

## Education-related health inequities in noncommunicable diseases: an analysis of the *Brazilian National Health Survey, 2013 and 2019*

Inequidades relacionadas à escolaridade na prevalência de doenças crônicas não transmissíveis: uma análise da *Pesquisa Nacional de Saúde, 2013 e 2019*

Inequidades de salud relacionadas con la educación en enfermedades no transmisibles: un análisis de la *Encuesta Nacional de Salud brasileña, 2013 y 2019*

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### Abstract

*This study assesses changes in the prevalence and distribution of noncommunicable diseases (NCDs) and related risk factors among Brazilian adults from the 2013 and 2019 Brazilian National Health Surveys (PNS). It is based on the hypothesis that deteriorating socioeconomic conditions over this period would lead to increased NCDs among the least advantaged populations. We estimated adjusted prevalence ratios by education category and three inequality measures – the slope index of inequality (SII), the relative index of inequality (RII), and population attributable fraction (PAF) – for obesity, hypertension, arthritis, asthma, cancer, depression, diabetes, heart disease, having any chronic condition, and multimorbidity by survey year. We also estimated the 27 Brazilian Federative Units RII and prevalence rates for diabetes and multimorbidity per year and plotted the RII against prevalence by year. Results showed that all NCDs increased over the period observed, ranging from an 8% increase in the adjusted prevalence of arthritis to a 24% increase in the adjusted prevalence of obesity. Measures of inequality showed that most conditions exhibited significant educational inequities in both 2013 and 2019. However, on average, education-based inequities did not significantly change between the two periods. Considering the deterioration of the socioeconomic conditions of most Brazilians, the erosion of social protections, and the continuing economic, political, and health crises occurring in the nation, we observed an urgent need for discussion about the best way to adopt equity-promoting health policies and programs and action to reduce socioeconomic and geographic inequalities in NCDs throughout the country.*

*Health Status Disparities; Noncommunicable Diseases; Education; Socioeconomic Factors*

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## Introduction

While economic inequalities in Brazil are still remarkable, some measures, such as the Gini coefficient had been declining steadily since the early 2000s<sup>1</sup>. However, from 2014 to 2016, the country suffered a devastating recession<sup>2</sup> that led to double-digit unemployment rate, as well as a worsening income inequality in subsequent years<sup>3</sup>. The period of the economic recession was followed by significant cuts to social spending with important consequences for population health and health inequality<sup>4,5</sup>.

Noncommunicable diseases (NCDs) and related risk factors, such as obesity have become more prevalent in Brazil since the population grows older and increasingly adopts lifestyles that combine higher consumption of processed food, reduced physical activity, and more sedentary occupations<sup>6</sup>. The burden of NCDs has increased considerably in the last three decades; ischemic heart disease was the fourth leading cause of years of life lost (YLL) in 1990 and, in 2016, was the first cause<sup>7</sup>. Implicit to this high burden of NCD is the increasing contribution of metabolic risk factors, including high body mass index (BMI) (particularly for women) and high systolic blood pressure, contributing to diabetes and cardiovascular disease<sup>7</sup>. Hypertension and diabetes were reported by 21% and 6% of the adult population, respectively, according to a 2013 national survey<sup>8</sup>. Multimorbidity – the presence of two or more NCDs in the same individual – has also increased over time<sup>9</sup> and is strongly associated with changes in lifestyle. Also, it is associated with higher mortality risk, lower quality of life, and greater need for healthcare services and medications<sup>10</sup>. NCDs and multimorbidity are particularly common in older adults (50 or older) and are often concentrated among those of lower socioeconomic status<sup>11</sup>. Inequalities in health are also pronounced in Brazil and have been widely documented<sup>12</sup>.

In the past decades, prevalence of chronic non-communicable diseases, such as diabetes, hypertension, stroke, and arthritis have been consistently higher for individuals with low schooling level, compared to those with a higher education<sup>13</sup>. However, distinct patterns seem to be emerging over time for different conditions. Evidence of this evolving pattern was described by Beltrán-Sánchez & Andrade<sup>8</sup>, using a series of cross-sectional surveys between 1998 and 2013. They found that educational inequality for diabetes grew consistently over this period, whereas, for hypertension and heart disease, educational inequality remained mostly stable. While Brazil had seen progress in reducing inequalities for some health outcomes, especially for children<sup>14,15</sup>, the period since 2015 has seen worsening of socioeconomic conditions and reduced government expenditures on poverty alleviation programs, as well as other social services, such as healthcare via the Brazilian Unified National Health System (SUS)<sup>16</sup>. It is currently unknown how such circumstances have affected the NCDs and the related inequalities within the country.

This study intends to stimulate a debate about (1) whether rising NCDs – especially during a period of increasing social and economic inequalities amidst an erosion of government support for public services – are primarily experienced by those in the lowest socioeconomic position, and (2) what course(s) of action would be most effective in combatting persistent health inequities by socioeconomic position and other factors, such as geography.

## Methods

Data from two cross-sectional population-based surveys, the 2013 and 2019 editions of the *Brazilian National Health Survey* (PNS) were used, conducted by the Brazilian Institute of Geography and Statistics (IBGE) in partnership with the Brazilian Ministry of Health to provide estimates that are representative at the national, regional, state, and state capital levels<sup>17</sup>. The PNS uses a complex sample design in three stages. In the first stage, primary sampling units (PSU), represented by census tracts, are randomly selected from a master file of census tract stratified by geographic region, and urban/rural situation. In the second stage, households are selected from PSUs. Finally, participants are randomly selected from the households. Pre-scheduled face-to-face interviews are conducted using structured questionnaires that cover a range of demographic, socioeconomic, and health-related questions<sup>17,18</sup>. A recently released version of the PNS 2013 was used, in which IBGE had recalibrated the expansion factors to make the 2013 PNS comparable with the 2019 study<sup>19</sup>. Our analytic sample included 60,202 and 88,509 respondents aged 18 or older, from the PNS 2013 and PNS 2019, respec-

tively. Approximately 6% of the respondents had at least one missing response and were dropped from the analyses resulting in a final sample size of 139,322.

