REVISTA CONTRIBUCIONES A LAS CIENCIAS SOCIALES

Exploratory study of the prevalence of high risk for coronary events in the brazilian population: evidence from two population-based surveys

Estudo exploratório da prevalência de alto risco para eventos coronarianos na população brasileira: evidências de dois inquéritos de base populacional

DOI: 10.55905/revconv.16n.6-093

Recebimento dos originais: 16/05/2023
Aceitação para publicação: 23/06/2023

Pedro Gilson Beserra da Silva
Master in Demography by Departamento de Demografia e Ciências Atuariais of Universidade Federal do Rio Grande do Norte
Institution: Universidade Federal do Rio Grande do Norte
Adress: Natal - RN, Brasil
E-mail: pedrogilsonsilva@yahoo.com.br
Orcid: https://orcid.org/0000-0002-3888-5807

Daniel Cardoso Portela Câmara
PhD in Sciences by Instituto Oswaldo Cruz of Fundação Oswaldo Cruz
Institution: Global Research and Analyses for Public Health Network (GRAPH–NETWORK)
Adress: Geneva - Suíça
E-mail: dcpchamber@gmail.com
Orcid: https://orcid.org/0000-0002-5439-4477

Taynãna César Simões
PhD in Public Health Epidemiology by Escola Nacional de Saúde Pública Sergio Arouca of Fundação Oswaldo Cruz
Institution: Instituto de Pesquisa René Rachou da Fundação Oswaldo Cruz
Adress: Belo Horizonte - MG, Brasil
E-mail: taynana.simoes@fiocruz.br
Orcid: https://orcid.org/0000-0002-5849-343X

Juliano dos Santos
PhD in Adult Health Nursing by Escola de Enfermagem of Universidade de São Paulo
Institution: Instituto Nacional de Câncer do Hospital do Câncer III
Adress: Rio de Janeiro - RJ, Brasil
E-mail: jlnsantos@yahoo.com.br
Orcid: https://orcid.org/0000-0001-9961-3576

REVISTA
CONTRIBUCIONES
A LAS CIENCIAS
SOCIALES

Aline Alves Ferreira
PhD in Public Health Epidemiology by Escola Nacional de Saúde Pública Sergio Arouca da Fundação Oswaldo Cruz
Institution: Instituto de Nutrição Josué de Castro da Universidade Federal do Rio de Janeiro
Adress: Rio de Janeiro - RJ, Brasil
E-mail: alineaf@nutricao.ufrj.br
Orcid: https://orcid.org/0000-0001-5081-3462

Angela Maria Geraldo Pierin
PhD in Adult Health Nursing by Escola de Enfermagem of Universidade de São Paulo
Institution: Universidade de São Paulo
Adress: São Paulo - SP, Brasil
E-mail: pierin@usp.br
Orcid: https://orcid.org/0000-0002-3274-7729

Karina Cardoso Meira
PhD in Epidemiology by Escola Nacional de Saúde Pública Sergio Arouca of Fiocruz
Institution: Universidade Federal do Rio Grande do Norte
Adress: Natal - RN, Brasil
E-mail: karina.meira@ufrn.br
Orcid: https://orcid.org/0000-0002-1722-5703

ABSTRACT
Circulatory system diseases are the leading causes of death and disability in the Brazilian's population. To carry out an exploratory analysis of temporal changes in the prevalence of high risk coronary events and associated factors in the Brazilian population based on the first phase of risk stratification of the Brazilian Guidelines on Cardiovascular Risk. This cross-sectional study was carried out in panels to assess temporal changes in the prevalence of high risk coronary events in Brazilian adults according to the first phase of risk stratification of the Brazilian Guidelines for Cardiovascular Prevention based on self-reported information from two national household surveys. Proportional differences tests and generalized linear models (Poisson Regression) were used to consider the complex survey samplings, namely NHS 2013 and NHS 2019. There was an increase in the proportion of high risk coronary events between the two surveys (10.05 vs 12.11, p<0.001). There was a higher prevalence of high risk coronary events in residents from the Center-South region of Brazil (PR=1.40; 95% CI 1.31-1.50), with advancing age (PR=4.87;95% CI 3.85-6.15), male (1.15 ; 95% CI 1.09-1.21), with regular, poor, or very poor health self-assessment (PR=2.63;95% CI 2.44-2.85), a smoking history (PR=1.12; 95% CI 1.06-1.17), underlying health conditions factors such as hypertension (PR=1.82 ; 95% 1.70-1.95) and high cholesterol (PR=1.31; 95% CI 1.08-1.60) and overweight/obesity (PR=1.42; 95% CI 1.32-1.56). There was an increase in the prevalence of high risk coronary events in the five years in the Brazilian population. The higher prevalence of this outcome was associated with sociodemographic factors, underlying health conditions factors, and a history of smoking and being overweight and obese.

Keywords: surveys, chronic noncommunicable diseases, epidemiological transition, cardiovascular diseases, risk factors.

REVISTA
CONTRIBUCIONES
A LAS CIENCIAS
SOCIALES

RESUMO

As doenças do aparelho circulatório são as principais causas de morte e incapacidade na população brasileira. Realizar uma análise exploratória das mudanças temporais na prevalência de eventos coronarianos de alto risco e fatores associados na população brasileira com base na primeira fase de estratificação de risco das Diretrizes Brasileiras de Risco Cardiovascular. Este estudo transversal foi realizado em painéis para avaliar as mudanças temporais na prevalência de eventos coronarianos de alto risco em adultos brasileiros de acordo com a primeira fase de estratificação de risco das Diretrizes Brasileiras de Prevenção Cardiovascular, com base em informações auto-referidas de dois inquéritos domiciliares nacionais. Foram utilizados testes de diferenças proporcionais e modelos lineares generalizados (Regressão de Poisson) para considerar as amostragens complexas das pesquisas, a saber, a PNS 2013 e a PNS 2019. Verificou-se um aumento da proporção de eventos coronários de alto risco entre os dois inquéritos (10,05 vs 12,11, p<0,001). Houve maior prevalência de eventos coronarianos de alto risco em residentes da região Centro-Sul do Brasil (RP=1,40; IC95% 1,31-1,50), com idade avançada (RP=4,87;IC95% 3,85-6,15), do sexo masculino (1,15 ; IC95% 1,09-1,21), com autoavaliação de saúde regular, ruim ou muito ruim (RP=2. 63; IC 95% 2,44-2,85), história de tabagismo (RP=1,12; IC 95% 1,06-1,17), factores de saúde subjacentes como hipertensão (RP=1,82; IC 95% 1,70-1,95) e colesterol elevado (RP=1,31; IC 95% 1,08-1,60) e excesso de peso/obesidade (RP=1,42; IC 95% 1,32-1,56). Houve um aumento na prevalência de eventos coronarianos de alto risco nos cinco anos na população brasileira. A maior prevalência desse desfecho esteve associada a fatores sociodemográficos, fatores de condições de saúde subjacentes, história de tabagismo e sobrepeso e obesidade.

