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Artigo Original

Associated Factors with Self-reported Systemic Arterial Hypertension and Diabetes in Brazilian Older Adults: Populational-Based Cross-Sectional Study

Fatores Associados com Hipertensão Arterial Sistêmica e Diabetes Autorreportada em Idosos Brasileiro: Estudo Transversal de Base Populacional

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RESUMO

Objetivo: Esse estudo transversal objetivou avaliar a prevalência e fatores associados de hipertensão arterial sistêmica (HAS) e diabetes mellitus (DM) em idosos. **Materiais e Métodos:** HAS e DM (desfechos) autorreportados foram obtidos por um questionário estruturado. Esse questionário também coletou as variáveis independentes (características sociodemográficas, uso de fármacos e acesso a serviços de saúde bucal). Obesidade, atividade física e perda dentária foram avaliados por instrumentos validados. Regressão de Poisson com variância robusta, bivariadas e ajustadas, foram realizadas para determinar a razão de prevalência (RP) e o intervalo de confiança de 95% (IC95%). **Resultados:** Um total de 282 idosos foram, com uma prevalência de 71,28% e 21,63% para HAS e DM, respectivamente. HAS foi significativamente associada com aumento na idade do indivíduo (RP:1,01; IC95%:1,00–1,02) e diagnóstico de obesidade (PR:1,24; IC95%:1,09–1,43). Aqueles que não usam fármacos para outras condições (RP:0,74; IC95%:0,60–0,71) apresentaram significativamente menor RP para HAS. Idosos não sedentários possuem menor RP para DM (RP:0,42; IC95%:0,24–0,74). **Conclusões:** Uma alta prevalência de HAS e DM foi observada entre os idosos, e os principais fatores associados foram relacionados com características demográficas, saúde geral e hábitos comportamentais.

Palavras-chave: Idoso; Diabetes Mellitus; Epidemiologia; Hipertensão.

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ABSTRACT

Objective: This cross-sectional study aimed to assess the prevalence and associated factors of Systemic Arterial Hypertension (SAH) and Diabetes Mellitus (DM) in older adults. **Material and Methods:** Self-reported SAH and DM (outcomes) were obtained through a structured questionnaire. This questionnaire also collected the independent variables (sociodemographic characteristics, use of medicines and access to the oral health service). Obesity, physical activity, and tooth loss were assessed using validated instruments. Crude and adjusted Poisson regression with a robust error variance were performed to determine the prevalence ratio (PR) and 95% confidence interval (95%CI). **Results:** A total of 282 older adults were included, with the prevalence of 71.28% and 21.63% for SAH and DM, respectively. SAH was significantly associated with increase in the individuals' age (PR:1.01; 95%CI:1.00–1.02) and the positive diagnosis for obesity (PR:1.24; 95%CI:1.09–1.43). Those that do not use medicines for other conditions (PR:0.74; 95%CI:0.60–0.71) presented significantly lower PR for SAH. Non-sedentary older adults have the lower RP of DM (PR: 0.42; 95%CI: 0.24–0.74). **Conclusions:** A high prevalence of SAH and DM was observed among the older adults, and the main associated factors were mainly related to demographic characteristics, general health and behavioral habits.

Keywords: Aged; Diabetes Mellitus; Epidemiology; Hypertension.

INTRODUCTION

Population aging is a global phenomenon arising from increasing life expectancy and decreasing fertility. By 2050, the population of older adults is estimated to reach approximately 2.1 billion[1,2]. Between 1980 and 2025, the number of individuals in this age group is expected to grow by 217% in Latin America and by 412% in Brazil[3]. In addition to this process, a major impact on the economics and health systems of several countries is expected. Special attention must be given to underdeveloped countries, such as Brazil, whose history shows high social inequalities, limitations in health care access, and inadequacies in the social security system[4].

Literature demonstrates that health problems in older adults are related to Non-Communicable Diseases (NCDs) and their consequences[5-7]. According to the World Health Organization (WHO), the main types of NCDs are cardiovascular diseases, diabetes mellitus (DM), cancer, and chronic pulmonary obstructive disease[5]. These diseases are associated with loss in quality of life, high degrees of functional limitations, reduced capacity to perform activities of daily living, and impact on familial economy[8].

