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Prevalence of concomitant hypertension and diabetes in Brazilian older adults: individual and contextual inequalities

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Abstract *The simultaneous occurrence of specific diseases in older adults is explored little in the literature. The aim of this study was to estimate the prevalence of concomitant hypertension and diabetes in Brazilian older adults and determine associated contextual and individual factors. A population-based cross-sectional study was conducted with 10,991 older adults (≥ 60 years of age) interviewed during the 2012 Vigitel Survey. Statistical analysis involved multi-level Poisson regression. Mean age was 69.4. The prevalence of the concomitant occurrence of hypertension and diabetes was 16.2%, with differences found among the capital cities. Higher prevalence rates were found in cities located in the southern, southeastern and central-western regions of the country as well as among black and brown older adults, those with up to eight years of schooling, non-smokers, ex-smokers and those with excess weight. The effect of geographic region was demonstrated by the 23.5% increase in the prevalence of the concomitant diseases after adjusting for individual variables. The present findings enabled gauging the effect of context (region of residence) on the prevalence of the main diseases related to an increased mortality rate in the older population.*

Key words *Epidemiological surveys, Arterial hypertension, Diabetes mellitus, Elder health*

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Introduction

Systemic arterial hypertension and diabetes *mellitus* are among the five main global risk factors for mortality in the world[1] and are recognized risk factors for cardiovascular disease and causes of death in the older population[2,3]. The high prevalence rates currently place these two diseases among the main public health problems[1] due to the associations with morbidity and mortality rates as well as major geriatric syndromes[2,3].

Arterial hypertension is the most common cardiovascular disease and leads to reductions in both quality of life and life expectancy. Considered a multifactor clinical condition characterized by sustained high blood pressure levels, hypertension is associated with functional and/or structural changes in target organs (heart, brain, kidneys and blood vessels) as well as metabolic changes[2]. Moreover, there is a direct relationship between blood pressure and age. In Brazil, the prevalence of hypertension among older adults is approximately 50%[4-9].

Diabetes *mellitus* (DM) is a heterogeneous group of metabolic disorders involving hyperglycemia due to the defective secretion and/or action of insulin. This chronic glucose metabolism disorder involving the persistent increase in blood sugar can lead to acute and chronic complications in the cardiovascular, renal and neurological systems[3,10]. Type 2 DM accounts for 90 to 95% of cases of this disease[3] and a 69% increase in the number of adults with diabetes in developing countries and a 20% increase in developed countries are estimated between 2010 and 2030[11]. Data from the Brazilian National Health Survey show an estimated 9.2 million Brazilians with a diagnosis of DM, corresponding to 6.2% of the adult population[12]. The prevalence also increases with age[12,13]. In the population of Brazilian older adults, data from the 2008 National Household Survey reveal a prevalence rate of more than 15%. According to the National Health Survey,the prevalence among older adults aged 65 to 74 years and those aged 75 years or older was 19.9% and 19.6%,respectively, in 2013[12]. For the population aged 60 years or older, studies conducted in specific locations report rates higher than 13%[4,7,14-16].

The increase in the prevalence of these health conditions in general and specifically among older adults is strongly reflected in the demand for healthcare services, the high use of medications in this age group[4,7] and restrictions with regard to activities among affected individuals, which has substantial social impact[17,18]. Indeed, severe to very severe limitations with regard to activities of daily living are found among 7.0% of individuals with DM, with reports of hospitalizations among 13.4% in the previous 12 months[18]. This increase in the demand for healthcare services in both primary care and services of greater complexity represents a high burden for the Brazilian public healthcare system, imposing the need for the reorganization, qualification and broadening of care[19].

Morbidity and mortality rates are higher when arterial hypertension and DM are combined, with an increased risk of kidney disease, coronary disease, stroke and heart failure. These conditions are also associated with comorbidities, such as dyslipidemia, a pro-thrombotic state and autonomic heart dysfunction[20]. Studies report that the prevalence of hypertension is approximately twofold higher among individuals with diabetes in comparison to those without diabetes and the risk of cardiovascular disease is approximately fourfold higher among individuals with both diseases[21,22].