Palavras-chave: inquéritos, doenças crônicas não transmissíveis, transição epidemiológica, doenças cardiovasculares, fatores de risco.

1 INTRODUCTION

Circulatory System Diseases represent the world's primary morbidity and cause of death due to population aging, urbanization, and westernization of habits and lifestyles, resulting from the demographic and epidemiological transition (GBD, 2020; WHO,2020). These morbidities are associated with a high degree of limitation and reduced ability to perform daily activities (GBD, 2020; Schmidt *et al*.,2020; WHO,2020), in addition to promoting a great socioeconomic impact on society due to the high cost of health and social security, as well as the life of families who usually spend resources to treat these morbidities (Abegunde *et al*.,2007;Pirani *et al*.,2017; Pullar *et al*.,2018). Low-income families are more exposed to risk factors for chronic non-communicable diseases (NCDs), have less access to health services, and are economically impacted. Furthermore, due to the costs associated with the treatment of NCDs, they reduce the resources to be spent on healthy food, housing, and education, feeding back the cycle of poverty associated with chronic diseases (Abegunde *et al*.,2007;Pirani *et al*.,2017; Pullar *et al*.,2018).

In Brazil, Circulatory System Diseases represent 31.2% of deaths, with the most prevalent underlying causes being Acute Coronary Syndrome (ACS), Stroke, Unstable Angina, and Decompensated Heart Failure. They represent the leading causes of death, along with neoplasms and external causes, generating high health costs due to prolonged treatment and social security due to disability retirement and withdrawal from treatments (Oliveira *et al*.,2020).In the last decade, in Brazil, there was a reduction in mortality from CSD due to the expansion of access to health services after the implementation of a universal and free Unified Health System (SUS - Sistema Único de Saúde) that promoted the expansion of Primary Health Care, access to medicines, as well as the improvement of Urgency and Emergency Networks and care for chronic non-communicable diseases (Macinko & Mendonça, 2018; Viacava *et al*.,2018). However, the SUS has not been able to correct the historical disparities in the access and quality of health services between Brazilian regions. Thus, the reduction in NCDs mortality rates is more significant in the Center-South region of Brazil. However, Brazilian deaths rates are very high compared to developed countries, with higher rates in individuals aged 40 to 59 years (Oliveira *et al*.,2020; Macinko & Mendonça, 2018; Malta *et al*.,2020; Viacava *et al*.,2018).

Faced with this reality and knowing that it is possible to advance NCDs prevention and control policies, Brazil, through the Global Plan to Combat chronic non-communicable Diseases and the 2030 Agenda of the Sustainable Development Goals, launched the Action Plan Strategies for Coping with NCDs in Brazil (2021 to 2030) (Brasil,2021). Through this plan, a surveillance system for these morbidities was implemented in the last years, which aims to reduce mortality from CSD 2030, as well as to decrease the prevalence of smoking, alcohol abuse, sedentary lifestyles, and unhealthy eating habits in the Brazilian population (Brasil,2021). Some population surveys stand out in their surveillance, information, evaluation, and monitoring axis, such as the National Health Survey in 2013 and 2019. The National Health Surveys (NHS) make it possible to know the health profiles and the distribution of risk factors in a population, with periodic updates and time-sequenced comparisons between geographic areas (IBGE,2015; Stopa *et al*.,2020). Due to the need for continuous surveillance of chronic non-communicable diseases, this study aims to carry out an exploratory analysis of temporal changes in the prevalence of high risk coronary events and associated factors in the Brazilian population based on the first phase of risk stratification of the I Brazilian Guidelines on Cardiovascular Risk (SBC,2014; SBC,2019).

2 METHODS

2.1 DATA SOURCE

This is a cross-sectional study carried out in panels to assess temporal changes in the prevalence of high risk for coronary events in Brazilian adult population according to the first phase of risk stratification of the I Brazilian Guidelines for Cardiovascular Prevention, based on information from two national household surveys. Changes in the prevalence of the variable of interest over time (2013 vs. 2019) and the influence of sociodemographic factors, eating habits, lifestyles, and health conditions on the prevalence of high risk for coronary events were evaluated. Data were obtained from the National Health Survey (NHS) in 2013 and 2019 by the Brazilian Institute of Geography and Statistics (IBGE) (IBGE,2015; Stopa *et al*.,2020). The NHS, with a 5-year periodicity, the sample was household-based, with samples stratified in three cluster stages: census sectors (primary units); households (second stage) and adult dwellers (third stage) (IBGE,2015; Stopa *et al*.,2020). The population of interest was composed of individuals participating in the surveys, aged 18 years and older, who were selected and had already answered the interview, totaling 60,202 adults in the NHS 2013 and 88,531 in the NHS 2019.Further details about the NHS sample design and other methodological aspects can be found elsewhere (IBGE,2015; Stopa *et al*.,2020).

2.2 DEPENDENT VARIABLE AND COVARITES

The dependent variable of this study, high risk for a coronary event (yes/no), was defined according to the recommendations of the first stratification phase of the I Brazilian Guidelines on Cardiovascular Prevention (SBC,2014) (Table 1). In the first phase of stratification, individuals at high risk for coronary events who present at least one of the conditions that characterize a significant atherosclerotic disease or its equivalent: type 1 or 2 diabetes mellitus; chronic kidney disease; or coronary artery, cerebrovascular or peripheral obstructive atherosclerotic disease with clinical manifestations (cardiovascular events) or a history of stroke or acute myocardial infarction or Angina Pectoris; and arterial revascularization procedures (and bypass or stent surgery) (SBC,2014). In this study we used the variables related to self-report of diabetes mellitus, history of acute myocardial infarction, angina, stroke, chronic kidney failure, and bypass or stent surgery.

The I Brazilian Guidelines on Cardiovascular Prevention risk stratification consists of four phases. Phase one assesses health history, and phases two to four require laboratory tests and blood pressure measurements (SBC,2014) Considering that the surveys used in this study do not present data on blood pressure measurements nor laboratory test results for all adults that were interviewed (Szwarcwald *et al.*,2019), only the first phase of the stratification was used to identify the prevalence of high risk for coronary events in the following ten years in the total number of adults that were interviewed in NHS 2013 (n=62,202) and NHS 2019 (n=88,531).

The covariates analysed in this study were sociodemographic variables, lifestyle (alcohol consumption, current smoking and past smoking, physical activity, and sedentary lifestyle), self-assessment of health and health conditions (systemic arterial hypertension, altered cholesterol, limitations for performing daily activities due to the presence of hypertension) and body mass index (BMI) were extracted. After combining and integrating the common variables in the two surveys through verification of completeness, coding of names, and standardization of response categories, an integrated database was created. The population of interest was composed of individuals participating in the surveys, aged 18 years and older, who were selected and had already carried out the interview

2.3 STATISTICAL ANALYSIS

The first step of the statistical analysis was to assign the sampling design using the weights and design effects of the two surveys, now in a single and integrated database, of which the sampling plan considers an interaction term between the sampling stratum and the observation period, in addition to the particularities of each individual drawing (Lee *et al.*,2006).

