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Occurrence and inequalities by education in multimorbidity in Brazilian adults between 2013 and 2019: evidence from the National Health Survey

Ocorrência e desigualdades por escolaridade em multimorbidade em adultos brasileiros entre 2013 e 2019: evidências da Pesquisa Nacional de Saúde

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ABSTRACT: *Objective:* The aims of this study were: 1) to estimate the prevalence of multimorbidity in 2013 and 2019 in adults aged 20–59 years; 2) to assess inequalities in the prevalence of multimorbidity in 2013 and 2019 according to educational level. *Methods:* Data from two cross-sectional surveys from the Brazilian National Health Survey in 2013 and 2019 were used. Multimorbidity was assessed from 14 lifetime self-reported morbidities (except back problems) and defined using the cutoff point of ≥2 diseases. The prevalence of multimorbidity and individual morbidities were described according to gender, age, skin color, and education. For education, crude, and relative inequalities in prevalence of multimorbidity were calculated using the Slope Index of Inequality and the Concentration Index, respectively. *Results:* The prevalence of multimorbidity increased from 18.7% (95%CI 18.0–19.3) in 2013 to 22.3% (95%CI 21.7–22.9) in 2019, being higher among women and adults between 30–59 years in both periods. Asthma/bronchitis, depression, and back problems were the conditions that increased the most in the study period. Absolute and relative inequalities by education status were observed in the study period, with worse multimorbidity profiles among the less educated. *Conclusion:* The prevalence of multimorbidity increased between 2013 and 2019. Inequalities in the prevalence of multimorbidity were observed according to educational level.

Keywords: multimorbidity. chronic disease. health status disparities. adult. cross-sectional studies.

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RESUMO: *Objetivos:* Os objetivos do presente estudo foram: 1) estimar a prevalência de multimorbidade nos anos de 2013 e 2019 em adultos de 18 a 59 anos; 2) avaliar as desigualdades na prevalência de multimorbidade em 2013 e 2019, de acordo com a escolaridade. *Métodos:* Foram utilizados dados de dois inquéritos transversais da Pesquisa Nacional de Saúde de 2013 e 2019. A multimorbidade foi avaliada a partir de 14 morbidades autorreferidas a partir de diagnóstico médico na vida (exceto problema na coluna) e definida usando-se o ponto de corte de ≥ 2 doenças. As prevalências de multimorbidade e morbidades individuais foram descritas de acordo com sexo, idade, cor da pele e escolaridade. Desigualdades brutas e relativas nas prevalências conforme a escolaridade foram calculadas utilizando-se o *Slope Index of Inequality* e o *Concentration Index*, respectivamente. *Resultados:* A prevalência de multimorbidade aumentou de 18,7% (IC95% 18,0–19,3), em 2013, para 22,3% (IC95% 21,7–22,9), em 2019, sendo maior entre mulheres e adultos entre 30 e 59 anos em ambos os períodos. Asma/bronquite, depressão e problemas na coluna foram as condições que mais aumentaram no período. Desigualdades absolutas e relativas foram observadas, com prevalências superiores entre os menos escolarizados e sem diferença entre os anos. *Conclusões:* A prevalência de multimorbidade aumentou no período de 2013 a 2019. Desigualdades na prevalência de multimorbidade foram observadas de acordo com a escolaridade.

Palavras-chave: Multimorbidade. Doenças crônicas. Desigualdades em saúde. Adultos. Estudos transversais.

INTRODUCTION

Multimorbidity is a health problem characterized by the presence of multiple chronic diseases in the same individual, which is usually defined by the presence of ≥2 or ≥3 concomitant diseases[1,2]. This condition is associated with long-term functional disability and high health care expenses[3]. Also, multimorbidity can worsen physical and mental quality of life, in addition to increase the risk of depressive symptoms and functional disability[4-6]. As a consequence, it is responsible for a high number of consultations in primary care and greater use of emergency services[7,8].