Among the main NCDs, Systemic Arterial Hypertension (SAH) and DM are characterized as conditions with high prevalence within high, low- and lower-middle-income countries[9]. Systematic reviews with meta-analyses showed that the prevalence of self-reported SAH and DM in Brazilian older adults are, approximately, 49% and 7%, respectively[10,11]. In addition, both NCDs are considered potential risk factors for the development of other chronic pathological conditions[6,7]. Different behavioral and metabolic risk factors may contribute to the occurrence of both conditions, which includes unhealthy diet, exposure to alcohol and tobacco, insufficient physical activity (PA) and overweight/obesity[8,9,12-18]. In this context, one of the major problems observed in different countries is the fact that some of these older adults are unable to control these diseases or even ignore their presence[19,20].

Recent efforts have sought to identify the relationship between aspects of oral health, such as tooth loss, and the occurrence of NCDs[21,22]. In general, the hypothesis that correlates the presence of tooth loss and SAH and DM is based on the development of chronic immune dysfunction in individuals with these systemic conditions, which enhances the onset of oral disorders that favor tooth loss[21,22,23]. Therefore, studies demonstrated an independent association between tooth loss and increased blood pressure[24] and the diagnosis of DM[25].

Despite the high prevalence of these conditions in older adults, the literature is still unclear to

associated factors with these conditions, including obesity, level of PA and oral health. Therefore, the present study aimed to assess the prevalence and associated factors of SAH and DM in home-dwelling older adults from a Southern city of Brazil.

MATERIAL AND METHODS

Study design and location

This is a population-based cross-sectional study conducted with older adults in the city of Veranópolis, Rio Grande do Sul, Brazil. The study report followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). This study was approved by the Human Research Ethics Committee from the local University under protocol #2990088. All participants received verbal explanations about the study, and those who agreed signed an informed consent.

Study design

Sample was composed by home-dwelling older adults with at least 60 years of age, from both urban and rural areas of Veranópolis, a city located in the northeast of the state Rio Grande do Sul, Brazil. According to data provided by the Brazilian Institute of Geography and Statistics - *Instituto Brasileiro de Geografia e Estatística* (IBGE), the city has a population of approximately 26,533 inhabitants[26]. Of these, 3,554 were 60-year-old or older (42.91% male and 57.09% female), with 87.00% living in the urban area of the municipality. According to the latest data, the Municipal Human Development Index of Veranópolis (MHDI) was 0.77 (2020), the GDP per capita was R$ 59,746.82 Brazilian Reais (2020) - US$ 11,03 on February 24, 2021 -, and the Gini Index was 0.4836 (2010).

Sample calculation and recruitment strategy

The sample size calculation of the present study was based on the formula shown below:

$$Sample\ size = \frac{(standardized\ variation)^2 \times (outcome\ prevalence) \times (1 - outcome\ prevalence)}{(absolute\ error)^2}$$

According to epidemiological data previously found, the estimated sample was based on a prevalence of SAH and DM in, respectively, 79.5% and 16.0%[27,28]. An error of 5% (standardized variation of 1.96) and an absolute error of 5% were assigned. Finally, this calculation resulted in a sample of 251 and 207 older adults for SAH and DM, respectively.

Based on the map of the urban area of the city, all blocks were numbered. A total of 82 blocks (20%) from the urban area were selected in a simple random way to participate in the study. The randomization process for the blocks were performed using the website www.random.org. In addition, the corners of the blocks were numbered from one to four, and a new randomization process was conducted to determine the starting point of the first interview. In each block, three households were visited with at least one older adult resident. After the first interview, the visits continued in a clockwise direction until the completion of the planned work. New blocks were selected to include the number of households required, when, for some reason, the blocks drawn did not have enough individuals.

A total of three rural communities were also included in the study. They were also randomly selected among all rural communities in the municipality. Within each community, households were visited until reaching at least 12 older adults interviewed and examined. In this area, all households in the central nucleus of the community and households located along the various side roads to access the community were visited.

Inclusion and exclusion criteria

The criteria adopted for inclusion in this study were: (a) individuals aged 60 years or older; (b) residents in the selected households; (c) individuals whose physical, medical and mental condition made it possible to carry out the study, as well as the rational understanding of the examinations and interviews that were proposed. If more than one resident met the eligibility criteria, all of them were invited to participate.

