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# Diseases and chronic health conditions, multimorbidity and body mass index in older adults

## *Doenças e condições crônicas de saúde, multimorbidade e índice de massa corporal em idosos*

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**Abstract** – The aim of this study was to analyze the association between diseases and chronic health conditions, multimorbidity and body mass index (BMI) in older adults from southern Brazil. Epidemiological cross-sectional study, with household basis was carried out with 343 older adults aged 60-79 years, selected by probability sampling and all aged 80 years or older (n=134). Hypertension, diabetes, cancer, chronic pulmonary diseases, coronary heart disease, cerebrovascular disease, arthritis, osteoporosis, depression, history of falls and dependency in activities of the daily living were assessed by self-report. Associations between independent variables and BMI (outcome) were tested using simple and multiple linear regression. Participated in the study 270 women (73.2±8.8 years) and 207 men (73.3±9.0 years). After adjustment (age, education, living arrangement, smoking, alcohol consumption, waist circumference, cognitive status and all other disease and chronic health conditions), the associations identified were: hypertension with higher BMI values (β 3.43; 95%CI: 2.38 to 4.48), for women, and chronic pulmonary disease with lower BMI values (β -2.05; 95%CI: -3.50 to -0.60). There was a linear trend between number of diseases and BMI for both sexes. Conclusion: The results showed an independent association between specific chronic diseases and BMI. Monitoring of nutritional status in older adults is important to identify extreme BMI values, especially those with more than two diseases and chronic health conditions.

**Key words**: Aging; Body weight; Chronic diseases.

**Resumo** – *O estudo teve como objetivo analisar a associação entre doenças e condições crônicas de saúde, multimorbidade e índice de massa corporal (IMC) em idosos do sul do Brasil. Estudo epidemiológico transversal, de base domiciliar. Foram entrevistados 477 pessoas, sendo 343 de 60 a 79 anos (amostragem probabilística) e todos aqueles com 80 anos ou mais (n=134). A hipertensão, diabetes, câncer, doença crônica pulmonar, doença coronariana, doença vascular cerebral, artrite, osteoporose, depressão, o histórico de quedas e dependência nas atividades da vida diária foram avaliados por meio de autorrelato. As associações entre as variáveis independentes e o IMC (desfecho) foram testadas por meio de regressão linear simples e múltipla. Participaram da pesquisa 270 mulheres (73,2±8,8 anos) e 207 homens (73,3±9,0 anos). Após ajuste (idade, escolaridade, arranjo familiar, tabagismo, consumo de álcool, circunferência da cintura, estado cognitivo e todas as doenças e condições crônicas de saúde) as associações identificadas foram: hipertensão e maiores valores de IMC (β 3,43; IC95%: 2,38 a 4,48), para as mulheres e; doença crônica pulmonar e menores valores de IMC (β -2,05; IC95%: -3,50 a -0,60). Houve tendência linear entre o número de doenças e condições crônicas de saúde e o IMC, para ambos os sexos. Os resultados mostraram associação independente entre doenças crônicas específicas e IMC. O monitoramento do estado nutricional da população idosa é importante para identificar valores extremos de IMC, especialmente naqueles com mais de duas doenças e condições crônicas de saúde.*

**Palavras-chave**: *Envelhecimento; Doenças crônicas; Peso corporal.*

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## INTRODUCTION

Population aging is the largest demographic phenomenon of the twenty-first century and one of the main problems of this process is the high prevalence of chronic noncommunicable diseases, account for most morbidity and mortality burden in Brazil[1]. In addition to diseases, other persistent chronic health conditions that require some sort of care impair mobility and autonomy, such as falls and disabilities[2], also contribute to increase spending in the health sector[3].

The simultaneity of diseases/symptoms, functional, cognitive and physical limitations, defined as multimorbididity[4] is a common condition in the elderly[1,3]. Data from the Brazilian National Survey of Household Sample (PNAD 2008) showed that 5.9% of the population reported having three or more chronic diseases and the proportion increases with age. Among older adults, 79.1% reported having at least one chronic disease, 15.2% reported restrictions in usual activities and about 12% reported hospitalization history in the last 12 months[5].