The prevalence of multimorbidity can vary according to age, gender, income, education and, mainly, by the forms of measurement (number of morbidities used, way of measuring each disease – medical diagnosis referred by the respondent and/or objective measures/diagnosis criteria) and of operationalization (cutoff points: ≥ 2, ≥ 3, and/or complex multimorbidity)[9]. In Brazil, this prevalence in individuals aged 18 years old or older, including aged people, is approximately 25%[10,11], reaching 29% in regional studies[12,13]. The occurrence is higher among women, aged people and those from lower socioeconomic positions[10,11,14]. Analyses restricted to the adult population in Brazil (under 60 or 65 years of age) indicate occurrence between 11%, in 2014, and 21%, in 2007[15,16]. Socioeconomic inequalities were observed, but with different patterns, according to the study population and indicators used[11,15-17].

Education is associated with the occurrence of multimorbidity, which can be considered a proxy of socioeconomic position, which may directly reflect the educational level,

reaching a strong determinant of employment and income conditions. It also reflects the contextual load of each individual[18]. In a systematic review, with 24 cross-sectional studies, it was identified that individuals with less education had 64% more chance of multimorbidity[19]. In addition, the aging of the population can generate a greater burden of disease, especially in economically active older adults and in more vulnerable socioeconomic groups[20]. Despite this, only part of the increase in multimorbidity can be attributed to demographic changes[21]. Although international evidence indicates an increase in the occurrence of multimorbidity, as far as is known, there are no comparable findings on its trend, at different periods, among adults in Brazil. The National Health Survey (*Pesquisa Nacional de Saúde* – PNS), carried out in 2013 and 2019, is able to assess this trend, with high comparability of morbidities in the period.

Thus, the aims of this study were: 1) to estimate the prevalence of multimorbidity in 2013 and 2019 in adults aged 18 to 59 years; 2) to assess inequalities in the prevalence of multimorbidity in 2013 and 2019, according to educational level.

METHODS

SAMPLE

Study with data from two cross-sectional population-based surveys of the PNS, collected in 2013 and 2019 by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – IBGE) in partnership with the Ministry of Health. The data are in the public domain and are available on the IBGE website (https://www.ibge.gov.br/).

The selection of the PNS sample was carried out by means of cluster sampling, divided into three stages. The first was the selection of primary sampling units (census sectors or set of sectors). The second guaranteed the selection of households, within each primary sampling unit, using a fixed number of permanent private households by simple random sampling. The third stage included the selection of a resident in each household by simple random sampling, with a minimum age to answer to the questionnaire (18 years or more, in 2013, and 15 years or more, in 2019). The PNS sample is representative of the Brazilian population residing in permanent private households, covering, in addition to the national territory, urban and rural areas, the five geographic macro-regions and the federation units, capitals, and metropolitan regions[22].

After the selected residents signed the informed consent, trained interviewers collected sociodemographic and health information in both surveys using handheld computers. The 2013 and 2019 data collections were approved by the National Commission for Ethics in Research/National Health Council, under protocol numbers 10853812.7.0000.0008 and 3.529,376, respectively.

DEPENDENT VARIABLES

Multimorbidity was assessed using a list of 14 morbidities reported by the individual. Morbidities were identified, in the Q module of chronic diseases in both surveys, through the following question: "Has any doctor ever given you the diagnosis of...?", listing the diseases: hypertension, high cholesterol, depression, diabetes, arthritis or rheumatism, bronchitis, asthma or wheezing; work-related musculoskeletal disorders (WMSD), cancer, heart problems, stroke, chronic kidney failure, chronic obstructive pulmonary disease (COPD), back problems, and other chronic diseases. In the case of depression, the question was: "Has any doctor or mental health professional (psychiatrist or psychologist) ever given you a diagnosis of depression?". To identify a spinal problem, the question was: "Do you have a chronic spine problem, such as chronic back or neck pain, low back pain, sciatica, vertebrae or disc problems?". Multimorbidity was defined from the cutoff point of ≥ 2 morbidities[23]. Among women, episodes of high blood pressure and diabetes occurred during pregnancy were not considered.

