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.

N. 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 factors¹. 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 services².

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 diseases³. 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 population⁴.

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^{5,6}. 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 factors7-13.

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 facilitated¹⁴. 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 diseases¹⁴.

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 subject7-13. 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 multimorbidity7-13. 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 triglycerides¹⁵. 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 diseases⁸. 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 diseases7-13. Because most of the elderly are married, younger, white, do not consume alcohol and do not smoke, reflects the general characteristics of the Brazilian population¹⁶. Most older adults residing in Brazil are married or widowed and self-declared white16. 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^{17,18}.

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

Variable Category Hypertension and Hypertension an	measures.									
η_{0} <	Variable	Category	Presence of Hypertension and High Cholesterol	Absence of Hypertension and High Cholesterol	PR	95% CI	d	PR	95% CI _{ADJ}	*d
Gender Male 2.38 7.6.2 0.68 0.53.0.78 < 0.001			%	%						
Age Erende 3.2 6.43 1.00 \cdot 0.024 1.01 \cdot 0.004 \cdot 0.014 1.01 \cdot 0.016 \cdot <th< td=""><td>Gender</td><td>Male</td><td>23.8</td><td>76.2</td><td>0.68</td><td>0.58-0.78</td><td>< 0.001</td><td>0.94</td><td>0.93-0.96</td><td>< 0.001</td></th<>	Gender	Male	23.8	76.2	0.68	0.58-0.78	< 0.001	0.94	0.93-0.96	< 0.001
Age 60-69 years 31.9 68.1 1.00 00.3 1.00 <td></td> <td>Female</td> <td>35.2</td> <td>64.8</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		Female	35.2	64.8						
70-79 years 13 11 0.58 0.50-0.66 0.91 0.90-0.92 80 years and over 12.7 87.3 0.40 0.33-0.49 0.91 0.90-0.95 Back 14.2 88.6 0.45 0.35-0.56 0.35-0.56 0.94 0.93-0.95 Brown 158 84.2 0.56 0.35-0.89 0.94	Age	60-69 years	31.9	68.1	1.00		0.024	1.00		< 0.001
80 years and over 127 87.3 0.40 0.33.0.49 0.94 0.93-0.95 Shin color or ethnicity White 14.4 68.6 1.00 - 0.56.6 0.94 0.33-0.35 Brown 15.8 84.2 0.53 0.35-0.58 0.35-0.58 0.94 0.93-0.56 Brown 15.8 84.2 0.56 0.35-0.58 0.44-0.56 0.54-0.56 1.00 - 0.56 0.3-0.56 Married Married 16.0 84.0 0.49 0.41-0.59 0.54-0.5 0.54-0.56 0.52-0.56 0.54-0.56 0.52-0.56 0.54-0.56 0.52-0.56 0.54-0.56 0.54-0.56 0.54-0.56<		70-79 years	18.3	81.7	0.58	0.50-0.66		0.91	0.90-0.92	
Shin color or thirting White 31.4 68.6 1.00 · 0.566 Back 14.2 85.8 0.45 0.35.0.38 9.40.53 Brown 17.7 82.3 0.56 0.35.0.36 9.41.0.58 Brown 17.7 82.3 0.50 0.35.0.36 9.44.0.58 Married 17.7 82.3 0.41.0.59 0.41.0.59 9.44.0.59 Married 16.0 84.0 0.49 0.41.0.59 0.41.0.59 Married 16.0 84.0 0.49 0.41.0.59 0.44.0.59 Scholing 11.7 82.5 0.35.0.58 0.44.0.59 0.44.0.59 Nover 32.1 0.43 0.44.0.59 0.44.0.59 0.44.0.59 Scholing 11.6 9.44.0.64 0.41.0.59 0.44.0.59 0.44.0.59 Nover 17.7 82.6 0.35.0.68 0.44.0.59 0.44.0.59 0.44.0.59 Nover 17.1 0.43 0.44.0.56 0.44.0.56 0.44.0.56 <td< td=""><td></td><td>80 years and over</td><td>12.7</td><td>87.3</td><td>0.40</td><td>0.33 - 0.49</td><td></td><td>0.94</td><td>0.93 - 0.95</td><td></td></td<>		80 years and over	12.7	87.3	0.40	0.33 - 0.49		0.94	0.93 - 0.95	
