

## Factors associated with the most frequent multimorbidities in Brazilian older adults

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**Abstract** *This study aimed to identify an association between the most frequent multimorbidities in Brazilian older adults and socioeconomic and lifestyle variables. National Health Survey's data were used. The Chi-square test and the Poisson multiple regression were used to analyze data. A total of 5,575 older adults with multimorbidity and mean age of 70.3 years participated in the study. Most of them are female (66.3%), white (56.1%), are sedentary (75.3%), with low schooling (40%), no health plan (65.3%), did not consume alcohol (78.7%) and did not smoke (90.1%). The most prevalent multimorbidities were hypertension and high cholesterol (31.3%), hypertension and stroke (30.9%) and hypertension and diabetes (23.3%). There was an association of the first condition with females, younger adults and no tobacco use. On the other hand, the second condition was associated with females and low level of schooling. The third group was associated with low schooling, sedentary lifestyle and no tobacco use. We can conclude that multimorbidity in Brazilian older adults is a frequent condition in women, younger seniors and those socioeconomically disadvantaged. Also, socioeconomic conditions and lifestyle influenced the prevalence of primary multimorbidities.*

**Key words** *Multimorbidity, Elderly, Chronic diseases*

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## Introduction

The world health scenario experiences an epidemiological transition with a profound change in health and disease patterns, which interact with demographic, economic, social, cultural and environmental factors<sup>1</sup>. Although infectious diseases are still relevant and present, chronic noncommunicable diseases have recorded a significant increase, among which cardiovascular diseases, cancers, diabetes, chronic respiratory diseases and neuropsychiatric diseases have accounted for high mortality and loss of quality of life. Also, these conditions can generate disabilities, a high degree of limitation in their activities of daily living and leisure and, consequently, exert considerable pressure on health services<sup>2</sup>.

Within this context, the occurrence of multiple chronic diseases in a single individual, known as multimorbidity, has also become quite present in the world population. This situation is possibly due to the reduced positive diagnostic threshold for most chronic diseases, the transition from a young population to an elderly population or by the increased prevalence of these diseases<sup>3</sup>. In older adults, precisely due to its high vulnerability, multimorbidity is itself an even more frequent clinical condition. This may be closely related to an increased life expectancy of the population<sup>4</sup>.

Considered as a public health problem, the prevalence of multimorbidity in older adults can reach a percentage above 50%, and when present, this condition can have serious consequences, including more significant risks of death, functional decline and shorter life expectancy of this population<sup>5,6</sup>. Studies have shown a strong association of the prevalence of multimorbidity with highly prevalent harmful factors, such as smoking, alcohol abuse, overweight, high cholesterol, low consumption of fruits and vegetables, and sedentary lifestyle in the general population. However, these studies looked for factors associated only with the fact of having multimorbidity and the number of chronic diseases, neglecting the types of concurrent diseases in older adults and their associated factors<sup>7-13</sup>.

Thus, with the identification of the profile of older adults with multimorbidity and the factors associated with the central concurrent diseases, the formulation of public policies aimed at the prevention of these diseases are facilitated<sup>14</sup>. Therefore, this population-wide study aimed at finding the association of the most frequent multimorbidities with socioeconomic and lifestyle variables.

## Materials and methods

A cross-sectional and population-based study was carried out using the National Health Survey (PNS) database with data collection started in 2013 and completed in 2014. The PNS is representative of individuals over the age of 18 living in Brazilian households. These households were located in urban and rural areas, covering the five geographic macro-regions of the country. The only unit of analysis of this study was older adults (60 years of age and over) with multimorbidity. The older adults considered with this condition must have been diagnosed with two or more concurrent chronic diseases. The PNS research project was approved by the National Research Ethics Commission on June 26, 2013.

The chronic diseases that have multimorbidity were those surveyed in PNS and diagnosed by a physician. The presence of the following conditions among the existing chronic diseases were analyzed: diabetes, hypertension, heart disease, high cholesterol, stroke, asthma, arthritis or rheumatism, depression, spinal problems, mental diseases (schizophrenia, bipolar disorder or obsessive-compulsive disorder), pulmonary diseases (chronic bronchitis, emphysema or chronic obstructive pulmonary disease), kidney failure and cancer. We performed a 2x2 combination of all the chronic diseases evaluated and then a frequency analysis to identify the most prevalent multimorbidities.

