in this specific population. Such a finding underscores the magnitude of the issue and reinforces the link between diet quality and cardiovascular health, specifically highlighting UPF as potential risk factors for HF in older adults. The inclusion of various UPF groups (processed meats, beverages, snacks, and sweets) enhances the understanding of their impact.

CONCLUSION

In this study, the consumption of ultra-processed foods (UPF) more than tripled the chances of older adults having heart failure (HF), and the chances were up to five times higher among older adults who simultaneously consumed all four groups of UPF. Although we did not find differences in the proportion of men and women

with HF, the prevalence was high. It is essential for health authorities to promote awareness of the risks associated with UPF consumption, actively encouraging and fostering the adoption of healthy and balanced dietary patterns. Targeted nutritional education strategies can be implemented, focusing on reducing UPF consumption and increasing the intake of whole and minimally processed foods among older adults. Future research could delve deeper into the underlying mechanisms linking UPF to HF, as well as explore effective interventions to prevent and control the disease in the older adult's population.

AUTHORSHIP

- Guilherme J. S. Ribeiro – Study conception and design; Data analysis and interpretation; Drafting of the original manuscript; Approval of the final version.
- Luciana N. Nobre – Study conception and design; Manuscript revision and editing; Approval of the final version.
- Gabriela R. Santos – Study conception and design; Manuscript revision and editing; Approval of the final version.
- Emilio H. Moriguchi – Study conception and design; Critical review; Approval of the final version to be published.
- André de Araújo Pinto – Study conception and design; Critical review; Approval of the final version to be published; responsible for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Edited by: Letícia Sampaio Figueiredo

REFERENCES

1. Savarese G, Lund LH. Global Public Health Burden of Heart Failure. Card Fail Rev. 2017;3(1):7–11. Available at: doi: 10.15420/cfr.2016:25:2.
2. James SL, Abate D, Abate KH, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2018;392(10159):1789–58. Available at: doi: 10.1016/S0140-6736(18)32279-7.
3. McDonagh TA, Blue L, Clark AL, et al. European Society of Cardiology Heart Failure Association Standards for delivering heart failure care. Eur J Heart Fail. 2011;13(3):235–41. Available at: doi: 10.1093/eurjhf/hfq221.
4. Arruda VL de, Machado LMG, Lima JC, et al. Tendência da mortalidade por insuficiência cardíaca no Brasil: 1998 a 2019. Rev Bras Epidemiol. 2022;25:E220021. Available at: doi: 10.1590/1980-549720220021.2.
5. World Health Organization. Envelhecimento ativo: uma política de saúde. 2005. Acesso em 07 de janeiro, 2024. Available at: https://bvsms.saude.gov.br/bvs/publicacoes/envelhecimento_ativo.pdf
6. Malta DC, Morais Neto OLD, Silva Junior JBD. Apresentação do plano de ações estratégicas para o enfrentamento das doenças crônicas não transmissíveis no Brasil, 2011 a 2022. Epidemiol e Serviços Saúde. 2011;20(4):425–38. Available at: doi: 10.5123/S1679-49742011000400002.
7. Song P, Rudan D, Zhu Y, et al. Global, regional, and national prevalence and risk factors for peripheral artery disease in 2015: an updated systematic review and analysis. Lancet Glob Health. 2019;7(8):e1020–30. Available at: doi: 10.1016/S2214-109X(19)30255-4.
8. Kotseva K, De Backer G, De Bacquer D, et al. Lifestyle and impact on cardiovascular risk factor control in coronary patients across 27 countries: Results from the European Society of Cardiology ESC-EORP EUROASPIRE V registry. Eur J Prev Cardiol. 2019;26(8):824–35. Available at: doi: 10.1177/2047487318825350.
9. Kopp W. How western diet and lifestyle drive the pandemic of obesity and civilization diseases. Diabetes Metab Syndr Obes. 2019;12:2221–36. Available at: 10.2147/DMSO.S216791.
10. Du S, Kim H, Rebholz CM. Higher Ultra-Processed Food Consumption Is Associated with Increased Risk of Incident Coronary Artery Disease in the Atherosclerosis Risk in Communities Study. J Nutr. 2021;151(12):3746–54. Available at: doi: 10.1093/jn/nxab285.

11. Malik VS, Pan A, Willett WC, et al. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. Am J Clin Nutr. 2013;98(4):1084–102. Available at: doi: 10.3945/ajcn.113.058362.

12. Willett WC. Dietary fats and coronary heart disease. J Intern Med. 2012;272(1):13–24. Available at: doi: 10.1111/j.1365-2796.2012.02553.x.

13. Martini D, Godos J, Bonaccio M, et al. Ultra-Processed Foods and Nutritional Dietary Profile: A Meta-Analysis of Nationally Representative Samples. Nutrients. 2021;13(10):3390. Available at: doi: 10.3390/nu13103390.

14. Louzada ML da C, Cruz GL da, Silva KAAN, et al. Consumption of ultra-processed foods in Brazil: distribution and temporal evolution 2008–2018. Rev Saúde Pública. 2023;57:12. Available at: doi: 10.11606/s1518-8787.2023057004744.