INDEPENDENT VARIABLES

The independent variables included in the study were gender (male and female), skin color (white, brown, black, yellow, and indigenous), age in full years (18–29 and 30–59 years) and education (no education/incomplete elementary or middle school, complete middle school/incomplete high school, complete high school/incomplete higher education, and complete higher education).

STATISTICAL ANALYSIS

Analyses were performed using Stata statistical software, version 17®, using expansion factors and sample weights with the svy command. The variables of primary sampling unit (PSU_PNS), individual weight (V00291), and stratum (V0024) were used. The proportions of the variables and their respective 95% confidence intervals (95%CI) were estimated according to the year of the surveys. Comparisons were evaluated using confidence intervals (95%CI), considering statistically significant comparisons when there was no overlap between them. Also, equiplots (www.equidade.org/equiplot) were used for graphical presentation of the prevalence of isolated morbidities according to the year of the survey (2013 and 2019).

Inequalities related to the prevalence of each of the diseases according to educational level were estimated using, respectively, the Slope Index of Inequality (SII) and Concentration Index (CIX). The SII is a complex measure of absolute inequality from a logistic regression. To estimate the SII according to education levels, individuals in the population were ranked from the least to the most educated. This index represents the absolute difference,

in percentage points, of the outcome between the values predicted by the regression line of the extremes of the distribution of the variable used to rank the individuals (education). The CIX, on the other hand, is a complex measure of relative inequalities, in which individuals are also ranked according to education categories (from the least to the most educated), and the cumulative prevalence of the outcome is compared with the distribution of individuals in each education category, in an approach similar to the Lorenz curve. The values of both indexes can vary between -1 and 1, where negative values indicate that the prevalence of the analyzed disease is higher among less educated individuals, while positive values indicate higher prevalence among more educated ones. When SII and CIX are equal to zero, they indicate the absence of inequalities in the prevalence of the disease analyzed in relation to education. To facilitate the interpretation of the SII, its values were multiplied by 100, being, therefore, interpreted as differences in percentage points. More information about the calculations of both indexes can be found in another publication[24]. All analyses took into account the complexity of the survey sampling design.

RESULTS

In 2013, 49,205 adults between 18 and 59 years of age were interviewed, of which 18.7% (95%CI 18.0–19.3) reported having two diseases or more. In 2019, there were 65,803 adults, and 22.3% (95%CI 21.7–22.9) presented multimorbidity. The sample characteristics were similar between years for gender and age (Table 1).

Figure 1 shows the prevalence of each disease according to the year of surveys. There was an increase, from 2013 to 2019, in the prevalence of asthma/bronchitis: from 4.3% (95%CI 4.0–4.6) to 5.5% (95%CI 5.1–5.8); other chronic diseases: from 5.1% (95%CI 4.7–5.5) to 7.5% (95%CI 7.1–7.9); depression: from 7.2% (95%CI 6.7–7.6) to 9.8% (95%CI 9.4–10.2); back problem: from 16.4% (95%CI 15.8–17.1) to 19% (95%CI 18.4–19.6); diabetes: from 3.6% (95%CI 3.3–3.9) to 4.3% (95%CI 4.0–4.5); cholesterol: from 9.9% (95%CI 9.4–10.4) to 11.1% (95%CI 10.6–11.5); and chronic renal failure: from 2.6% (95%CI 2.3–2.8) to 3.1% (95%CI 2.9–3.4). Other diseases remained stable between one period and another.

The prevalence of multimorbidity increased from 2013 to 2019, being higher among women (23.0% in 2013 to 27.0% in 2019), among individuals aged 30 to 59 years (from 24.4% in 2013, to 27.7% in 2019), and among those without education or with incomplete elementary/middle education (from 24.6% in 2013 to 29.6% in 2019) (Table 2).

