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**ORIGINAL ARTICLE /** *ARTIGO ORIGINAL*

# Lifestyle, high Body Mass Index, and markers of socioeconomic conditions associated with multimorbidity in women

## *Estilo de vida, alto índice de massa corporal e marcadores de condições socioeconômicas associados à multimorbidade em mulheres*

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**ABSTRACT:** ***Objective***: This study aimed to identify the prevalence of multimorbidity and its associated factors in women in southern Brazil. ***Methods:*** We conducted a cross-sectional, population-based study with a sample of 1,128 women (age 20–69 years), living in São Leopoldo, southern Brazil. Multimorbidity was defined as two or more chronic conditions measured using the therapeutic and chemical anatomical classification of continuous use medications prescribed by a physician. Poisson regression model with robust variance was used to assess the association between sociodemographic and lifestyle variables and multimorbidity. ***Results***: The prevalence of multimorbidity was 21.7% (95%CI 19.3–24.2), and 26 chronic conditions were identified. A direct linear association was observed with age and income and an inverse association with education. Being unemployed was a risk factor for multimorbidity (PR 1.95; 95%CI 1.51–2.52). Alcohol consumption (moderate or excessive) had a protective effect. Overweight and obese women were 53% (PR 1.53; 95%CI 1.09–2.15) and 76% (PR 1.76; 95%CI 1.27–2.45) more likely to have multimorbidity than eutrophic women. ***Conclusion***: Over 20% of the adult women had multimorbidity, and its occurrence was strongly associated with socioeconomic characteristics, such as fewer years of schooling, higher income, and not having an occupation. The results regarding alcohol consumption are still insufficient to propose a public policy for the prevention of multimorbidity. Excess weight was an independent risk factor and should be addressed in public health policies for the prevention and management of multimorbidity.

***Keywords:*** Multimorbidity. Multiple chronic conditions. Chronic disease. Risk factors. Women.

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**RESUMO:** ***Objetivo***: Identificar a prevalência de multimorbidade e seus fatores associados em mulheres no Sul do Brasil. Métodos: Estudo transversal de base populacional, com amostra de 1.128 mulheres (20–69 anos) residentes em São Leopoldo (RS). A multimorbidade foi definida como duas ou mais condições crônicas, medidas usando-se a classificação anatômica química e terapêutica de medicamentos de uso contínuo prescritos por médico. A regressão de Poisson com variância robusta foi utilizada para avaliar a associação entre variáveis sociodemográficas e de estilo de vida e multimorbidade. ***Resultados***: A prevalência de multimorbidade foi de 21,7% (intervalo de confiança — IC95% 19,3–24,2), e 26 condições crônicas foram identificadas. Observou-se associação linear direta com idade e renda e associação inversa com escolaridade. Estar sem ocupação foi fator de risco para multimorbidade (razão de prevalência — RP 1,95; IC95% 1,51–2,52). O consumo de álcool (moderado ou excessivo) teve efeito protetor. Mulheres com sobrepeso e obesidade tiveram probabilidade de 53% (RP 1,53; IC95% 1,09–2,15) e 76% (RP 1,76; IC95% 1,27–2,45) maior de ter multimorbidade do que mulheres eutróficas, respectivamente. ***Conclusão***: Mais de 20% das mulheres adultas apresentavam multimorbidade, e sua ocorrência esteve fortemente associada a características socioeconômicas como menor escolaridade, maior renda e não possuir ocupação. Os resultados referentes ao consumo de álcool ainda são insuficientes para propor uma política pública de prevenção de multimorbidade. O excesso de peso foi um fator de risco independente e deve ser abordado em políticas públicas de saúde para prevenção e manejo da multimorbidade.

***Palavras-chave:*** Multimorbidade. Múltiplas condições crônicas. Doença crônica. Fatores de risco. Mulheres.

## INTRODUCTION

The term "multimorbidity" is generally defined as the presence of two or more chronic health conditions in the same individual[1,2]. In the conception of multimorbidity, none of the diseases is understood as the main one, believing in the comprehensive management of all health problems that the individual presents[3]. The complexity of assisting patients with multiple chronic diseases brings multimorbidity as a major challenge, especially since health guidelines are usually based on treating isolated conditions[4-9].