The prevalence of high risk coronary events (yes/no) and of the independent variables and respective 95% confidence intervals were estimated in the survey periods. The differences between these prevalences were tested using Pearson's chi-square test with the Rao-Scott correction, which considers sample weights and design effects in the calculations (Rao & Scot,1986). The significance of the differences was evaluated through the p-values of these tests and not through the overlapping of confidence intervals between the categories of variables. This practice can lead to erroneous conclusions since there is an increase in the probability of detecting false differences (Type I Error) (Rao & Scot,1986). Subsequently, the high risk for a coronary events Prevalence Ratios (PR) and 95% Confidence Intervals (CI) to time effect were estimated

using Generalized Linear Models (GLM) with Poisson probability distribution (Barros & Hirata,2003). The sociodemographic variables, habits and lifestyle, and health conditions were used for adjustment. We also evaluated the significance of the terms of the interaction of these explanatory variables with the year of the survey to assess changes in associations with the prevalence of high risk for a coronary event over time. All point and interval estimates, tests of differences in proportions, and regression models considered the sample weights and correction for design effects through the Survey package of the statistical software R (Barros & Hirata,2003; Lumley,2010; R Core Team,2020)

Multiple models were adjusted using as a predictor the potential factors pointed out in the univariate analyses. Variables with a value of $p \leq 0.20$ were the initial candidates to compose the final model using a non-optimized stepwise-forward method (Hosmer & Lemeshow,2000). The candidate variables that would make up the final model were all variables. After inclusion and exclusion of added variables in the order of greatest to least significant with the outcome, the significance of interactions between variables that remained throughout the process was tested. The comparison of the fit of the models was performed using the Akaike Information Criterion (AIC) (Hosmer & Lemeshow,2000). The choice of the final model considered epidemiological and biological plausibility, in addition to a statistical significance at the 5% level, with estimates of associations based on adjusted PR and 95% CI (Hosmer & Lemeshow,2000).

2.4 ETHICAL CONSIDERATIONS

The National Health Survey (NHS 2013 and 2019) was carried out by the Brazilian Institute of Geography and Statistics in partnership with the Ministry of Health, which provide microdata from the surveys without identifying the participants at the following website (IBGE,2021). The data used in this research are secondary data of universal access in which there is no identification of the subjects, and thus it was not submitted to the Research Ethics Committee according to Resolution 196/96 of the National Health Council.

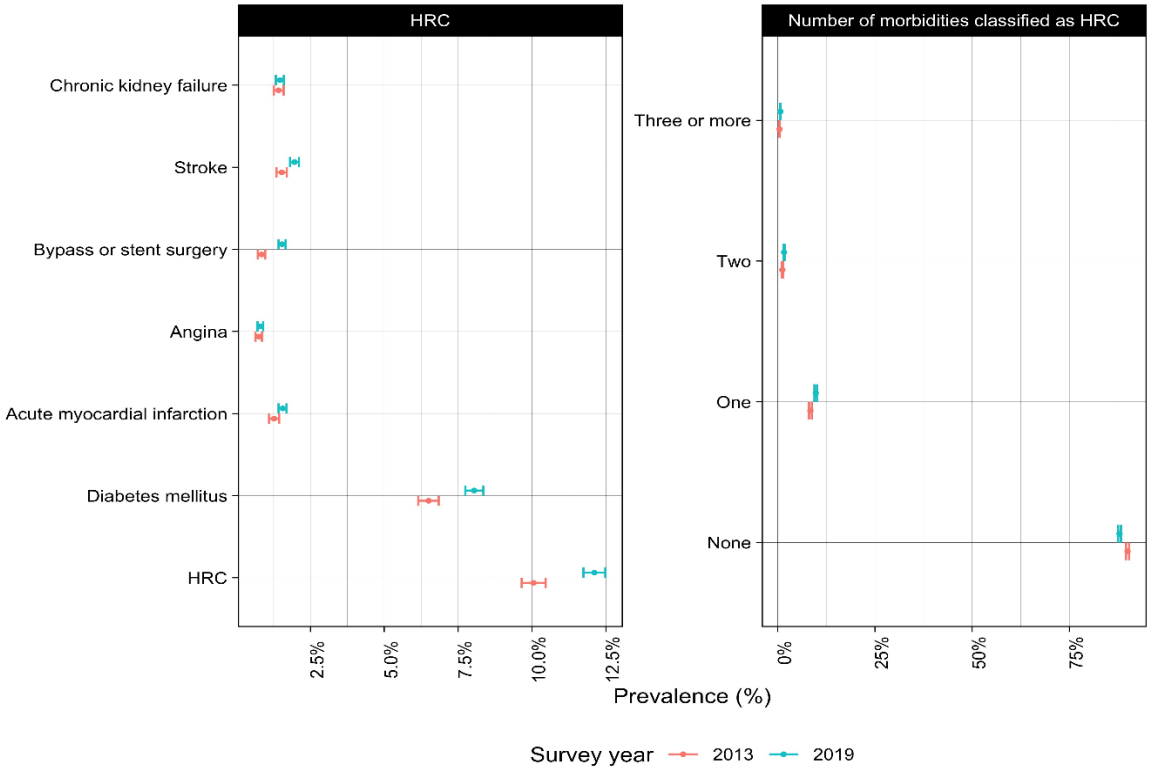
3 RESULTS

The estimates of the high risk for coronary events in the Brazilian adult population were 10.05 and 12.11% in 2013 and 2019, respectively. There was an increase in the prevalence of high risk coronary events in the Brazilian adult population between 2013 and 2019 (10.05 vs

12.11, p<0.001). The health conditions with the highest burdens on the prevalence of high risk for coronary events were diabetes mellitus, stroke, and chronic renal failure. It is noteworthy that in both periods, there was a significant increase among all health conditions that are part of the risk stratification, except for chronic renal failure (1.42 vs. 1.47, p=0.67) and angina (0.75 vs. 0.80, p=0.49) (Figure 1).

Individuals at high risk for coronary events (HRC) mostly lived in regions with more significant socioeconomic development in Brazil's Southeast, South, and Central-West. Residents in the Southeast (PR=1.25) and South (PR=1.29) regions had a higher prevalence of high risk for coronary events, and residents in the North region had a lower prevalence (PR=0.83) when compared to the geographical reference region of the Northeast. Residents of urban areas had a higher prevalence of HRC than residents of rural areas (PR=1.25) (Table 1). Regarding the sociodemographic variables adjusted for the year the survey was carried out, there was a progressive increase in the prevalence of high risk coronary events with advancing age. Men, people with higher education levels, non-whites, and people who did not live with a partner were less likely to be classified as being at high risk for coronary events and individuals who reported being in labor activity. On the other hand, having the household registered in the Family Health Strategy (FHS) increased the probability of high risk for coronary events (Table 1).