Black 14.2 5.3 0.45 0.35-0.58 Brown 15.8 84.2 0.50 0.44-0.58 Brown 17.7 82.3 0.56 0.44-0.58 Other 17.7 82.3 0.50 0.44-0.58 Martiel status Single 100 - 0.643 Martiel status Single 10.0 - 0.643 Martiel status Single 10.0 - 0.643 Martiel status Separate/divorced 14.7 82.3 0.45 0.56-57 Vidover 17.4 82.6 0.53 0.44-064 0.155 Incomplete primary school 17.9 82.1 0.25 0.56-57 Primary school completed and 14.6 83.4 0.43 0.41-056 Incomplete primary school 17.9 83.4 0.43 0.41-056 Primary school completed and 14.6 83.4 0.43 0.41-056 No No No 0.55 0.55-0.13 0.	Skin color or ethnicity	White	31.4	68.6	1.00		0.566			
Brown 15.8 84.2 0.50 0.44-0.58 Other 177 82.3 0.56 0.35-0.89 Marrial status Single 177 82.3 0.56 0.35-0.89 Marrial status Single 177 82.3 0.49 0.41-0.59 Separated/storced 147 85.3 0.44-0.69 0.41-0.59 Nidower 77.4 82.6 0.53 0.41-0.56 Nidower 30.1 69.9 1.00 - 0.155 Incomplete primary school 17.9 82.4 0.48 0.41-0.56 Nidower 30.1 6.99 1.00 - 0.155 Primary school complete primary school 17.9 82.4 0.48 0.41-0.56 No 0 0.59 0.55-0.68 0.55-0.68 0.55 Health plan Ye 0.44 0.41 0.59 0.55 No Ye 0.44 0.48 0.44 0.48 0.44 No Ye </td <td></td> <td>Black</td> <td>14.2</td> <td>85.8</td> <td>0.45</td> <td>0.35 - 0.58</td> <td></td> <td></td> <td></td> <td></td>		Black	14.2	85.8	0.45	0.35 - 0.58				
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Married 16.0 84.0 0.49 0.41.059 Separated/divorced 14.7 85.3 0.45 0.36.057 Widower 17.4 82.6 0.55 0.44.064 Widower 30.1 69.9 1.00 0.155 Incomplete primary school 17.4 82.6 0.53 0.41.056 Incomplete primary school 17.9 82.1 0.52.0.68 0.155 Incomplete primary school 17.9 82.1 0.52.0.68 0.52.0.68 Incomplete primary school 17.9 82.1 0.48 0.41.0.56 Net Yes 32.9 67.1 1.08 0.23.2 Alcohol use Yes 32.0 63.5 0.77-1.06 0.194 No No 32.0 68.5 0.57-0.94 0.97 0.95-0.99 Physical activity Yes 24.1 75.9 0.77-1.06 0.194 No No 32.1 69.3 0.77-1.06 0.97 0.95-0.99 Physi	Marital status	Single	32.7	67.3	1.00	ı	0.643			
Separated/divorced 14.7 85.3 0.45 0.36-0.57 Widower 17.4 82.6 0.53 0.41-0.64 Widower 30.1 69.9 1.00 0.155 Incomplete primary school 17.9 82.1 0.59 0.52-0.68 Primary school 17.9 82.1 0.59 0.52-0.68 No Net 17.9 85.4 0.41-0.56 No Yes 32.9 67.1 1.08 0.32-0.68 No Yes 32.9 67.1 1.08 0.41-0.56 Alcohol use Yes 33.2 69.5 1.1 0.23 Alcohol use Yes 28.9 71.1 0.90 0.77-1.06 0.194 No No 32.0 68.6 0.75 0.59-0.94 0.95-0.99 0.90 Physical activity Yes 24.1 75.9 0.77-1.06 0.97 0.97-0.99 0.97 Physical activity Yes 24.1 75.9 0.77		Married	16.0	84.0	0.49	0.41-0.59				
Widower 17.4 82.6 0.53 0.44-0.64 Schooling Illiterate 30.1 69.9 1.00 0.155 Incomplete primary school 17.9 82.1 0.59 0.52-0.68 0.155 Primary school completed and 14.6 82.1 0.59 0.52-0.68 1.00 Primary school completed and 14.6 82.1 0.52 0.41-0.56 1.55 Health plan Yes 32.9 67.1 1.08 0.95-1.21 0.232 No No 30.5 69.5 1 1.08 0.97-1.06 1.94 Alcohol use Yes 30.5 69.5 1 0.99 0.97 Alcohol use Yes 23.0 68.9 0.77-1.06 0.97 0.95-0.99 No No 32.0 68.9 0.77-1.06 0.97 0.95-0.99 0.90 Physical activity Yes 0.97 0.99 0.97 0.95-0.94 0.97 0.95-0.99 Physical activity		Separated/divorced	14.7	85.3	0.45	0.36-0.57				
