ORIGINAL ARTICLE

Prevalence and factors associated with arterial hypertension in adults living in Senador Canedo, Goiás, Brazil: a population-based study, 2016*

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Resumo

Objective: To estimate prevalence and factors associated with hypertension in adults in Senador Canedo, Goiás, Brazil, in 2016. **Methods:** This was cross-sectional survey, with three-stage cluster sampling. A questionnaire was applied and weight, height, waist circumference, blood pressure and total cholesterol levels were measured. Poisson regression was used to estimate prevalence ratios (PR) and 95% confidence intervals (95%CI). **Results:** Hypertension prevalence was 23.6% (95%CI – 19.3;28.6) among the 709 participants. The associated factors were: sedentarism (PR=1.7 – 95%CI% 1.1;2.5); enlarged waist circumference (PR=5.9 – 95%CI 3.6;9.6); hypercholesterolemia (PR=2.6 – 95%CI 1.3;5.2); and age ≥60 years (PR=2.9 – 95%CI 1.3;6.2). **Conclusion:** Hypertension prevalence was lower than that described for Brazil as a whole in 2013. Physical inactivity, accumulated abdominal fat and age were factors associated with hypertension.

Keywords: Hypertension; Risk Factors; Chronic Disease; Health Surveys; Prevalence.

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Introduction

Arterial hypertension (AH), a disease of worldwide relevance, represents one of the most prevalent public health conditions, besides being widely associated with increased risk of negative outcomes, such as acute myocardial infarction, heart failure, peripheral artery disease, stroke, and chronic kidney disease.[1] This association contributes to AH being one of the main causes of decreased quality of life and life expectancy, associated with premature deaths and disabilities. The 'Global Burden of Disease' study estimated that high blood pressure contributed to 211.8 million of the years of life lost to disability in 2015.[2] It is estimated that 25% of the world's population is living with AH and a 60.0% increase in the number of cases is projected by 2025.[3] In the Region of the Americas, prevalence of the disease is estimated at 35.0% among adults over 24 years of age. In Brazil, self-reported frequency of AH is estimated at 21.4%.[4]

> *Population surveys with the purpose of determining NCD prevalence and their risk factors in the population are important for monitoring and evaluating interventions aimed at addressing these diseases, at the national, state and municipal levels of health management.*

The risk factors for AH are multiple and shared. They are classified into nonmodifiable risk factors, such as age, gender, race/skin color and family history of AH, and modifiable risk factors, which include smoking, alcohol abuse, inappropriate eating behaviors (excessive intake of saturated fat and cooking salt), overweight, obesity, and central/abdominal obesity.[1,5] Moreover, metabolic disorders such as diabetes *mellitus* and dyslipidemia are important determinants for the development of AH.[1]

The main goal for the treatment of chronic noncommunicable diseases (NCD) is to reduce the modifiable risk factors associated with these diseases, especially diseases of the circulatory system. This requires monitoring the trend of NCDs, as well as their risk factors.[5,6]

Population surveys with the purpose of determining NCD prevalence and their risk factors in the population are important for monitoring and evaluating interventions aimed at addressing these diseases, at the national, state and municipal levels of health management. In Brazil, the National Health Survey and the Non-Communicable Disease Risk and Protective Factors Surveillance Telephone Survey System (VIGITEL) are the main strategies for monitoring these diseases and their determinants.[7,8] These surveys reflect the reality of states and state capital cities. Few studies seek to assess these factors in cities with lower population densities in order to guide local policies on NCD surveillance, prevention and health promotion, as well as comprehensive care for NCD sufferers in these municipalities. This study aimed to estimate prevalence and factors associated with AH in the adult population living in Senador Canedo, a mid-sized city in the state of Goiás, in the Midwest region of Brazil.

Methods

This is a cross-sectional population-based survey, conducted in the city of Senador Canedo, state of Goiás, Midwest region of Brazil. The municipality is located in the metropolitan region of Goiânia, capital of the state of Goiás, and had an estimated population of 95,018 inhabitants and a human development index (HDI) of 0.701 in 2010.

The study sample was comprised of adult individuals (age 18 or older) living in permanent private households located in the urban area of Senador Canedo. In each household, all individuals in the age group of interest were considered eligible, except those with any physical and/or mental disability that prevented them from answering the questionnaire. In order to define the sample size (n), the sample calculation was made according to the following parameters: estimated population of 95,018 individuals; expected prevalence of AH in the Brazilian population of 22.8%;[4] precision of 5.0%; confidence level of 95.0%; and design effect of 1.5.[9] As such, the minimum sample was 400 participants.