Figure 1. Prevalence estimates (with 95% confidence intervals) of morbidities and 270 health conditions of high-risk coronary event (HRC) according to the first phase of 271 risk stratification of the Brazilian Guidelines for Cardiovascular, according to year 272 of survey



PR= prevalence ratio; **CI95%=95% confidence intervals
Source: National Health Survey,2013 and 2019

Table 1: Prevalence estimates and PR with the HRC outcome adjusted for the year of the survey (with 95% confidence intervals) of the sociodemographic variables. Featured estimates in bold were considered significant at 5% significance.

Variables	High risk for coronary events yes (CI95%)	High risk for coronary events no (CI95%)	Adjusted PR* (CI95%)**
Geographic Region			
Northeast	9.70 (9.29-10.11)	90.30 (89.89-90.71)	
Central-West	10.97 (10.31-11.62)	89.03 (88.38-89.69)	1.13 (1.05-1.21)
North	8.09 (7.57-8.62)	91.91 (91.38-92.43)	0.83 (0.77-0.90)
Southeast	12.10 (11.59-12.60)	87.90 (87.40-88.41)	1.25 (1.17-1.32)
South	12.47 (11.82-13.12)	87.53 (86.88-88.18)	1.29 (1.20-1.38)
Zone			
Rural	9.16 (8.66-9.65)	90.84 (90.35-91.34)	
Urban	11.44 (11.14-11.75)	88.56 (88.25-88.86)	1.25 (1.18-1.33)
Age range (Years)			
18 to 24	1.68 (1.33-2.03)	98.32 (97.97-98.67)	
25 to 39	3.3 (3.01-3.58)	96.70 (96.42-96.99)	1.96 (1.56-2.45)
40 to 59	12.04 (11.53-12.54)	87.96 (87.46-88.47)	7.13 (5.76-8.83)
60 years or more	28.56 (27.74-29.38)	71.44 (70.62-72.26)	16.87(13.68-20.80)
Sex			
Female	12.06 (11.67-12.44)	87.94 (87.56-88.33)	
Male	10.07 (9.66-10.48)	89.93 (89.52-90.34)	0.84 (0.79-0.88)

Race/color			
White	11.73 (11.29-12.16)	88.27 (87.84-88.71)	
Non-white	10.63 (10.29-10.97)	89.37 (89.03-89.71)	0.90 (0.86-0.94)
Education			
None and pre-primary school	15.43 (14.90-15.95)	84.57 (84.05-85.10)	
High school	6.98 (6.59-7.37)	93.02 (92.63-93.41)	0.45 (0.42-0.48)
University education	10.84 (10.35-11.32)	89.16 (88.68-89.65)	0.71 (0.67-0.75)
Marital status			
Living with a partner	13.30 (12.84-13.77)	86.7 (86.23-87.16)	
Living without a partner	9.41 (9.09-9.72)	90.59 (90.28-90.91)	0.71 (0.67-0.74)
Do you work?			
No	16.89 (16.41-17.37)	83.11 (82.63-83.59)	
Yes	6.77 (6.45-7.08)	93.23 (92.92-93.55)	0.40 (0.38-0.42)

*PR= prevalence ratio; **CI95%=95% confidence intervals
Source: National Health Survey,2013 and 2019

Regarding alcohol consumption (number of days/week), people who were classified as being at high risk for coronary events were less likely to report alcohol abuse (men who had five doses or more at a time and women who had four doses or more at a time) (Table 2). As for smoking, there was no difference in the prevalence of high risk coronary events between smokers and non-smokers. However, there was a higher proportion of ex-smokers among individuals classified with HRC (Table 2). Concerning a sedentary lifestyle, there was a lower prevalence of physical activity in individuals with a high- risk for coronary events. In line with this, it was observed that a more significant proportion of individuals at high risk for coronary events were watching television for up to 6 hours a day (Table 2).

A more significant proportion of Brazilian residents at high risk for coronary events self-rated their health status as regular, poor, or very poor (Table 3). Furthermore, there was a higher prevalence of systemic arterial hypertension, high cholesterol, overweight, and obesity in individuals at high risk for coronary events (Table2). A gradient of increased prevalence of high risk for a coronary event with lifetime living with hypertension was observed. Furthermore, individuals with a high risk for a coronary event had a higher prevalence of limitations due to hypertension (Table 2).

Table 2. Prevalence estimates and PR with HRC outcome adjusted for the year of survey (with 95% confidence intervals) for lifestyle and behavioral variables, and health condition variables. Featured estimates in bold were considered significant at 5% significance.

Variables	**High risk for coronary events yes (CI95%)**	**High risk for coronary events no (CI95%)**	**Adjusted PR[a] (CI95%)[b]**
			Eating habits
			Habits and Lifestyle

Alcohol consumption (days/week)			
None	12.63 (12.31-12.96)	87.37 (87.04-87.69)	
Up to 5 days	6.04 (5.59-6.49)	93.96 (93.51-94.41)	0.47 (0.44-0.51)
More than 5 days	13.54 (11.23-15.85)	86.46 (84.15-88.77)	1.08 (0.90-1.28)
Physical activity practice			
No	12.85 (12.49-13.21)	87.15 (86.79-87.51)	
Yes	8.19 (7.78-8.59)	91.81 (91.41-92.22)	0.62 (0.59-0.66)
Hours watching TV			
Up to 3 hours	10 (9.68-10.32)	90 (89.68-90.32)	
Up to 6 hours	13.38 (12.82-13.95)	86.62 (86.05-87.18)	1.32 (1.26-1.40)
More than 6 hours	14.37 (12.71-16.03)	85.63 (83.97-87.29)	1.63 (1.43-1.85)
Currently smokes			
No	11.23 (10.93-11.52)	88.77 (88.48-89.07)	
Yes	10.49 (9.69-11.30)	89.51 (88.70-90.31)	0.94 (0.87-1.02)
Smoked in the past			
Yes	9.34 (9.05-9.63)	90.66 (90.37-90.95)	
No	17.39 (16.68-18.09)	82.61 (81.91-83.32)	1.83 (1.74-1.93)
			Health conditions
Health self-assessment			
Very good/good	5.47 (5.23-5.72)	94.53 (94.28-94.77)	
Regular	19.75 (19.08-20.42)	80.25 (79.58-80.92)	3.61 (3.41-3.82)
Poor/very poor	33.81 (32.23-35.38)	66.19 (64.62-67.77)	6.18 (5.79-6.60)
Hypertension			
No	5.69 (5.45-5.92)	94.31 (94.08-94.55)	
Yes	28.84 (28.04-29.64)	71.16 (70.36-71.96)	5.04 (4.80-5.30)
Limitation due to hypertension			
No	9.15 (8.88-9.41)	90.85 (90.59-91.12)	
Yes	40.23 (38.59-41.87)	59.77 (58.13-61.41)	4.41 (4.19-4.64)
High cholesterol			
No	8.42 (8.15-8.68)	91.58 (91.32-91.85)	
Yes	28.33 (27.26-29.41)	71.67 (70.59-72.74)	3.35 (3.18-3.52)