Regarding inequalities in multimorbidity according to education, in 2013 and 2019, it was observed that the prevalence of multimorbidity was just over 10 percentage points higher among less educated individuals compared to more educated individuals in both years [2013: SII =-11.2 (95%CI -13.6–-8.7); 2019: SII=-10.1 (95%CI -12.2–-7.9)]. Relative inequalities were observed regarding the prevalence of multimorbidity according to educational groups, with CIX equal to -0.07 (95%CI -0.09–-0.05), in 2013, and -0.05 (95%CI - 0.07– -0.04), in 2019. Despite this difference between the CIX values, the confidence intervals indicate that there

Chart 1. Description of demographic, socioeconomic, and multimorbidity characteristics in adults according to the year of the survey. Brazil, 2013-2019.

	2013 (95%CI)	2019 (95%CI)
Gender		
Male	47.9 (47.1–48.7)	47.8 (47.1–48.5)
Female	52.1 (51.3–52.9)	52.2 (51.5–52.9)
Age		
18–29	31.9 (31.1–32.6)	28.2 (27.5–28.9)
30–59	68.1 (67.4–68.9)	71.8 (71.1–72.5)
Skin color		
White	46.2 (45.3–47.1)	41.3 (40.5–42.1)
Black	9.1 (8.6–9.6)	11.8 (11.3–12.3)
Yellow	0.9 (0.7–1.0)	0.8 (0.7–1.0)
Brown	43.4 (42.5–44.2)	45.6 (44.8–46.3)
Indigenous	0.4 (0.4–0.5)	0.5 (0.4–0.7)
Education		
No education – incomplete elementary/middle school	31.2 (31.1–32.9)	26.9 (26.2–27.6)
Complete middle school – incomplete high school	17.2 (16.6–17.8)	15.8 (15.4–16.4)
Complete high school – incomplete higher education	37.4 (36.6–38.2)	40.2 (39.5–40.9)
Complete higher education	13.4 (12.7–14.2)	17.1 (16.4–17.8)
Multimorbidity (2+)	18.7 (18.0–19.3)	22.3 (21.7–22.9)
Mean of diseases – people with multimorbidity	2.71* (2.67–2.75)	2.77* (2.73–2.81)

was no increase or decrease in the relative inequality of multimorbidity according to educational groups between 2013 and 2019 (Table 3).

For the assessed diseases, absolute and relative inequalities were observed in 2013 and 2019. The greatest absolute inequalities were observed for back problems and hypertension, in which the prevalence of these diseases in 2013 were, respectively, 12.6 and 11.6 percentage points higher in less educated individuals compared to more educated ones (Figure 2). Of the nine diseases that had negative SII values in 2013, eight of them identified an increase in inequality in 2019. The only exception was in relation to depression, in which there was a reversal of the pattern. In 2013, the prevalence of depression was 2.1 percentage points higher among the less educated, in 2019 it was 0.6 higher among the more educated. Cancer, WMSD, and asthma/bronchitis were more prevalent among the most educated in both 2013 and 2019.
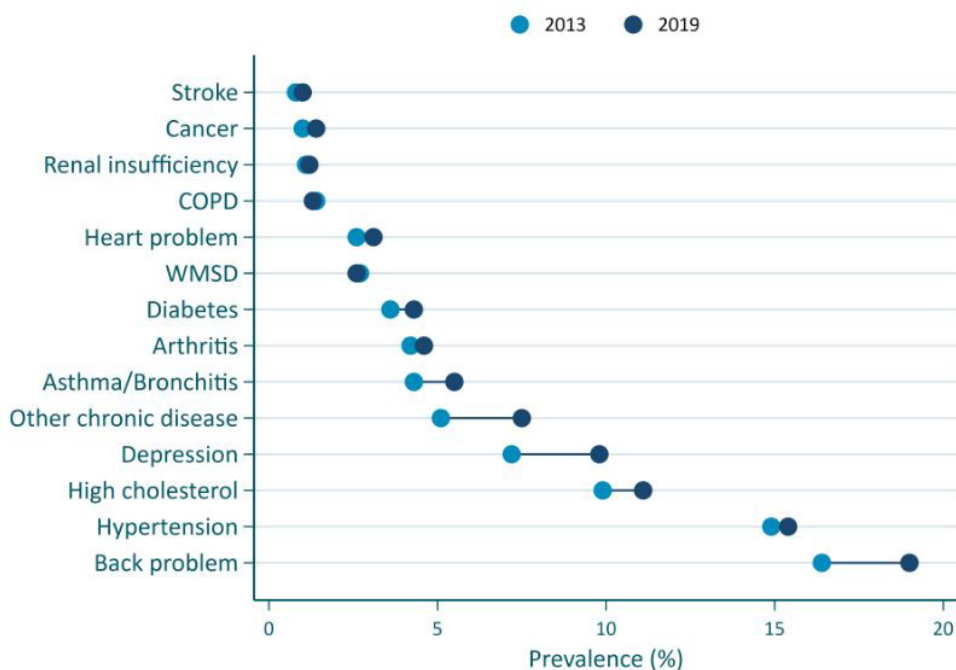
Figure 1. Prevalence of individual morbidities in adults according to the year of research. Brazil, 2013-2019.

