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ORIGINAL ARTICLE / *ARTIGO ORIGINAL*

Contextual and individual factors associated with arterial hypertension among Brazilian older adults (National Health Survey – 2013)

Fatores contextuais e individuais associados à hipertensão arterial entre idosos brasileiros (Pesquisa Nacional de Saúde – 2013)

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ABSTRACT: ***Objective:*** To investigate the association of contextual and individual variables with systemic arterial hypertension (SAH) among elderly Brazilians. ***Methods:*** Cross-sectional study with data from the National Health Survey (2013) and the Atlas of Human Development in Brazil. SAH was defined by direct measurement of blood pressure and/or the use of medications for this condition. The contextual independent variables were the Municipal Human Development Index (MHDI) and the Gini Index, by Federation Unit. The individual independent variables included sociodemographic factors, health behaviors, health conditions, and the use of health service. Multilevel logistic models were used to study the associated factors. ***Results:*** Among the 10,211 participants aged 60 years and older, the prevalence of hypertension was 66.7% (95%CI 65.1 – 68.3). After adjusting for all variables, the chance of hypertension was higher in the Federation Units with the highest MHDI, in women, aged 70 years or older, in non-whites, with one or more chronic diseases, overweight and obesity, high waist circumference, and among those who had four or more medical appointments in the previous year. On the other hand, a negative association was observed between hypertension and education. ***Conclusion:*** The individual profile associated with hypertension was similar to what had already been reported in the scientific literature, but it is noteworthy that the elderly residing in the higher MHDI Federation Units were more likely to have this condition, suggesting a higher survival of hypertensive patients in these regions.

Keywords: Hypertension. Aged. Health surveys. Socioeconomic factors.

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RESUMO: ***Objetivo:*** Investigar a associação de variáveis contextuais e individuais com a hipertensão arterial sistêmica (HAS) em idosos brasileiros. ***Métodos:*** Estudo transversal com dados da Pesquisa Nacional de Saúde (2013) e do Atlas de Desenvolvimento Humano no Brasil. A HAS foi definida pela medida direta da pressão arterial e/ou pelo uso de medicamentos para essa condição. As variáveis independentes contextuais foram o Índice de Desenvolvimento Humano Municipal (IDHM) e o índice de Gini, por Unidade da Federação (UF). As variáveis independentes individuais incluíram fatores sociodemográficos, comportamentos em saúde, condições de saúde e uso de serviço de saúde. Utilizaram-se modelos logísticos multiníveis para o estudo dos fatores associados. ***Resultados:*** Entre os 10.211 participantes com 60 anos ou mais, a prevalência de HAS foi de 66,7% (IC95% 65,1 – 68,3). Após ajuste para todas as variáveis, a chance de HAS foi maior nas UF com maior IDHM, em mulheres, com 70 anos ou mais, não brancas, com uma ou mais doenças crônicas, com excesso de peso e circunferência da cintura aumentada e entre aqueles que realizaram quatro ou mais consultas médicas no ano anterior. Por outro lado, foi observada associação negativa entre HAS e escolaridade. ***Conclusão:*** O perfil individual associado à HAS foi semelhante ao já reportado na literatura, mas chama atenção que os idosos residentes nas UF de maior IDHM apresentaram maior chance de ter essa condição, sugerindo maior sobrevida dos hipertensos dessas regiões.

Palavras-chave: Hipertensão. Idoso. Inquéritos epidemiológicos. Fatores socioeconômicos.

INTRODUCTION

Systemic arterial hypertension (SAH) is the main chronic non-communicable disease among older adults[1], with high prevalence and incidence[2]. It is an important risk factor for cardiovascular disease, and it is related to geriatric syndromes, in addition to contributing to the burden of diseases, disability, and mortality among older adults[1].

Besides individual characteristics such as sociodemographic, economic, and health behaviors, which influence the development of SAH[1], contextual factors play an important role in determining this condition[3]. Contextual factors can be expressed in different geographical boundaries, ranging from national to local levels[4], and may express different conditions of these contexts, such as the level of development or the degree of inequality in income distribution in a society[5]. It has been shown that context can interfere in several events, regardless of individual factors[3,6], placing this level as an important determinant of health events.