Self-reported data were used on seven chronic conditions, i.e., hypertension, arthritis, asthma, cancer, depression, diabetes, and heart disease. Presence of these conditions among respondents was confirmed by the question: “Have you ever been told by a doctor that you had (insert condition)?” in both surveys. Also, it was used measures of weight and height collected from participants to calculate BMI. Obesity was defined as a BMI greater than 30kg/m<sup>2</sup>. Measures of weight and height were obtained from all respondents in 2013 and a subsample of respondents (n = 6,571) in 2019. Two other outcome variables were established, “any chronic condition”, defined as any of the eight conditions or risk factors previously listed, and “multimorbidity”, defined as two or more of those chronic conditions or risk factors.

Respondent’s education was classified into four categories: less than primary (including those unable to read or write), primary complete (including those with only a few years of secondary school), high school complete, and incomplete or complete higher education. Education was confirmed by the same question in both surveys.

Also, data on age (a continuous measure of age was interacted with its square to capture the non-linear effects of age on each outcome), birth sex (male, female), dummy variables for each Brazilian Federative Units and the Federal District (hence referred to as states), and a measure of wealth derived from principal components analysis of a list of household goods (e.g., T.V., refrigerator, washer, microwave, computer, car, internet service, landline, cell phone, and other common household items) were used and categorized into quintiles. The same variables were used in both surveys to construct all measures.

### **Statistical analysis**

Proportions/means and 95% confidence intervals (95%CI) for age, sex, education category, and income by survey year were described. Prevalence rates for all outcomes, eight chronic conditions and/or risk factors, and two combinations, i.e., any chronic and multimorbidity by survey year were also described. Considering the complex, weighted survey design, design-corrected F and t-tests were used to test the differences between the two surveys and adjusted Wald tests for hypothesis testing<sup>20</sup>. Previous analysis using PNS data have shown that combining data from different versions of a survey can produce unbiased estimates if the survey designed is properly accounted for in the analysis<sup>21</sup>.

The associations between health outcomes and sociodemographic characteristics were estimated using robust survey-weighted Poisson regression to obtain adjusted prevalence ratios. These models were adjusted for age, age-squared, sex, state fixed effects, education level, wealth quintiles, and survey year as defined above. Interaction terms between educational level and survey year were not statistically significant and, therefore, were not included in analyses<sup>8</sup>.

To explore health inequities, the slope index of inequality (SII), the relative index of inequality (RII), and the population attributable fraction (PAF) were compared. The SII and RII are regression-based inequality metrics used to quantify the socioeconomic gradient of a given outcome in absolute and relative terms, respectively. These measures of inequality consider changes in the proportion of people across different socioeconomic groups, and thus can be used to compare inequalities across different periods and populations<sup>22,23</sup>. The PAF was also calculated. In our case, the PAF represents the fraction of the outcome that could have been avoided if the exposure (low educational attainment, defined here as less than high school) was reduced to zero and everyone had at least completed high school. A generalized linear model (GLM) with binomial distribution were used with a logit link function to estimate the SII and a log link function to estimate the RII, following standard practice for equity analyses<sup>24,25</sup>. The exponentiated values for the RII were presented in order to interpret in a way similar to odds ratios, also following standard practice<sup>25</sup>. To assure comparability between years and by state, GLM models were adjusted for age and sex. The postestimation command “punaf” were used in Stata<sup>26</sup> after estimating robust Poisson regression models adjusted for age, age-squared, sex, and the wealth index in order to calculate PAF and its 95%CI. Finally, to explore whether the relationship between NCD prevalence and education-related inequality changed from 2013 to 2019, the 27 Federative Units of Brazil RII and prevalence rates were estimated for two outcomes with high

national levels of inequality in 2013 (diabetes and multimorbidity) plotting the RII against NCD prevalence and assessing the fit for each year using fractional polynomial regression, given the complex, non-linear relationship among variables. An estimation about these state-specific measures was carried out by using the “subpop” command in Stata separately for each state and year. Stata 17 (<https://www.stata.com>) software program was used for all analytical procedures. All analyses accounted for complex survey design and individual sampling weights.

This study used publicly-available and de-identified versions of the PNS 2013 and 2019 surveys and was, therefore, considered exempt from further reviews with human. The 2013 PNS was approved by the Brazilian National Research Ethics Committee (CONEP) in June 2013 (n. 328,159) and the 2019 PNS in August 2019 (n. 3,529,376).

## Results

Table 1 shows the increased mean age from 42 to 44 years between 2013 and 2019. A little more than 50% of the sample was female in both years. The distribution of educational attainment changed between 2013 and 2019; the proportion of the population that did not complete primary school reduced from 39% in 2013, to 35% in 2019, ( $p < 0.001$ ). Meanwhile the proportion of those with higher education increased from 17%, in 2013, to 20%, in 2019 (Table 1).

Prevalence rates for all NCDs also increased. In 2013, unadjusted prevalence rates varied from 22% for hypertension to 1.8% for cancer. One out of five people was obese; more than one-third of the population had at least one chronic condition/risk factor, and 1 out of 10 had multimorbidity in 2013. In 2019, unadjusted prevalence rates varied from 25% for hypertension to 2.2% for cancer. In 2019, obesity was present among one out of four people. The proportion of the population with any chronic condition/risk factor (41%) and comorbidity (16%) also increased compared to the previous period (Table 1) ( $p < 0.001$ ).