Along with the presence of diseases and / or other chronic health conditions, vulnerable nutritional status, identified by body mass index (BMI) is common among the elderly[6]. Both overweight and underweight are factors associated with morbidity and mortality in these individuals. That is, association between all-cause mortality / morbidity occurs in the form of U-shaped curve, with wide base[7,8]. Generally, associations between chronic health conditions and BMI are checked for specific diseases using BMI cutoff values used in epidemiological surveillance[9] or determined by roc curve[10]. The association between BMI and multimorbididity is scarce in literature[11]. Moreover, the association of this indicator as a continuous variable in the context of multimorbididity has not been explored.

According to literature (Medline, Scielo, from 2010 to Jan/2015), studies investigating multimorbidity and BMI in the elderly have not been identified. Only one study conducted in the UK found association between multimorbidities and overweight/obesity in 300,006 adults (≥30 years) seen in the primary health care[11].

It is believed that the use of BMI as a continuous variable will enable studying the association between diseases and chronic health conditions throughout BMI distribution with no loss of information due to categorization[12]. Given the above, the aim of this study was to analyze the association between chronic diseases, multimorbidities and body mass index in the elderly of a community in southern Brazil.

## METHODOLOGICAL PROCEDURES

This is a cross-sectional study with secondary analysis of epidemiological data of population and household basis held in the municipality of Antônio Carlos, state of Santa Catarina in 2010 and 2011. In 2010, the population of the municipality was 7,458 inhabitants, with approximately 70.0%

living in small rural properties. Older adults accounted for 12.3% of the population[13]. Access to primary health care was conducted through a basic health unit and three Family Health Strategy Program (FHS) teams that met the entire population in three distinct areas.

The study population consisted of individuals aged 60 years or older (N = 917) of both sexes, residents in rural and urban areas. The identification of individuals was made from the FHS records in 2009. For the age group of 60-79 years (n = 783), 343 individuals selected by probabilistic sampling were interviewed (margin of error of 5.0 percentage points, prevalence of 50% for unknown outcome and sample loss of 15%), according to the FHS area. All individuals aged 80 years and over were interviewed.

Sample loss criteria were absence of informant, person not found after at least three visits (every other day) and lack of access to residence due to unfavorable conditions of rural roads.

The research protocol was approved by the Ethics Committee on Human Research of the Federal University of Santa Catarina, under protocol No. 189/09 and with the agreement signed for participation. In the case of participant's inability to sign the consent form, guardians were asked to sign.

Data were collected on a special form based on the SABE-Survey on Health, Welfare and Aging questionnaire (http://www.fsp.usp.br/sabe/index.php). SABE survey was conducted in six countries in Latin America and the Caribbean, including Brazil. Interviews were realized at the residence in just one visit. Data were collected by previously trained students (undergraduate and graduate).

## Explanatory variables

The presence of chronic disease (yes or no) was identified by the following question: "Has a doctor or nurse ever told you that you have ..." hypertension; diabetes; cancer (excluding minor skin cancers); chronic lung disease; coronary disease; cerebrovascular disease; arthritis, rheumatism, osteoarthritis; osteoporosis or depression.

Information on falls (yes or no) was obtained through the following question: "Have you had any fall in the last 12 months?

Questions related to dependency (yes or no) in basic activities of the daily living (ADLs) investigated the presence or absence of difficulty to cross a room walking; dressing up; taking a bath; feeding; sitting and getting up from the bed and going to the bathroom. Individuals were considered dependent (yes) when they reported difficulty performing one or more tasks.

Those related to dependency (yes or no) in instrumental activities of the daily living (IADLs) investigated the presence or absence of difficulty to perform or prepare a hot meal; to take care of their own money; to go places alone; to go food shopping; to use the phone; to do light housework; to make heavier housework and to take medicine. The response options were "yes", "no", "I cannot", "do not usually do," "do not know" and "no response". In the case of individuals have responded alternative "do not usually do" in at

least one of the questions were classified according to most answers given to other questions, since this alternative is more related to personal habits than to performance difficulties[14]. Individuals were considered dependent (yes) when they presented difficulties to perform one or more tasks.