Evidence suggests that as individuals age and become ill, they are more susceptible to the characteristics of the environment where they live[7]. Individuals living in areas without investments in health support infrastructure or with social and economic problems (inadequate investments in human capital, unhealthy housing, crime, violence, for example), may be subject to high levels of chronic stress, which increases the chance of developing SAH[8]. In addition, lower levels of education and income in a region promote unhealthy habits related to diet and physical activity, and interfere with the proper use of health services, contributing to increase the risk of hypertension[8].

Given this context and considering the rapid Brazilian demographic transition, it is relevant to study the contextual factors, along with those already classically studied at an individual level, related to SAH among older adults in Brazil. It can broaden scientific knowledge, favoring the detection of more vulnerable groups, with emphasis on the context in which they live, and contributing to the planning of more effective interventions in relation to hypertension, aiming at improving the quality of life of the elderly population[2]. Thus, the objective of this study was to investigate the association of contextual and individual variables with hypertension among Brazilian older adults.

METHOD

STUDY POPULATION

This is a cross-sectional study including data from the National Health Survey (NHS), a household-based and national study conducted in 2013 by the Oswaldo Cruz Foundation (FIOCRUZ) and the Ministry of Health, in partnership with the Brazilian Institute of Geography and Statistics (IBGE). The NHS was approved by the National Commission for Research Ethics in 2013 (Process no. 328,1590), and all participants signed a consent form[9].

Sampling was performed in three stages. The first consisting of selecting census tracts, followed by residences and, finally, individuals aged 18 or older[10]. Data were collected through structured questionnaires and physical measurements in the sampled residences[10]. For the present study, we used a sample of 10,211 individuals aged 60 years or older (91.4% of the elderly respondents of the NHS), who had complete information for all variables of interest[9].

VARIABLES AND DATA COLLECTION PROCEDURES

Both the dependent variable of this study and the individual exploratory variables were obtained from the NHS database. The context variables, considered to be the Federation Units, assessed in 2010, were obtained from the Atlas of Human Development in Brazil[5].

The selection of individual and contextual variables was based on previous studies, in which an association with hypertension was observed[3,11-14].

The dependent variable was hypertension defined by changes in blood pressure levels (systolic blood pressure greater than or equal to 140 mmHg and/or diastolic blood pressure greater than or equal to 90 mmHg) and/or the report of medication use for this disease[15]. Blood pressure was measured by a properly trained team using a calibrated digital device at the participant's house. The examiner followed a protocol to take these measurements, which were performed with the individual sitting and after a minimum rest time of five minutes. Individual independent variables (level 1) were included in three blocks, as described below. Sociodemographic variables: gender (male, female); age group in years (60 to 69, 70 to 79, 80 or more); education in years of schooling (0 to 4 years; 5 to 8 years; 9 years or more); self-reported skin color (white, non-white); and per capita household income in tertiles (1st tertile: ≤ R$ 678.24; 2nd tertile: R$ 678.25 to R$ 1,180; 3rd tertile: ≥ R$ 1,180.01). Health behaviors: recommended fruit and vegetable intake (no, yes); physical activity in leisure time (no; yes); consumption of alcohol (not consumed/recommended, above recommended); and current smoker (no, yes). Health conditions and use of health services: number of chronic diseases, excluding SAH (none, one or more); overweight and obesity (no, yes); waist circumference (normal, high/significantly high); and number of doctor visits in the last 12 months (0 to 3, ≥ 4).

For the calculation of per capita household income, we took into consideration the monthly gross income in the main job done by the all the residents, gross monthly income or earnings in other jobs, amount of money received in retirement benefits and alimony, maintenance, rent and lease, unemployment insurance and unemployment insurance for closed fishing season, welfare benefit, family allowance program, other government social programs, passbook savings account income, financial interest or dividends, and other types of income. All these items were summed and divided by the number of house residents at the time of the interview.