A three-stage cluster sampling plan was used: the primary sampling unit consisted of the urban census tracts; the secondary unit, the households; and the tertiary unit consisted of adult residents (≥18 years).[8] Systematic random sampling was performed to select

the primary and secondary units. Simple random probability sampling was carried out by drawing lots in order to select the tertiary unit.

The households were visited by trained interviewers. At least three contact attempts in each sampled household were made on alternate days, including weekends. No substitutes were used.

The data was obtained through household interviews, conducted between May and December 2016, in three stages: (i) application of the survey questionnaire; (ii) measurement (blood pressure; weight; height; waist circumference); and (iii) venous blood collection for total cholesterol measurement.

Health professionals (nurses and biomedical professionals) were recruited, with technical capacity in blood pressure measurement and blood sampling, and they all received training on all stages of data collection. In order to guarantee the quality of data collection, the interviewers also underwent prior calibration tests.

The National Health Survey standardized questionnaire was used to collect sociodemographic data and data on health conditions, living habits and potential NCD risk/protection factors.[4]

The anthropometric measurements were taken twice, using portable electronic weighing scales, a portable stadiometer and an anthropometric measuring tape, considering the average of the two measurements.

Blood pressure was measured on the left arm of the seated participants, with an appropriate-sized cuff and digital meter, taking the average of three measurements obtained.

Venous blood samples were collected for total cholesterol measurement.

The dependent variable analyzed was arterial hypertension (AH). Hypertensive people were considered to be those who self-reported medical diagnosis of AH, obtained by (i) asking the question "*Has any doctor ever given you a diagnosis of hypertension (high blood pressure)?*"[4] and/or (ii) calculation of the mean of the three measurements of systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg at the time of the interview.[10,11] With this strategy, the variable of interest included individuals who were not classified as hypertensive according to their blood pressure measurement because they were on antihypertensive medication and presented normalized blood pressure measurement (although they had a medical diagnosis of AH), and they were added to those who did not have a medical diagnosis of AH but were classified as hypertensive according to their blood pressure measurement.

The independent variables analyzed corresponded to the main factors associated with AH described in the literature. The following variables were considered:

a) Sociodemographic
   - Sex (male; female);
   - Age (in years: <60; ≥60);
   - Race/skin color (self-reported: white; black; brown; other [yellow or indigenous]);
   - Marital status (lives with spouse: lives without spouse);
   - Education (higher education or complete high school; incomplete high school or complete elementary school; no education or incomplete elementary school).

b) Eating habits
   - Recommended intake of fruit and vegetables (defined as the daily intake of 5 or more portions of these foods: no; yes);[12]
   - Intake of meat or chicken with excess fat (defined as self-reported intake of meat with excess visible fat or chicken with skin: no; yes);[12]
   - High salt intake (defined as self-reported 'high' or 'very high' intake: no; yes).[12]

c) Use of alcohol and tobacco
   - Abuse of alcohol in the last 30 days (intake of 5 or more doses on a single occasion for men; intake of 4 or more doses on a single occasion for women [no; yes]);[12]
   - Tobacco use (stratified into three categories: nonsmoker [individual who has never smoked tobacco products]; former smoker [smoker of tobacco products in the past]; current smoker [current smoker of tobacco products]).

d) Physical activity during leisure time
   - Participants who reported a minimum of 150 minutes per week of moderate exercise or at least 75 minutes per week of vigorous leisure-time exercise.[13]

e) Nutritional status and waist circumference
   - Enlarged waist circumference (assessed by calculating the average of two waist circumference measurements, whereby enlarged waist was

considered to be: values greater than or equal to 88cm of circumference for women; and values greater than or equal to 102cm for men);[14]

- Nutritional status (evaluated by the body mass index [BMI], calculated by the weight/height ratio^2: normal or eutrophic [BMI: 18.5 to 24.9kg/m^2]; overweight [BMI: 25.0 to 29.9kg/m^2]; obese [BMI: ≥30kg/m^2]).[15]

f) Hypercholesterolemia

This was measured by total and self-reported cholesterol. We considered individuals with hypercholesterolemia to be those who reported a medical diagnosis of high cholesterol when they answered (i) 'Yes' to the question "*Has any doctor ever given you a diagnosis of high cholesterol?*" and/or (ii) whose total cholesterol measurement was greater than or equal to 200mg/dL.[16]