15. Ribeiro GJ, Mendes AEP, Costa E de A, et al. Trends in food consumption by adults in a Brazilian northeastern state. J Taibah Univ Med Sci. 2023;18(6):1261–67. Available at: doi: 10.1016/j.jtumed.2023.04.008.

16. Oliveira GMM de, Brant LCC, Polanczyk CA, et al. Estatística Cardiovascular – Brasil 2020. Arq Bras Cardiol. 2020;115(3):308–439. Available at: doi: 10.36660/abc.20200812.

17. Rohde LEP, Montera MW, Bocchi EA, et al. Diretriz Brasileira de Insuficiência Cardíaca Crônica e Aguda. Arq Bras Cardiol. 2018;111(3):436–539. Available at: doi: 10.5935/abc.20180190.

18. Ministério da Saúde. Orientações para Avaliação de Marcadores de Consumo Alimentar na Atenção Básica Brasília, DF: Ministério da Saúde; 2015. Acesso em 07 de janeiro de 2024. Available at: http://bvsms.saude.gov.br/bvs/publicacoes/marcadores_consumo_alimentar_atencao_basica.pdf.

19. Louzada ML da C, Couto VDCS, Rauber F, et al. Food and Nutrition Surveillance System markers predict diet quality. Rev Saúde Pública. 2023;57:82. Available at: doi: 10.11606/s1518-8787.2023057005087.

20. Jacob L, Breuer J, Kostev K. Prevalence of chronic diseases among older patients in German general practices. Ger Med Sci. 2016;14:03. Available at: doi: 10.3205/000230.

21. Danielsen R, Thorgeirsson G, Einarsson H, et al. Prevalence of heart failure in the elderly and future projections: the AGES-Reykjavík study. Scand Cardiovasc J. 2017;51(4):183–9. Available at: doi: 10.1080/14017431.2017.1311023.

22. Benjamin EJ, Muntner P, Alonso A, et al. Heart Disease and Stroke Statistics-2019 Update: A Report From the American Heart Association. Circulation. 2019;139(10):e56–e528. Available at: doi: 10.1161/CIR.0000000000000659.

23. Fernandes ADF, Fernandes GC, Mazza MR, et al. A 10-Year Trend Analysis of Heart Failure in the Less Developed Brazil. Arq Bras Cardiol. 2020;114(2):222–31. Available at: doi: 10.36660/abc.20180321.

24. Rahman I, Wolk A, Larsson SC. The relationship between sweetened beverage consumption and risk of heart failure in men. Heart. 2015;101(24):1961–65. Available at: 10.1136/heartjnl-2015-307542.

25. Bechthold A, Boeing H, Schwedhelm C, et al. Food groups and risk of coronary heart disease, stroke and heart failure: A systematic review and dose-response meta-analysis of prospective studies. Crit Rev Food Sci Nutr. 2019;59(7):1071–90. Available at: doi: 10.1080/10408398.2017.1392288.

26. Monteiro CA, Cannon GJ. The role of the transnational ultra-processed food industry in the pandemic of obesity and its associated diseases: problems and solutions. World Nutr. 2019;10(1):89–99. Available at: doi: 10.26596/wn.201910189-99.

27. Pacheco LS, Lacey JV, Martinez ME, et al. Association Between Sugar-Sweetened Beverage Intake and Mortality Risk in Women: The California Teachers Study. J Acad Nutr Diet. 2022;122(2):320-33. Available at: doi: 10.1016/j.jand.2021.08.099.

28. Aeberli I, Gerber PA, Hochuli M, et al. Low to moderate sugar-sweetened beverage consumption impairs glucose and lipid metabolism and promotes inflammation in healthy young men: a randomized controlled trial. Am J Clin Nutr. 2011;94(2):479–85. Available at: doi: 10.3945/ajcn.111.013540.

29. Wang Y-J, Yeh T-L, Shih M-C, et al. Dietary Sodium Intake and Risk of Cardiovascular Disease: A Systematic Review and Dose-Response Meta-Analysis. Nutrients. 2020;12(10):2934. Available at: doi: 10.3390/nu12102934.

30. Ma H, Wang X, Li X, et al. Adding Salt to Foods and Risk of Cardiovascular Disease. J Am Coll Cardiol. 2022;80(23):2157–67. Available at: doi: 10.1016/j.jacc.2022.09.039.

31. Konerman MC, Hummel SL. Does Limiting Salt Intake Prevent Heart Failure? A Critical Appraisal. Curr Cardiovasc Risk Rep. 2016;10(2):7. Available at: doi: 10.1007/s12170-016-0487-4.

32. Khan MS, Jones DW, Butler J. Salt, No Salt, or Less Salt for Patients With Heart Failure? Am J Med. 2020;133(1):32–8. Available at: doi: 10.1016/j.amjmed.2019.07.034.

33. Barroso WKS, Rodrigues CIS, Bortolotto LA, et al. Brazilian Guidelines of Hypertension - 2020. Arq Bras Cardiol. 2021;116(3):516–658. Available at: doi: 10.36660/abc.20201238.

34. Levitan EB, Wolk A, Mittleman MA. Consistency with the DASH diet and incidence of heart failure. Arch Intern Med. 2009;169(9):851–7. Available at: doi: 10.1001/archinternmed.2009.56.