An increase in the proportion of older adults has occurred in both developed and developing countries and this increase has been unequal among the different regions of Brazil[23]. The occurrence of diseases and their distribution in society is strongly influenced by social, economic, cultural, environmental and political factors as well as individual (sociodemographic and behavioral) aspects[24]. Brazil is a large country with contrasting sociodemographic and epidemiological characteristics among its different regions[5,8,12,23]. Considering that cardiovascular risk progressively increases with the number of risk factors present, the distribution of hypertension and diabetes simultaneously in the studied population, characterizes a situation of greater risk for cardiovascular diseases[21].

The aim of the present study was to estimate the prevalence of the concomitant occurrence of arterial hypertension and diabetes *mellitus* in among Brazilian older adults as well as determine associated contextual and individual factors to identify inequalities in the distribution of these factors.

Methods

This study involved the analysis of data from the 2012 Vigitel Survey. The Brazilian Health Ministry has been conducting this telephone survey in capital cities and the Federal District

annually since 2006.The system selects a sample of the adult population (≥ 18 years) who reside in homes with at least one landline.

The present population-based cross-sectional study involved three-stage probabilistic sampling. The first step considered of the systematic selection of five thousand telephone lines divided into subsamples of 200 lines each reproducing the same proportion of lines per region of the city or area code. The second stage included the identification of active residential lines considered eligible for the system. Business lines, out-of-service lines, inexistent lines and lines for which no answer was obtained after six attempts on different days and at different times were excluded. In the third stage, adults (≥ 18 years of age) residing in the homes identified as eligible were selected for the interviews[25].

In 2012, a minimum sample of 2000 interviews per city was considered to enable estimates of the frequency of risk factors for chronic diseases among the adult and senior populations with a 95% confidence interval and 2% maximum margin of error. Weighting factors were used to compensate for the bias of the non-universal coverage of landlines. The estimates were adjusted to the Brazilian adult population using a post-stratification weight calculated based on 36 analysis categories stratified by sex (female and male), age group (18-24, 25-34, 35-44, 45-54, 55-64 and ≥65 years) and level of schooling (none or incomplete primary school, complete primary school or incomplete high school, complete high school or incomplete university and complete university). The post-stratification weight of each individual in the sample was calculated using the "rake" method[25].

The Vigitel questionnaire addresses demographic and socioeconomic characteristics, eating habits, physical exercise, weight, height, the frequency of tobacco and alcohol consumption, self-rated health, use of medications and a medical diagnosis of diseases. The concomitant occurrence of diseases was determined based on the answers to the following questions: *Has any doctor ever told you that you have high blood pressure? Has any doctor ever told you that you have diabetes?* Based on the answers (yes or no) among the older adults, a dichotomous variable was created for the presence/absence of the concomitant occurrence of these two diseases.

The independent variables in the present study were geographic macro-region (north/northeast and south/southeast/central west), sex (male and female), age group (60 to 64, 65 to 69, 70 to 74, 75 to 79 and ≥ 80 years), marital status (single, married/stable union, widowed and separated/divorce), skin color/race (white, brown, black and yellow/indigenous), schooling (0 to 4, 5 to 8 and 9 or more years of study), having health insurance (yes or no), smoking (non-smoker, ex-smoker and smoker), body mass index (< 22, 22 to 27 and > 27 Kg/m^2)[26] and practice of physical activity (yes or no). The division of geographic regions into north/northeast and south/southeast/central west was based on the Human Development Indexof capital cities according to the 2010 census[27].

Relative frequencies were considered for the characterization of the sample. Pearson's chi-squared test with a second-order correction (Rao-Scott test) was used to test associations between the independent variables and the occurrence of the two diseases, with the level of significance set to 5%. Prevalence ratios (PR) and respective 95% confidence intervals (CI) were estimated using Poisson regression with robust variance. The sampling design effect for the analysis of surveys involving complex designs was considered for all analyses using the Stata 12.0 program.