During the initial contact with the residents, if the researcher noticed that the older adult is not able to take part in the research, or even if the person responsible for the individual informed that they were not able to participate, the older adult was excluded. Residential buildings in the urban area included only one apartment in the study. In the case of the participant's absence on the day of data collection, a new attempt was made, and the household was excluded from the recruitment strategy only after the absence of response was detected on the second attempt. Visitors at home (non-residents), institutionalized older adults (Long-Term Care), and commercial or uninhabited properties were excluded.

Data collection

Data collection was performed between December 2018 and January 2019 by two previously trained teams. Each team was composed by an interviewer, an examiner for anthropometric measurements and another for the assessment of oral health.

The training of the team was organized in two stages, which are: (1) theoretical classes on the subject, discussion of all questions in the questionnaire, as well as explanations on the performance of oral health exams and evaluation of anthropometric measures; (2) practical activities involving the application of the research instrument, oral health examination and anthropometric measures in older adults in treatment at the clinics of a Faculty of Dentistry. The intra-examiner and inter-examiner reproducibility for the oral clinical examination was verified in 5% of the total number of participants chosen at random.

A structured questionnaire was applied, which included sociodemographic, behavioral and medical history variables[29]. The sociodemographic variables included were: age (in years); sex (female and male); skin color (caucasian: white and non-caucasian: black, brown, yellow, or indigenous); level of education (low: illiterate and individuals with complete elementary education; medium: incomplete or complete high school; high: at least incomplete tertiary education); marital status (married and unmarried: widowed, single, or divorced); living area (urban and rural); retirement (not retired, retired, retired who still have laboral activities).

The Body Mass Index (BMI), defined by weight (kg) / height (m^2), was evaluated according to the criteria established by the WHO. Weight was verified using an electronic scale (EKS®, Sweden), with a maximum capacity of 200 kg. Height evaluations were measured in the vertical position with an anthropometric ruler (WISO®, Brazil) fixed on the wall, whose mobile cursor was graduated in centimeters. After the evaluations, data were used to calculate BMI, which considers normal weight (BMI: 18.5-24.9 kg/m²), overweight (BMI: 25-29.9 kg/m²) and obese (BMI: ≥30 kg/m²). In the present study, obesity was dichotomized into non-obese (BMI ≤29.9 kg/m^2) and obese (BMI ≥30 kg/m^2)[30].

The practice of PA was assessed by applying the short Brazilian version of the International Physical Activity Questionnaire (IPAQ)[31]. This version allows estimating the weekly time spent on PA of walking and physical efforts of moderate and vigorous intensity, as well as physical inactivity in the sitting position. For purposes of statistical analysis, this study considered sedentary or irregular individuals (PA <150 minutes/week) and very active/active (PA ≥150 minutes/week)[32].

Use of daily medicines (except for SAH and DM) was also verified through the following question: "Are you continuously using any medicines to treat any disease?". Confirmation of the use of another medicines was also carried out by checking the physical presence of the medicines or its prescription.

The variable was dichotomized into yes or no. For this variable, medicines used for SAH and DM were not considered.

Smoking exposure was categorized into smokers, former smokers and never smokers. Older adults that reported alcohol exposure at least regularly were categorized as “yes” to alcohol exposure. Those that reported to not drink or drink without any frequency were categorized as “no”.

The oral health examination was assessed by the access to dental care and teeth counting. Access to dental care considered individuals who went to the dental office in the last 12 months (yes) and those who had not been to the dentist in that period (no). Tooth loss was determined by an oral health examination in accordance with WHO standards[33]. With the aid of a wooden spatula and without the use of artificial lighting, all teeth were counted, except for third molars. Teeth or roots indicated for extraction were considered as absent (tooth loss). In the present study, number of lost teeth was used as a continuous variable. The Kappa coefficients for tooth loss were >0.90 for both intra- and inter-examiner.

Outcomes

Both outcomes of the present study were self-reported. SAH and DM were obtained through the following questions: “Has any doctor ever given you a diagnosis of hypertension (high blood pressure)?” and “Has any doctor ever diagnosed you with diabetes?”. Both questions allowed the following answers: yes or no. The self-reported use of medicines for the treatment of these diseases were also considered for the definition of each outcome. Prescriptions and boxes of medicines were considered for the use of medicines.