Epidemiological studies on multimorbidity have shown great methodological differences, which makes it difficult to compare them[8,10]. Even so, there is a consensus that multimorbidity has a high prevalence in both high-income countries and developing countries, such as Brazil, burdening health systems[11-15].

In the adult population, multimorbidity reaches about 20% in most studies, affecting more women and those with unfavorable socioeconomic conditions[11,12,15-21]. Among the elderly, it affects the majority, reaching up to 98% of this group[10,13,15,22]. In southern Brazil, a population-based study carried out with adults and the elderly observed an overall prevalence of multimorbidity of almost 30%, while in the female population, the prevalence was over 35%[12].

Individuals with multimorbidity have a lower quality of life, lower functional capacity, reduced life expectancy, and a higher risk of mortality than those with isolated conditions[12,15,23-25]. These individuals use health services more and receive complex and multiple treatments, which makes adherence to treatment difficult and increases the risk of adverse effects[19,26,27].

In this context, it is important to identify the factors associated with multimorbidity so that preventive measures may be applied effectively. It is already established that lifestyle factors such as smoking, unhealthy eating, alcohol consumption, physical inactivity, and being overweight are associated with the occurrence of many chronic diseases when they are assessed individually[28]. Regarding multimorbidity, studies have shown that presenting with a combination of lifestyle factors that is considered unhealthy increases the chances of multimorbidity[29,30]; but when evaluated separately, the literature is not consistent about the association of these behavioral characteristics with multimorbidity.

With regard to the above, this study aimed to identify the prevalence of multimorbidity and its associated factors in women in southern Brazil.

## METHODS

We conducted a cross-sectional population-based study, with a representative sample of women living in urban areas in the city of São Leopoldo, RS. This research is part of a larger project entitled "Living conditions and health of adult women: population-based study in the Rio dos Sinos Valley – Evaluation after 10 years" carried out in 2015. This study employs multiple-stage sampling methods; details of the methodology used have already been published[31]. The sample size was calculated based on the outcomes of interest; we chose the one that required a larger sample size. The total sample of 1,128 women made it possible to estimate the prevalence of multimorbidity, with a margin of error of 3% points. For associations, the chosen sample size allowed the detection of prevalence ratios (PR) of ≥1.4, with a power of 80%, using 95% confidence intervals (CIs).

Women who were residents of the urban area of São Leopoldo, residents of the sectors and households drawn, and aged between 20 and 69 years were eligible for inclusion in the study population. Those who may have been in the household drawn at the time of the study but were not residents of that household and pregnant women were excluded. A standardized and pretested questionnaire was administered to each participant in a pilot study. Data quality control was carried out using a shorter questionnaire, which was applied to 10% of the participants.

The outcome "multimorbidity" was assessed from the identification, classification, and usage of drugs prescribed by a doctor that the participant reported, through the question: "Are you (Mrs.) currently using any medication prescribed by a doctor?" To correctly register each medication, it was requested the presentation of the prescription, packaging, or package insert, when possible. To determine the health condition for which each medication was used, the following were taken into account:

1. Main therapeutic indication of the medication (established by the Anatomical Therapeutic Chemical [ATC] classification[32], a system adopted by the World Health Organization [WHO] to classify drugs according to the organ or system on which they act);
2. The indication of use referred by the participant; and
3. Other medications used and their therapeutic indication.

When necessary, other auxiliary information was used, such as age and the Self-Reporting Questionnaire (SRQ-20) score[33], the latter being used to confirm the presence of common mental disorders (CMD). The drugs in use that were referred to for acute health conditions or occasional use were not included. Those who presented two or more chronic conditions were considered multimorbid[2].