In analyses controlling for individual-level factors including age, sex, and wealth, we confirmed the increase in prevalence of chronic conditions and risk factors over time (Table 2). Obesity and depression had the largest percent increases in 2019, with rates 24% and 30% higher than those observed in 2013, after controlling for changing demographic characteristics between the two periods. We associated educational attainment with most NCDs, except for asthma and cancer. For most conditions, we related higher education with lower prevalence rates; individuals with incomplete or complete higher education were 40% less likely to report diabetes, 24% less likely to report multimorbidity, 23% less likely to report hypertension, 20% less likely to report arthritis, 19% less likely to report obesity and heart disease, and 8% less likely to report any chronic condition, compared to those with less than primary education, after adjusting for covariates. Individuals who completed high school were 17% less likely to report depression than those with less than primary education, however individuals with incomplete or complete higher education were as likely to report depression as those with less than primary education (Table 2).

Table 3 shows all three measures of inequality. The RII shows that most conditions presented significant educational inequalities in 2013 (except for obesity and depression) and 2019 (except for obesity). Consistent with results for adjusted prevalence rates, the relative indices of educational inequality show that the probability of diabetes, hypertension, heart disease, arthritis, any chronic condition, and multimorbidity are higher among those with a lower educational attainment. Diabetes had the largest relative and absolute inequality (RII = 1.61 in 2013 and 1.86 in 2019; SII = 0.55 in 2013 and 0.73 in 2019), as well as the largest PAF among all NCDs, with estimates indicating that 21.7% and 18.8% of the diabetes cases could have been avoided in 2013 and 2019, respectively, if the exposure (low education attainment) was reduced to zero and if everyone had at least completed high school. The prevalence of any chronic condition and multimorbidity also presented relative and absolute inequities with much larger indices for multimorbidity (RII = 1.22 in 2013 and 1.31 in 2019; SII = 0.25 in 2013 and 0.38 in 2019) (Table 3).

Relative indices for cancer and asthma showed that the probability of these conditions increases with higher (rather than lower) educational attainment. This pattern was consistent for relative and absolute measures, but the PAF values for these two NCDs were less reliable. For depression, absolute

**Table 1**Characteristics of the study population by year of survey. *Brazilian National Health Surveys (PNS) 2013 and 2019.*

Characteristic	2013 (N = 60,202)		2019 (N = 88,509)		Change		Test for difference (2019-2013)
	Mean	95%CI or SD	Mean	95%CI or SD	Mean	95%CI or SD	
Age	42.9	0.14	44.9	0.12	2.01	0.18	p < 0.0001
Female (%)	52.9	52.1, 53.7	53.2	52.6, 53.8	0.3	-1.1, 1.7	p = 0.598
Education							
Less than primary	39.0	38.1, 40.0	34.8	34.1, 35.4	-4.2	-5.9, -2.7	
Primary complete	15.5	15.0, 16.1	14.5	14.1, 14.9	-1.0	-2.0, -0.1	p < 0.0001
High school complete	28.1	27.4, 28.8	28.8	29.2, 30.4	0.7	0.4, 3.0	
Higher education or more	17.4	16.6, 18.2	20.9	20.2, 21.7	3.5	2.0, 5.1	
Income	BRL 1,177	24.7	BRL 1,618	24.7	BRL 441	35.0	p < 0.0001
Obesity (%)	20.8	20.2, 21.4	26.5	23.6, 29.7	5.7	2.2, 9.5	p = 0.0001
Hypertension	22.0	21.4, 22.7	25.9	25.4, 26.4	3.9	2.7, 5.0	p < 0.0001
Arthritis	6.4	6.1, 6.8	7.6	7.2, 7.9	1.2	0.4, 1.8	p < 0.0001
Asthma	4.4	4.1, 4.7	5.3	5.0, 5.5	0.9	0.3, 1.4	p < 0.0001
Cancer	1.8	1.6, 2.1	2.6	2.4, 2.7	0.8	0.3, 1.1	p < 0.0001
Depression	7.6	7.2, 8.1	10.2	9.8, 10.6	2.6	1.7, 3.4	p < 0.0001
Diabetes	7.0	6.7, 7.4	8.2	7.9, 8.6	1.2	0.5, 1.9	p < 0.0001
Heart disease	4.1	3.8, 4.49	5.3	5.0, 5.6	1.2	0.51, 1.8	p < 0.0001
Any chronic condition	35.3	34.6, 36.0	41.8	41.2, 42.4	6.5	5.2, 7.8	p < 0.0001
Multimorbidity	12.7	12.2, 13.2	16.1	15.6, 16.5	3.4	2.4, 4.3	p < 0.0001

95%CI: 95% confidence interval; SD: standard deviation.

Source: PNS 2013 and 2019.

Notes: weighted proportions, means, and 95% confidence intervals are adjusted for survey design. Health conditions were self-reported based on the question: "Have you been told by a health care provider that you have (insert condition)?" Obesity was defined as BMI larger than 30kg/m<sup>2</sup>. Measures of weight and height were obtained from all respondents in 2013 and a subsample of respondents (n = 6,571) in 2019.

and relative inequality seems to be shifting from null to higher probability of depression with higher educational attainment (Table 3).

Regarding the state-level estimates of the relationship between relative inequalities (RII) and prevalence rates for diabetes for the two periods, Figure 1 shows increases in both diabetes prevalence and relative inequality between 2013 and 2019. State diabetes prevalence rates were not significantly correlated with the RII in 2013 or 2019 ( $p > 0.05$ ). In general, the pattern indicates that for states with prevalence rates below the national average, the RII tended to rise along with prevalence rates. Whereas for states that had prevalence rates above the national average, inequality seems to decline slightly even as prevalence increased. By 2019, some of the richer states, e.g., Minas Gerais, Paraná, Rio Grande do Sul, and São Paulo, showed both the highest prevalence rates and highest rates of inequalities (RII).

Figure 2 presents the relationship between state-level multimorbidity estimates and their relative inequality related to education. We observed a clear pattern of increasing prevalence of multimorbidity with most states shifting right in 2019 (blue) compared to 2013 (red). Prevalence rates were weakly correlated with the RII in 2013, which became stronger in 2019 ( $p < 0.01$ ). We also observed some influential outliers, e.g., Maranhão and Goiás, which presented high RII for relatively low prevalence, particularly in 2013. Some of the richest states, e.g., Rio Grande do Sul, Minas Gerais, São Paulo, and Rio de Janeiro, had higher prevalence rates, as well as higher inequalities relative to the national average for both years.