Statistical analysis

In this study, the following independent variables were considered: “age”, “sex”, “skin color”, “level of education”, “marital status”, “retirement”, “living area”, “obesity”, “physical activity”, “use other medicines”, “smoking exposure”, “alcohol exposure”, “access to oral care” and “tooth loss”. These variables were chosen based on a previous theoretical background. Independent analyses were performed for both SAH and DM outcomes using the individual as the unit of analysis. As the literature shows higher rates of tooth loss among those with SAH[21] and DM[22], tooth loss was defined as the primary outcome of the present study to both outcomes.

Regarding the continuous variables, data distribution was assessed by the Shapiro-Wilk test, and asymmetric distribution was detected to both age and tooth loss. Therefore, a non-parametric test was used. Bivariate analyses between the dependent and independent variables were tested using the chi-square or Mann-Whitney test. Crude and adjusted Poisson regression with robust variance were performed to test associations between variables. Only those variables that presented a p <0.20 in the bivariate analysis were included in the initial multivariate model. The maintenance of independent variables in the final model was provided by the combination of p <0.05 and analysis of effect changes. Regardless of the p-value present, the number of tooth loss was maintained in the final multivariate model. Backward strategy was performed in both models. Multicollinearity analyzes between independent variables were performed, but none were observed. The level of significance was 5%. Data were analyzed using the IBM®SPSS 26.0 software. (SPSS Inc., Chicago, USA).

RESULTS

A total of 282 older adults were included in the study, as described in the flowchart (Figure 1). The median age of the sample was 71.42 (interquartile range - [IQ]: 65; 76) years, with the majority of participants being female (71.28%), caucasian (89.36%), with low level of education (79.79%) and married (59.19%). Regarding living areas, 86.52% of them lived in the urban area, and 88.30% were

beneficiaries of social retirement. Most individuals were not diagnosed with obesity (65.96%), and the very active or active practice of PA was demonstrated in 42.91%. The daily use of medicines to treat other conditions was detected in 71.28% of the older adults. Regarding smoking and alcohol exposure, it was found that the majority of the sample was never smoker (68.79%), while 55.32% were exposed to alcohol. Access to dental care was observed in 46.45% of the older adults. The median number of missing teeth among the elderly was 20.72 (IQ: 15.75; 28). Table 1 presents the general characteristics of the sample and the association between the independent variables with SAH and DM.

The prevalence of SAH was 71.28% (95% confidence interval [95%CI]: 65.96 – 76.59), while DM was detected in 21.63% (95%CI: 16.80 – 26.47) of the older adults. Only 20.21% (95%CI: 15.50 – 24.93) of them had SAH and DM. The bivariate analysis showed that the highest prevalence of SAH was significantly associated with the following variables: age (p = 0.005), retirement (p = 0.001), obesity (p = 0.003) and use of medicines for other conditions (p <0.001). Still in this context, the highest significant prevalence of DM was found between the variable's physical activity (p <0.001) and use of medicines for other conditions (p = 0.037) (Table 1).

Table 1. Sample characteristics and univariate analysis between independent variables with Systemic Arterial Hypertension (SAH) and Diabetes Mellitus (DM).