Concerning factors associated with the occurrence of the main multimorbidities in the Brazilian older adults, two variables were analyzed, and they are lifestyle variables (alcohol and tobacco use, and physical activity) and socioeconomic variables (gender, age, skin color or ethnicity, civil service, schooling, and health plan). Also, the profile of the older adults with multimorbidity was identified from the distribution of this population within these same blocks of variables.

Data were analyzed using Statistical Package for Social Science (SPSS), version 20.0. A priori, the frequency distribution of all variables of the study was made. Finally, the Chi-square test and the Poisson multiple regression were used to verify the association between sociodemographic variables and lifestyle with the most frequent multimorbidity, with a confidence interval of 95%. We initially tested multicollinearity to determine the independent variables that entered the multivariate analysis by performing chi-square tests among those that obtained  $p < 0.200$

in the univariate analysis. Due to the sample size, such associations were considered significant for a value of  $p = 0.000001$ . Next, the adjusted prevalence ratios were estimated using Poisson multiple regression. Data from this study were weighted considering the effect of the sampling plan, non-response rates, and post-stratification weights.

## Results

In total, 5,575 Brazilians older adults with multimorbidity and mean age of 70.3 years ( $\pm 0.2$ ) were evaluated, ranging from 60 to 101 years. Most older adults with multimorbidity were female (66.3%), younger adults, aged between 60 and 69 years (53%), white (56.1%), married (44%), incomplete primary education (40%), with no health plan (65.3%), with a sedentary lifestyle (75.3%) and no alcohol consumption (78.7%) and no tobacco use (44%). On average, these elderly had 3.1 ( $\pm 0.3$ ) chronic diseases. The most frequent multimorbidities were hypertension and high cholesterol (31.3%), hypertension and stroke (30.9%) and hypertension and diabetes (23.3%).

Table 1 shows the frequency of the independent variables and the association with the fact of having hypertension and high cholesterol from the univariate analysis. Based on the data presented, we can observe that the prevalence of hypertension and high cholesterol in older adults is associated with females, younger seniors and no tobacco use at the moment of the research. In the multivariate analysis, also found in Table 1, the variables remained significant considering the model fit.

When seeking the association of older adults with hypertension and stroke with the independent variable (Table 2), the univariate and multivariate analysis showed that the prevalence of this condition was associated with females and older adults with incomplete primary education. Finally, in Table 3, we searched for an association between the prevalence of hypertension and diabetes and the socioeconomic and lifestyle variables. In the univariate analysis, we can observe that this condition was associated with incomplete primary education and no alcohol/tobacco use at the time of the interview and sedentary lifestyle. In the multivariate analysis (Table 3), the fact that older adults had an incomplete elementary education, did not smoke and had a sedentary lifestyle remained significant.

## Discussion

This study aimed to find an association of the most frequent multimorbidities in Brazilian older adults with socioeconomic and lifestyle variables. In parallel, the profile of this population segment with multimorbidity was also identified. The results found are representative of Brazil and its large regions. Faced with a negative impact on the public health and quality of life of these older adults, the identification of the factors associated with the primary multimorbidities that affect this population is of great value for the establishment of measures aimed at health promotion and prevention of these diseases<sup>14</sup>.

Most older adults with multimorbidity are female, white, sedentary, with low schooling, no health plans, married, and no alcohol and tobacco use. The predominance of females compared males corroborates most of the literature reviewed on the subject<sup>7-13</sup>. This can be explained because the world and the national female population is larger than the male population, and women have a longer life expectancy, which increases the possibility of multimorbidity<sup>7-13</sup>. Concerning a sedentary lifestyle, it is already known that this habit is associated with a higher prevalence of falls, physical weakness, mood swings, obesity and elevated levels of glucose and triglycerides<sup>15</sup>. Thus, the lack of physical activity found in most of these seniors may be a contributing factor to the prevalence of multimorbidity.