**Table 2**Factors associated with chronic conditions, Brazilian adults aged 18 and older. *Brazilian National Health Surveys 2013-2019.*

	Obesity	Hypertension	Arthritis	Asthma	Cancer	Depression	Diabetes	Heart disease	Any chronic	Multimorbidity
Male	0.69 *	0.77 *	0.38 *	0.71 *	0.81 *	0.36 *	0.89 *	0.96	0.75 *	0.56 *
(95%CI)	(0.65, 0.73)	(0.75, 0.80)	(0.35, 0.42)	(0.65, 0.77)	(0.71, 0.91)	(0.33, 0.39)	(0.83, 0.95)	(0.89, 1.04)	(0.73, 0.76)	(0.54, 0.59)
Age [years]	1.08 *	1.15 *	1.17 *	0.97 *	1.15 *	1.08 *	1.22 *	1.09 *	1.08 *	1.16 *
(95%CI)	(1.07, 1.09)	(1.15, 1.16)	(1.15, 1.18)	(0.96, 0.98)	(1.12, 1.18)	(1.07, 1.10)	(1.20, 1.24)	(1.07, 1.11)	(1.07, 1.08)	(1.15, 1.17)
Primary complete [vs. less]	0.98	0.98	1.04	0.99	0.98	0.95	0.97	0.98	0.98	1.01
(95%CI)	(0.90, 1.07)	(0.93, 1.03)	(0.94, 1.16)	(0.87, 1.14)	(0.80, 1.21)	(0.86, 1.05)	(0.87, 1.08)	(0.85, 1.12)	(0.95, 1.02)	(0.94, 1.08)
High school complete	0.93 **	0.87 *	0.93	0.90	1.07	0.83 *	0.79 *	0.84 ***	0.89 *	0.86 *
(95%CI)	(0.87, 1.00)	(0.83, 0.91)	(0.84, 1.03)	(0.79, 1.02)	(0.91, 1.27)	(0.76, 0.90)	(0.72, 0.88)	(0.73, 0.96)	(0.87, 0.92)	(0.81, 0.91)
Higher education and more	0.81 *	0.77 *	0.80 *	1.08	1.45	0.99	0.60 *	0.81 ***	0.92 *	0.76 *
(95%CI)	(0.74, 0.90)	(0.73, 0.81)	(0.71, 0.90)	(0.94, 1.23)	(1.20, 1.76)	(0.90, 1.10)	(0.53, 0.68)	(0.70, 0.94)	(0.88, 0.95)	(0.71, 0.83)
2019 [vs. 2013]	1.24 *	1.09 *	1.08 **	1.19 *	1.21 ***	1.30 *	1.11 *	1.17 ***	1.11 ***	1.15 *
(95%CI)	(1.11, 1.39)	(1.05, 1.12)	(1.00, 1.16)	(1.09, 1.29)	(1.06, 1.38)	(1.22, 1.40)	(1.04, 1.19)	(1.07, 1.29)	(1.09, 1.14)	(1.10, 1.21)
N	60,839	139,322	139,322	139,322	139,322	139,322	127,509	139,322	139,322	139,322

95%CI: 95% confidence interval.

Source: PNS 2013 and 2019.

Notes: figures are adjusted prevalence ratios and their 95%CIs from robust survey-weighted Poisson regression. Models additionally control for age-squared, wealth quintiles derived from principal components analysis of a list of common household goods and state fixed effects. Obesity is calculated from directly measured height and weight and was only assessed in a subsample in 2019.

\*  $p < 0.05$ ;\*\*  $p < 0.01$ ;\*\*\*  $p < 0.001$ .

## Discussion

We found that NCDs and related risk factors increased in Brazil from 2013 to 2019, ranging from an 8% increase in the adjusted prevalence of arthritis to a 24% increase in the adjusted prevalence of obesity. Generally, those conditions that had education-related inequalities in 2013 continued to present inequalities in 2019 of a similar or larger magnitude.

Regarding specific conditions for diabetes, hypertension, heart disease, and arthritis, we observed significant inequity concentrated among those with the lowest levels of education, with highly consistent and clear patterns over time. However, cancer and asthma followed different patterns, as well as were primarily concentrated among those with more education, even after controlling for age and wealth quintiles. Depression showed a pattern that seems to be changing over time, from a more equal distribution (and low prevalence) in the early period to increased burden among higher education groups in 2019. Relative and absolute inequalities were also present for the prevalence of any chronic condition and multimorbidity, with much higher indices for multimorbidity consistently across the three measures. For obesity, inequality was not present when using the full education distribution in the RII. This finding could be due to the large uncertainty around the point estimates, a consequence of the relatively small number of participants for which height and weight measures were collected. Finally, we found evidence of a correlation between changes in state prevalence rates, as well as in relative inequality for multimorbidity, but the pattern for diabetes was more complex. Nevertheless,

**Table 3**Adjusted \* education-related inequalities, by year and condition. *Brazilian National Health Surveys 2013-2019.*