The analysis of factors associated with the prevalence of the concomitant occurrence of hypertension and diabetes was performed using multilevel Poisson regression with a fixed-effects model and random intercept, which enabled examining groups and individuals within these groups simultaneously, considering the response variable measured on the individual level and explanatory variables measured on the both the individual level and in the groups to which the individuals belonged[28]. Two levels of data organization were considered: macro-region and individuals interviewed.

In the theoretical model for the investigation of contextual and individual factors associated with the prevalence of the simultaneous occurrence of hypertension and diabetes among older adults, macro-region of the country was considered the contextual variable. Sex, age, marital status and skin color/race were the demographic variables. Socioeconomic status was evaluated based on schooling and having health insurance, which are considered proxies. Health-related behaviors were evaluated based on smoking habit, body mass index and the practice of physical exercise. The multi-level regression analysis took into consideration the theoretical model of outcome determination presented in Figure 1.

Hierarchical Poisson multiple regression analysis was performed. In the first step, all de-

mographic variables (sex, age group, marital status and skin color/race) were incorporated and adjusted to each other and the variable on level 1 (region of residence). The socioeconomic variables (schooling and having health insurance) were then incorporated and those with a p-value less than 0.25 after adjustments for variables on the same level, the demographic variables and the context variable were maintained in the model. Next, the variables related to health behaviors (smoking, BMI and practice of physical activity) were incorporated and those with a p-value less than 0.05 after adjustments for all individual variables and region of residence were maintained in the model.

Sex and age remained as adjustment variables in all steps, as the regions of the country have differences regarding the distribution of the older population by sex and age group. Moreover, differences are found between men and women regarding the risk of becoming ill, the perception of signs and symptoms, the use of healthcare services and mode of care[8,29]. Regarding the prevalence of chronic diseases, the distribution pattern by age differs depending on the type of health problem[8].

Thus, a compositional effect was obtained in each step: the effect of individual factors on the individual outcome (concomitant occurrence of hypertension and diabetes) considering the effect of the region of residence to which the individuals belonged. Therefore, the prevalence ratios were adjusted by variables situated on the same level of determination (individual) as well as the variable situated on the most distal level (context). Finally, the contextual variable (region of residence) was adjusted by variables that represented individual characteristics significantly associated with the outcome.

All individuals received clarifications regarding the objectives of the study during the telephone contact and written informed consent was replaced with oral consent. This study received approval from the National Human Research Ethics Committee of the Brazilian Health Ministry.

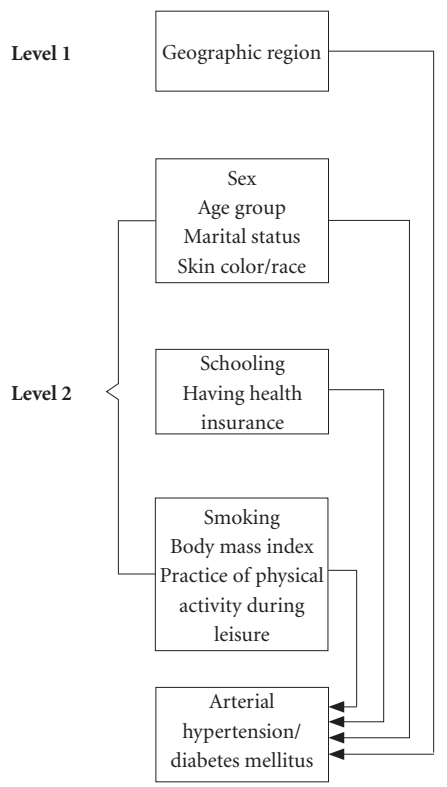

Figure 1. Theoretical model for investigation of contextual and individual factors associated with the prevalence of the concomitant occurrence of arterial hypertension and diabetes mellitus in older adults structured in hierarchical levels.