The independent variables were classified as demographic, socioeconomic and lifestyle variables, and nutritional status. The demographic variables were age (categorized every 10 years), self-reported skin color (white, black, indigenous, yellow, and parda – the latter being Brazilians of mixed ethnic ancestries), and marital status (not having a partner and having a partner). Socioeconomic variables were education (≥15 years; 11–14 years; 8–10 years; 5–7 years; ≤4 years), household income per capita in quartiles (≤R$ 525.30; >R$ 525.30, and ≤R$ 869.00; >R$ 869.00 and ≤R$ 1,547.00; ≥R$ 1,547.01; corresponding to about two minimum wages, considering a national minimum wage of R$ 788.00, approximately U$ 245 at the time of the study), economic class (A+B; C; D+E; according to the economic classification criteria proposed by the Brazilian Association of Research Companies – which is based on the possession of certain material goods, the education of the head of the family, and the number of employees)[34], and occupation (employed and unemployed).

Lifestyle variables assessed were smoking (non-smoker; former smoker; current smoker), alcohol consumption (does not consume; moderate consumption; excessive consumption), physical activity (active and inactive), and consumption of fruits and vegetables (adequate and inadequate). Alcohol consumption was established based on the frequency, type of drink, and quantity ingested[35] and was classified as excessive when consumption was ≥15 g of ethanol/day[36]. Only 60 (5.8%) women were in the excessive consumption category, and only 2 of these were multimorbid; for this reason, this category was incorporated into the category of moderate consumption in the multivariate analysis. Participants were considered physically active when they reached at least 150 min of weekly physical activity, verified by the International Physical Activity Questionnaire – IPAQ (short version)[37]. The consumption of fruits and vegetables was considered adequate when ≥5 times/day[29,38].

Nutritional status was defined by the body mass index (BMI), which is given by the measurement of weight in kilograms divided by the square of the height in meters, and classified according to criteria from the WHO as follows: <18.5 kg/m²=low weight; ≥18.5 and ≤24.9 kg/m²=eutrophy; ≥25.0 and ≤29.9 kg/m²=overweight; and ≥30.0 kg/m²=obesity[39]. Weight and height measurements were recorded by trained interviewers. Weight was measured with a portable analog scale, with the participant wearing light clothes and no shoes, and distributing their body weight equally between their feet. Height was measured with a portable stadiometer on the wall, with the interviewee in an upright posture and arms loose along the body. Both measurements were performed in duplicate, and the respective mean values were considered. Only 20 (1.8%) women in the study were classified as underweight, and none of them had multimorbidity. Thus, this category was incorporated into the eutrophic category for the multivariate analysis.

Statistical analysis of the data was performed using Stata version 12.0 statistical software (StataCorp LP, College Station, TX, USA). To verify the association of the exposures of interest with the presence of multimorbidity, a Poisson regression analysis with robust variance was performed[40], according to the multivariable model of analysis[41]. According to the model, the first level includes distal variables (sociodemographic), which can determine the intermediate variables (lifestyle variables). These, in turn, are interrelated and can determine the third-level variable (nutritional status), which proximally determines the outcome. All variables were adjusted to those at the same level and higher levels, considering a p-value <0.20. Variables with p-value <0.05 were considered to be associated with the outcome.

The project was approved by the Ethics and Research Committee of the University of Vale do Rio dos Sinos (protocol 650.443). All participants signed the informed consent form.

## RESULTS

The prevalence of multimorbidity was 21.7% (95%CI 18.9–24.6). Among the 1,128 women interviewed, 9.5% (n=107) had two chronic conditions, 6.7% (n=76) had three chronic conditions, and 5.5% (n=62) had four or more chronic conditions. Table 1 shows the 26 chronic conditions found in the study population, with the most prevalent being hypertension (23.2%; 95%CI 20.8–25.8), followed by CMD (13.5%; 95%CI 11.5–15.6), which included anxiety and depression disorders.

Regarding sociodemographic characteristics, as seen in Table 2, there was a homogeneous distribution between the age categories, and the average age was 43.4 years (SD=13.4). Most women reported being white (74.5%), living with a partner (63.8%), having 8 or more years of education (59.5%), belonging to economic class C (53.1%), and being employed (58.1%). A quarter of the study population reported family income per capita up to R$ 525.30, and the average family income per capita was R$ 1,295 (SD=1,395).

The prevalence of multimorbidity increased with increasing age, with 59.2% of women between 60 and 69 years of age being multimorbid. Multimorbidity showed an inverse association with educational level, occurring in 38.2% of the population with less than 5 years of education and was also found in 35.8% of women who were unemployed. No statistically significant differences were found in the prevalence of multimorbidity according to skin color, marital status, economic class, and family income per capita.