Concerning low schooling found in older adults with multimorbidity, this condition hinders individual search for knowledge and prevention to avoid the accumulation of chronic diseases<sup>8</sup>. The same consequence extends to seniors without a health plan. Lower access to health services reduces guidelines and medical care pertinent to these older adults to avoid the installation of chronic diseases<sup>7-13</sup>. Because most of the elderly are married, younger, white, do not consume alcohol and do not smoke, reflects the general characteristics of the Brazilian population<sup>16</sup>. Most older adults residing in Brazil are married or widowed and self-declared white<sup>16</sup>. Regarding lifestyle, the prevalence of alcohol abuse in Brazil is 6.1%, while concerning tobacco use in the 1990-2015 period, the percentage of daily smokers in the country fell from 29% to 12% among men and from 19% to 8% among women<sup>17,18</sup>.

The simultaneous prevalence of hypertension and high cholesterol was 31.3%, that of hypertension and stroke, 30.9%, and hypertension and diabetes, 23.3%.

**Table 1.** Association between the presence of hypertension and high cholesterol in older adults with the socioeconomic and lifestyle variables, and their crude and adjusted prevalence ratio measures.

Variable	Category	Presence of Hypertension and High Cholesterol		PR	95% CI	P	PR <sub>ADJ</sub>	95% CI <sub>ADJ</sub>	p*
		%	Absence of Hypertension and High Cholesterol %						
Gender	Male	23.8	76.2	0.68	0.58-0.78	< 0.001	0.94	0.93-0.96	< 0.001
	Female	35.2	64.8						
Age	60-69 years	31.9	68.1	1.00	-	0.024	1.00	-	< 0.001
	70-79 years	18.3	81.7	0.58	0.50-0.66		0.91	0.90-0.92	
Skin color or ethnicity	80 years and over	12.7	87.3	0.40	0.33-0.49		0.94	0.93-0.95	
	White	31.4	68.6	1.00	-	0.566			
Marital status	Black	14.2	85.8	0.45	0.35-0.58				
	Brown	15.8	84.2	0.50	0.44-0.58				
	Other	17.7	82.3	0.56	0.35-0.89				
	Single	32.7	67.3	1.00	-	0.643			
	Married	16.0	84.0	0.49	0.41-0.59				
Schooling	Separated/divorced	14.7	85.3	0.45	0.36-0.57				
	Widower	17.4	82.6	0.53	0.44-0.64				
	Illiterate	30.1	69.9	1.00		0.155			
Health plan	Incomplete primary school	17.9	82.1	0.59	0.52-0.68				
	Primary school completed and over	14.6	85.4	0.48	0.41-0.56				
Alcohol use	Yes	32.9	67.1	1.08	0.95-1.21	0.232			
	No	30.5	69.5						
Tobacco use	Yes	28.9	71.1	0.90	0.77-1.06	0.194			
	No	32.0	68.0						
Physical activity	Yes	24.1	75.9	0.75	0.59-0.94	0.010	0.97	0.95-0.99	0.005
	No	32.1	67.9			0.712			
	Yes	30.7	69.3	0.97	0.85-1.11				
	No	31.5	68.5						

\*P-value adjusted from the Poisson multiple regression.

**Table 2.** Association between the presence of Hypertension and Stroke in older adults with the socioeconomic and lifestyle variables, and their crude and adjusted prevalence ratio measures.