Results

In 2012, Vigitel conducted 45,448 interviews with adults (≥ 18 years)in 27 cities throughout the country. The participation rate was 64.9%, ranging from 60.8% in Belém and 73.1% in Palmas. Refusals to participate in the monitoring system occurred either during initial contact with the home or after the random selection of the individual to be interviewed and corresponded to 5.9% of the eligible lines. The mean duration of the interviews was approximately 11 minutes (range: 5 to 58 minutes).

A total of 10,991 of the interviewees were older adults. The prevalence of the concomitant occurrence of arterial hypertension and diabetes *mellitus* was 16.2% ($CI_{95\%}$: 14.8 to 17.7%), with variations among the cities. The prevalence rate was higher in Sao Paulo and Curitiba compared to Boa Vista and Manaus (Figure 2).

Table 1 displays the distribution of the older population and prevalence of the diseases according to region of the country and the individual characteristics analyzed. Higher prevalence rates were found in capital cities located in the southern, southeastern and central-western regions of the

country as well as among black and indigenous older adults, those with up to eight years of schooling, non-smokers, ex-smokers and those with excess weight at the time of the interview. No association was found between physical inactivity and the occurrence of the two diseases (PR = 1.20; $CI_{95\%}$: 1.00 to 1.44).

The prevalence of the concomitant occurrence of hypertension and diabetes among older adults residing in the southern, southeastern and central-western regions was 17.0% higher than among those living in the northern and northeastern regions. The adjusted analyses revealed individual inequalities: the prevalence was 48.0% and 55.0% higher among those with brown and black skin color, respectively. The prevalence was also higher for those with up to eight years of schooling and particularly for those with excess weight (PR = 2.63; $CI_{95\%}$: 1.82 to 3.80). The concomitant prevalence of the two diseases was significantly lower among smokers (PR = 0.45; $CI_{95\%}$: 0.27 to 0.74) (Table 2).

Table 3 displays the prevalence ratios for the context variable (geographic region) before and after the adjustment for the individual variables. A 23.5% increase in the magnitude of the prevalence ratio was found after the adjustment (from 1.17 to 1.21), indicating that this vari-