In the context of lifestyle variables, most women reported an inadequate consumption of fruits and vegetables (56.3%), were inactive (85.6%), had a moderate consumption of alcohol (61.1%), and did not smoke (58.6%). Regarding nutritional status, 33.2% of women were overweight and 32.9% were obese. The prevalence of multimorbidity was higher among those who had an adequate consumption of fruits and vegetables, those who did not consume alcohol, and those who were ex-smokers. The prevalence also increased with an increase in BMI levels. There were no statistically significant differences in the prevalence of multimorbidity according to physical activity (Table 2).

Table 3 shows that after adjusting for potential confounding factors, age and income showed a direct linear association with multimorbidity. Those who aged 60–69 years were

Table 1. Prevalence of chronic conditions in the sample of women, São Leopoldo (RS), Brazil, 2015 (n=1,128).

| Chronic conditions (ATC classification) | n | Prevalence% (95%CI)* |
|---|---|---|
| Arterial hypertension (C02, C03, C07–C09) | 262 | 23.23 (20.80–25.80) |
| CMD (N05, N06) | 152 | 13.48 (11.54–15.61) |
| Acid-related digestive disorders (A02, A03) | 98 | 8.69 (7.11–10.49) |
| Dyslipidemia (C10) | 97 | 8.60 (7.03–10.39) |
| Thyroid diseases (H03) | 65 | 5.76 (4.48–7.29) |
| Diabetes (A10) | 60 | 5.32 (4.08–6.80) |
| Circulatory disorders (B01, C05) | 55 | 4.88 (3.69–6.30) |
| Chronic pain (M01, H02, N02, M03) | 45 | 3.99 (2.92–5.30) |
| Osteoporosis/osteopenia (M05, A12, A11) | 36 | 3.19 (2.25–4.39) |
| Rheumatic diseases (M01, L04, H02, M03) | 26 | 2.30 (1.51–3.36) |
| Asthma/bronchitis (R03) | 22 | 1.95 (1.23–2.94) |
| Other heart disease (C09, B01, C07, C01) | 20 | 1.77 (1.10–2.73) |
| Chronic headache/migraine (M01, N02) | 12 | 1.06 (0.55–1.85) |
| Labyrinthitis (N07) | 12 | 1.06 (0.55–1.85) |
| Allergic diseases (R06, R03) | 9 | 0.80 (0.37–1.51) |
| Epilepsy (N03) | 9 | 0.80 (0.37–1.51) |
| HIV/AIDS (J05) | 9 | 0.80 (0.37–1.51) |
| Acne (J01, D10) | 4 | 0.35 (0.10–0.91) |
| Cancer (L02, L01) | 4 | 0.35 (0.10–0.91) |
| Inflammatory bowel diseases (L04, H02, A07) | 3 | 0.27 (0.05–0.78) |
| Glaucoma (C07, S01) | 3 | 0.27 (0.05–0.78) |
| Gout (M04) | 2 | 0.18 (0.02–0.64) |
| Lupus (H02) | 2 | 0.18 (0.02–0.64) |
| Parkinson's disease (N04) | 1 | 0.09 (0.00–0.49) |
| Sjögren's syndrome (M01) | 1 | 0.09 (0.00–0.49) |
| ADHD (N06) | 1 | 0.09 (0.00–0.49) |

*95%CI: 95% confidence interval; CMD: common mental disorders; ADHD: attention deficit hyperactivity disorder.