## Dependent variable

Body mass index (BMI = body mass / [height] $^2$) was calculated from body mass (BM) and height measurements.

In case of impossibility or difficulty to obtain body mass measurement, the equation proposed by Chumlea et al.[15] was used, that takes into account the arm and calf circumference values. Knee height measurement was used to estimate height by means of the equation proposed by Chumlea et al.[16].

Measurements were performed in triplicate (excluding body weight) and the average value of each was used. Height and knee height were measured according to Chumlea et al.[16] and circumferences were measured according to standardization of Callaway et al.[17]

## Adjustment variables

The variables used were: age (in years), education (literate or illiterate); living arrangement (lives alone or lives accompanied), smoking (never smoked, former smoker or current smoker), alcohol consumption (> once/week or < once/week). Cognitive status (normal or abnormal) was verified by the Mini-Mental State Examination (MMSE), considering the value > 13 points as without probable cognitive deficit[18]. Waist circumference (continuous variable) was measured using inelastic tape according to the Callaway et al.[17] protocol.

## Statistical procedure

Descriptive analysis used: mean, standard deviation (continuous variables) and proportion of individuals (categorical variables), according to each one of them and according to sex. For the assessment of gender differences in the descriptive variables, confidence interval (95% CI) was used.

In assessing the association between chronic diseases and BMI, multiple linear regression (crude and adjusted) with respective confidence intervals (95% CI) was used. Three regression models for association of chronic diseases and BMI were considered: 1) adjusted for age, living arrangement and education; 2) age, education, living arrangement, smoking, alcohol consumption, waist circumference and cognitive state; 3) adjusted for all the above variables and all diseases and chronic health conditions (IADLs, ADLs and falls).

For trend analysis between mean BMI values and number of chronic diseases (multimorbididity), multiple linear regression adjusted for age, education, living arrangement, smoking and cognitive status was used.

The significance level adopted was 5%. All analyses were performed in the complex sample module of the SPSS 17.0 statistical package.

## RESULTS

Study participants were 270 women (56.6%) and 207 men (43.4%). The age ranged from 60 to 100 years (73 ± 8.9 years). The average age of women was 73.2 ± 8.8 years and men 73.3 ± 9.0 years.

According to Table 1, compared to women, men showed higher frequency of individuals who lived with other people, alcohol consumers and smokers. In relation to chronic conditions, women showed higher incidence of hypertension, diabetes, arthritis / rheumatism / arthritis, depression, osteoporosis, history of falls and dependency in ADLs and IADLs.