Recommended fruit and vegetable intake were assessed by the weekly frequency of fruit and/or lettuce and tomato salad or salad of any other raw vegetables and/or cooked vegetables intake (except potatoes, cassava, or yam), considering recommended five times a day on five or more days a week[16]. Older adults who practiced at least 150 minutes of mild or moderate physical activity or at least 75 minutes of vigorous weekly physical activity in leisure time were considered sufficiently active[17]. Alcohol consumption, as recommended by the American College of Cardiology/American Heart Association Guideline Task Force on Clinical Practice[18], in order not to increase blood pressure, was up to one dose per day (up to seven doses per week) for women and up to two doses per day (up to 14 doses per week) for men. Above these levels, it was considered as "above recommended" consumption. Smoking was assessed by current consumption of any tobacco product regardless of frequency.

The number of chronic diseases was defined by self-reported medical diagnosis of the following health conditions: diabetes, heart disease, stroke, arthritis, work-related musculoskeletal disorder, depression, chronic obstructive pulmonary disease, cancer, chronic kidney disease, high cholesterol, asthma, chronic spinal problem, and mental illness (schizophrenia, bipolar disorder, psychosis, or Obsessive Compulsive Disorder). Anthropometric indicators were estimated by direct measurements, obtained by standardized equipment and techniques, with the individual standing, erect, and without assistance. A portable digital scale was used to measure weight and a portable stadiometer was used to measure height. Having measured weight and height, the body mass index (BMI) was calculated and the following categorization was created: without overweight (BMI < 28 kg/m^2); overweight and obesity (BMI ≥ 28 kg/m^2)[19]. Waist circumference was measured using an inelastic and flexible measuring tape. The reading was taken at the midpoint between the last rib and the iliac crest at the end of a normal expiration. Waist circumference was considered high or significantly high if ≥ 94 cm for men and ≥ 80 cm for women[20].

For the contextual level (level 2), considered as aggregation by Federation Units, we used the Municipal Human Development Index (MHDI) and the Gini Index, both referring to the year 2010, available in the Atlas of Human Development in Brazil[7], which were incorporated into the NHS database. The Brazilian Federation Units were chosen because they represent the maximum aggregation level that the NHS data allowed, maintaining the entire sample[10]. These measurements were considered as continuous in the models.

MHDI is a summary measure of long-term progress, considering three basic components of human development (education, income, and health) and ranges from 0 to 1, with higher values indicating better human development[5]. The Gini index measures the degree of inequality in the distribution of per capita income in a society. This index ranges from 0 to 1, with 0 corresponding to equal income distribution (in which everyone has the same income) and 1 to complete inequality in income distribution (one person owns all the wealth in the region)[5]. Among the Federation Units, there was a variation of 0.631 to 0.824 (average 0.705) for the MHDI, and a variation of 0.490 to 0.650 (average 0.590) for the Gini Index.

DATA ANALYSIS

Data analysis was performed using Stata® software (the StataCorp LLP, College Station, TX, United States) version 14.1. We performed a descriptive analysis of all variables included in this study for the total and stratified population according to the outcome of interest. The comparison of the distribution of these variables between the dependent variable categories was performed by Pearson's test with Rao-Scott correction, considering the design effect.

The association between the independent, contextual, and individual-level variables and the outcome of interest was estimated using multilevel logistic models, which allow to analyze correlated data in hierarchical structure (individuals grouped in their respective Federation Units), incorporating the dependence and structure of correlation of errors in a random effects model[21].

The specification of multilevel logistic models assumed random intercept and fixed effect for the independent variables included in the model. Odds ratios (OR) were obtained with respective 95% confidence intervals (95%CI). Initially, a null model was created without covariates and then a model was adjusted only with context variables (level 2) (model 1). Finally, three other models were adjusted, with sequential input of individual variables (level 1): model 1 + sociodemographic variables (model 2); model 2 + health behaviors (model 3); model 3 + health condition and use of health service (model 4).

RESULTS

Among the 11,697 elderly participants of the National Health Survey, 10,211 had information on the selected variables. The prevalence of hypertension observed in this study was

66.7% (95%CI 65.1 – 68.3), with no significant difference (p = 0.731) between men (66.4% — 95%CI 63,9 – 68.8) and women (66.9% — 95%CI 64.8 – 69.1).