Table 2. Profile of the sample of women and prevalence of multimorbidity according to demographic, socioeconomic, lifestyle, and nutritional status characteristics, São Leopoldo (RS), Brazil, 2015 (n=1,128).

| Variables | n (%) | % Multimorbidity (95%CI) | p-value |
|---|---|---|---|
| Age (years) | | | |
| 20–29 | 216 (19.2) | 1.4 (0.3–4.0) | <0.001* |
| 30–39 | 244 (21.7) | 4.5 (2.3–7.9) | |
| 40–49 | 276 (24.5) | 16.3 (12.1–21.2) | |
| 50–59 | 228 (20.2) | 39.0 (32.7–45.7) | |
| 60–69 | 164 (14.5) | 59.2 (51.2–66.7) | |
| Skin color | | | |
| White | 840 (74.5) | 21.4 (18.7–24.4) | 0.420‡ |
| Parda† | 181 (16.1) | 25.4 (19.2–32.4) | |
| Black | 84 (7.5) | 20.2 (12.3–30.4) | |
| Indigenous | 11 (1.0) | 9.1 (0.2–41.3) | |
| Yellow | 12 (1.7) | 8.3 (0.2–38.5) | |
| Marital status | | | |
| Not having a partner | 408 (36.2) | 21.8 (17.9–26.1) | 0.954‡ |
| Having a partner | 720 (63.8) | 21.7 (18.7–24.9) | |
| Education (years) | | | |
| ≥15 | 110 (9.8) | 13.6 (7.8–21.5) | <0.001* |
| 11–14 | 360 (32.0) | 12.8 (9.5–16.7) | |
| 8–10 | 199 (17.7) | 18.6 (13.4–24.7) | |
| 5–7 | 253 (22.5) | 26.5 (21.2–32.4) | |
| 0–4 | 204 (18.1) | 38.2 (31.5–45.3) | |
| Economic class | | | |
| A+B (high) | 390 (34.8) | 19.0 (15.2–23.2) | 0.226* |
| C | 596 (53.1) | 23.2 (19.8–26.8) | |
| D+E (low) | 136 (12.1) | 22.1 (15.4–30.0) | |
| Household income per capita (quartiles) | | | |
| I (low) | 273 (25.0) | 17.2 (12.9–22.2) | 0.058* |
| II | 273 (25.0) | 23.1 (18.2–28.5) | |
| III | 273 (25.0) | 22.0 (17.2–27.4) | |
| IV (high) | 272 (25.0) | 24.6 (19.6–30.2) | |
| Occupation | | | |
| Employed | 654 (58.1) | 11.6 (9.3–14.3) | <0.001‡ |
| Unemployed | 472 (41.9) | 35.8 (31.5–40.3) | |

Continue...

Table 2. Continuation.

| Variables | n (%) | % Multimorbidity (95%CI) | p-value |
|---|---|---|---|
| Consumption of fruits and vegetables | | | |
| Adequate | 492 (43.7) | 28.5 (24.5–32.7) | <0.001‡ |
| Inadequate | 634 (56.3) | 16.6 (13.8–19.7) | |
| Physical activity | | | |
| Active | 162 (14.4) | 18.5 (12.9–25.4) | 0.286‡ |
| Inactive | 966 (85.6) | 22.3 (19.7–25.0) | |
| Alcohol consumption | | | |
| Does not consume | 346 (33.2) | 33.2 (28.3–38.5) | <0.001* |
| Moderate consumption | 637 (61.1) | 14.8 (12.1–17.8) | |
| Excessive consumption | 60 (5.8) | 3.3 (0.4–11.5) | |
| Smoking status | | | |
| Non-smoker | 661 (58.6) | 19.5 (16.6–22.7) | <0.001‡ |
| Former smoker | 259 (23.0) | 31.7 (26.0–37.7) | |
| Current smoker | 208 (18.4) | 16.4 (11.6–22.1) | |
| Nutritional status | | | |
| Eutrophy | 380 (33.9) | 10.5 (7.6–14.1) | <0.001* |
| Overweight | 373 (33.2) | 23.6 (19.4–28.2) | |
| Obesity | 369 (32.9) | 31.4 (26.7–36.4) | |
| Class I obesity | 205 (18.3) | 28.8 (22.7–35.5) | |
| Class II obesity | 94 (8.4) | 31.9 (22.7–42.3) | |
| Class III obesity | 70 (6.2) | 38.6 (27.2–51.0) | |

*p-value of the chi-square test for linear trend; †Brazilians of mixed ethnic ancestries; ‡p-value of the chi-square test for heterogeneity of proportions.