In order to correct possible response bias, given the characteristics of cluster sampling, post-stratification weights were calculated.[17] The rake method was used to construct the weights, using the 'age' and 'sex' variables. Design and post-stratification weights were calculated by age and sex, using the SAS statistical package, using the *rakinge.sas* macro and the 2010 Census population distribution.[17,18] This statistical method allows comparisons to be made between the sample and the population for each selected sociodemographic variable, which results from the creation of the weights.[18]

The analyses were conducted with STATA software, version 14.0, using the complex sample module (*survey*). Initially, the gross Poisson regression method with calculation of prevalence ratios (PR) was applied in order to establish potential associations between the outcome and the independent variables analyzed. A p-value ≤0,20 in the crude analysis was the cutoff point chosen for including variables in the multiple logistic Poisson regression; variables that presented p-values <0.05 in the final model were considered statistically associated.

The interviews were carried out after the written consent of the participants had been obtained. The study was approved by the Human Research Ethics Committee of the Federal University of Goiás: Opinion No. 1,369,638, issued on December 15, 2015; Certificate of Submission for Ethical Appraisal No. 50285015.5.0000.5083.

Results

A total of 1,393 households were randomly selected, 603 of which participated in the study, totaling 709 individuals in the sample. There was, therefore, a loss of 57% of the households, which motivated the use of post-stratification weighting to correct the high proportion of losses. After the post-stratification weight calculation, the female sex accounted for 50.7% of the sample.

Of the total participants, 16.6% (95%CI 13.8;19.7) reported having AH diagnosed by a physician and 13.2% (95%CI 10.7;16.1) presented high blood pressure (≥140/90 mmHg) at the time of the interview; of these, 54.0% (95%CI 41.1;66.4) reported having no medical diagnosis of hypertension. Considering the definition adopted in this study, the overall prevalence of AH was 23.6% (95%CI 19.3;28.6) (Table 1).

In the crude analysis, the following factors were associated with the outcome: age ≥60 years (PR=4.1 – 95%CI 3.2;5.1), complete elementary school or incomplete high school education (PR=1.5 – 95%CI 1.1;2.2), no education or incomplete elementary school education (PR=2.6 - 95%CI 1.8;3.8), physical inactivity during leisure time (PR=1.8 – 95%CI 1.3; 2.6), previous smoking (PR=2.0 – 95%CI 1.4;2.8), increased abdominal circumference (PR=2.7 – 95%CI 1.9;3.8), overweight (PR=1.7 – 95%CI 1.1; 2.6), obesity (PR=2.6 – 95%CI 1.7;3.8) and hypercholesterolemia (PR=2.2 – 95%CI 1.7;2.8) (Table 2).

In the final adjusted model, the following factors were found to have significant association with AH: physical inactivity during leisure time (PR=1.7 – 95%CI 1.1;2.5), enlarged waist circumference (PR=5.9 - 95%CI 3.6;9.6), hypercholesterolemia (PR=2.6 – 95%CI 1.3;5.2) and age ≥60 years (PR=2.9 – 95%CI 1.3;6.2) (Table 2).

Discussion

In this study, prevalence of self-reported hypertension was 16.6% – 95%CI 13.8;19.7 – this being lower than that estimated in the 2013 VIGITEL study (24.1% – 95%CI 23.4;24.8)[19] and in the National Health Survey (21.4% – 95%CI 20.8;22.0) in 2013,[4] both conducted with the Brazilian adult population. Frequency was lower than that described for the Midwest region (21.2% – 95%CI 20.0;22.4)[4] and similar to that

Table 1 – Hypertension prevalence and prevalence ratios according to independent variables, Senador Canedo, Goiás, 2016

Variables	N	AH prevalence[a]	
		%	95%CI[b]
Education			
Complete high school, incomplete higher education and complete higher education	250	14.0	(9.9;19.4)
Complete elementary school and incomplete high school	160	21.6	(15.0;30.1)
No education and incomplete elementary school	298	36.4	(28.3;45.3)
Marital status			
No	212	20.8	(14.7;28.6)
Yes	488	24.7	(19.8;30.3)
Race/skin color (self-reported)			
White	173	27.0	(19.7;30.9)
Black	62	21.0	(11.1;36.2)
Brown	439	23.6	(18.3;29.7)
Other	26	15.5	(7.8;28.5)
Intake of meat or chicken with excess fat			
No	381	23.4	(18.4;29.2)
Yes	328	23.9	(18.5;30.4)
High salt intake			
No	204	35.3	(25.6;46.5)
Yes	504	20.3	(16.2;25.1)
Recommended intake of vegetables and fruits			
No	389	22.1	(17.0;28.2)
Yes	320	25.6	(19.1;33.4)
Physical activity during leisure time			
Active	131	14.4	(10.2;20.0)
Inactive	578	26.2	(21.4;31.9)
Alcohol abuse			
No	573	24.4	(19.0;30.8)
Yes	134	21.2	(15.8;28.0)
Smoking			
Never smoked	438	19.2	(15.1;24.2)
Former smoker	142	37.7	(27.3;49.4)
Smoker	111	26.6	(18.3;37.0)
Nutritional status			
Eutrophic	239	14.7	(10.1;20.8)
Overweight	255	24.6	(18.0;32.7)
Obesity	192	37.9	(28.0;48.8)