**Table 1.** Sample distribution according to sex and characteristics investigated. Antonio Carlos-SC (2010-2011).

| | Male (n=207) | Female (n=270) |
|---|---|---|
| | % (95% CI) | % (95% CI) |
| Education | | |
| Literate | 76.7 (72.5-80.9) | 87.0 (84.1-89.9) |
| Illiterate | 23.3 (19.1-27.5) | 13.0 (10.1-15.9) |
| Living arrangement | | |
| Lives alone | 5.6 (3.3-7.9) | 18.8 (15.4-22.2) |
| Lives accompanied | 94.4 (92.1-96.7) | 81.2 (77.8-84.6) |
| Smoking | | |
| Never smoked | 39.3 (34.5-44.1) | 92.7 (90.5-94.9) |
| Ex-smoker / smoker | 60.7 (55.9-65.5) | 7.3 (5.1-9.5) |
| Alcohol consumption | | |
| < Once a week | 67.4 (62.8-72.0) | 96.4 (94.8-98.0) |
| > Once a week | 32.6 (28.0-37.2) | 3.6 (2.0-5.2) |
| Abnormal cognitive state | 6.6 (4.1-9.1) | 11.9 (9.1-14.7) |
| Hypertension | 58.8 (53.9-63.7) | 80.3 (76.9-83.7) |
| Diabetes | 12.1 (8.9-15.3) | 25.2 (21.5-28.9) |
| Cancer | 7.0 (4.5-9.5) | 4.1 (2.4-5.8) |
| Chronic lung disease | 11.6 (8.4-14.8) | 10.6 (7.9-13.3) |
| Coronary heart disease | 25.8 (20.0-31.6) | 28.4 (24.5-32.3) |
| Cerebrovascular disease | 7.6 (5.0-10.2) | 7.7 (5.4-10.0) |
| Arthritis / rheumatism / arthrosis | 21.7 (17.6-25.8) | 40.1 (35.9-44.3) |
| Depression | 26.5 (22.1-30.9) | 36.6 (32.4-40.8) |
| Osteoporosis | 4.0 (0.0-10.9 | 31.3 (27.2-35.4) |
| Falls in the last year | 15.8 (12.2-19.4) | 31.4 (27.4-35.4) |
| ADLs | 21.9 (17.8-26.0) | 29.9 (26.0-33.8) |
| IADLs | 33.4 (28.7-38.1) | 51.6 (47.3-55.9) |

CI: confidence interval; ADLs: basic activities of the daily living; IADLs: instrumental activities of the daily living.

Tables 2 and 3 show the results of associations between chronic conditions and body mass index for women and men, respectively. In simple analyses, for women, BMI was 3.43 kg / $m^2$ higher for those with hypertension (β 3.43; 95% CI 2.38 to 4.48; p≤0,001) and at least 1.5 kg / $m^2$ higher for those with diabetes (β 1.51; 95% CI 0.50 to 2.52; p≤0.003) and dependency in ADLs (β 1.50; 95% CI 0.54 to 2.47; p≤0.003). When considering adjustment models 1 and 2 (age,

living arrangement, education, smoking, waist circumference, cognitive status and alcohol consumption), BMI was at least 1.18 kg / m$^2$ lower for women with history of falls. Hypertension, diabetes and dependency in ADLs remained associated with BMI with few differences in magnitude. In the final model adjusted for all diseases and chronic conditions, only hypertension (β 3.22; 95% CI 2.10 to 4.34; p≤0.001) remained positively associated with BMI (Table 2).

**Table 2.** Simple and multiple linear regression analysis to test association between each chronic disease and BMI in women. Antônio Carlos, Santa Catarina (2010-2011).

| | Crude Analysis | Model 1 | Model 2 | Model 3 (final) |
|---|---|---|---|---|
| | β (IC95%) | β (IC95%) | β (IC95%) | β (IC95%) |
| Hypertension | 3.43 (2.38;4.48) | 3.55 (2.53;4.57) | 3.45 (2.42;4.47) | 3.22 (2.10;4.34) |
| Diabetes | 1.51 (0.50;2.52) | 1.65 (0.68;2.62) | 1.78 (0.79;2.77) | 1.01 (-0.28;2.05) |
| Cancer | -1.20 (-3.40;0.99) | - 0.99 (-3.09;1.11) | -1.02 (-3.12;1.07) | 0.49 (-1.64;2.63) |
| Pulmonary chronic disease | 1.16 (-0.24;2.57) | 0.91 (-0.443;2.27) | 0.91 (- 0.46;2.30) | 0.34 (-1.08;1.77) |
| Coronary vascular disease | 0.48 (-0.50;1.48) | 0.69 (-0.26;1.64) | 0.70 (-0.26;1.67) | 0.25 (-0.80;1.30) |
| Cerebral vascular disease | -1.26 (-3.06;0.53) | - 1.36 (-3.11;0.38) | -1.25 (-3.03;0.52) | -1.45 (-3.24;0.33) |
| Arthritis / rheumatism / arthrosis | 0.56 (-0.33;1.46) | 0.34 (-0.52;1.20) | 0.25 (-0.62;1.13) | 0.10 (-0.81;1.01) |
| Depression | -0.07 (-0.98;0.84) | - 0.26 (-1.14;0.62) | - 0.38 (-1.26;0.51) | -0.91 (-1.89;0.06) |
| Osteoporosis | -0.15 (-1.12;0.80) | 0.12 (-0.80; 1.05) | 0.02 (-0.91;0.96) | -0.89 (-1.86;0.07) |
| History of falls | 0.72 (- 0.22;1.67) | 1.25 (0.34;2.16) | 1.18 (0.26;2.11) | 0.69 (-0.28;1.66) |
| IADLs | 0.25 (-0.62;1.13) | 0.82 (-0.03;1.69) | 0.92 (0.06;1.79) | 0.32 (-0.69;1.33) |
| ADLs | 1.50 (0.54;2.47) | 1.53 (0.61;2.47) | 1.54 (0.58;2.49) | 0.93 (-0.23;2.11) |