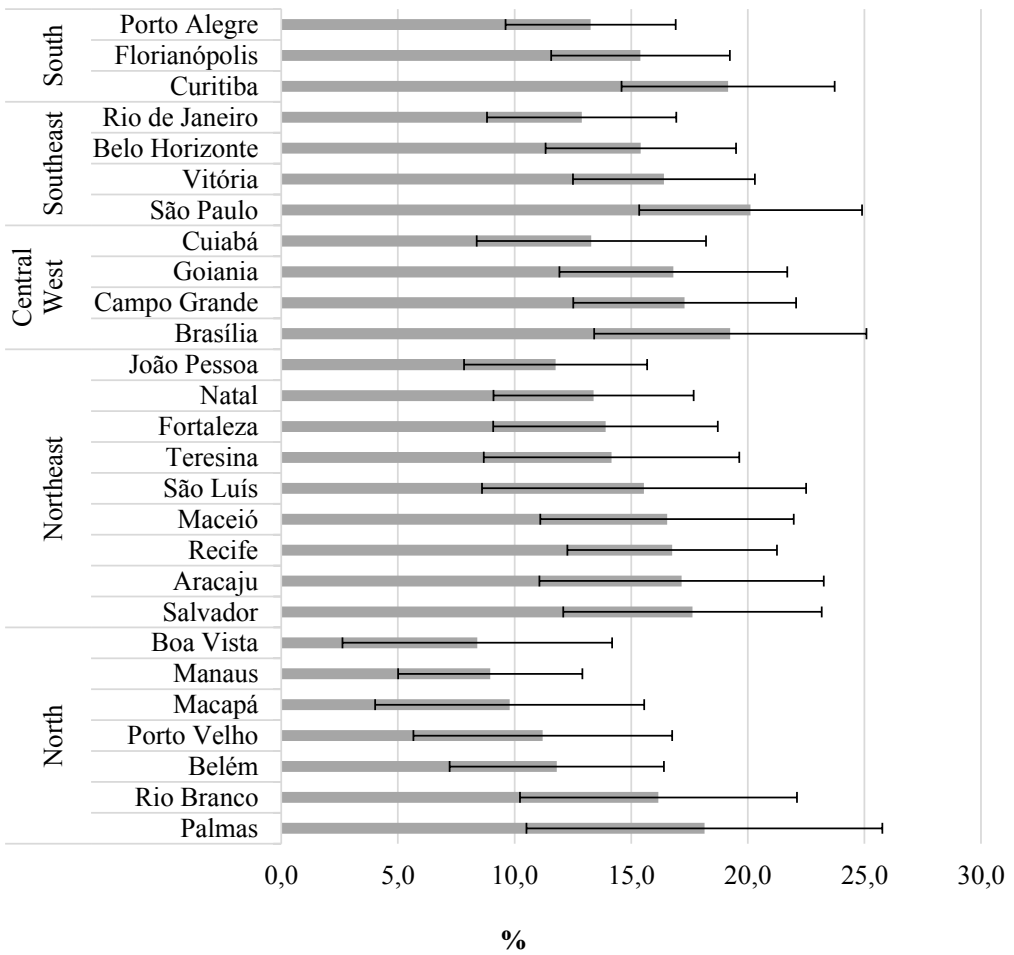

Figure 2. Prevalence of the concomitant occurrence of arterial hypertension and diabetes mellitus among older adults in Brazilian capital cities. Vigitel, Brazil, 2012.

Table 1. Prevalence of concomitant occurrence of arterial hypertension and diabetes mellitusin older adults according to geographic region, demographic, socioeconomic and behavioral characteristics. Vigitel, Brazil, 2012.

Variables/categories	Frequency (%)	Prevalence (%)	p*
Level 1: Context			
Geographic region			
Macro-region			**0.041**
North and Northeast	29.4	14.5	
South, Southeast and Central West	70.6	17.0	
Level 2: Individuals			
Demographic characteristics			
Sex			0.175
Male	39.4	15.0	
Female	60.6	17.1	
Age group (years)			0.444
60 - 64	33.5	14.7	
65 - 69	22.7	17.9	
70 - 74	18.0	17.2	
75 - 79	14.1	17.5	
80 or more	11.7	15.0	
Marital status			0.301
Single	10.6	13.4	
Married/stable union	57.6	16.1	
Widowed	23.8	18.2	
Separated/divorced	8.0	16.9	
Skin color/race			**0.035**
White	56.3	15.2	
Brown	28.5	15.4	
Black	9.8	20.8	
Yellow/indigenous	5.4	23.6	
Socioeconomic characteristics			
Schooling (years of study)			**0.016**
≤ 4	43.7	17.8	
5 - 8	24.1	17.5	
≥ 9	32.2	13.3	
Private health insurance			0.133
No	49.6	17.5	
Yes	50.4	15.2	
Behavioral characteristics			
Smoking			< **0.001**
Non-smoker	55.2	17.1	
Ex-smoker	35.6	17.4	
Smoker	9.2	7.6	
Body mass index			< **0.001**
< 22 Kg/m2	12.1	8.8	
22 to 27 Kg/m2	39.6	12.9	
> 27 Kg/m2	48.3	21.0	
Physical inactivity			**0.051**
No	69.2	15.4	
Yes	30.8	18.4	

*p-value of chi-squared text with Rao-Scott correction.

able remained associated with the concomitant occurrence of hypertension and diabetes, independently of the individual variables.

Discussion

The prevalence of the concomitant occurrence of arterial hypertension and diabetes *mellitus*

among the older adults interviewed was 16.2%, with differences among the Brazilian state capitals. The prevalence of chronic diseases is high among older adults[8,30,31]. In the Bambuí Study, 69% of older adults reported having at least one chronic disease[30]. In the Cardiovascular Health Study, only 18.5% of older adults reported not having any chronic diseases[31]. In a study eval-

Table 2. Multilevel analysis of factors associated with prevalence of concomitant occurrence of arterial hypertension and diabetes mellitus in older adults. Vigitel. Brazil. 2012.