Table 3 Crude and adjusted multimorbidity analyzes according to the investigated independent variables, São Leopoldo (RS), Brazil, 2015 (n=1,128).

| Variables | Multimorbidity | | | |
|---|---|---|---|---|
| | Crude PR (95%CI) | p-value | Adjusted PR (95%CI) | p-value |
| Level 1* | | | | |
| Age (years) | | | | |
| 20–29 | 1.0 | <0.001† | 1.0 | <0.001† |
| 30–39 | 3.24 (0.91–11.49) | | 3.39 (0.96–12.04) | |
| 40–49 | 11.74 (3.70–37.28) | | 10.63 (3.32–34.06) | |
| 50–59 | 28.12 (9.03–87.51) | | 22.03 (7.07–68.64) | |
| 60–69 | 42.59 (13.74–132.01) | | 26.48 (8.55–82.03) | |

Continue...

Table 3. Continuation.

| Variables | Multimorbidity | | | |
|---|---|---|---|---|
| | Crude PR (95%CI) | p-value | Adjusted PR (95%CI) | p-value |
| Education (years) | | | | |
| ≥15 | 1.0 | <0.001† | 1.0 | 0.011† |
| 11–14 | 0.94 (0.54–1.61) | | 1.28 (0.75–2.19) | |
| 8–10 | 1.36 (0.78–2.37) | | 1.57 (0.92–2.68) | |
| 5–7 | 1.94 (1.16–3.24) | | 1.60 (0.95–2.68) | |
| 0–4 | 2.80 (1.70–4.63) | | 1.73 (1.03–2.89) | |
| Household income per capita (quartiles) | | | | |
| I (low) | 1.0 | 0.055† | 1.0 | 0.011† |
| II | 1.34 (0.96–1.89) | | 1.14 (0.85–1.53) | |
| III | 1.3 (0.91–1.80) | | 1.16 (0.86–1.58) | |
| IV (high) | 1.4 (1.03–2.00) | | 1.51 (1.11–2.05) | |
| Occupation | | | | |
| Employed | 1.0 | <0.001‡ | 1.0 | <0.001‡ |
| Unemployed | 3.08 (2.42–3.93) | | 1.95 (1.51–2.52) | |
| Level 2§ | | | | |
| Consumption of fruits and vegetables | | | | |
| Adequate | 1.0 | <0.001‡ | 1.0 | 0.153‡ |
| Inadequate | 0.58 (0.47–0.73) | | 0.86 (0.69–1.06) | |
| Alcohol consumption | | | | |
| No | 1.0 | <0.001‡ | 1.0 | <0.001‡ |
| Yes | 0.41 (0.33–0.53) | | 0.67 (0.54–0.85) | |
| Smoking status | | | | |
| Non-smoker | 1.0 | <0.001‡ | 1.0 | 0.0785‡ |
| Former smoker | 1.62 (1.28–2.06) | | 1.23 (0.99–1.54) | |
| Current smoker | 0.84 (0.59–1.18) | | 0.91 (0.64–1.29) | |
| Level 3// | | | | |
| Nutritional status | | | | |
| Eutrophy | 1.0 | <0.001† | 1.0 | 0.001† |
| Overweight | 2.24 (1.59–3.17) | | 1.53 (1.09–2.15) | |
| Obesity | 2.99 (2.15–4.15) | | 1.76 (1.27–2.45) | |

PR: prevalence ratio; *variables adjusted to each other; †wald's test for linear trend; ‡wald's test for heterogeneity of proportions; §variables adjusted to each other and to those of the level above; //variable adjusted to those of the above levels.

26.5 times more likely to have multimorbidity than those who aged 20–29 years (PR 26.48; 95%CI 8.55–82.03), while those with higher income were 51% more likely (PR 1.51; 95%CI 1.11–2.05) to have multimorbidity than those with lower income. There was an inverse linear association between schooling and multimorbidity, where those with 0–4 years of schooling were 73% more likely (PR 1.73; 95%CI 1.03–2.89) to have multimorbidity than those who had ≥15 years of schooling. Those who were unemployed were almost twice as likely to have multimorbidity than those who were employed (PR 1.95; 95%CI 1.51–2.52). Women who consumed alcohol were 33% (PR 0.67; 95%CI 0.54–0.85) less likely to have multimorbidity than those who did not. Overweight and obese women were 53% (PR 1.53; 95%CI 1.09–2.15) and 76% (PR 1.76; 95%CI 1.27–2.45) more likely to have multimorbidity than eutrophic women, respectively.