	2013			2019		
	RII ** (95%CI)	SII ** (95%CI)	PAF *** (95%CI)	RII ** (95%CI)	SII ** (95%CI)	PAF *** (95%CI)
Obesity	1.00 (0.91, 1.11)	-0.02 (-0.15, 0.11)	5.54 (1.95, 9.01)	1.07 (0.79, 1.45)	0.01 (-0.42, 0.45)	4.55 (-4.13, 12.50)
Hypertension	1.30 # (1.18, 1.43)	0.40 # (0.26, 0.55)	10.93 (6.71, 14.96)	1.40 # (1.31, 1.49)	0.60 # (0.50, 0.71)	10.85 (8.36, 13.28)
Arthritis	1.31 ## (1.07, 1.60)	0.32 ## (0.09, 0.54)	8.98 (0.24, 16.95)	1.30 ## (1.11, 1.52)	0.33 # (0.15, 0.52)	9.90 (3.53, 15.85)
Asthma	0.76 ### (0.60, 0.97)	-0.28 ### (-0.54, -0.03)	1.37 (-6.79, 8.90)	0.69 # (0.57, 0.84)	-0.39 # (-0.60, -0.18)	2.55 (-3.17, 7.95)
Cancer	0.36 # (0.25, 0.52)	-1.08 # (-1.46, -0.69)	-26.00 (-47.14, -7.89)	0.48 # (0.38, 0.61)	-0.77 # (-1.02, -0.51)	-6.49 (-17.97, 3.87)
Depression	1.05 (0.87, 1.27)	0.05 (-0.16, 0.27)	9.58 (3.03, 15.69)	0.84 * (0.74, 0.96)	-0.21 ** (-0.37, -0.06)	4.24 (0.22, 8.10)
Diabetes	1.61 # (1.31, 1.99)	0.55 # (0.31, 0.78)	21.72 (12.51, 29.96)	1.86 # (1.61, 2.15)	0.73 # (0.57, 0.90)	18.88 (12.79, 24.54)
Heart disease	1.35 ### (1.03, 1.78)	0.32 ### (0.03, 0.61)	15.38 (3.29, 25.95)	1.19 ### (1.00, 1.42)	0.20 ### (0.01, 0.39)	10.51 (2.22, 18.11)
Any chronic conditions	1.02 # -	0.16 ### (0.03, 0.28)	7.34 (4.63, 9.98)	1.01 # -	0.15 ## (0.05, 0.24)	5.03 (3.30, 6.73)
Multi-morbidity	1.22 ## (1.07, 1.39)	0.25 ## (0.07, 0.42)	12.84 (6.96, 18.35)	1.31 # (1.20, 1.42)	0.38 # (0.25, 0.50)	12.62 (9.04, 16.05)

95%CI: 95% confidence interval; PAF: population attributable fraction; RII: relative index of inequality; SII: slope index of inequality.

Note: models that did not fully convergence do not contain a 95% confidence error.

\* Results adjusted for age, sex, survey year and weights, and sampling design;

\*\* RII &gt; 1 or SII &gt; 0 indicate higher prevalence among groups with lower (vs. high) educational attainment. Values of the RII &lt; 1 and values for the SII &lt; 0 indicate higher prevalence among groups with higher educational attainment;

\*\*\* PAF calculated in terms of a scenario in which all individuals completed at least secondary education and, besides, controlled for wealth quintiles.

PAF is the proportion of cases that could have been avoided if the exposure (low educational attainment) were reduced to zero;

# p &lt; 0.001;

### p &lt; 0.05;

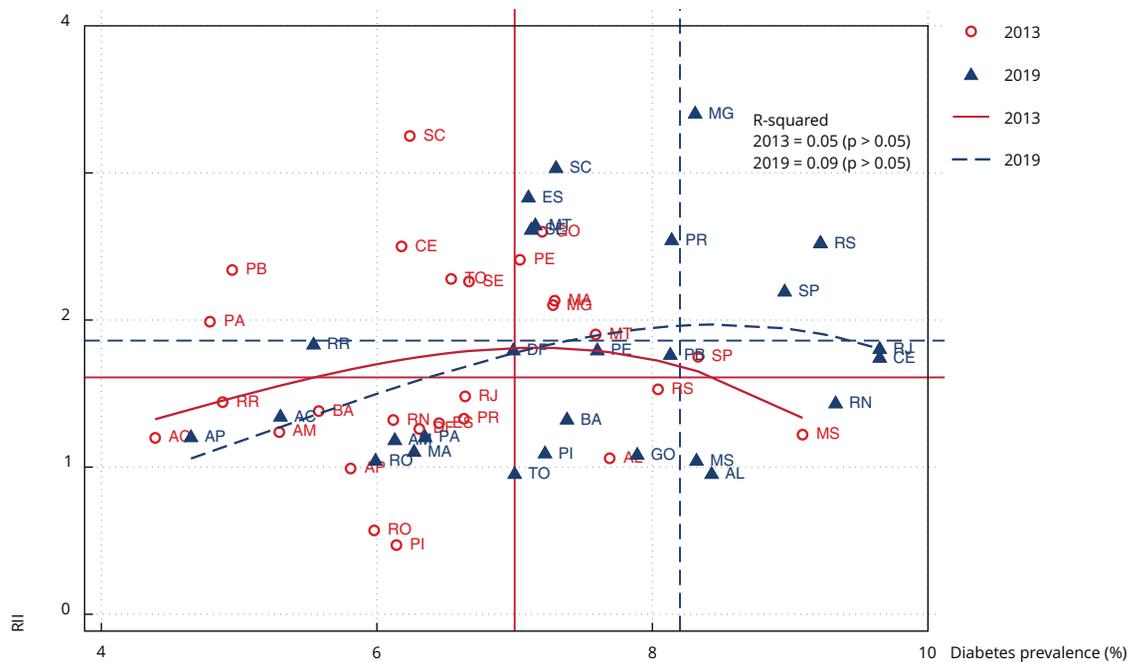
## p &lt; 0.01.

for both outcomes, some of the richest states in the country presented the highest levels of inequity, especially in 2019.

This study has several significant limitations. The first limitation stems from the self-reported nature of the chronic conditions examined here (except for obesity, which was objectively measured). As access to care is correlated with educational attainment, it is likely that the inequalities observed here have been underestimated. The second, although we have two time periods to observe, each data point comes from a cross-sectional survey. Therefore, we cannot track individuals over time to directly estimate how changes in individual socioeconomic circumstances may have affected people's health and well-being during this period. Finally, we only explore a small number of outcomes and assess inequities only through the lens of education. We observed many other dimensions of health inequality, such as those assessed by differences in racial identity, gender, and sexual orientation, belonging to an indigenous population, with a physical or mental disability, and the many possible intersections between these categories. We also found ways of assessing social stratification besides education, such as via income, consumption, and occupation. Each of these dimensions could yield different patterns of NCD inequities <sup>27</sup>. Despite these limitations, we found several information in this analysis that may benefit from further debate and analysis.