Variables		SAH		*p*-value	DM		*p*-value
		No (n = 81; 28.7%)	Yes (n = 201; 71.3%)		No (n = 221; 78.4%)	Yes (n = 61; 21.6%)	
Age	Median (IQ 25; 75)	68.0 (63.0; 75.0)	71.0 (66.0;78.0)	**0.005#**	70.0 (65.0; 76.0)	71.0 (67.0; 77.5)	0.167#
Sex	Male – n (%)	25 (30.9)	56 (27.9)	0.614*	67 (30.3)	14 (23.0)	0.260*
	Female – n (%)	56 (69.1)	145 (72.1)		154 (69.7)	47 (77.0)	
Skin color	Caucasian– n (%)	72 (88.9)	180 (89.6)	0.870*	199 (90.0)	53 (86.9)	0.479*
	Non-caucasian – n (%)	9 (11.1)	21 (10.4)		22 (10.0)	8 (13.1)	
Level of education	Low – n (%)	59 (72.8)	166 (82.6)	0.121*	174 (78.7)	51 (83.6)	0.529*
	Medium – n (%)	12 (14.8)	23 (11.4)		30 (13.6)	5 (8.2)	
	High – n (%)	10 (12.3)	12 (6.0)		17 (7.7)	5 (8.2)	
Marital status	Married – n (%)	48 (59.3)	102 (50.7)	0.195*	118 (53.4)	32 (52.5)	0.897*
	Not married – n (%)	33 (40.7)	99 (49.3)		103 (46.6)	29 (47.5)	
Living area	Urban – n (%)	71 (87.7)	173 (86.1)	0.724*	188 (85.1)	56 (91.8)	0.173*
	Rural – n (%)	10 (12.3)	28 (13.9)		33 (14.9)	5 (8.2)	
Retirement	Not retired – n (%)	9 (11.1)	24 (11.9)	**0.001***	24 (10.9)	9 (14.8)	0.440*
	Retired – n (%)	41 (50.6)	142 (70.6)		142 (64.3)	41 (67.2)	
	Retired and working – n (%)	31 (38.3)	35 (17.4)		55 (24.9)	11 (18.0)	
Obesity	Non obese – n (%)	64 (79.0)	122 (60.7)	**0.003***	150 (67.9)	36 (59.0)	0.196*
	Obese – n (%)	17 (21.0)	79 (39.3)		71 (32.1)	25 (41.0)	
Physical activity	Sedentary/not regular – n (%)	36 (44.4)	125 (62.2)	0.006*	114 (51.6)	47 (77.0)	**<0.001***
	Active or very active – n (%)	45 (55.6)	76 (37.8)		107 (48.4)	14 (23.0)	
Use of medicines to other conditions	Yes – n (%)	44 (54.3)	157 (78.1)	**<0.001***	151 (68.3)	50 (82.0)	**0.037***
	No – n (%)	37 (45.7)	44 (21.9)		70 (31.7)	11 (18.0)	
Smoking exposure	Smokers – n (%)	7 (8.6)	13 (6.5)	0.642*	15 (6.8)	5 (8.2)	0.919*
	Former smokers – n (%)	17 (21.0)	51 (25.4)		53 (24.0)	15 (24.6)	
	Never smokers – n (%)	57 (70.4)	137 (68.2)		153 (69.2)	41 (67.2)	
Alcohol exposure	Yes – n (%)	47 (58.0)	109 (54.2)	0.562*	122 (55.2)	34 (55.7)	0.941*
	No – n (%)	34 (42.0)	92 (45.8)		99 (44.8)	27 (44.3)	
Access to dental care	Yes – n (%)	41 (50.6)	90 (44.8)	0.374*	107 (48.4)	24 (39.3)	0.209*
	No – n (%)	40 (49.4)	111 (55.2)		114 (51.6)	37 (60.7)	
Tooth loss	Median (IQ 25; 75)	21.0 (13.0; 28.0)	28.0 (16.5; 28.0)	0.185#	25.0 (15.0; 28.0)	28.0 (16.5; 28.0)	0.693#

Legend: IQ: Interquartile Range; *Chi-square test; # Mann-Whitney Test. Bold p-values mean statistically significant (p <0.05).

The prevalence ratio (PR) and the 95% CI of the crude analysis are demonstrated in Table 2. It is possible to observe that, according to the increase of 1 year of age, there is an increase of 1.01% (95%CI: 1.00 – 1.02; p = 0.002) in the PR of having SAH. Obesity was also associated with a higher PR among individuals with SAH (PR: 1.25; 95%CI: 1.09 – 1.44; p <0.001). In contrast, retired individuals who still perform some work activity had 28% (95%CI: 0.53 – 0.99; p = 0.004) lower PR for presenting SAH, when compared to not retired ones. Nevertheless, very active or active practice of PA (PR: 0.80;

95%CI: 0.68 – 0.95; p = 0.001], as well as not using other medicines (PR: 0.69; 95%CI: 0.56 – 0.86; p <0.001) are also significantly associated with less occurrence of SAH.

Regarding DM, when compared to sedentary older adults or those who do not exercise regularly, individuals who are very active or active regards PA had 61% (95%CI: 0.22 – 0.99; p <0.001) lower PR of having DM. Likewise, older adults who do not use other types of medicines also had a lower PR of having DM (PR: 0.54; 95%CI: 0.30 – 0.99; p = 0.004) when compared to those that use other types of medicines (Table 2).