Regarding relative inequalities, the highest were observed for stroke, where the CIX was -0.26 in 2013, reaching -0.33 in 2019. Of the nine diseases with negative CIX (highest prevalence among the less educated), six had increased inequalities between 2013 and 2019 (stroke, kidney failure, arthritis, diabetes, hypertension, COPD). In contrast, of the six CIX-positive diseases in 2013, three had reduced inequalities in 2019 (cancer, WMSD, other NCDs) (Figure 2).

DISCUSSION

The results showed an increase in the prevalence of multimorbidity from 2013 to 2019, similar between genders. Older adults (30–59 years) had a higher occurrence compared to younger adults. Individuals with white skin color had the highest prevalence in 2019, but individuals with black and yellow skin colors had the highest percentage increase in this six-year period. Between 2013 and 2019, the prevalence of multimorbidity increased by five percentage points among the least educated, while among individuals with complete higher education, there was an increase of 3.8 percentage points. Asthma/bronchitis, other

Chart 2. Prevalence of multimorbidity in adults according to the year of the survey. Brazil, 2013-2019.

	2013 (95%CI)	2019 (95%CI)
Gender		
Male	13.9 (13.1–14.7)	17.1 (16.3–17.9)
Female	23.0 (22.1–24.0)	27.0 (26.1–27.8)
Age		
18–29	6.4 (5.7-7.2)	8.5 (7.6–9.4)
30–59	24.4 (23.6–25.2)	27.7 (27.0–28.4)
Skin color		
White	20.0 (19.0–21.0)	24.2 (23.2–25.2)
Black	18.3 (16.2–20.4)	21.8 (20.2–23.4)
Yellow	14.8 (9.1–20.4)	21.5 (13.9–29.1)
Brown	17.4 (16.5–18.2)	20.7 (19.9–21.6)
Indigenous	22.8 (14.1–31.4)	18.7 (12.8–24.7)
Education		
No education – incomplete elementary/middle school	24.6 (23.4–25.8)	29.6 (28.3–30.8)
Complete middle school – incomplete high school	16.9 (15.4–18.4)	19.5 (18.2–20.8)
Complete high school – incomplete higher education	14.1 (13.2–15.0)	18.0 (17.1–19.0)
Complete higher education	19.5 (17.5–21.5)	23.3 (22.0–24.7)

Chart 3. Crude (Slope Index of Inequality) and relative (Concentration Index)* inequalities in the occurrence of multimorbidity among adults, according to the year of the survey. Brazil, 2013-2019.