**Figure 1**

Diabetes prevalence and educational inequalities (RII), by Federative Units of Brazil (states and the Federal District). *Brazilian National Health Surveys* 2013 and 2019.



Federative Units: AC: Acre; AL: Alagoas; AM: Amazonas; AP: Amapá; BA: Bahia; CE: Ceará; DF: Distrito Federal; ES: Espírito Santo; GO: Goiás; MA: Maranhão; MG: Minas Gerais; MS: Mato Grosso do Sul; MT: Mato Grosso; PA: Pará; PB: Paraíba; PE: Pernambuco; PI: Piauí; PR: Paraná; RJ: Rio de Janeiro; RN: Rio Grande do Norte; RO: Rondônia; RR: Roraima; RS: Rio Grande do Sul; SC: Santa Catarina; SE: Sergipe; SP: São Paulo; TO: Tocantins.

RII: relative index of inequalities.

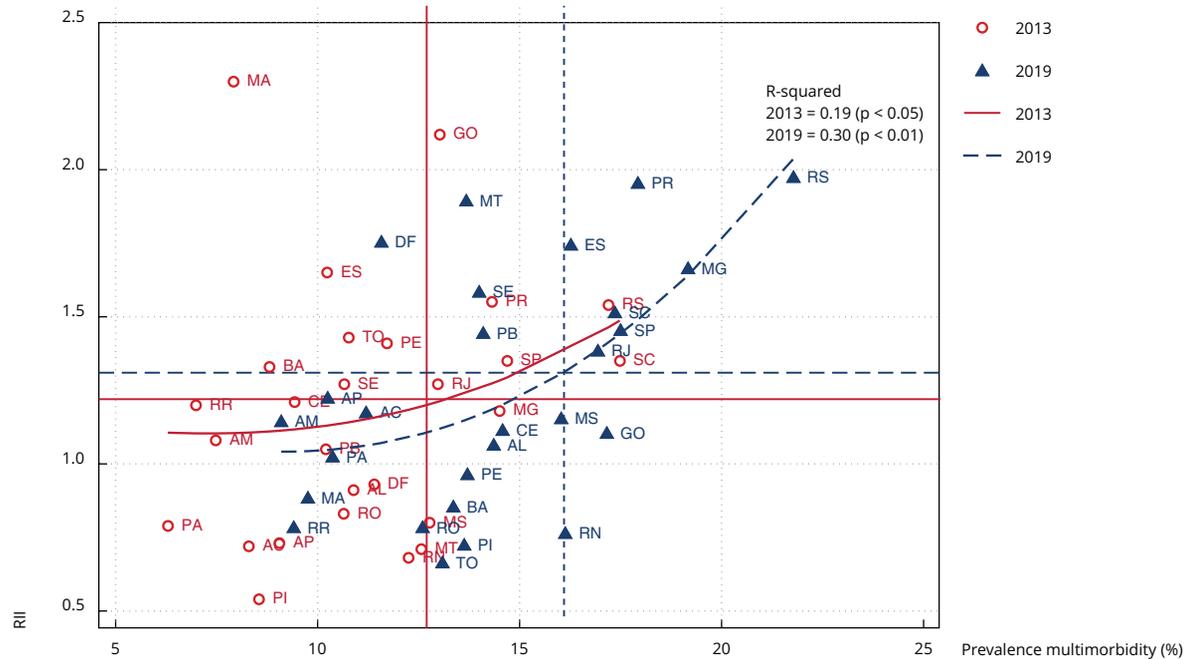
Note: solid red lines represent national RII and multimorbidity prevalence for the country as a whole, whereas dashed blue lines represent the same respective values for 2019. R-squared values from fractional polynomial regression of RII on prevalence rates for each year.

The major question that arises from this analysis is why did we not see substantially increased inequities for all conditions? It is important to emphasize how significant the change in the socio-economic context has been in Brazil. In 2013, unemployment was 6.98%, close to 2015 historic low of 6.6%. By 2019, it had nearly doubled to 12.08%. Unemployment was the highest for the youth (23.8% for the 18-24 age group), women (13.1 vs. 9.2% for men), and for those with less schooling (18.5% for those with incomplete secondary vs. only 5.6 for those with tertiary education)<sup>28</sup>. Poverty also increased during this time. From 2014 to 2016, the number of Brazilians living in extreme poverty (defined as less than USD 1.90 per day in 2011 purchasing power parity – PPP) reached 8 million. Whereas some aspects of economic recovery began in 2017, growth was unevenly distributed and, consequently, the number of people living in extreme poverty continued to grow, reaching 9.3 million by 2018<sup>28</sup>. Brazilians also experienced significant loss of purchasing power as the average cost of staple foods and necessities increased during this period. In 2016, the purchasing power of the minimum wage (about BRL 880 per month) was the lowest since 2009, based on the cost of a month's supply of staple foods for a family of four<sup>29</sup>.

One explanation for our findings could be lower rates of disease diagnosis, especially among those with lower educational attainment. This could result from the unequal distribution of resources for NCD screening (such as the availability of mammograms or mental health professionals), so that populations with greater education may be more likely than those with lower education to receive

**Figure 2**

Multimorbidity prevalence and educational inequalities (RII), by Federative Units of Brazil (states and the Federal District). *Brazilian National Health Surveys 2013 and 2019.*



Federative Units: AC: Acre; AL: Alagoas; AM: Amazonas; AP: Amapá; BA: Bahia; CE: Ceará; DF: Distrito Federal; ES: Espírito Santo; GO: Goiás; MA: Maranhão; MG: Minas Gerais; MS: Mato Grosso do Sul; MT: Mato Grosso; PA: Pará; PB: Paraíba; PE: Pernambuco; PI: Piauí; PR: Paraná; RJ: Rio de Janeiro; RN: Rio Grande do Norte; RO: Rondônia; RR: Roraima; RS: Rio Grande do Sul; SC: Santa Catarina; SE: Sergipe; SP: São Paulo; TO: Tocantins.