Table 2 Crude prevalence ratio (PR) and 95% confidence intervals (CI) for the association between Systemic Arterial Hypertension (SAH) and Diabetes Mellitus (DM) and independent variables.

Variables		SAH		*p*-value	DM		*p*-value
		PRCRUDE	**(95%IC)**		**PR**CRUDE	**(95%IC)**	
Age		1.01	(1.00–1.02)	**0.002**	1.01	(0.99–1.04)	0.238
Sex	Male	1			1		
	Female	1.04	(0.88–1.23)	0.622	1.35	(0.79–2.31)	0.271
Skin color	Caucasian	1			1		
	Non-caucasian	0.98	(0.76–1.25)	0.873	1.26	(0.66–2.40)	0.467
Level of education	Low	1			1		
	Medium	0.89	(0.69–1.14)	0.367	0.63	(0.27-1.47)	0.285
	High	0.73	(0.50–1.09)	0.128	1.00	(0.44-2.24)	0.995
Marital status	Married	1			1		
	Not married	1.10	(0.95–1.27)	0.193	1.03	(0.66-1.60)	0.897
Living area	Urban	1			1		
	Rural	1.03	(0.84–1.27)	0.715	0.57	(0.24-1.33)	0.199
Retirement	Not retired	1			1		
	Retired	1.06	(0.85–1.33)	0.569	0.82	(0.44-1.52)	0.534
	Retired and working	0.72	(0.53–0.99)	**0.045**	0.61	(0.28-1.32)	0.213
Obesity	Non obese	1			1		
	Obese	1.25	(1.09–1.44)	**<0.001**	1.34	(0.86-2.10)	0.193
Physical activity	Sedentary/not regular	1			1		
	Active or very active	0.80	(0.68–0.95)	**0.010**	0.39	(0.22-0.99)	**<0.001**
Use of medicines to other conditions	Yes	1			1		
	No	0.69	(0.56–0.86)	**<0.001**	0.54	(0.30-0.99)	**0.048**
Smoking exposure	Smokers	1			1		
	Former smokers	1.15	(0.81–1.63)	0.422	0.88	(0.36-2.12)	0.781
	Never smokers	1.08	(0.77–1.51)	0.627	0.84	(0.37-1.89)	0.683
Alcohol exposure	Yes	1	1		1		
	No	1.04	(0.90–1.21)	0.560	0.98	(0.62-1.53)	0.941
Access to dental care	Yes	1			1		
	No	1.07	(0.92–1.24)	0.377	1.33	(0.84-2.11)	0.213
Tooth loss		1.00	(0.99–1.01)	0.228	1.00	(0.97-1.02)	0.810

Legend: Bold p-values mean statistically significant (p <0.05).

After the analysis adjusted for the possible confounding factors, the increase in the individuals' age (PR: 1.01; 95%CI: 1.00 – 1.02; p = 0.032) and the diagnosis of obesity (PR: 1.24; 95%CI: 1.09 – 1.43; p = 0.02) remained significantly associated with a higher prevalence of SAH. Those that do not use medicines for other conditions (PR: 0.74; 95%CI: 0.60 – 0.71; p = 0.005) presented significantly lower PR for SAH (Figure 2). As for the factors associated with DM, it was possible to observe that non-sedentary older adults have a lower PR (PR: 0.42; 95%CI: 0.24 – 0.74; p = 0.002) (Figure 3).

DISCUSSION

The findings of this study show a high self-reported prevalence of SAH and DM in a representative sample of older adults living in the municipality of Veranópolis, Brazil. In short, the increase in the individuals' age and the diagnosis of obesity were factors associated with a higher prevalence of SAH, while those who did not use medicines for other conditions were less affected by the disease. Individuals who maintain an active or very active weekly routine of PA presented the lowest prevalence of DM.

Within the context of population aging, the development of both diseases is strongly associated with

lifestyle, physical inactivity, poor nutrition and low educational level[18,34]. Therefore, the city of Veranópolis was chosen because it is one of the pioneer municipalities in addressing issues related to human aging in Brazil, and has been the subject of several researches in all areas of interest in Gerontology and Geriatrics in recent years[35-37]. It is well known that population aging is associated with a burden of NCDs.