CI: confidence interval; ADLs: basic activities of the daily living; IADLs: instrumental activities of the daily living. Model 1: age, living arrangement and education; Model 2: age, education, living arrangement, smoking, alcohol consumption, waist circumference and cognitive status; Model 3 (final): Adjusted for all of the above variables and all diseases and chronic health conditions.

In men, hypertension (β 2.27; 95% CI 1.35 to 3.19; p≤0.001) and diabetes (β 2.82; 95% CI 1.38 to 4.28; p≤0.001) were also associated with BMI, the first in lower and the second in higher magnitude than for women. BMI was 2.05 kg / m$^2$ lower for men with report of chronic lung disease (β -2.05, 95% CI -3.50 to -0.60; p≤0.001) and 1.57 kg / m$^2$ lower for those with history of falls in the last year (β -1.57, 95% CI -2.85 to -0.29; p≤0.016). In the adjusted analyses, associations of BMI with high blood pressure, diabetes and chronic lung disease were kept up to the adjustment in model 2 (age, education, living arrangement, smoking, waist circumference, cognitive status and alcohol consumption). In the final model adjusted for other chronic conditions, only chronic lung disease remained inversely associated with BMI. BMI values were 42% lower in men reporting chronic lung disease (β - 1.71, 95% CI -2.41 to -1.01; p≤0.001) when compared to data from the crude analysis.

Figure 1 shows the trend chart for number of diseases and chronic health conditions and BMI for men and women. The model was adjusted for age, education, living arrangement, smoking and cognitive status. The BMI of women with 3 or more diseases was significantly higher compared to those with 0 or 1-2 diseases (β 1.06; 95% CI, 24.12 to 28.32; p≤0.001). For men, the BMI of those with 3 or more diseases was higher compared to BMI of individuals with 1-2 diseases (β 0.339, 95% CI 27.11 to 28.44; p≤0.001).

**Table 3.** Simple and multiple linear regression analysis to test association between each chronic disease and BMI in men. Antônio Carlos, Santa Catarina (2010-2011).