BMI			
Low to Normal	7.99 (7.61-8.36)	92.01 (91.64-92.39)	
Overweight	11.90 (11.39-12.42)	88.10 (87.58-88.61)	1.48 (1.39-1.58)
Obesity	17.47 (16.63-18.31)	82.53 (81.69-83.37)	2.17 (2.03-2.32)

[a]PR= prevalence ratio; [b]CI95%=95% confidence intervals
Source: National Health Survey,2013 and 2019

Among NHS (2013) and NHS (2019), after estimating the multiple models, an increase in the prevalence of high-risk coronary events was observed with advancing age. Likewise, there was a higher prevalence of high risk in men (PR=1.15) compared to women and in the Southeast, South, and Midwest regions compared to the Northeast region, and in those who reported a history of smoking, who evaluated their health as regular, poor or very poor. An increase in the prevalence of high risk for coronary events was also observed in Brazilians who reported arterial hypertension (PR=1.82), and high cholesterol, who said limitations in their day-to-day activities due to systemic arterial hypertension, and who were overweight or obese. (Table 3). On the other hand, there was a lower prevalence of high risk for a coronary event among the surveys in individuals who reported that they were working. (Table 3).

Table 3: Factors associated with high risk for a coronary event in the multiple model, according to the I Brazilian Guidelines on Cardiovascular Prevention, based on data from the National Health Survey, Brazil, 2013 and 2019.

Variables	**Unadjusted PR[a] (IC95%)**	**Adjusted PR (IC95%[b])**
Sociodemographic Variables		
Age group (years)		
18 - 24	1	
25-39	1.96 (1.56-2.45)	1.51 (1.18-1.93)
40 - 59	7.13 (5.76-8.83)	3.27 (2.59-4,14)
60 or older	16.87 (13.68-20.80)	4.87 (3.85-6.15)
Sex		
Female	1	
Male	0.84 (0.79-0.88)	1.15 (1.09-1.21)
Geographic region		
Northeast	1	
North	1.13 (1.05-1.21)	1.03 (0.96-1.11)
Southeast	0.83 (0.77-0.90)	1.40 (1.32-1.48)
South	1.25 (1.17-1.32)	1.40 (1.31-1.50)

Central-West	1.29(1.20-1.38)	1.34 (1.25-1.44)
Do you work?		
No	1	
Yes	0.40 (0.38-0.42)	0.81 (0.76-0.86)
Health conditions		
Self-assessment of health condition		
Very good/good	1	
Regular	3.61 (3.41-3.82)	2.05 (1.92-2.18)
Poor/very poor	6.18 (5.79-6.60)	2.63 (2.44-2.85)
Diagnosis of high blood pressure		
No	1	
Yes	5.04 (4.80-5.30)	1.82 (1.70-1.95)
High cholesterol		
No	1	
Yes	3.35 (3.18-3.52)	1.31 (1.08-1.60)
Limitation due to hypertension		
No		
Yes	4.41 (4.19-4.64)	1.31 (1.06-1.81)
Body mass index		
Low to Normal	1	
Overweight	1.48 (1.39-1.58)	1.21 (1.12-1.31)
Obesity	2.17 (2.03-2.32)	1.42 (1.32-1.56)
Habits and Lifestyle		
Smoked in the past		
No	1	
Yes	1.83 (1.74-1.93)	1.12 (1.06-1.17)

[a]PR= prevalence ratio; [b]CI95%=95% confidence intervals
Source: National Health Survey,2013 and 2019

4 DISCUSSION

There was an increase in the prevalence of adult Brazil residents classified as being at high risk for a coronary event between 2013 and 2019, and the prevalence of at least one of the conditions that characterize a significant atherosclerotic disease, or its equivalent was greater than 12%, highlighting diabetes mellitus, chronic renal failure, and history of stroke in two periods analyzed. Also, considering that in this study, it was only possible to carry out the first phase of risk stratification, it is believed that the prevalence of high risk coronary events in the Brazilian population may be higher than that observed in the present study. As evidenced by studies carried out with the 2013 HNS subsample, which found a prevalence of 38.1% of high

risk for coronary events in the adult population between the ages of 45 and 64 years according to the Brazilian Guidelines on Cardiovascular Prevention (Malta *et al*.,2021a), and 19.4% according to the Framingham score, being 8.7% in women and 21.6% in men (Malta *et al*.,2021b). Notably, studies on the stratification of cardiovascular risk were performed with a subsample of the National Health Survey (2013), in which laboratory tests and blood pressure measurements were measured.

The increase in the prevalence of Brazilian adults being classified at high risk for a coronary event is related to the accelerated population aging that occurred in Brazil in the last five decades, which is associated with urbanization, industrialization, and westernization of habits and lifestyles (GDB,2020;Oliveira *et al*.,2020; Nascimento *et al*.,2018;Vasconcelos & Gomes,2012;), which has contributed to the increase in the incidence, prevalence, and mortality of non-communicable diseases. This increase in prevalence in high risk coronary events can also be evaluated as a positive indicator of access to health services necessary for the diagnosis of a disease (diabetes mellitus, angina, chronic renal failure, acute myocardial infarction, and stroke) and/or for performing surgical procedures for performing a bypass graft and/or placement of stents (Barros et al.,2011; Macinko & Mendonça,2018).

It is believed that the greater access of Brazilians to clinical and laboratory diagnostic tests due to the implementation of the universal and free SUS, contributed to the increase in the longevity of individuals affected by NCDs (Viacava *et al*.,2018). Confirmation of this hypothesis can be seen by comparing three Brazilian population surveys carried out between 2008,2013 and 2019, which show an increase in the proportion of medical appointments in the last year and an increase in the coverage of the family health strategy, characterizing increased access to services among individuals with some NCDs (Simões *et al*.,2021). Despite the advances observed after the implementation of the SUS, there are still weaknesses in reducing exposure to risk factors, creating environments that make them accessible and encourage healthy choices, in addition to weaknesses in the provision of a line of care with the ability to detect early conditions of intermediate health care for a coronary events, promote timely treatment and reduce sequelae and deaths, especially in geographic regions of greater socioeconomic vulnerability (Brasil, 2021;Castro *et al*.,2019).