Estimates demonstrate an increase in the prevalence of SAH in developing countries[17]. Analysis performed from the baseline of the Brazilian Longitudinal Study of Aging (ELSA-Brazil), a national survey conducted in 2015-2016, estimated the self-reported prevalence of SAH in 51.1% in those aged ≥ 50 years[33]. In this study, the prevalence of self-reported positive diagnosis for SAH (71.28%) was higher than that verified in ELSA-Brazil survey[38], and in other population-based Brazilian studies demonstrated a slightly variation in this prevalence, ranging from 50% to 68% in individuals from the same age group[10,15,39]. From a global perspective, the prevalence of SAH in older adults differs among countries, since the prevalence of SAH in the present study was lower, similar and higher than the frequency of the disease in older adults from Asia, Africa and Europe, respectively[40].

The higher prevalence of SAH among older adults is justified by the alteration of the structure and function of the human vascular system according to the increase in age. Structural changes in the vasculature increase arterial stiffness, which reduces arterial buffering capacity and increase the changes in blood pressure[13]. Furthermore, other pathophysiological influencing factors for SAH are the decreased baroreceptor sensitivity, increased responsiveness to sympathetic nervous system stimuli, altered renal and sodium metabolism, and altered renin-aldosterone relationship[41]. In the present study, the increase of one year in the age of individuals was significantly associated with a higher prevalence of SAH, which corroborates with the findings in the medical literature where the prevalence of the disease increases linearly with advancing age[10,39].

It is important to highlight that obese individuals presented a significantly higher PR to self-report SAH. The association between weight and SAH among older people has been shown previously[15,38,42,43], as the excess body weight is associated with an increased cardiovascular risk and earlier onset of cardiovascular morbidity[44].The mechanisms that associate excess weight with hypertension include hyperactivity of the sympathetic nervous system and renin-angiotensin system, related especially to the buildup of visceral abdominal fat. Therefore, the increase of this type of fat is associated with an increase of inflammatory mediators, oxidative stress, and decreased endothelial vasodilatation[45].

In Brazil, the use of many medicines (polypharmacy) is widely observed among individuals aged[60] or over[46,47]. Most hypertensive older adults suffer from concomitant diseases, which expose them to the prescription to multiple medicine therapies, frequently given by several different physicians48.These facts may justify the higher prevalence of SAH found among older adults who used medicines to treat other conditions. Unfortunately, there are negative consequences associated with polypharmacy. Specifically, the burden of taking multiple medicines has been associated with greater health care costs and an increased risk of adverse medicine events, medicine-interactions, non-adherence to treatment, reduced functional capacity and multiple geriatric syndromes[48,49]. It is important to contextualize what conditions polypharmacy should occur, considering that literature related this phenomenon to the inappropriate use of medicines[50].These aggravating factors might impair the adequate control of SAH.

The global prevalence of DM is estimated to increase about 2.2% per year[51], while still approximately 46% of cases are undiagnosed[52]. A meta-analysis performed with data from Brazilian population-based studies estimated that the self-reported prevalence of diabetes was 7.5% in adults[14].The latest national survey ELSA-Brazil showed a prevalence of DM in 6.2%, reaching 19.8% in those with more than 65 years.[53] Our results demonstrated a prevalence of DM of 21.63%, which is considered a high prevalence when compared to the previous findings[14,53].

Regular PA may help people with DM to achieve a variety of goals, including improvements in the glycemic control[54], insulin sensitivity[55] and beta-cell function[56]. In addition, promoting weight loss, decreasing risk of cardiovascular disease[57], and improving overall quality of life may be observed[58]. PA was also associated with lower all-cause or cardiovascular mortality in individuals with DM[59]. In the

present study, the lower PR of DM was detected in older adults who perform weekly PA with a duration of at least 150.

Considering the multiple health benefits that PA offers, different medical association recommended that all people with DM engage in moderate-intensity PA for at least 150 minutes per week or vigorous-intensity PA for at least 90 minutes per week, and the practice of activities should be distributed over at least 3 days in a week, with no more than 2 consecutive days without PA[60,61]. In Brazil, the prevalence of PA counseling for the general adult population is about 20%[62], while among diabetic individuals assisted by the public health system, this frequency can reach about 84.4% of people with the disease[63]. In this sense, the current results emphasize the necessity to recommend PA, since this is one of the main measures of widespread intervention for the control of DM in the country[32,62,63].