| | Crude Analysis | Model 1 | Model 2 | Model 3 (final) |
|---|---|---|---|---|
| | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) |
| Hypertension | 2.27 (1.35;3.19) | 2.34 (1.47;3.22) | 1.80 (0.92;2.69) | 0.15 (-0.28;0.58) |
| Diabetes | 2.82 (1.38;4.28) | 2.30 (0.91;3.70) | 1.64 (0.24;3.04) | -0.29 (-0.98;0.40) |
| Cancer | -0.50 (-2.42;1.41) | -0.67 (-2.54;1.20) | -1.66 (-3.48;0.16) | 0.10 (-0.82;0.84) |
| Pulmonary chronic disease | - 2.05(-3.50;-0.60) | -1.20 (-2.61;0.22) | -1.99 (-3.38;0.60) | -1.71 (-2.41;-1.01) |
| Coronary vascular disease | 0.71 (-0.35;1.79) | 1.28 (0.26;2.30) | 0.77 (-0.24;1.79) | -0.47 (-0.97;0.03) |
| Cerebral vascular disease | - 0.35 (-2.20;1.48) | 0.01 (-1.73;1.75) | - 1.06 (-2.77;0.66) | -0.74 (-1.58;0.09) |
| Arthritis / rheumatism / arthrosis | - 0.10 (-1.22;1.01) | - 0.01 (-1.08;1.05) | 0.06 (-0.97;1.10) | 0.17 (-0.32; 0.67) |
| Depression | 0.29 (-0.80;1.40) | 0.08 (-0.96;1.13) | - 0.40 (1.42;0.62) | 0.09 (-0.38;0.56) |
| Osteoporosis | - 2.04 (-4.36;0.28) | -2.17 (-4.37;0.02) | -1.52 (-3.69;0.65) | -0.53 (-1.60;0.53) |
| History of falls | - 1.57(-2.85;-0.29) | -0.62 (-1.89;0.65) | - 0.36 (-1.59;0.87) | 0.39 (-0.20;0.97) |
| IADLs | - 0.14 (-1.16;0.87) | 0.30 (-0.69;1.28) | -0.28 (-0.73;0.17) | -0.14 (-0.61;0.33) |
| ADLs | 1.02 (-0.16;2.20) | 1.15 (0.03;2.28) | 0.50 (- 0.61;1.60) | -0.53 (-1.08;0.02) |

CI: confidence interval; ADLs: basic activities of the daily living; IADLs: instrumental activities of the daily living. Model 1: age, living arrangement and education arrangement. Model 2: age, education, living arrangement, smoking, alcohol consumption, waist circumference and cognitive status. Model 3 (final): Adjusted for all of the above variables and all diseases and chronic health conditions.

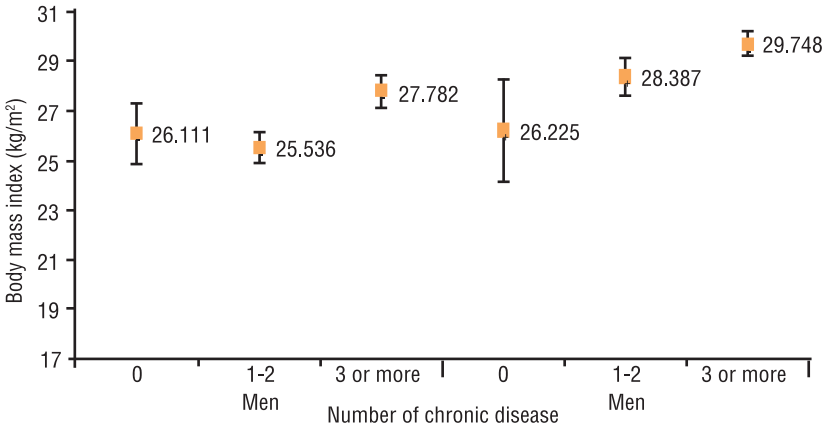


**Figure 1.** Trend analysis graph of BMI and number of diseases and disorders in men and women from a community in southern Brazil

## DISCUSSION

The results showed differences between men and women in the estimated prevalence of diseases and chronic health conditions. Similarly, diseases and chronic health conditions associated with BMI differed between sexes. In women, hypertension was independently associated with higher BMI and chronic lung disease was associated with lower BMI values for men. In addition, the number of diseases and chronic health conditions showed a significant linear trend with BMI for men and women.

Gender differences in health conditions have been previously identified in epidemiological studies with older adults[6,9,10,14]. Women in this study had higher prevalence of hypertension, arthritis, depression, osteoporosis and history of falls than men. Differences between sexes may be related to increased demand of women for health services, especially in chronic situations[19].

Association between hypertension and higher BMI for women is consistent with previous studies[9,20,21]. However, unlike the present study, this association has been identified by categorized BMI using different cutoffs to classify overweight[9,20]. It is noteworthy that studies[20,21] did not make adjustments for other diseases or chronic health conditions or just adjustment for diabetes[9], a frequent comorbidity of hypertension.