In the present study, the highest prevalence of high risk for coronary was observed in residents of the Center-South region of Brazil and this finding may be related to the fact that this

region has an older population and is in a more advanced stage of the demographic transition, where there are higher rates of incidence, prevalence, and mortality from NCDs (Oliveira *et al*.,2018; Malta *et al*.,2020; Vasconcelos & Gomes,2012; Simões *et al*.,2021). In addition, these locations have the most organized Health System and greater access to health services at all levels of care complexity, reducing the lethality of NCDs and increasing the prevalent cases of these morbidities (Castro *et al*.,2019; Simões *et al*.,2021; Viacava *et al*.,2018). Thus, these findings may be related to the survival bias, that may appear in cross-sectional studies because when studying prevalent cases, factors associated with a greater or lesser probability of survival will interfere with the probability of being part of the study sample.In addition to the geographic region of residence, other socioeconomic and demographic variables related to high risk for coronary events were the male gender, age, and being in a labor activity at the time of the interview.The higher prevalence of high risk for a coronary in men can be associated greater exposure to factors risk for chronic non-communicable diseases, especially regarding smoking, alcohol abuse and non-adherence to the treatment of NCDs that predispose them to get sick and die from these diseases (Malta *et al*.,2017;Malta *et al*.,2020;Malta *et al*.,2021a; Velasquez-Melendez *et al*.,2015).

The association between high risk for a coronary events and advancing age result since aging generates greater stiffening of the arteries and peripheral vascular resistance, a physiological situation that, associated with prolonged exposure to risk factors for NCDs, increases the incidence and prevalence of cardiovascular diseases (GDB,2020; Malta *et al*.,2021;Nascimento *et al*.,2018;Oliveira *et al*.,2020; Pullar *et al*.,2018;WHO,2020), as well as related disabilities to these diseases. The disabilities generated by the complications of NCDs and changes related to advancing age may also explain the fact that there is a higher prevalence of activity limited by the presence of arterial hypertension in individuals classified as at high risk for coronary events (GDB,2020; Malta *et al*.,2021a; Nascimento *et al*.,2018; Oliveira *et al*.,2018; Schmidt *et al*.,2020; WHO,2020). A lower ability to perform activities of daily living may be associated with a higher prevalence of high risk individuals classifying their health as regular, poor or very poor (Malta *et al*.,2021a).

On the other hand, the lower prevalence of high risk for coronary events in individuals who reported work activities at the time of the surveys can be explained by the fact that the comorbidities used in the first stage of risk stratification of the I Brazilian Guidelines for

Cardiovascular Prevention are more prevalent in the elderly and are related to disabilities that make it impossible to work (SBC,2014;Schmidt *et al*.,2020) , and thus, possibly, many of the individuals classified as being at high risk for coronary events would already be retired due to age or disability, or on sick leave for health treatment in the context of the surveys. It is noteworthy that the incapacity to work related to NCDs and their sequelae cause a great financial impact on the Health System, social security, income and quality of life of individuals and their families (Abegunde *et al*.,2007; GDB,2020;Pullar *et al*.,2018;WHO,2020). Studies have shown that the reduction in income associated with the presence of NCDs increases the exposure of these families to risk factors for these morbidities at the same time reducing access to health services and adoption of preventive measures, contributing to the vicious cycle of poverty-related to NCDs (Abegunde *et al*.,2007; GDB,2020;Pullar *et al*.,2018;WHO,2020).

Brazilians at high risk for a coronary event showed a higher prevalence of high risk for a coronary event in Brazilians who self-reported arterial hypertension, high cholesterol, overweight and obesity. Hypertension is the main modifiable risk factor for cardiovascular disease, chronic kidney disease, and premature death. A recent study identified that 25% of the Brazilian adult population self-reported arterial hypertension, associated with advancing age, among former smokers, with high salt intake and ultra-processed foods (Malta *et al*., 2022). Despite pharmacological and non-pharmacological treatments of proven efficacy and effectiveness for treating this morbidity, the prevalence of blood pressure control has been only 10.30% in middle and low-income countries, increasing the risk of coronary events (Geldsetzer *et al*.,2019). In our study, Brazilians who self-reported hypertension had a 1.82 chance of a history of diabetes, heart attack, stroke, chronic renal failure, angina, and revascularization surgery, compared to those who did not report this disease.

The excess of weight, represented by overweight and obesity, is also considered one of the main risk factors for diseases of the circulatory system and predisposes individuals to other risk factors such as physical inactivity, hypertension, diabetes mellitus and dyslipidemia. Therefore, it is expected that the interaction between dyslipidemia and overweight would increase the probability of a coronary events (Pirani *et al*.,2017; Malta *et al*.,2020; Mozaffarian *et al*.,2016; Tzoulaki *et al*.,2016). Brazil is in an accelerated demographic, epidemiological, and nutritional transition process, showing an upward trend in the prevalence of overweight and obesity (Brasil,2022; Ferreira *et al*.,2021). According to data from Vigitel, from 2006 to 2021,

there was a significant increase in the prevalence of obesity in all Brazilian capitals, in both sexes and adults. In the period from 2006 to 2021, the prevalence of obesity ranged from 11.8% to 22.4 (+89.8%), with an annual percentage variation of 0.66% (CI95% 0.57-0.74%) (Brasil,2022) We believe that this change in the nutritional status of the Brazilian population may be associated with changes in the pattern of food consumption, with a significant increase in the consumption of ultra-processed foods (Gonçalves *et al*.,2019;Jaime *et al*.,2015;Oliveira *et al*.,2020).

The consumption of ultra-processed foods reflects the nutritional transition, driven by the process of urbanization and westernization of habits and lifestyle, which has intensely changed food consumption in various locations, due to greater access to ultra-processed foods, in addition to the high cost of fresh foods such as fruits and vegetables. This context has increased the risk of circulatory system diseases, especially in low-income and vulnerable populations (Oliveira *et al*.,2020; Gonçalves *et al*.,2019;Jaime *et al*.,2015).

In the present study among the risk factors for NCDs, only past smoking history remained associated with high risk for a coronary event after estimating the multiple model.It is believed that the association between past smoking history and high risk for coronary events, and the non-association with current smoking, may be related to the survival bias present in prevalence studies. Thus, individuals with comorbidities used in risk stratification, who maintain the habit of smoking, are more likely of complications and death in relation to individuals who no longer smoke.

The results of the present study should be carefully evaluated, as its data sources are cross-sectional surveys in which information on health history and risk factors can be associated with differentiated access to health services, in addition to survival bias. Furthermore, this is an exploratory study of initial high risk screening for a coronary event, in which only the first stage of stratification of the Global Risk Score (GRS) was performed. However, it makes a great contribution to the monitoring of Noncommunicable Diseases, as it is a study whose surveys are nationally representative, with internal validity of the information (Stopa *et al*., 2020; Moreira *et al*., 2020). The health conditions used in the risk stratification of the present study are based on self-report (diabetes mellitus, chronic renal failure, angina, history of infarction, history of stroke, history of coronary artery bypass graft surgery), and thus are subject to less validity than information based on the evaluation of medical records and, therefore, the prevalence of target organ damage in the Brazilian adult population may be higher than that evidenced in our study.