RII: relative index of inequalities.

Note: solid red lines represent national RII and multimorbidity prevalence for the country as a whole, whereas dashed blue lines represent the same respective values for 2019. R-squared values from fractional polynomial regression of RII on prevalence rates for each year.

diagnoses of common cancers or depression<sup>30</sup>. It could also stem from recent national reductions in healthcare supply, due to the elimination of the *Programa Mais Médicos* (More Doctors Program) program, which made the distribution of primary care doctors more equitable, especially in remote areas<sup>31</sup>, and cuts in healthcare spending: government expenditures on health decreased from USD 436.8 or 44.5% of healthcare spending in 2013, to USD 353.5 or 41.6% in 2018, adjusting for inflation<sup>28</sup>. However, the PNS data (Supplementary Material: [http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00137721\\_4796.pdf](http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00137721_4796.pdf)) show that rates of medical appointment in the past year actually increased over this period from 74.1% in 2013 to 80.7% in 2019 ( $p < 0.001$  for difference between years). Regarding NCD screening, we found increasing reports of recent blood pressure reading (from 80.5% in 2013 to 83.5% in 2019;  $p < 0.001$  for difference between years) during this period, with similar rates for those in the lowest educational level (83.6% for those with less than high school education vs. 88.6% for those with incomplete or complete higher education).

Another possible explanation for the lack of substantial increases in NCD inequities is that mortality increased among those with lower education, as we introduced survivor bias into these results. One example might be late diagnosis of and premature mortality from cancer among those with lower educational attainment<sup>32,33</sup>. Based on the existing literature, it is unclear exactly how much such phenomena may be generating inequities in NCDs in general, but, for some conditions, higher prevalence rates among those with higher education may be a clear marker of unequal screening,

treatment, and survival – all of which would likely affect our estimates of health inequities and their evolution over time <sup>34</sup>.

Given that respondents reported increased rates of health service utilization, it is also possible that SUS helped to dampen at least some of the negative socioeconomic effects, especially among lower education populations – whereas those with higher education may have had greater problems paying for private sector coverage. Along with the PNS data (Supplementary Material: [http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00137721\\_4796.pdf](http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00137721_4796.pdf)) we observed that a statistically significant decrease in private health plan coverage (from 30.1% in 2013 to 27.02% in 2019,  $p < 0.001$ ) and that these reductions were considerable even among those with lower educational attainment. Moreover, the coverage of adults in the Family Health Strategy (FHS) also increased from 54.5% in 2013 to 61.5% in 2019 ( $p < 0.001$ ). This change was concentrated primarily among those with lower education: the lowest education group increased from 64% FHS coverage in 2013 to 72% in 2019 ( $p < 0.001$ ). Previous studies have documented the important role that FHS coverage has performed in the reduction of adult mortality and hospitalizations, especially those resulting from chronic conditions <sup>35,36,37</sup>. We note that in the PNS, FHS coverage rate is self-reported and may reflect both expansion of the program and increased awareness of it by survey participants.

Still another explanation is that the fairly stable levels of inequities observed here may be a result of the time it takes for chronic conditions to develop. The significant increase in rates of obesity and hypertension may be indications of an incoming “wave” of chronic disease. Other longer-term process may also have initiated. Given the worsening economic conditions of families for those in the lowest socioeconomic position over this period, we may expect increased risk of certain chronic diseases and risk factors (obesity, diabetes, cardiovascular disease) due to maternal stress and malnutrition, as well as adverse early life experiences related to poverty <sup>38</sup>. These factors may have already occurred, with their effects unlikely to be seen for decades <sup>39</sup>. This argument is an additional justification for returning full funding to educational programs that include early childhood development, as well as conditional cash transfers, such as *Bolsa Família* Program (Brazilian Income Transfer Program), which helped to reverse at least some of the negative effects of such early-life experiences <sup>40,41</sup>.

The second point for discussion is around the development of strategies to prevent and control NCDs and inequalities in their distribution going forward. Our results corroborates with previous studies that indicate the need to adopt public policies that have the potential to reach a large share of the population by targeting major risk factors for NCDs, such as diet. In 2019, Brazil approved regulation to reduce and eventually to ban trans-fat from industrially processed foods by 2023 <sup>42</sup>. This type of population-based approach reduced social inequalities because it reaches a broader base of the population, rather than targeting only people at high risk <sup>43</sup>. Salt and sugar reduction in processed foods is also a promising way to promote healthier diets and Brazil took important steps to partner with the industry to reduce salt and sugar content in processed food <sup>44</sup>. However, these policies need to work in conjunction with programs to increase the availability of unprocessed or minimally processed foods, particularly fruits and vegetables <sup>45</sup> to the poorest and those who have been most affected by the current economic and health crisis.

Another strategy could focus directly on the social determinants of health. If education is a risk factor (as the PAFs indicate), can we consider investing in education an effective public health strategy? Whereas the PAFs show undue burden among those with low educational attainment, fundamental cause theory posits that social inequalities may be replicated even among new circumstance and that only a comprehensive set of policies addressing the social determinants of health can drive meaningful change in health inequalities <sup>46</sup>. Some of these policies may include those tied to reducing poverty (e.g., strengthening the *Bolsa Família* Program conditional cash transfer program or other approaches to poverty alleviation), expanding basic education, or more radically, instituting a more progressive income tax code <sup>47</sup>. These proposals would probably not only be controversial among some members of the general public but may also generate fierce opposition from powerful economic groups. However, some research suggests that people may be more open to supporting more redistributive policies after facing economic hardship themselves <sup>48</sup>. Other researchers indicate how these bold proposals should be framed and communicated to garner the greatest popular support <sup>49,50</sup>. Nevertheless, it is open for debate what would be a successful strategy to increase investment in policies that reduce health inequalities and whether framing these policies as “health-related”

would provide greater political support for them rather than discussions that frame them in other ways, such as their importance for economic growth, contribution to social justice, or necessity to fulfill human rights obligations.