Inequality indexes	Multimorbidity		
	2013	2019	Difference (2019-2013)
Slope Index of Inequality	-11.2	-10.1	1.1
	(-13.6 – -8.7)	(-12.2 – -7.9)	
Concentration Index	-0.07	-0.05	0.02
	(-0.09 – -0.05)	(-0.07 – -0.04)	

*Socioeconomic index: education.

chronic diseases, depression, and back problems were the problems that increased the most in the period.

The increase in multimorbidity is accompanied by an increase in the use of health services in Brazil, both in public and private institutions[25]. This is one possible explanation for the

Absolute inequality
according to schooling

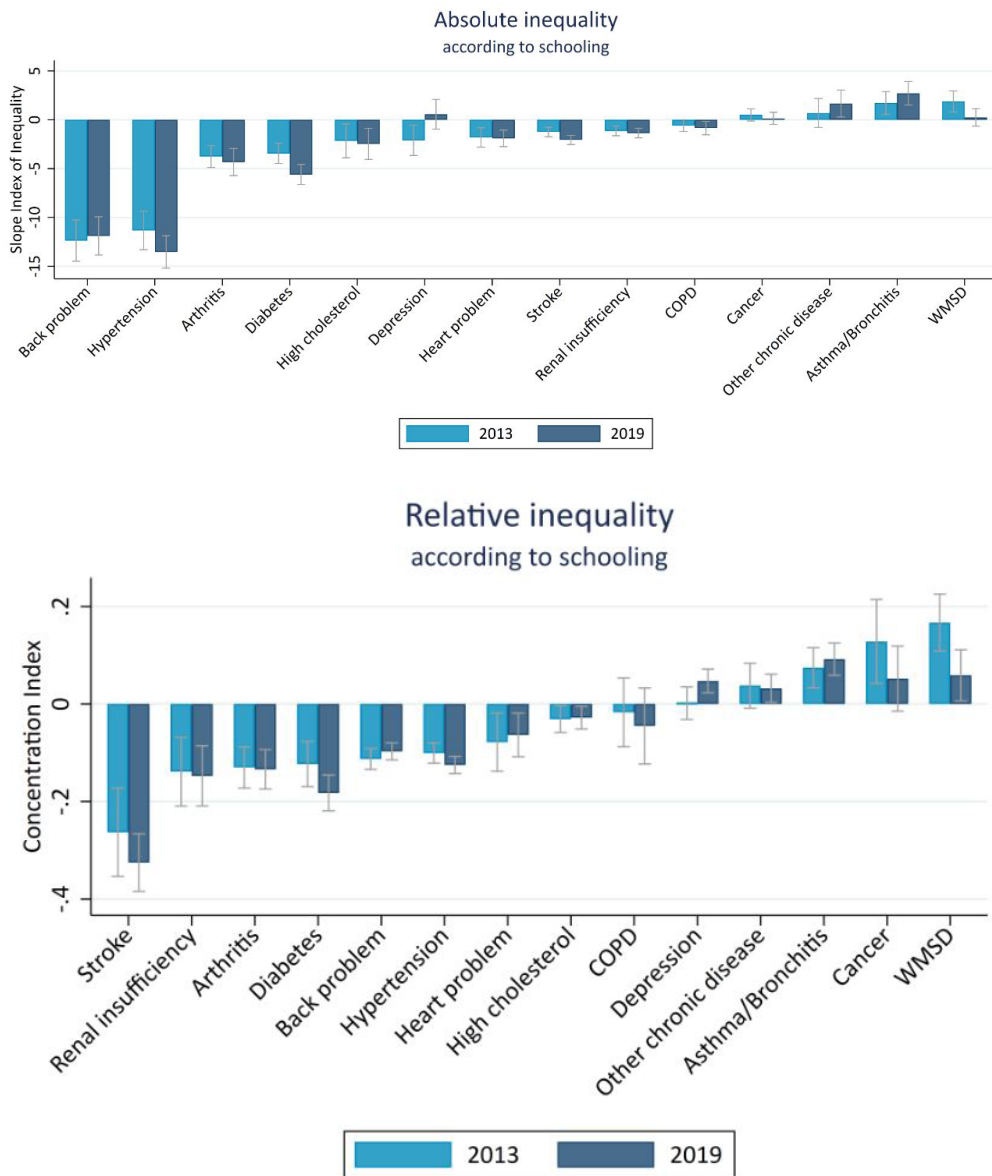

Relative inequality
according to schooling

Figure 2. Absolute (Slope Index of Inequality) and relative (Concentration Index)* inequalities in the occurrence of morbidities among adults, according to the year of the survey. Brazil, 2013-2019.

observed results, as the greater use of health services can result in a greater number of medical diagnoses of chronic diseases. A study that evaluated the coverage of the Family Health Strategy (*Estratégia Saúde da Família* – ESF) in Brazil, carried out between 2013 and 2018, identified an increase of 7.7 percentage points over the five-year period[26]. Studies that seek to understand this relationship (possibly bidirectional) between morbidities and access to services will be relevant to understand, in more detail, the trend in the occurrence of multimorbidity.

The increase in the prevalence of diseases, such as depression and back problems, may explain the greater occurrence of multimorbidity in 2019. Global estimates from the World Health Organization point to an increase in the prevalence of depression in the world[27], while those from the Global Burden of Disease suggest an increase of spinal problems in Brazil[28]. In addition, in recent decades, the frequency of diagnosis of morbidities has increased as a result of the reduction in thresholds for diagnosis, the inclusion of new diagnoses and new risk factors[29], being verified, for example, the reduction of thresholds of 140/ 90 to 130/80 mmHg for the diagnosis and control of hypertension, according to the guidelines of the American College of Cardiology/ American Heart Association[30], or the insertion of the pre-diabetes category, according to the guidelines of the American Diabetes Association[31]. These changes may contribute to an increase in the prevalence of multimorbidity, even if they do not directly reflect the increase in the burden of morbidities and the low quality of life related to the individual's health[32].