However, several studies that evaluated the reliability of chronic non-communicable diseases and their risk factors such as BMI, physical activity, diet, arterial hypertension and self-reported diabetes mellitus have shown satisfactory validity and reproducibility, when these self-reported variables are compared with those measured (Monteiro *et al*.,2008; Moreira *et al*.,2020; Najafi *et al*.,2019;Onur *et al*.,2008). Therefore, self-reported data constitute an important tool in the epidemiological surveillance of the prevalence of chronic non-communicable diseases and their risk and protection factors at the population level, helping in the planning and evaluation of health policies (Monteiro *et al*.,2008; Moreira *et al*.,2020; Najafi *et al*.,2019; Oneur *et al*.,2008).

Despite the limitations of the present study, it makes a great contribution to the monitoring of Non-Communicable Diseases, signaling for the increase in the prevalence of high risk for a coronary event among population surveys, with more than 12% of the adult Brazilian population in 2019. These Brazilians are at high risk of an acute coronary event in the next ten years (risk >20% for men and >10% for women over a 10-year period), if prevention and control measures are not carried out. These findings represent a challenge for the Brazilian health system, especially regarding the design and implementation of health policies for the prevention and care of individuals with CNCD, with a longitudinal and comprehensive approach. will need a well-articulated care network, from primary care to prevention to high complexity.

5 CONCLUSIONS

Between the NHS (2013) and NHS (2019), there was an increase in the high risk for a coronary event in the Brazilian adult population, according to the Brazilian Guideline for Cardiovascular Prevention, and the high risk for a coronary event was associated with sociodemographic factors, living conditions health and habits and lifestyle. A greater chance of high risk was observed in Brazilian adults residing in the most developed regions of Brazil (Center-South), with advancing age, male, with regular, poor, or very poor health self-assessment, a smoking history, underlying health conditions factors such as hypertension and high cholesterol and overweight/obesity. The results of this study point to the need for more effective measures with a longitudinal and comprehensive approach to preventing and caring for affected individuals to prevent new acute coronary events in the next ten years.

REFERENCES

Abegunde, D.O., Mathers, C.D., Adam, T., Ortegon, M., & Strong, K.(2007). The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet*.;370: (9603) 929–38.

Barros, A.J., & Hirakata, V.N.(2003). Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol*, 3;23.

Barros, M.B.A., Francisco, P.M.S.B., Zanchetta, L.M., & César, C.L.G. Tendências das desigualdades sociais e demográficas na prevalência de doenças crônicas no Brasil, PNAD: 2003- 2008.(2011). *Ciênc. Saúde Coletiva*,16:3755-3768.

Brasil.Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Análise em Saúde e Vigilância de Doenças Não Transmissíveis. Plano de Ações Estratégicas para o Enfrentamento das Doenças Crônicas e Agravos não Transmissíveis no Brasil 2021-2030.(2021). Brasília: Ministério da Saúde.

Brasil.Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Análise em Saúde e Vigilância de Doenças Não Transmissíveis. Vigitel Brasil 2006-2021: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico : estimativas sobre frequência e distribuição sociodemográfica do estado nutricional e consumo alimentar nas capitais dos 26 estados brasileiros e no Distrito Federal entre 2006 e 2021 : estado nutricional e consumo alimentar.(2022); Brasília: Ministério da Saúde.

Castro, M.C., Massuda, A., Almeida, G., Menezes –Filho, N.A., Andrade, M.V., Noronha, K.V.M.S., *et al*.(2019) Brazil's unified health system: the first 30 years and prospects for the future. *Lancet*,394:345-356

Ferreira, A.P. de S., Szwarcwald, C.L., Damacena, G.N., & Souza -Júnior, P.R.B. de. Increasing trends in obesity prevalence from 2013 to 2019 and associated factors in Brazil.(2021). *Revista Brasileira de Epidemiologia*,24(suppl 2). https://doi.org/10.1590/1980-549720210009.supl.2
Foundation for Statistical Computing. R Core Team. (2020). R: *A language and environment for statistical computing*.

GBD 2019.(2020). Risk factors collaborators. Global burden of 87 risk factors in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*, 396(10258) :1223-1249.

Geldsetzer, P., Manne-Goehler, J., Marcus, M.E., Ebert, C., Zhumadilov, Z., Wesseh, C.S., *et al*.(2019). The state of hypertension care in 44 low-income and middle-income countries: a cross-sectional study of nationally representative individual-level data from 1·1 million adults. *Lancet* , 24;394(10199):652-662.

Gonçalves, R.P.F., Haikal, D.S., Freitas, M.I.F., Machado, Í., & Malta, D.C.(2019) Self-reported medical diagnosis of heart disease and associated risk factors: National Health Survey. *Rev Bras Epidemiol*, 22 (Suppl 02).

Hosmer, D.W., Lemeshow,S. (2000).*Applied logistic regression*. 2nd Edition, John Wiley e Sons, Inc.

Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saúde 2013: Acesso e utilização dos serviços de saúde, acidentes e violências: Brasil, Grandes Regiões e Unidades da Federação.(2015). IBGE.

Instituto Brasileiro de Geografia e Estatística (IBGE). *Sistema IBGE de recuperação automática* . Rio de Janeiro (RJ): IBGE; 2021.

Jaime, P.C., Stopa, S.R., Oliveira, T,P., Vieira, M.L., Szwarcwald, C.L.,& Malta, D.C.(2015). Prevalence and sociodemographic distribution of healthy eating markers, National Health Survey, Brazil 2013.. *Epidemiol. Serv. Saúde*,24(2).

Lee, S., Davis, W.W., Nguyen, H.A., McNell, T.S., Brinck, J.M., & Flores-Cervantes, I.(2006). Examining trends and Averages Using Combined Cross-Sectional Survey Data from Multiple Years. *Center for Health Policy Research*,24:1-25.

Lumley, T. *Complex Surveys: A Guide to Analysis Using R*.(2010) . John Wiley.

Macinko, J., & Mendonça, C.S. Estratégia Saúde da Família, um forte modelo de Atenção Primária à Saúde que traz resultados. (2018). *Saúde debate*, 42(1): 18-37. https://doi.org/10.1590/0103-11042018S102

Malta, D.C., Bernal, R.T.I., Lima, M.G., Araújo, S.S.C., Silva, M.M.A., & Freitas, M.I.F. (2017).Doenças crônicas não transmissíveis e a utilização de serviços de saúde: análise da Pesquisa Nacional de Saúde no Brasil. *Revista de Saúde Pública*,51, Supl: 1-4s.