To be continue

Continuation

Table 1 – Hypertension prevalence and prevalence ratios according to independent variables, Senador Canedo, Goiás, 2016

Variables	N	AH prevalence[a]	
		%	95%CI[b]
Waist circumference			
Normal	408	14.8	(11.2;19.4)
Enlarged	280	40.5	(30.9;50.9)
Hypercholesterolemia			
No	505	19.2	(15.3;23.9)
Yes	194	41.6	(32.2;51.6)
Sex			
Female	438	26.0	(20.2;32.7)
Male	271	21.2	(16.2;27.3)
Age (years)			
<60	606	18.9	(15.2;23.2)
≥60	103	76.6	(67.5;83.8)

Notes: a) AH: arterial hypertension; b) 95%CI: 95% confidence interval.

Table 2 – Crude and adjusted prevalence ratios according to variables of interest, Senador Canedo, Goiás, 2016

Variables	Bivariate analysis		p-value[c]	Multivariate analysis		p-value
	PR[a]	95%CI[b]		PR[a]	95%CI[b]	
Education						
Complete high school, incomplete higher education and complete higher education	1.0			1.0		
Complete elementary school and incomplete high school	1.5	(1.1;2.2)	<0.001	1.3	(0.9;1.9)	0.099
No education and incomplete elementary school	2.6	(1.8;3.8)		1.6	(0.9;2.7)	
Marital status						
No	1.0					
Yes	1.2	(0.8;1.7)	0.335	–	–	–
Race/skin color (self-reported)						
White	1.0					
Black	0.8	(0.4;1.6)	0.272	–	–	
Brown	0.9	(0.6;1.2)				–
Other	0.6	(0.3;1.2)				
Intake of meat or chicken with excess fat						
No	1.0					
Yes	1.0	(0.8;1.3)	0.853	–	–	–
High salt intake						
No	1.0					
Yes	0.9	(0.5;1.3)	0.512	–	–	–

To be continue

Continuation

Table 2 – Crude and adjusted prevalence ratios according to variables of interest, Senador Canedo, Goiás, 2016

Variables	Bivariate analysis		p-value[c]	Multivariate analysis		p-value
	PR[a]	95%CI[b]		PR[a]	95%CI[b]	
Recommended intake of vegetables and fruits						
No	1.0					
Yes	1.2	(0.8;1.6)	0.406	–	–	–
Physical activity during leisure time						
Active	1.0					
Inactive	1.8	(1.3;2.6)	<0.001	1.7	(1.1;2.5)	0.018
Alcohol abuse						
No	1.0					
Yes	0.9	(0.6;1.3)	0.445	–	–	–
Smoking						
Never Smoked	1.0			1.0		
Former Smoker	2.0	(1.4;2.8)	0.003	1.1	(0.7;1.5)	0.241
Smoker	1.4	(1.0;1.9)		1.3	(0.9;1.9)	
Nutritional status						
Eutrophic	1.0			1.0		
Overweight	1.7	(1.1;2.6)	<0.001	1.6	(0.7;3.4)	0.898
Obesity	2.6	(1.7;3.8)		1.1	(0.3;4.2)	
Waist circumference						
Normal	1.0					
Enlarged	2.7	(1.9;3.8)	<0.001	5.9	(3.6;9.6)	<0.001
Hypercholesterolemia						
No	1.0					
Yes	2.2	(1.7;2.8)	<0.001	2.6	(1.3;5.2)	0.009
Sex						
Female	1.0					
Male	0.8	(0.6;1.1)	0.211	–	–	–
Age (years)						
<60	1.0					
≥60	4.1	(3.2 5.1)	<0.001	2.9	(1.3;6.2)	0.010

Notes: a) PR: prevalence ratio; b) 95%CI: 95% confidence interval; c) p: p-value in Wald test.