In general, the sample had a predominance of females (58.0%), aged 60 to 69 years (56.4%), with 5 to 8 years of schooling (46.3%), who declared themselves white (55.0%), and had a per capita household income less than or equal to R$ 678.24 (1st tertile) (41.0%). Regarding to health behaviors, most elderly did not meet the recommended consumption of fruits and vegetables (74.8%), did not practice physical activity in leisure time at the recommended levels (85.7%), did not consume alcohol above the recommended levels (88.0%), and did not smoke at the time of the interview (88.2%). Higher proportion of older adults with one or more chronic diseases (67.8%), non-overweight (61.9%), high waist circumference (70.4%), and less than four doctor visits in the previous year (58.4%) was also observed. SAH presented an unadjusted and significant association with a higher proportion of individuals aged 70 or over, with education up to 8 years, per capita household income up to R$ 1,180, non-smokers, older adult with one or more chronic diseases, with overweight and obesity, with high / significantly high waist circumference, and four or more medical appointments ($p < 0.05$).

Regarding multilevel modeling, the null model, which does not include covariates, showed that there was significant evidence that the variance between the Federation Units is nonzero ($p < 0.001$), indicating that it is relevant to consider the hierarchical structure of the data in the association analysis between all independent variables (contextual and individual) and the outcome of interest. Regarding the contextual variables and after adjustment for individual factors, a statistically significant association was only observed between the MHDI and SAH (OR = 8.04; 95%CI 1.54 – 42.09) (Table 1).

Table 1. Association between systemic arterial hypertension and contextual and individual variables among Brazilian older adults. National Health Survey, 2013.

Variables*	Model 1[a] OR (95%CI)	Model 2[b] OR (95%CI)	Model 3[c] OR (95%CI)	Model 4[d] OR (95%CI)
Level 2: Contextual				
Human Development Index	4.38 (0.90 – 21.3)	**10.87 (2.04 – 58.09)**	**10.75 (1.95 – 59.25)**	**8.04 (1.54 – 42.09)**
Gini Index	0.17 (0.02 – 1.94)	0.14 (0.01 – 1.76)	0.13 (0.01 – 1.67)	0.18 (0.01 – 2.14)
Level 1: Individual				
Gender				
Male		1.00	1.00	1.00
Female		**1.22 (1.12 – 1.33)**	**1.20 (1.10 – 1.31)**	**1.34 (1.21 – 1.49)**

Continue...

Table 1. Continuation.

Variables*	Model 1[a] OR (95%CI)	Model 2[b] OR (95%CI)	Model 3[c] OR (95%CI)	Model 4[d] OR (95%CI)
Age group (years)				
60–69		1.00	1.00	1.00
70–79		**1.35 (1.23 – 1.48)**	**1.33 (1.21 – 1.47)**	**1.37 (1.24 – 1.51)**
80 or +		**1.38 (1.21 – 1.57)**	**1.36 (1.19 – 1.55)**	**1.45 (1.26 – 1.66)**
Schooling (years)				
0 to 4		1.00	1.00	1.00
5 to 8		0.94 (0.86 – 1.05)	0.94 (0.85 – 1.04)	0.93 (0.84 – 1.03)
≥ 9		**0.68 (0.60 – 0.77)**	**0.67 (0.59 – 0.77)**	**0.68 (0.60 – 0.78)**
Self-reported skin color				
White		1.00	1.00	1.00
Non-White		**1.13 (1.03 – 1.23)**	**1.13 (1.03 – 1.24)**	**1.16 (1.06 – 1.28)**
Per capita household income in tertiles (R$)				
1º (≤ R$ 678.24)		1.00	1.00	1.00
2º (R$ 678.25 to R$ 1,180)		0.96 (0.86 – 1.08)	1.03 (0.90 – 1.18)	0.94 (0.84 – 1.05)
3º (≥ R$ 1,180.01)		0.94 (0.85 – 1.05)	0.99 (0.86 – 1.13)	0.93 (0.83 – 1.04)
Recommended fruit and vegetable consumption*				
No			1.00	1.00
Yes			1.01 (0.91 – 1.12)	0.99 (0.89 – 1.10)
Physical activity in leisure time**				
No			1.00	1.00
Yes			1.01 (0.89 – 1.14)	1.03 (0.91 – 1.16)

Continue...

Table 1. Continuation.