Although the mechanisms involved in the association between hypertension and overweight are not yet fully understood, some physiological changes and body dysfunctions that occur in overweight individuals have implications in this relationship. In these individuals, there is greater activation of the sympathetic nervous system and in the renin-angiotensin-aldosterone system, in addition to the renal dysfunction, insulin resistance and leptin, and reduced action of natriuretic peptides[22].

In women, hormonal changes after menopause play an important role in body weight gain and presence of hypertension. The effects of estrogens on smooth endothelial and vascular cells serve to prevent and protect against vasoconstriction, and in menopause, with decreased levels of this hormone, the effect is lost, resulting in higher blood pressure values[22]. Overweight is common condition in women aged 60 years and over[6,9] and although weight gain cannot be attributed to menopause, hormonal changes are associated with increased body fat and increased fat in the abdominal region[23].

The results showed an association between chronic lung disease and lower BMI values for men. This association is consistent with studies that find association of this disease and low weight without adjustment for other diseases[24].

Older men are more likely to develop chronic obstructive pulmonary disease (COPD) due to exposure to risk factors, including the frequent consumption of tobacco[24]. Reduced body weight is common in subjects with COPD mainly due to loss muscle mass, but reduction in body fat is less significant[25]. in addition, the proinflammatory status of individuals with COPD increases energy expenditure, which favors weight loss[24]. Individuals with COPD require 20% energy supplementation in relation to basal values[26], in addition to high levels of catecholamines that induce hypermetabolism, increasing energy expenditure and muscle catabolism.

The results of the trend analysis between number of diseases and chronic health conditions and BMI indicated a linearity relationship between high number of diseases and high BMI in both sexes, regardless of adjustment variables. The mean BMI values of women with one or more diseases and men with 3 or more diseases were higher than those adopted in Brazil by the Food and Nutrition Surveillance System[27].

There are only few studies scientific literature analyzing the relationship between multimorbidity and BMI. The only study found (Medline and Scielo) examined this association in 300,006 adults aged 30 or over[11]. The authors found that the overall multimorbidity prevalence (32%) was attributed to overweight and obesity, classified according to the WHO criteria[28], with increased multimorbidity prevalence associated with age in

each BMI category. Regardless of cutoff points used to classify overweight and obesity, there is an association between multimorbidity and excess body fat in the elderly.

It is noteworthy that although some studies have pointed to the contribution of overweight in chronic diseases[6,9,10], in older adults this effect seems attenuated[8]. The literature points to the obesity paradox, showing that higher BMI has a protective effect on individuals with chronic diseases[8], including COPD[25], hypertension and comorbidity conditions[8].

Possible explanations involve physiological and behavioral factors. Overweight individuals can receive better medical treatment or respond better to therapeutic procedures depending on the type of chronic condition[29]. Individuals with higher BMI values have higher lean mass and body fat, as well as greater cardioprotective effect of leptin and adiponectin[30], which are insulin resistance-related hormones.

The present study has limitations that should be mentioned. The first refers to the cross-sectional design, where subjects were analyzed at a given time and cannot establish a causal relationship. Second, the information was collected in a self-reported way and omissions may have occurred. However, the presence of chronic diseases was confirmed by the use of medicines and information from health workers. Third, it was not possible to investigate the severity of diseases and this may be a more important factor than their number. The use of a representative sample of the elderly population, the training of interviewers, the use of direct body weight and height measurement and the fact of being the first Brazilian study to investigate the association between chronic diseases, multimorbididity and BMI in older adults are study strengths.

## CONCLUSION

This research using BMI as a continuous variable allowed identifying association with hypertension and chronic pulmonary disease in women and men, respectively. These associations were independent of age, education, living arrangement, smoking, alcohol consumption, waist circumference, cognitive state and all diseases and chronic health conditions. BMI also showed linear trend with number of diseases and chronic health conditions. The monitoring of the nutritional status of older adults is important to identify extreme BMI, especially in those with more than two diseases and chronic health conditions.

Given the differences between men and women in the health conditions observed, it is important to identify specific needs for each group. The implementation of targeted public policies to each group seems to be essential.

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