The association between NCDs and different sociodemographic factors (e.g. sex, education, or income) is well established in the literature[8,9,12-18]. It has also been demonstrated that NCDs share common risk factors. However, the present study did not find a significant association between both tested outcomes and the mentioned sociodemographic variables. Lower access to health services, poor habits and behaviors towards a better health are directly associated with lower level of education and income, which may be detected among the included individuals. These factors might interfere with the understanding of the diseases and their control, the lack of PA, poor nutrition and the exposure to cigarettes and alcohol. All these questions may explain the serious problem observed in many countries, where there is a large percentage of older adults who are unable to control their chronic diseases, especially SAH and DM[17,28]. In this sense, common risk approaches have been recommended. This should have effects that go beyond one specific disease/condition. Therefore, controlling smoking exposure, the abusive use of alcohol, stimulating physical exercise, having a healthy diet, among others have been recommended. Even though no direct relationship might be detected, a healthy lifestyle is beneficial.

This study found no statistically significant association between the number of missing teeth with SAH and DM. Overall, it is believed that it is not necessarily the number of teeth that is associated with the occurrence of SAH, but rather the reasons that lead to tooth loss[64]. Periodontitis, for example, is a major cause of tooth loss, being able to cause low-grade inflammation, contributing to SAH[65]. This relationship is basically due to the hyperactive immune response caused by periodontitis, responsible for promoting a procoagulant, vasodilatory, antithrombotic, and anti-inflammatory state - which favors the increase in blood pressure[66].

In addition, in the last decade, the literature has indicated that individuals with DM have more severe oral diseases than other patients[22,67,68]. In fact, individuals with DM are more likely to have a history of tooth loss than those without DM[22]. It is understood that DM triggers a worst inflammatory condition that may lead to poorer oral health, which is directly associated with higher tooth loss[69,70]. Despite this knowledge, the higher rates of tooth loss detected in the present sample might explain the lack of significant association between SAH and DM with tooth loss.

The present study has some limitations. The first limitation regards the cross-sectional design of the study, whose reverse causality bias, caused by simultaneous measurements of risk or protection factors and of outcomes, results in limited inferences about the directionality of causality. Secondly, the use of self-reported morbidity data depends on the access to health services for the diagnosis; thus, users who more often use these services have a higher opportunity for medical diagnosis of diseases investigated in this study. In an epidemiological setting, self-reported diseases are frequently used, as this is an easy and lower way to estimate a disease occurrence in a population[12,16]. Both quality and reliability of these data are important to estimate health indices (such as incidence and prevalence) and their determinants[20]. However, it is important to highlight that several limitations may arise from self-reported outcomes. Furthermore, the present study did not verify the status of disease control (controlled vs. uncontrolled).

Despite the limitations of this survey, the study design allows generalization of data for comparisons with other home-based studies with representative samples. This study is representative

of the socioeconomic strata in the city of Veranópolis, RS, Brazil. With a probabilistic per conglomerate sampling strategy, the study was conducted considering the proportionality between urban and rural areas, as well as the level of education of the older adults, which were similar to those observed in the last census for that municipality[26]. Finally, the results detailed in this study allow the establishment of a set of factors associated with major NCDs among Brazilian older adults, contributing to the rational construction of public policies for prevention and health promotion.

CONCLUSIONS

It was demonstrated a high prevalence of SAH and DM among older adults. SAH was associated with increase in age, diagnosis of obesity and use of medicines to treat other conditions. Additionally, the highest prevalence of DM was observed among the older adults who are sedentary or have irregular PA. Both SAH and DM were not associated with tooth loss.

Author Contribution

FVP: Helped in data collection, interpreted the data, wrote the manuscript, revised the literature, and approved the final version of the manuscript.

FWMGM: Helped in the study design, performed the data analysis, wrote the manuscript, and approved the final version of the manuscript.

MSF: Wrote the manuscript, revised the literature, and approved the final version of the manuscript.

DGS: Helped in data collection, interpreted the data, wrote the manuscript, revised the literature, and approved the final version of the manuscript.

CKR: Helped in the study designed and writing the manuscript, and approved the final version of the manuscript.

PRGC: Designed the study, helped in data collection, revised the literature, wrote the manuscript, and approved the final version of the manuscript.

Conflict of interest

There is no conflict of interest.

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