In previous studies, an increase in the prevalence of multimorbidity has been observed. Between 1994 and 2010, a study conducted in Canada evaluated data from five birth cohorts (1925–1974) and identified a greater chance of multimorbidity in each cohort when compared to the previous one[33]. Another study, in the United Kingdom, with retrospective data from electronic health records of adults over 18 years old, observed that the prevalence of multimorbidity increased from 16 to 25% over a period of approximately 10 years[34]. These results are consistent with the increase found in the present study.

Characteristics such as female gender, low income, obesity, smoking, and sedentary lifestyle were associated with greater chances of multimorbidity[33]. In the present study, in both periods, women had a higher prevalence of multiple chronic diseases. The explanation for their higher occurrence in women may be related to greater health care by women and gender inequalities[35,36]. Women, in general, adopt more preventive behaviors and access health services more often, thus being able to have more knowledge about their health problems. According to data from PNS 2019, 82.3% of Brazilian women consulted a doctor in the 12 months prior to the interview, against 69.4% of men[37].

The prevalence of multimorbidity in the present study was similar to that found in a study carried out in São Paulo[16] and higher than that detected in a national study[15]. The study carried out in the city of São Paulo, with 2,713 adults, found a prevalence of 21%, being higher in women, older people, and individuals with lower socioeconomic conditions[16]. Despite the differences in morbidities and in the forms of measurement performed, occurrence and associated factors were consistent. Regarding the findings of the National Survey on Access, Use and Promotion of the Rational Use of Medicines in Brazil (*Pesquisa Nacional sobre o Acesso, Utilização e Promoção do Uso Racional de Medicamentos no Brasil* – PNAUM), a prevalence of multimorbidity of 11% was identified, lower than that obtained in the present study[15]. This difference may be due to the high prevalence of spinal problems, which is the most prevalent morbidity in our study, which was not evaluated in the study using PNAUM data.