## DISCUSSION

We identified that one-fifth of the adult and elderly women had two or more chronic conditions, whereas when the category of elderly women was evaluated separately, individuals with multimorbidity represented the majority. Twenty-six chronic conditions were identified, the most prevalent being hypertension and CMD. The occurrence of multimorbidity was strongly associated with socioeconomic characteristics, such as fewer years of schooling, higher income, and not having an occupation. For the characteristics related to lifestyle, the study corroborated the association of multimorbidity with excess weight and found that alcohol consumption had a protective effect.

Our study's reported prevalence of multimorbidity (21.7%) was lower than that in the National Health Survey (PNS 2013), which evaluated a nationally representative sample and found multimorbidity in 26.1% of Brazilian women, considering 22 preestablished chronic conditions[42] and was also lower than the prevalence found among Brazilian women in the Amazon region, northern Brazil, where multimorbidity reached 35.8%, considering 12 preestablished chronic conditions[43]. These differences can be related to the method of identifying chronic conditions, since the two studies above used self-reported information regarding the presence of chronic conditions from a preestablished list. Our study adopted the use of medicines as a proxy for detecting multimorbidity and, therefore, newly diagnosed women without pharmacological treatment were not included. Thus, it can be assumed that the prevalence of multimorbidity in this population may be even higher.

The positive association between advancing age and multimorbidity has already been demonstrated in other studies[14,15,19,44,45]. However, our data highlight the fact that between 40 and 49 years old, the prevalence of multimorbidity was 16.3%, while at 50–59 years, it became 39%. Even considering that women consult the doctor more as they age and are, therefore, more likely to be diagnosed with health problems[31], it is observed that middle age has a significant impact on the occurrence of multimorbidity, which thus indicates an important avenue for prevention. Although it was not evaluated in our study, the hypothesis that our findings are related to the menopausal status of these women cannot be ruled out,

since the post-menopause phase is associated with multimorbidity[16]. Nevertheless, it is also biologically plausible that the association between age and multimorbidity is related to an accumulation of stressors throughout life that favor illness and consequently the increase in the number of diseases[46].

In alignment with literature[14,47], an inverse linear association between schooling and the occurrence of multimorbidity was observed. This is relevant because studies have shown that, in hypertensive patients, low education is associated with limited knowledge about the disease (most prevalent condition in our study), which can negatively affect its control and also contribute to the development of other diseases[48,49]. Besides, our finding also shows how exposure to a marker of a socioeconomic level that is difficult to reverse impacts the development of multimorbidity, increasing the need for public health measures aimed at reducing social inequalities.

On evaluating social inequality indicators, an association was observed between low-income or lower socioeconomic status and multimorbidity[19,21,44,45,50] However, similar to our findings, data from the PNS 2013 showed that the southern states of Brazil, which are more developed in terms of both income and education, showed an increase in the occurrence of multimorbidity, possibly related to an increase in the life expectancy in these states in comparison with the others states[42]. Additionally, it is known that higher income is associated with greater access to health care services[31], which may be related to a higher number of diagnoses and, therefore, a higher percentage of multimorbidity.

We found association between women who were unemployed and multimorbidity. PNS 2013 data also showed that unemployed adults were almost 20% more likely to have multimorbidity than those who were employed[51]. The authors stated that it should be taken into account that primary health care services are only offered during weekdays and daytime hours in the Brazilian public health system, impairing the access of those who work, thereby impacting the diagnosis of multimorbidity, which should be considered when interpreting our results. However, we cannot rule out the possibility of reverse causality, since the presence of chronic diseases increases the chances of the individual not being able to work precisely because of poor health[52]. According to a national sample of American adults, as the level of multimorbidity increased, the chances of the individual not working significantly increased[53].