Schooling Illiterate 30.1 69.9 1.00 0.155 Incomplete primary school 17.9 82.1 0.59 0.52-0.68 Primary school completed and 14.6 85.4 0.41-0.56 Over 1 1.6 0.59 0.52-0.68 Health plan Yes 32.9 67.1 1.08 0.41-0.56 No 30.5 69.5 1.10 0.90 0.77-1.06 0.194 Alcohol use Yes 28.9 71.1 0.90 0.77-1.06 0.194 Alcohol use Yes 28.9 71.1 0.90 0.77-1.06 0.194 No 32.0 68.9 71.1 0.90 0.77-1.06 0.97 0.95-0.99 0.00 Inbiscial scivity Yes 24.1 75.9 0.77-1.06 0.97 0.97-0.99 0.00 Physical activity Yes 32.1 67.9 0.77 0.97 0.97-0.99		Widower	17.4	82.6	0.53	0.44 - 0.64				
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 Net 14.6 85.4 0.48 0.41-0.56 Health plan Yes 32.9 67.1 1.08 0.95-1.21 0.232 Alcohol use Yes 30.5 69.5 71.1 0.90 0.77-1.06 0.194 Alcohol use Yes 23.0 68.0 71.1 0.90 0.77-1.06 0.194 No 32.0 68.0 0.77-1.06 0.194 0.95-0.99 0.00 Tobacco use Yes 24.1 75.9 0.77 0.97 0.95-0.99 0.00 No 32.1 68.3 0.77 0.97 0.97 0.95-0.99 0.00 Physical activity Yes 32.1 67.9 0.97 0.97 0.95-0.99 0.00 No Yes 30.7 69.3 0.97 0.85-1.11 0.712 0.97	Schooling	Illiterate	30.1	6.69	1.00		0.155			
Primary school completed and 14.6 85.4 0.48 0.41-0.56 over over		Incomplete primary school	17.9	82.1	0.59	0.52-0.68				
over over Health plan Yes 32.9 67.1 1.08 0.95-1.21 0.232 No 30.5 69.5 Alcohol use Yes 30.5 69.5 Alcohol use Yes 28.9 71.1 0.90 0.77-1.06 0.194 No 32.0 68.0 71.1 0.90 0.77-1.06 0.97 No 32.0 68.0 Physical activity Yes 24.1 75.9 0.75 0.59-0.94 0.09 0.95-0.99 0.00 Physical activity Yes 32.1 67.9 0.85-1.11 0.712 0.95-0.99 0.00 Physical activity Yes 31.5 69.3 0.97 0.85-1.11 0.712		Primary school completed and	14.6	85.4	0.48	0.41 - 0.56				
Health plan Yes 32.9 67.1 1.08 0.95-1.21 0.232 No 30.5 69.5		over								
No 30.5 69.5 Alcohol use Yes 28.9 71.1 0.90 0.77-1.06 0.194 No 32.0 68.0 Tobacco use Yes 24.1 75.9 0.75 0.59-0.94 0.97 0.95-0.99 0.00 Physical activity Yes 32.1 67.9 0.75 0.85-1.11 0.712 0.97 0.95-0.99 0.00 Physical activity Yes 31.5 68.5 0.85-1.11 0.712 0.712 0.712	Health plan	Yes	32.9	67.1	1.08	0.95 - 1.21	0.232			
Alcohol use Yes 28.9 71.1 0.90 0.77-1.06 0.194 No 32.0 68.0		No	30.5	69.5						
No 32.0 68.0 Tobacco use Yes 24.1 75.9 0.75 0.59-0.94 0.97 0.95-0.99 0.00 No 32.1 67.9 0.75 0.59-1.11 0.712 0.97 0.95-0.99 0.00 Physical activity Yes 30.7 69.3 0.97 0.85-1.11 0.712 No 31.5 68.5 0.85 0.97 0.85 0.85	Alcohol use	Yes	28.9	71.1	0.90	0.77-1.06	0.194			
Tobacco use Yes 24.1 75.9 0.75 0.59-0.94 0.010 0.97 0.95-0.99 0.00 No 32.1 67.9 0.97 0.85-1.11 0.712 0.95-0.99 0.00 Physical activity Yes 30.7 69.3 0.97 0.85-1.11 0.712 No 31.5 68.5 68.5 0.97 0.85-1.11 0.712		No	32.0	68.0						
No 32.1 67.9 Physical activity Yes 30.7 69.3 0.97 0.85-1.11 0.712 No 31.5 68.5 68.5 68.5 68.5 68.5	Tobacco use	Yes	24.1	75.9	0.75	0.59 - 0.94	0.010	0.97	0.95 - 0.99	0.005
Physical activity Yes 30.7 69.3 0.97 0.85-1.11 0.712 No 31.5 68.5 <td></td> <td>No</td> <td>32.1</td> <td>67.9</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		No	32.1	67.9						
No 31.5 68.5	Physical activity	Yes	30.7	69.3	0.97	0.85-1.11	0.712			
		No	31.5	68.5						