The increase in the occurrence of multimorbidity was greater among individuals with white and brown skin color, being different from that evidenced in other countries. A study conducted in the United States in 2015 observed that increasing age and black skin color were associated with a higher risk of multimorbidity, regardless of gender[38]. In a study, also carried out in the United States, with data from 2002 to 2014, from The National Health Interview Surveys (NHIS), involving adults aged 30 to 64 years old, there was a higher risk (7%) of multiple chronic diseases in non-Hispanic black individuals compared to non-Hispanic whites[39]. Additionally, individuals with black skin color had initial chronic disease counts 28% higher than whites, in addition to developing multimorbidity earlier[38,40], data corroborated by the morbidity network analysis approach[41].

Inequities regarding skin color are linked to socioeconomic aspects. According to the IBGE (2018), individuals with white skin color are the majority who attend higher education, with less unemployment and higher wages compared to those with black and brown skin color. These inequalities perpetuate poverty and hinder political participation and access to social goods and services for the black population[42]. This process is called structural racism, which permeates the formation of Brazilian society and constitutes an important determinant of the health-disease process[43].

This study identified inequalities in the prevalence of multimorbidity among the less educated, both for absolute and relative differences. According to the National Research Council and the Institute of Medicine, education is one of the most important social determinants of health[44], with direct effects on health-related factors[45]. In a study on the association of multimorbidity and education in Germany, it was identified that educational level was an important risk factor for the occurrence of multiple diseases[46]. In the present study, it was possible to observe inequalities greater than 11 points in the SII index. In the nationally-based study with data from the PNAUM, the CIX index showed inequality in multimorbidity, according to education, for men in Brazil and inequality among women in the Southern Region[15]. However, the SII index was not significant for either gender in the PNAUM study, even when stratified by region of the country.

In a study with data from public servants at a university in Rio de Janeiro, the Pró-Saúde Study (*Estudo Pró-Saúde* – EPS), it was identified that, according to the increase in education of women, the observed prevalence of multiple chronic diseases was lower, and when evaluating the total sample, a trend toward a reduction in prevalence was observed with the increase in education[17]. In a systematic review and meta-analysis, a 64% greater chance of multimorbidity was found among those with a lower level of education compared to the better educated group[19]. These findings corroborate the inequalities found in the present study, in which the prevalence was higher among the more educated and the mean difference found between the extremes of our distribution (more educated and less educated) was greater than ten percentage points, regardless of the year evaluated. Low education is directly related to greater global social deprivation, for example, lower income, neighborhood characteristics, and housing conditions, which may increase the risk of chronic diseases[47].

The present study has some limitations. First, information on self-reported chronic diseases may have less accuracy than objective measurements or those collected from medical records, for example[48]. Second, studies with self-reported diseases may overestimate the effect of education on multimorbidity, which may influence our results[49]. The use of measures based on diagnostic criteria (*e.g.*, objective measurement of blood pressure, cholesterol) and symptoms (*e.g.*, depression and heart problems) is recommended for future work on inequalities in multimorbidity. Finally, it is recognized that the manuscript is more exploratory due to the lack of evidence on the subject in Brazil. Nevertheless, the use of more comprehensive analyses (*e.g.*, intersectoriality) tends to reveal in more detail the observed inequalities[50], also due to the wide and diverse inequalities existing in Brazil. In this sense, analyses including regional characteristics (states of the Federation and geopolitical regions), residence (urban/rural and type of municipality), other variables of socioeconomic position (income and economic classification) added to the variables gender, age, color of skin, and education can contribute to a closer picture of the effect of health inequalities in the country[51,52].

In conclusion, our results showed that there was an increase in the prevalence of multimorbidity over the six-year period in Brazil, with greater increases in asthma/bronchitis and back problems among the less educated and an increase in opposite directions in cases of depression. Both in 2013 and in 2019, the indicators of absolute and relative inequalities showed that the occurrence of multimorbidity was concentrated in the less educated, with the differences being stable in the period.

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