Variables/categories	PR_{crude} (CI95%)	p	$PR_{adjusted}$ (CI95%)	p
Level 1: Context				
Geographic region				
Macro-region	1			
North and Northeast	1.17 (1.01 - 1.36)	0.040		
South, Southeast and Central West				
Level 2: Individuals				
Demographic characteristics				
Sex	1		1	
Male	1.14 (0.94 - 1.39)	0,177	1,11 (0,87 - 1,41)	0.404
Female				
Age group (years)	1		1	
60 - 64	1.22 (0.95 - 1.57)	0.126	1.27 (0.97 - 1.67)	0.087
65 - 69	1.17 (0.91 - 1.51)	0.219	1.21 (0.91 - 1.60)	0.187
70 - 74	1.19 (0.89 - 1.60)	0.233	1.26 (0.90 - 1.76)	0.176
75 - 79	1.02 (0.76 - 1.39)	0.871	0.98 (0.66 - 1.45)	0.915
80 or more				
Marital status				
Single	1		1	
Married/stable union	1.20 (0.87 - 1.64)	0.269	1.46 (1.03 - 2.08)	**0.035**
Widowed	1.35 (0.97 - 1.88)	0.072	1.50 (1.02 - 2.20)	**0.039**
Separated/divorced	1.26 (0.84 - 1.87)	0.257	1.41 (0.92 - 2.17)	0.112
Skin color/race				
White	1		1	
Brown	1.01 (0.82 - 1.25)	0.912	1.48 (1.07 - 2.04)	**0.018**
Black	1.36 (0.99 - 1.88)	0.057	1.55 (1.08 - 2.23)	**0.018**
Yellow/indigenous	1.55 (1.07 - 2.23)	0.020	1.07 (0.86 - 1.34)	0.511
Socioeconomic characteristics				
Schooling (years of study)				
≤ 4	1		1	
5 - 8	1.31 (1.04 - 1.67)	0.021	1.31 (1.00 - 1.71)	**0.047**
≥ 9	1.34 (1.10 - 1.65)	0.004	1.40 (1.09 - 1.81)	**0.009**
Private health insurance				
No	1		1	
Yes	1.07(0.98 - 1.17)	0.133	1.01(0.91 - 1.13)	0.840
Behavioral characteristics				
Smoking				
Non-smoker	1		1	
Ex-smoker	1.02 (0.85 - 1.23)	0.846	11.06 (0.87 - 1.30)	0.539
Smoker	0.45 (0.29 - 0.68)	< 0.001	0.45 (0.27 - 0.74)	**0.002**
Body mass index				
< 22 Kg/m2	1		1	
22 to 27 Kg/m2	1.47 (1.02 - 2.12)	0.040	1.66 (1.12 - 2.44)	**0.011**
> 27 Kg/m2	2.40 (1.69 - 3.40)	< 0.001	2.63 (1.82 - 3.80)	**< 0.001**
Physical inactivity				
No	1		1	
Yes	1.20 (1.00 - 1.44)	0.050	1.18 (0.90 - 1.55)	0.231

CI: confidence interval; PR: prevalence ratio

*Adjustment for geographic region and demographic variables; ** Adjustment for geographic region, demographic and socioeconomic characteristics; *** Adjustment for geographic region, demographic, socioeconomic and behavioral characteristics.

Table 3. Percentage increase in effect of geographic region on prevalence of concomitant occurrence of arterial hypertension and diabetes mellitus in older adults after adjustments for demographic, socioeconomic and behavioral factors. Vigitel, Brazil, 2012.