Variables*	Model 1[a] OR (95%CI)	Model 2[b] OR (95%CI)	Model 3[c] OR (95%CI)	Model 4[d] OR (95%CI)
Alcohol Consumption***				
Not consumed or recommended			1.00	1.00
Above recommended			0.98 (0.85 – 1.14)	0.99 (0.86 – 1.15)
Current smoker				
No			1.00	1.00
Yes			**0.81 (0.71 – 0.92)**	0.92 (0.81 – 1.05)
Number of chronic diseases				
None				1.00
One or more				**1.46 (1.33 – 1.59)**
Overweight and Obesity****				
No				1.00
Yes				**1.47 (1.32 – 1.62)**
Waist circumference*****				
Normal				1.00
High/Significantly high				**1.63 (1.46 – 1.82)**
Number of doctor visits in the last 12 months				
0 a 3				1.00
≥ 4				**1.32 (1.21 – 1.44)**

OR: *odds ratio*; 95%CI: confidence interval of 95% (multilevel logistic regression model); [a]model with context variables; [b]model 1 + sociodemographic variables; [c]model 2 + health behaviors; [d]model 3 + health condition and use of health services; *consumption of five servings daily at least five days a week; **at least 150 minutes of light or moderate physical activity or 75 minutes of vigorous weekly physical activity in leisure-time; ***recommended alcohol consumption so that there is no increase in blood pressure: up to one dose / day for women and up to two doses/day for men; ****body mass index ≥ 28 kg/m^2; *****waist circumference ≥ 94 cm for men and ≥ 80 cm for women.

Regarding the variables of individual level, after adjustment for all factors included in this study, higher chances of having hypertension were found among women (OR = 1.34; 95%CI 1.21 – 1.49), in the 70 to 79 age group (OR = 1.37; 95%CI 1.24 – 1.51) and 80 years or older (OR = 1.45; 95%CI 1.26 – 1.66), in those who declared themselves non-white (OR = 1.16; 95%CI 1.06 – 1.28), with one or more chronic diseases (OR = 1.46; 95%CI 1.33 – 1.59), overweight and obesity (OR = 1.47; 95%CI 1.32 – 1.62), high or significantly high waist circumference (OR = 1.63; 95%CI 1.46 – 1.82), and among older adults who reported having had four or more doctor visits in the 12 months prior to the interview (OR = 1.32; 95%CI 1.21 – 1.44). In addition, the group with nine or more years of schooling was less likely to have hypertension (OR = 0.68; 95%CI 0.60 – 0.78) (Table 1).

DISCUSSION

The results of the present study showed a high prevalence of hypertension among Brazilian older adults (66.7%). Hypertension was more frequent among women, old-aged, less educated, non-white, those with worse health conditions, and among those who had the highest number of medical appointments in the previous year. Moreover, older adults residing in the Federation Units with higher MHDI were more likely to be hypertensive.

The high prevalence of hypertension observed in this study is in line with prevalence observed in other older adult populations ranging from 52,6% to 79,8%[14,22-24]. This high prevalence could be attributed to an increase in the elderly population, emotional stressor and exposure to risk behaviors[2], drawing attention to the important burden of this disease among older adults.

Among the associated factors, the residence context may influence the geographic distribution of SAH[25], and this knowledge is important for the proper understanding of the differences in the distribution of this disease among populations living in different countries and even in different regions within the same country. In the present study, a paradoxical situation was observed if we consider that hypertension was positively associated with MHDI and negative with the individual's education, even after adjusting for all variables included in the analysis. Elderly residents in Federation Units with higher MHDIs were more likely to be hypertensive, while individuals with higher levels of education were less likely to be hypertensive.

The inverse association between hypertension and the individual's schooling may reflect a greater ease in recognizing health needs, greater access to health services, medical care, treatments needed for rehabilitation, and greater access to information among more educated individuals, leading to healthy practices and behaviors among this group[26]. On the other hand, positive association with MHDI could be explained by survival bias, possibly due to advances in medical treatment, which ensured longer life expectancy[6] for individuals with hypertension residing in more developed regions. Reinforcing this hypothesis, estimates obtained with the Sullivan method (data not shown)[27] presented a 0.66 correlation between the years lived with hypertension and the MHDI, indicating that the Federation Units with the highest MHDI are those in the which individuals live longer with hypertension, supporting the higher prevalence of this disease over time.