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		Presence of	Absence of						
Variable	Category	Hypertension and Stroke	Hypertension and Stroke	PR	95% CI	Р	PR	95% CI _{ADJ}	\mathbf{p}^{\star}
		%	%						
Gender	Male	27.7	72.3	0.85	0.75-0.97	0.014	0.98	0.96-0.99	0.001
	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				
	80 years and over	16.5	83.5	0.56	0.46 - 0.68				
Skin color or	White	32.0	68.0	1.00		0.184			
ethnicity	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	ı	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				
Schooling	Illiterate	33.3	66.7	1.00		0.003	1.00		< 0.001
	Incomplete primary school	17.5	82.5	0.52	0.45 - 0.61		0.92	0.90 - 0.93	
	Primary school completed and	12.7	87.3	0.38	0.32-0.45		0.94	0.94-0.95	
	over								
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.

Matches Hypertension and bis Hyperens Hyperens Hyperte			Presence of	Absence of						
% % % Gender Male 222 77.8 0.39 0.79-109 0.364 Fande 223 76.2 1.00 - 0.064 Fande 223 78.5 0.06 0.56-0.78 0.364 Age 60-69 years 11.3 85.5 0.06 0.56-0.78 0.064 Kin color Wilke 23.3 76.5 1.00 - 0.064 Skin color Wilke 23.3 76.5 1.00 - 0.332 Kin color Wilke 23.3 76.5 1.00 - 0.332 Marial status Sin color 10.8 89.2 0.49.0.73 0.331 Married 11.3 88.2 0.49 0.35 0.332 Married 11.3 87.9 0.46.0.72 0.33 1.00 Karried 11.3 87.9 0.41.0.67 0.33 0.35 Karried 11.3 87.9 0.41 0.34	Variable	Category	Hypertension and Diabetes	Hypertension and Diabetes	PR	95% CI	đ	PR	95% CI _{ADJ}	p*
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	Age	60-69 years	21.8	78.2	1.00	I	0.064			
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		Brown	10.8	89.2	0.46	0.39 - 0.55				
Marital status Single 23.2 76.8 1.00 - 0.831 Married Married 11.5 88.5 0.49 0.39-0.62 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.03 1.00 - 0.033 1.00 - 0.33 0.32 0.34 0.32 <td></td> <td>Other</td> <td>10.6</td> <td>89.4</td> <td>0.45</td> <td>0.26-0.78</td> <td></td> <td></td> <td></td> <td></td>		Other	10.6	89.4	0.45	0.26-0.78				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Marital status	Single	23.2	76.8	1.00	ı	0.831			
		Married	11.5	88.5	0.49	0.39-0.62				
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SchoolingIlliterate 23.3 76.7 1.00 0.003 1.00 $-$ Incomplete primary school 13.9 86.1 0.60 $0.51-0.70$ 0.93 $0.92-0.70$ Primary school completed and 9.5 90.5 0.41 $0.34-0.49$ 0.93 $0.92-0.70$ NoerNo 22.0 78.0 0.92 $0.77-1.09$ 0.314 Alcohol useYes 22.0 78.0 0.92 $0.77-1.09$ 0.314 No 24.0 78.0 0.92 $0.77-1.09$ 0.314 Alcohol useYes 14.9 85.1 0.58 $0.47-0.72$ < 0.001 Alcohol useYes 17.3 82.7 0.79 $0.55-0.94$ 0.912 $0.94-1$ Physical activityYes 17.3 82.7 0.79 $0.65-0.95$ 0.011 0.97 $0.95-1$		Widower	13.4	86.6	0.58	0.46 - 0.72				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Schooling	Illiterate	23.3	76.7	1.00		0.003	1.00	,	0.020