Contextual variable	PR_{crude} ($IC_{95\%}$)	$PR_{ajusted}$* ($IC_{95\%}$)	Increase** (%)	Deff***
Geographic region				
North and Northeast	1	1		
South, Southeast and Central West	1.17 (1.01 - 1.36)	1.21 (1.03 - 1.44)	23.5	2.25

CI: confidence interval; PR: prevalence ratio; *PR adjusted by demographic, socioeconomic and behavioral variables;.**Percentage increase in effect after adjustments. ***design effect.

uating sources for obtaining medications for hypertension and diabetes in Brazil using data from the 2011 Vigitel Survey, the prevalence of hypertension was 57.1% and 60.3% in the 60-to-69-year-old age group and the group aged 70 or older, respectively. Regarding diabetes *mellitus*, the figures for these two sub-groups were 18.8% and 22.0%[4].

The prevalence of the concomitant occurrence of specific diseases among older adults is described little in the national literature. Using data from the 1998, 2003 and 2008 National Household Surveys, Freitas and Garcia[32] revealed a rapid increase in the prevalence of concomitant diseases in the period; beginning with 50 years of age, significant increases were found in the different regions of Brazil, with prevalence rates higher than 15% among individuals65 years of age or older. In a study involving 297 individuals registered with the Arterial Hypertension and Diabetes Mellitus Care Reorganization Plan at a Family Health Center of the VI Regional Executive Secretary in the city of Fortaleza (northeastern Brazil) in 2009, the prevalence of both diseases was 19.5%[33]. Among the older adults who participated in the Bambuí Project at baseline (n = 1,606),942 had hypertension and/or diabetes, 77.5% of whom had only hypertension, 6.6% only had diabetes and 15.9% had both diseases[34]. Unlike the present investigation, the studies cited did not present confidence intervals associated with the estimates of the prevalence of the concomitant occurrence of the diseases, which renders comparisons impossible.

The individual factors associated with the outcome were similar to those reported in previous studies on hypertension and diabetes[6,9,14-16]. Schooling and race are social determinants of health conditions among older adults[35]. Both national and international data reveal inequalities in the occurrence of chronic diseases related to these two factors[8,36,37], which may stem from the association with the lack of access to social opportunities throughout one's lifetime, thereby increasing the vulnerability of this subgroup to unfavorable outcomes later in life. Specifically, skin color/race is an important variable in the investigation of social inequality and aspects of health[2,5,38,39]. Therefore, strategies directed at reducing these inequalities could have an impact on reducing the burden of chronic disease in more vulnerable segments of the population.

Smoking was inversely associated with the prevalence of the concomitant occurrence of the two diseases. Significant inverse associations between smoking and hypertension have previously been reported in older adults in the state of Rio Grande do Sul (southern Brazil)[40], the city of Campinas (southeastern Brazil)[41] and a study using a subsample of older adults from the Vigitel Survey[42]. Smoking is the main risk factor of mortality due to chronic non-communicable diseases[43] and the recommendation to quit smoking among individuals affected by such diseases should be an immediate measure. Although quitting smoking does not lower one's blood pressure, it is probably the most effective isolated measure for reducing the risk of cardiovascular disease[42].

According guidelines for quitting smoking[44], the harm caused by this habit can be reduced even in individuals who have smoked for three decades or more, enabling the better control of the evolution of preexisting diseases and an increase in life expectancy. The lower prevalence of smokers with hypertension and diabetes found in the present study may be partially explained by the fact that individuals with diagnoses of these diseases would have greater contact with health professionals and would therefore be more exposed to counseling and educational interventions. These results lend support to the hypothesis that a diagnosis of hypertension leads to quitting smoking[42].

Regarding the association between BMI ≥ 22 Kg/m^2 and the diseases, non-pharmacological measures are fundamental to the prevention and control of blood pressure and diabetes. Studies report that physical activity combined with an adequate diet assists in controlling both blood pressure and blood glucose as well as lowering weight, increasing muscle mass and reducing the occurrence of severe cardiovascular events[2,3].