The positive association with MHDI could also be related to a greater chance of receiving a medical diagnosis since these individuals have better social conditions, and consequently they would have greater access to health services[13]. However, this fact should not have occurred in the present study, as the diagnosis was done by direct blood pressure measurements at the participants' homes.

No association was observed between the Gini Index and SAH after adjusting for all variables included in this study. In a different way, findings from two studies were consistent with the hypothesis that income inequality is associated with increased risk of SAH[3,28]. Our findings could be attributed to the fact that equity-focused policies[29] could be contributing to the improvement of health among socially vulnerable individuals, which may possibly have minimized effect of income inequality, assessed by the Gini Index, on health conditions, including hypertension. Since income inequality is associated with underinvestment in social infrastructure[30], equity policies would represent an investment in individual health, providing a greater chance of having better access to health services and information.

Regarding the individual factors associated with hypertension, the greater chance of hypertension among women, older age and non-white individuals were also observed in other studies[12,13,31,32]. The greater chance of hypertension among women can be explained by the greater tendency for self-care and greater perception of their health condition[30]. The association with older age meets the criteria of biological plausibility, since the aging process leads to vascular changes[1]. The association between SAH and skin color may be justified by the higher social inequality observed among non-white individuals[33]. However, it is noteworthy the persisted association even after adjustment for individuals and contextual factors. This persistence could be attributed to the residual confounding effect, considering that the factors included in the adjustment did not portray the total living and health conditions of this population, or the influence of other variables in this association, such as heredity and genetic aspects that are involved in the determination of the disease[33].

The association between SAH and poorer health conditions, including higher numbers of chronic diseases, overweight and abdominal fat accumulation has been described in other studies[12,31,34]. It is noteworthy that the simultaneous occurrence of two or more chronic diseases, regardless of SAH, may increase the number of medical prescriptions, hospitalizations, worsen the general health status, and worsen the quality of life of these individuals[35]. In addition, the increase in body fat and reduction in muscle mass as well as the redistribution of body fat with accumulation in the abdominal region alter the individual's metabolic profile. These changes lead to increased insulin resistance, hormonal dysregulation, sodium retention, increased blood volume, cardiac output, and greater sympathetic activity, which may cause hypertension[1] as well as other health problems.

Finally, hypertension was more common among older adults who reported having had four or more medical appointments in the year prior to the interview. Other studies corroborated our finding[29,36], which was expected since hypertensive patients have a greater need to seek medical care[36] because they have more health problems. On the other hand, attending doctor appointments gives health professionals a greater chance to know their patient, identify problems related to adherence to the treatment, and propose goals and objectives for treatment adherence[37]. This leads to greater patient motivation, decreased complications, emergency consultations, hospitalizations, mortality, health care costs, and improved patient quality of life[38].

This study has some limitations. Its cross-sectional design does not allow to establish a temporal relationship between SAH and independent variables. In addition, Federation Units, used as an aggregation unit, represent a broader level of context, which encompasses a complexity of factors that affect the physical and social context, such as place of residence, workplace, social networks[38], degree of urbanization, and characteristics of streets, roads and services available at each location related to food sales[25].

In addition, to correct the sample design effect, NHS uses post-stratification weights, which is not supported when adjusting multilevel models. Therefore, logistic models of random effects do not rely on adjustment by design effect. However, as Federation Units constitute the highest level in the regression model, and this is not part of the sampling strategy, it is likely that the sample design did not affect the point estimates and standard errors of this level of analysis[39].

On the other hand, this is a nationwide study that used as a dependent variable the direct measurement of blood pressure instead of self-reported hypertension. It also brought together a wide range of individual factors, known to be associated with hypertension, as well as two context variables that portray the development of regions and income inequality.

Thus, the present analysis allowed to explore the joint effect of individual and contextual factors on the occurrence of hypertension, contributing to the knowledge about these factors in a group with fast and intense growth. The composition of individual and contextual aspects should be considered in health action planning, seeking to improve the living and health conditions of the older adult population.

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