Primary school completed and 9.5 90.5 0.41 0.34-0.49 0.96 0.95-0 over over 0		Incomplete primary school	13.9	86.1	0.60	0.51 - 0.70		0.93	0.92-0.95	
over over Health plan Yes 22.0 78.0 0.92 0.77-1.09 0.314 No No 24.0 76.0 76.0 0.314 Alcohol use Yes 14.9 85.1 0.58 0.47-0.72 <0.001		Primary school completed and	9.5	90.5	0.41	0.34 - 0.49		0.96	0.95-0.97	
Health planYes 22.0 78.0 0.92 $0.77-1.09$ 0.314 NoNo 24.0 76.0 76.0 76.0 Alcohol useYes 14.9 85.1 0.58 $0.47-0.72$ <0.001 No 25.5 74.5 74.5 74.5 <0.001 Tobacco useYes 17.3 82.7 0.72 $0.55-0.94$ 0.013 0.96 0.94^{-1} Physical activityYes 19.4 80.6 0.79 $0.65-0.95$ 0.011 0.97 0.95^{-1}		over								
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 0.74.5 0.79 0.57-0.94 0.013 0.96 0.94-1 Tobacco use Yes 17.3 82.7 0.72 0.55-0.94 0.013 0.96 0.94-1 Physical activity Yes 19.4 80.6 0.79 0.65-0.95 0.011 0.97 0.95-1	Health plan	Yes	22.0	78.0	0.92	0.77 - 1.09	0.314			
Alcohol use Yes 14.9 85.1 0.58 0.47-0.72 <0.001 No 25.5 74.5		No	24.0	76.0						
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 No 23.9 76.1 0.72 0.55-0.94 0.013 0.96 0.94-0 Physical activity Yes 19.4 80.6 0.79 0.65-0.95 0.011 0.97 0.95-0	Alcohol use	Yes	14.9	85.1	0.58	0.47-0.72	< 0.001			
Tobacco use Yes 17.3 82.7 0.72 0.55-0.94 0.013 0.96 0.94-0 No 23.9 76.1 23.9 76.1 23.9 76.1 23.9 23.9 76.1 23.9 23.9 23.9 76.1 23.9 23.9 26.1 23.9 23.9 23.9 23.9 26.1 23.9 23.9 26.1 23.9 23.9 26.1 23.9 26.1 27.1 27.9 27.9 26.5-0.95 0.011 0.97 0.95-1 Physical activity Yes 19.4 80.6 0.79 0.65-0.95 0.011 0.97 0.95-1		No	25.5	74.5						
No 23.9 76.1 Physical activity Yes 19.4 80.6 0.79 0.65-0.95 0.011 0.97 0.95-1	Tobacco use	Yes	17.3	82.7	0.72	0.55 - 0.94	0.013	0.96	0.94-0.98	< 0.001
Physical activity Yes 19.4 80.6 0.79 0.65-0.95 0.011 0.97 0.95-0		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
INO 24.0 10.4		No	24.6	75.4						

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

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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%¹⁹. 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 study¹⁹⁻²¹.

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 literature²².

However, when it comes to multimorbidity in older adults, females are more likely to accumulate chronic diseases7-13 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 studies7-13. 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 men²³. 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 condition²⁴. 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 attacks²⁵. 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^{26,27}. 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 measure²⁸. 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 impaired⁸. 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 diabetes²⁹. 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 before 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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