Regional inequalities found for various sociodemographic and health indicators[5,8,23] were also found with regard to the prevalence of the most common diseases in the older population. The prevalence of the concomitant occurrence of hypertension and diabetes was higher in geographic regions with a higher Human Development Index (south, southeast and central west), suggesting the influence of context on the outcome investigated. The diversity of individual characteristics results from biological and social forces that either favor or limit the occurrence of many diseases[45]. Social, economic, cultural, racial and behavioral factors are interrelated determinants of health outcomes overlapping in a hierarchical manner[46,47]. According to Goldstein[48], the multilevel model can be seen as a hierarchical system of regression equations enabling the estimation of intra-group (individual influences) and inter-group (contextual influences) effects.

It should also be noted that the regional disparities observed for the simultaneous prevalence of diseases may reflect less access to medical diagnosis, since the referred morbidity also depends on the access and use of medical services, shaped both by the capacity to seek and obtain care, and by the care organization that defines the offer, quality and resolubility of action and service[7,8].

The overlapping of chronic health problems becomes progressively more important with the mass displacement of the population distribution and not only due to the number of individuals in the age group at risk, demanding qualified attention.In the scopeof primary prevention, it is possible to delay the emergence of these diseases even at more advanced ages through health promotion actions. Secondarily, an early diagnosis enables offering and using treatment-appropriate drugs as well as counseling and educational measures for older adults with hypertension and diabetes, whichcan have a positive impact on both quality of life and life expectancy.

Among the limitations of the present study, use of self-reported information regarding the diseases merits particular attention. The validity of self-reported information on arterial hypertension and diabetes *mellitus* has been verified in studies that involved the older population[49] or considered older adults as a subgroup for analysis[50,51]. Particularly with regard to diabetes, the interviewees did not differentiate the disease type. However, 90% of all cases of diabetes in adults are type 2[3]. The use of fixed telephones lines ("landlines") for the purposes of selecting the sample should also be considered a limitation of the study. In metropolitan areas of the southern, southeastern and central western regions of the country, where telephone coverage is higher than 70%, bias due to the exclusion of homes without a landline may be considered negligible[52]. In the comparison of estimates obtained from household and telephone surveys regarding self-reported chronic diseases, no differences were found in the prevalence of hypertension and diabetes reported among older adults residing in the city of Campinas (southeastern region)[53].In the northern and northeastern regions of the country, where telephones coverage is less than 70%, Vigitel used the cell weighting method according to sex, age and schooling to correct potential biases, with the adjustment of the distribution of the sample to the characteristics of the population residing in each capital city (according to the census performed by the Brazilian Institute of Geography and Statistics) to reduce the differences between populations with and without a telephone[52].

As stated elsewhere, *health promotion affects the whole of the population in the context of daily living and is not focused on individuals who run the risk of developing specific diseases*[45]. The prevalences found are compatible with the natural history of both diseases and the accumulation of risk factors throughout the lifecycle. Changes in behavior and lifestyle in the population of adults and older adults are difficult to achieve. Early health promotion actions considering regional disparities for the definition of priorities increase the chances of reducing the premature emergence of the main diseases that affect older adults.

Conclusions

The prevalence of the concomitant occurrence of arterial hypertension and diabetes *mellitus* among Brazilian older adults was higher than 15% in 2012 and represents an important public health problem. Besides pharmacological treatment, the practice of physical activity and the

adoption of cardioprotective diets can diminish the risk of severe or even fatal cardiovascular events in this subgroup of the population.

More than the individual factors related to the outcome evaluated, longitudinal relationships among social health determinants involving in the health-disease process of such illnesses are evident when analyzing the population of older adults in different contexts. Brazil is a large country with different phases of epidemiological transition and polarization between different geographic areas and social groups. The constant monitoring of the prevalence of concomitant arterial hypertension and diabetes *mellitus*in different locations is necessary to the planning of health actions directed at these diseases. The present analysis enabled gauging the effect on context (region of residence) on the prevalence of the main diseases that affect the older population and are related to mortality in this age group.

Collaborations

PMSB Francisco drafted the proposed and wrote the article, planned, programmed and executed the statistical analyses and performed the review of the literature. FSA Borim contributed to the writing of the article and performed the review of the literature. NJ Segri and DC Malta reviewed the statistical analyses and performed a critical review of the manuscript.

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