Malta, D.C., Teixeira, R., Oliveira, G.M.M., & Ribeiro, A.L.P,. (2020). Mortalidade por doenças cardiovasculares segundo o sistema de informação sobre mortalidade e as estimativas do estudo carga global de doenças no Brasil, 2000-2017. *Arq. Bras. Cardiol*,115: 152-160.

Malta, D.C., Pinheiro, P.C., Texeira, R.A., Santos, F.M., Ribeiro, A.L.P., Brant, L.C.C., *et al*. Prevalência de alto risco cardiovascular na população adulta brasileira segundo diferentes critérios: estudo comparativo.(2021a). *Ciência & Saúde Coletiva*,26:1221-1231.

Malta, D.C., Pinheiro, P,C,, Texeira, R.A., Machado, I,E,, Santos, F,M,, Ribeiro, A.L.P., *et al*. Estimativas do risco cardiovascular em dez anos na população brasileira: Um estudo de base populacional.(2021b). *Arq Bras Cardiol*. 116:423-431.

Malta, D.C., Bernal,R.T.I.,Ribeiro,E.G.,Moreira,A.D.,Felisbino-Mendes,M.S., & Velásquez-Meléndez, J.G. Hipertensão arterial e fatores associados: Pesquisa Nacional de Saúde, 2019.(2022); *Rev Saude Publica*,56:122.

Monteiro, C.A., Florindo, A.A., Claro, R.M., & Moura, E.C. (2008).Validade de indicadores de atividade física e sedentarismo obtidos por inquérito telefônico. *Rev Saude Publica*, 42(4):575-581.

Moreira, A.D., Gomes, C.S., Machado, I.E., Malta, D.C., & Felisbino-Mendes, MS.(2020). Saúde cardiovascular e validação do escore autorreferido no Brasil: uma análise da Pesquisa Nacional de Saúde. *Ciênc. Saúde Coletiva*,25(11).

Mozaffarian, D., Benjamin, E.J., Go, A.S., Arnet,D.K., Blaha. M.J., Cushman, M., *et al*. (2016). Executive Summary: Heart Disease and Stroke Statistics—2016 Update A Report From the American Heart Association. *Circulation*,133:447-454.

Nascimento, B.R,, Brant, L.C.C., Oliveira, G.M.M., Malachias, M.V.B., Reis, G.M.A., Texeira, R.A., *et al*.(2018). Cardiovascular disease epidemiology in portuguese-speaking countries: data from the Global Burden of Disease, 1990 to 2016. *Arq Bras Cardiol*. 110:500-11

Najafi, F., Moradinazar, M., Hamzeh, B.,& Rezaeian, S. (2019).The reliability of self-reporting chronic diseases: how reliable is the result of population-based cohort studies. *J Prev Med Hyg*,60(4):E349-E353.

Oliveira, G.M.M., Brant, L.C.C., Polanczyk, C.A., Biolo, A., Nascimento, B.R., Malta, D.C., *et al*. Estatística Cardiovascular – Brasil 2020.(2020). *Arq. Bras. Cardiol*,115:308-439.

Onur, I., Velamuri, M. The gap between self-reported and objective measures of disease status in India.(2008). *PLoS ONE*, 13(8):e0202786. .

Pirani, N., & Khiavi, F.(2017). Population Attributable Fraction for Cardiovascular Diseases Risk Factors in Selected Countries: A comparative study. *Mater Sociomed*, 29(1):35-39.

Pullar, J., Allen, L., Townsend, N., Williams, J., Foster, C., Roberts, N., *et al*. The impact of poverty reduction and development interventions on non-communicable diseases and their behavioural risk factors in low and lower-middle income countries: A systematic review.(2018).*Plos One*, 23(13):e:0193378.

Rao, J.N.K., & Scott, A.J. (1984). On Chi-Squared Tests for Multiway Contingency Tables with Cell Proportions Estimated from Survey Data. *The Annals of Statistics*, 12:46-60.

Schmidt, T.P., Wagner, K.J.P., Schneider, J.C., & Danielewic, L. (2020). Multimorbidity patterns and functional disability in elderly Brazilians: a cross-sectional study with data from the Brazilian National Health Survey. *Cad. Saúde Pública*, 30;36(11):e00241619.

Simões, T.C., Meira, K.C., dos Santos, J.,& Câmara, D.C.P.(2021) Prevalence of chronic diseases and access to health services in Brazil: evidence of three household surveys. *Ciência & Saúde Coletiva*,26:1221-1231.

Sociedade Brasileira de Cardiologia. I Diretriz de prevenção cardiovascular da Sociedade Brasileira de Cardiologia - Resumo Executivo.(2014). *Arq. Bras. Cardiol*, 102:420-431

Sociedade Brasileira de Cardiologia. (2019).Atualização da diretriz de prevenção cardiovascular da Sociedade Brasileira de Cardiologia – 2019. *Arq Bras Cardiol*, 113:787-89.

Stopa ,S.R., Szwarcwald, C.L., Oliveira, M.M., Gouvea, E.C.D.P., Vieira, M.L.F.P., Freitas, M.P.S., *et al*. (2020).Pesquisa Nacional de Saúde 2019: histórico, métodos e perspectivas. *Epidemiol. Serv. Saúde*, 29(5), e2020315.

Szwarcwald, C.L., Malta, D.C., Souza, Júnior. P.R.B., Almeida, W.S., Damacena, G.N., Pereira, C.A., *et al*.(2019). Exames laboratoriais da Pesquisa Nacional de Saúde: metodologia de amostragem, coleta e análise dos dados. *Rev Bras Epidemiol.* 22:E190004.

Tzoulaki I, Elliott P, Kontis V, Ezzati M. Worldwide exposures to cardiovascular risk factors and associated health effects: current knowledge and data gaps. (2016). *Circulation*,133:2314-33.

Vasconcelos, A.M.N., & Gomes, M,M.F.(2012). Transição demográfica: a experiência brasileira. Epidemiol. Serv. Saúde,21:539-548.

Velasquez-Melendez, G., Felisbino-Mendes, M,S,, Matozinhos, F.P., Claro, R., Gomes, C.S., & Malta, D.C. (2015). Ideal cardiovascular health prevalence in the Brazilian population - National Health Survey (2013). *Rev Bras Epidemiol*,18:97-108.

Viacava, F., Oliveira, R.A.D., Carvalho, C.C., Laguardia, J., & Bellido, J.G.(2018). SUS: oferta, acesso e utilização de serviços de saúde nos últimos 30 anos. *Ciênc. Saúde Coletiva*,23:1751-1762.

World Health Organization. (2020). Noncommunicable diseases: progress monitor 2020. World Health Organization. Available from:

Zhang, Y.B., Pan, X.F., Chen, J., Cao, A., Xia, L., Zhang, Y., *et al*.(2021) Combined lifestyle factors, all-cause mortality and cardiovascular disease: a systematic review and meta-analysis of prospective cohort studies. *J Epidemiol Community Health.* 75:92-99.