Variable	Category	Prevalence of		PR	95% CI	p	PR <sub>ADJ</sub>	95% CI <sub>ADJ</sub>	p*
		Hypertension and Stroke	Absence of Hypertension and Stroke						
		%	%						
Gender	Male	27.7	72.3	0.85	0.75-0.97	<b>0.014</b>	0.98	0.96-0.99	<b>0.001</b>
	Female	32.6	67.4						
Age	60-69 years	29.5	70.5	1.00	-	0.316			
	70-79 years	18.0	82.0	0.61	0.53-0.70				
Skin color or ethnicity	80 years and over	16.5	83.5	0.56	0.46-0.68				
	White	32.0	68.0	1.00	-	0.184			
	Black	16.9	83.1	0.53	0.42-0.66				
	Brown	14.4	85.6	0.45	0.39-0.52				
	Other	9.2	90.8	0.29	0.15-0.55				
Marital status	Single	27.0	73.0	1.00	-	0.062			
	Married	16.2	83.8	0.60	0.49-0.74				
	Separated/divorced	13.4	86.6	0.50	0.39-0.63				
	Widower	18.0	82.0	0.66	0.55-0.80				
	Illiterate	33.3	66.7	1.00		0.003	1.00	-	< 0.001
Schooling	Incomplete primary school	17.5	82.5	0.52	0.45-0.61		0.92	0.90-0.93	
	Primary school completed and over	12.7	87.3	0.38	0.32-0.45		0.94	0.94-0.95	
Health plan	Yes	31.5	68.5	1.03	0.91-1.17	0.661			
	No	30.6	69.4						
Alcohol use	Yes	29.5	70.5	0.94	0.81-1.09	0.416			
	No	31.3	68.7						
Tobacco use	Yes	30.5	69.5	0.98	0.80-1.21	0.874			
	No	31.0	69.0						
Physical activity	Yes	28.9	71.1	0.91	0.80-1.04	0.177			
	No	31.6	68.4						

\*P-value adjusted from the Poisson multiple regression.

**Table 3.** Association between the presence of Hypertension and Diabetes in older adults with the socioeconomic and lifestyle variables, and their crudes and adjusted prevalence ratio measures.

Variable	Category	Presence of Hypertension and Diabetes		Absence of Hypertension and Diabetes		PR	95% CI	p	PR <sub>ADJ</sub>	95% CI <sub>ADJ</sub>	p*
		Hypertension and Diabetes	%	Hypertension and Diabetes	%						
Gender	Male	22.2	77.8	0.93	0.79-1.09	0.364					
	Female	23.8	76.2								
Age	60-69 years	21.8	78.2	1.00	-	0.064					
	70-79 years	14.4	85.6	0.66	0.56-0.78						
Skin color or ethnicity	80 years and over	11.3	88.7	0.52	0.41-0.66						
	White	23.5	76.5	1.00	-	0.332					
	Black	14.0	86.0	0.59	0.49-0.73						
	Brown	10.8	89.2	0.46	0.39-0.55						
Marital status	Other	10.6	89.4	0.45	0.26-0.78						
	Single	23.2	76.8	1.00	-	0.831					
	Married	11.5	88.5	0.49	0.39-0.62						
	Separated/divorced	12.1	87.9	0.52	0.41-0.67						
	Widower	13.4	86.6	0.58	0.46-0.72						
	Illiterate	23.3	76.7	1.00		0.003			1.00	-	0.020
Schooling	Incomplete primary school	13.9	86.1	0.60	0.51-0.70				0.93	0.92-0.95	
	Primary school completed and over	9.5	90.5	0.41	0.34-0.49				0.96	0.95-0.97	
Health plan	Yes	22.0	78.0	0.92	0.77-1.09	0.314					
	No	24.0	76.0								
Alcohol use	Yes	14.9	85.1	0.58	0.47-0.72	< 0.001					
	No	25.5	74.5								
Tobacco use	Yes	17.3	82.7	0.72	0.55-0.94	0.013			0.96	0.94-0.98	< 0.001
	No	23.9	76.1								
Physical activity	Yes	19.4	80.6	0.79	0.65-0.95	0.011			0.97	0.95-0.98	< 0.001
	No	24.6	75.4								

\*P-value adjusted from the Poisson multiple regression.

Unlike chronic diseases found in isolation, the concurrent nature of these diseases among the elderly is still poorly described in the national literature. A study using data from 1998, 2003, 2008 National Household Sample Survey (PNAD) showed a fast-growing prevalence of multimorbidity after the age of 50 years, and among senior Brazilians aged 65 or over, prevalence was above 15%<sup>19</sup>. The few studies that have proposed to study multimorbidity in the elderly, evaluating the types of diseases present, were limited to studying the simultaneous presence of hypertension and diabetes, and these obtained prevalence levels similar to that of this study<sup>19-21</sup>.