The association between alcohol consumption and multimorbidity still remains controversial. While some studies have shown no association between these variables[29,30], a Brazilian study conducted with individuals who aged 50 years or older found that those who did not consume alcohol had a higher prevalence of multimorbidity[46]. Along the same lines, we found alcohol consumption to be a protective factor for multimorbidity. Other evidence has also identified moderate alcohol consumption as a protective factor for chronic conditions[54,55]. However, it is possible that women with multimorbidity stopped consuming alcoholic beverages after diagnosis of chronic diseases, and for this reason, the temporality of this association should be investigated in longitudinal studies.

Finally, our investigation pointed out a significant dose-response relationship between BMI categories and the prevalence of multimorbidity. This association is consistent with

findings from several studies that have assessed the relationship between nutritional status and multimorbidity[16,30,44,45]. In this context, it is known that the prevalence of excess weight has been increasing over the years[56]. Therefore, one can speculate as to the negative impact this will have on the incidence of multimorbidity in the future. As it is also a chronic condition, some studies on multimorbidity have used the presence of obesity as part of the construction of the outcome, instead of as an exposure[11,50]. However, given its established role as a risk factor for chronic noncommunicable diseases[28], we chose to assess the presence of excess weight as a risk factor for multimorbidity, thereby highlighting the importance of public policies in combating this pandemic.

This study has some limitations. The cross-sectional design did not allow us to establish a temporal relationship between the exposure and outcome, although it appears that the hierarchical model accounted for those variables with possible reverse causality. In relation to the external validity, this is a population-based study carried out in a city in southern Brazil, and for this reason, it is possible that the findings cannot be extrapolated to populations with characteristics different from this study population.

The lifestyle variables assessed were self-reported; therefore, it is possible that behaviors that are recognized as negative by the general population may have been underreported and, as a result, would be higher than those presented in the study. For the assessment of nutritional status, gauging weight and measuring height circumvented the possibility of this bias.

One of the criticisms made of the concept of multimorbidity is that it often does not take into account the severity of the health conditions[57]. However, polypharmacy is common in multimorbidity and is associated with the occurrence of adverse effects due to drugs[27]. Additionally, the initial conduct during the management of some chronic conditions is the adoption of healthy habits associated or not with pharmacological treatment. Thus, when we include women already using medication, it can be assumed that nonpharmacological management as an isolated therapy was not effective and, therefore, due to the requirement of medication, the disease being treated is likely to be severe.

To the best of our knowledge, this is the first population-based study conducted among women in southern Brazil where medication usage was employed to detect chronic conditions, enabling the identification of a wide range of diseases, and pointing out its severity. As per our understanding, the strategy used to classify morbidity by reporting the name of the drug contributed to better data quality. Since the current use of medicines was considered, these were classified according to their main therapeutic indication and confirmed by the self-report of the individuals interviewed. The evaluation of medication use also allowed an unlimited number of health conditions to be considered without restricting it to a specific number of preestablished diseases, as observed in most available studies[14,30,50,51]. Furthermore, the use of ATC classification has already been considered as an up-to-date mapping approach to identify patients with chronic diseases using pharmacy data[58], and other studies investigating multimorbidity have also used this methodology[12,26,59,60]. However, due to the absence of a validated instrument for screening the variety of chronic conditions addressed in studies on multimorbidity, the use of various methods limits the comparability of results among the available studies.

## CONCLUSION

This study showed that the prevalence of multimorbidity in women increases significantly with increasing age and is not restricted only to the elderly population. Given the aging of the population, multimorbidity should be treated as a public health problem that is a cause for worry, especially since the prevention and management of multiple health conditions is a task of great complexity for health systems.

Our study identified a range of factors associated with increased multimorbidity, such as fewer years of education, higher income, and not having an occupation. Regarding nutritional status and lifestyle characteristics, excess weight was observed to be an independent risk factor for multimorbidity, while alcohol consumption displayed a protective effect. It is vital to understand the risk factors that must be addressed by both clinical guidelines and public health policies so that the strategies to be proposed address the challenge of preventing and managing multimorbidity.

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## ETHICAL APPROVAL

The project was submitted to and approved by the Ethics and Research Committee of the University of Vale do Rio dos Sinos (protocol 650.443) and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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