of Goiás in the National Health Survey (19.6% – 95%CI 17.6;21.6).[4] When considering the measured and/or self-reported AH classification criterion, prevalence of this condition was also lower than that observed for Brazil as a whole (32.3% – 95%CI 31.7;33.0) and for Goiás, 30.8% (95%CI 27.3;34.6) as per data collected by the 2013 National Health Survey.[20]

The result shows that, for the population studied, the criterion for classifying hypertensive individuals, using both criteria (blood pressure measured by instrument and/or self-reported medical diagnosis), increased the prevalence data of the condition. Among the interviewees that presented high blood pressure, 54.0% (95%CI 41.1;66.4) had no medical

diagnosis. Using only self-reported questionnaires for follow-up and assessment of AH prevalence may result in underestimation of the prevalence of the condition in the population.[7, 20]

In this study, association was found with age ≥60, corroborating results of other investigations.[19,21] In addition to exposure to multiple risk factors throughout life, aging itself leads to changes, which make the individual more prone to the development of AH, including vascular alterations of the aorta, stiffening of connective tissue, lipid and calcium deposition on vessel walls, and increased vascular resistance.[22]

Regular physical activity is an important protective factor for the development of various NCDs.[23] Significant association between hypertension and leisure-time physical inactivity has been widely described in the literature.[23,24] Regular physical activity promotes decreased vascular resistance, arterial stiffness and inflammation, reduced body weight, and increases the diameter of the arteries, contributing to AH prevention.[24,25]

Enlarged waist circumference was strongly associated with AH. Indeed, studies have shown that abdominal obesity is more strongly associated with blood pressure levels than just total weight increase.[26,27] The findings of this study reinforce the hypothesis of the greater importance of abdominal obesity as a risk factor for AH.

Association between AH and hypercholesterolemia was found, corroborating results of other observational studies.[28,29] Dyslipidemias and high blood pressure have common pathophysiological mechanisms that contribute to the process of atherogenesis. Hypercholesterolemia acts directly on the vascular endothelium, resulting in the stiffening of the vessel and consequent increase in blood flow pressure.[30]

This study has methodological limitations related to the complexity of the cluster sampling process. The first limitation was the household response rate lower than expected, although a number of participants with statistical power for analysis was obtained. The biggest difficulty found for the interview was the number of residences with no one at home, even though three visits were made to each household on different days and at different times, with one of the visits being made obligatorily on Saturdays. Other limitations are related to data collection using a questionnaire with questions in the educational characteristics module that were difficult to understand for some participants, so that the interviewer needed to reformulate some questions at the time of the interview.

Recall bias is also an important limitation of this study, since the questionnaire is long in the sections on living habits, health service utilization, reported morbidity, and other data collected. The cross-sectional nature of the study does not allow for the establishment of temporality in the association between the variables. Moreover, since it is a cross-sectional study, carried out in a short and determined period, prevailing cases observed tend to exclude early deaths, overestimating cases of longer survival, thus characterizing survival bias.

Despite its limitations, this was the first study carried out in a city in the interior region of the state of Goiás, using the same questionnaire applied by the 2013 National Health Survey. The statistical methods adopted minimized biases in the sample, since the results are consistent with previously published investigations. In addition, the use of blood pressure measurement, waist circumference measurements and the cholesterol test were important for estimating these variables, in a more qualified way than just the criterion of self-reported prevalence. AH prevalence in the adult population should be a guideline for health care models focused on NCDs, focusing on weight control interventions and consequent reduction of fat accumulation in the abdominal region, control of cholesterol levels, regular practice of physical exercises, comprehensive care by multiprofessional health team, disease and risk factor surveillance, and health promotion.

The high prevalence of overweight, obesity and abdominal obesity, in addition to physical inactivity, reflect the reality of Senador Canedo, and Brazil, as described in other national and regional surveys, which may reflect failures in programs aimed at health promotion and NCD prevention.

Health managers in the municipality should propose interventions to deal with NCDs and increase local articulation to guide actions mainly related to strengthening Family Health and Primary Care teams to promote food security, physical activity and thus contribute to the empowerment of the population facing the challenge of seeking healthier options to

reduce the burden of hypertension and other NCDs in the municipality.

Authors' contributions

Bazílio GS, Guimarães RA, Morais Neto OL, Ribeiro GMP, Morais FO and Yamamoto RKR contributed to the concept and design of the article, data analysis and interpretation, and drafting the first version of the manuscript, its analysis and final review. Bernal RTI contributed to data analysis and interpretation and critically reviewing the manuscript. All authors have approved the final version and are responsible for all aspects of the work, including ensuring its accuracy and integrity.

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