As a differential, this study evaluated the most frequent multimorbidities in Brazilian older adults. The most frequent condition, namely, hypertension and high cholesterol, was associated with females, younger adults and no tobacco use at the time of the research. When assessed separately, hypertension is more associated with males according to the pre-existing literature<sup>22</sup>.

However, when it comes to multimorbidity in older adults, females are more likely to accumulate chronic diseases<sup>7-13</sup> because of their higher life expectancy. Also, women experience minor practices of essential measures for the prevention of chronic diseases, such as physical activity. This greater occurrence of multimorbidity in women has also been reported in other studies<sup>7-13</sup>. In general, women use health services more, which increases their familiarity with medical terminology and increases the probability of receiving a diagnosis of multimorbidity compared to older men<sup>23</sup>. It is suggested, therefore, that these factors are linked to a higher association of females with the concurrent presence of hypertension and diabetes, as well as of hypertension and stroke. Regarding prevalence associated with younger seniors, hypertension is a common disease in young adults, and because it is chronic, it is a lifelong condition<sup>24</sup>. When associating with other diseases with a high negative health impact, such as high cholesterol, this type of multimorbidity can reduce life expectancy, which justifies a lower prevalence of these concurrent conditions in older people. It is also worth noting that the presence of high cholesterol is a risk factor for the development of atherosclerosis and, consequently, of heart attacks<sup>25</sup>. Thus, it is likely that older adults with this chronic disease associated with hypertension are dying earlier compared to those with other types of chronic diseases, which justifies a higher prevalence of this multimorbidity in the young and not the older ones.

Tobacco use had an inverse association with the concurrent presence of the diseases. Results such as these were seen in studies evaluating hypertension alone<sup>26,27</sup>. Because it is one of the main risk factors for mortality due to chronic noncommunicable diseases (NCDs), especially for those with hypertension, the recommendation of tobacco use cessation after diagnosis of chronic diseases is a frequent and immediate measure<sup>28</sup>. With this in mind, possibly the recommendations of not smoking were present in the population studied with this type of multimorbidity.

Besides the association with females, the second most frequent condition, namely, hypertension and stroke, was associated with low schooling levels. Thus, less knowledge is acquired and, consequently, access to preventive measures of hypertension and stroke are impaired<sup>8</sup>. Concerning the prevalence of hypertension and diabetes, the multivariate analysis showed an association with the fact that older adults had incomplete primary education, did not smoke and were sedentary. Non-use of tobacco and lower schooling levels follow the same logic of the previous conditions as possible justifications. In the case of hypertension and diabetes, physical inactivity appeared as an associated factor only for this condition. Several longitudinal studies have shown a beneficial effect of physical activity on carbohydrate metabolism, long-term insulin sensitivity, and the prevalence of obesity, which may prevent the incidence of diabetes<sup>29</sup>. Therefore, since hypertension was present in the other two multimorbidities studied, the consequences of physical inactivity probably had a more significant influence on the involvement of diabetes in older adults with accumulations of chronic diseases.

Finally, because it is a cross-sectional study, it does not facilitate the identification of a well-established cause and consequence relationship between the studied variables. It is suggested, therefore, to perform longitudinal studies on the subject that can confirm the hypotheses raised in this work. This study's research unit was Brazilian older adults with multimorbidity, with the feature of a broad population range. As a consequence, high power of inference to the profile of the Brazilian older adults can be established. Thus, greater attention should be paid to the establishment of preventive measures for female seniors, those with low schooling levels and who are sedentary. Also, instructions for healthy lifestyle habits should be provided to individuals be-

fore aging, since young adults are already being affected by multimorbidities.

### **Conclusion**

In conclusion, we identified that multimorbidity in Brazilian older adults is a quite frequent condition in women, in those younger and socioeconomically disadvantaged. Also, adverse socioeconomic conditions and lifestyle influenced the prevalence of primary multimorbidities.

### **Collaborations**

LA Melo worked on the collection and interpretation of data, on the design and final writing of the manuscript. KC Lima worked on the orientation of the study, data analysis, critical analysis and writing of the manuscript.



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