Finally, regarding the considerable differences in health inequities among different Brazilian states, another way would be to address the large and relatively persistent geographic differences seen among regions and states in healthcare resources, risk factors, and health outcomes<sup>51</sup>. Analyzing their differences in population size and composition, it is tempting to ask if some differences in NCD inequities merely reflect different stages of the epidemiologic transition<sup>52</sup>. Whereas such epidemiologic and demographic patterns cannot be ignored, they likely reflect underlying historical patterns of social disinvestment in certain regions and areas<sup>53,54</sup>. The question then is whether approaches to address inequalities in the social determinants of health should focus on individuals (through programs and services), smaller areas that have the highest inequities (such as the poorest neighborhoods within cities), or the larger geographic regions or states. If the latter, there appears to be mixed evidence on the most effective types of investments in reducing health inequalities<sup>55</sup> suggesting the need for a broad scoping of available strategies that would be most appropriate for each geographic area of focus and purpose (i.e., broader population-based strategies for primary prevention versus more focused ones for those who already have a chronic condition).

In conclusion, we found that the prevalence of NCDs increased in Brazil between 2013 and 2019, a period in which the country suffered a devastating economic recession and deteriorating national efforts toward reducing health inequities and the factors that cause them. Despite the increase in NCD prevalence overall, we did not see significant increases in education-based inequities in the same period, instead, for most NCDs, it remained of similar magnitude for the two periods. These results, although far from being conclusive, intended to initiate the discussion on the persistence of health inequities in Brazil, and more importantly, to stimulate a debate on the most effective ways to combat the factors that cause them.

## Contributors

J. Macinko and P. H. Mullachery participated in the design, analysis, and interpretation of data, drafting of the article, approval of the final version; and agreement to be accountable for all aspects of the study.

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## Additional informations

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## References

- Lustig N, Lopez-Calva LF, Ortiz-Juarez E, Monga C. Deconstructing the decline in inequality in Latin America. In: Basu K, Stiglitz JE, editors. *Inequality and growth: patterns and policy. v. II: regions and regularities*. London: Palgrave Macmillan UK; 2016. p. 212-47.
- Arestis P, Ferrari-Filho F, Resende MFC, Bittes Terra FH. A critical analysis of the Brazilian 'expansionary fiscal austerity': why did it fail to ensure economic growth and structural development? *Int Rev Appl Econ* 2021; 36:4-16.
- Neri MC. A escalada da desigualdade – qual foi o impacto da crise sobre distribuição de renda e pobreza? Rio de Janeiro: Fundação Getúlio Vargas; 2019.
- Hone T, Mirelman AJ, Rasella D, Paes-Sousa R, Barreto ML, Rocha R, et al. Effect of economic recession and impact of health and social protection expenditures on adult mortality: a longitudinal analysis of 5565 Brazilian municipalities. *Lancet Glob Health* 2019; 7:e1575-83.
- Rasella D, Basu S, Hone T, Paes-Sousa R, Ocke-Reis CO, Millett C. Child morbidity and mortality associated with alternative policy responses to the economic crisis in Brazil: a nationwide microsimulation study. *PLoS Med* 2018; 15:e1002570.
- Szwarcwald CL, Souza Júnior PRB, Marques AP, Almeida WS, Montilla DER. Inequalities in healthy life expectancy by Brazilian geographic regions: findings from the National Health Survey, 2013. *Int J Equity Health* 2016; 15:141.
- Marinho F, de Azeredo Passos VM, Malta DC, França EB, Abreu DMX, Araújo VEM, et al. Burden of disease in Brazil, 1990-2016: a systematic subnational analysis for the Global Burden of Disease Study 2016. *Lancet* 2018; 392:760-75.
- Beltrán-Sánchez H, Andrade FCD. Time trends in adult chronic disease inequalities by education in Brazil: 1998-2013. *Int J Equity Health* 2016; 15:139.
- de Souza ASS, Braga JU. Trends in the use of health services and their relationship with multimorbidity in Brazil, 1998-2013. *BMC Health Serv Res* 2020; 20:1080.
- de Almeida MGN, Nascimento-Souza MA, Lima-Costa MF, Peixoto SV. Lifestyle factors and multimorbidity among older adults (ELSI-Brazil). *Eur J Ageing* 2020; 17:521-9.
- Hosseinpoor AR, Bergen N, Mendis S, Harper S, Verdes E, Kunst A, et al. Socioeconomic inequality in the prevalence of noncommunicable diseases in low-and middle-income countries: results from the World Health Survey. *BMC Public Health* 2012; 12:474.
- Landmann-Szwarcwald C, Macinko J. A panorama of health inequalities in Brazil. *Int J Equity Health* 2016; 15:174.
- Malta DC, Bernal RTI, de Souza MFM, Szwarcwald CL, Lima MG, de Azevedo Barros MB. Social inequalities in the prevalence of self-reported chronic non-communicable diseases in Brazil: national health survey 2013. *Int J Equity Health* 2016; 15:153.
- Carvalho CA, Silva AAM, Victora C, Goldani M, Bettiol H, Thomaz EBAF, et al. Changes in infant and neonatal mortality and associated factors in eight cohorts from three Brazilian cities. *Sci Rep* 2020; 10:3249.
- França GVA, Restrepo-Méndez MC, Maia MFS, Victora CG, Barros AJD. Coverage and equity in reproductive and maternal health interventions in Brazil: impressive progress following the implementation of the Unified Health System. *Int J Equity Health* 2016; 15:149.
- Souza L, Barros RD, Barreto ML, Katikireddi SV, Hone TV, Paes de Sousa R, et al. The potential impact of austerity on attainment of the Sustainable Development Goals in Brazil. *BMJ Glob Health* 2019; 4:e001661.
- Stopa SR, Szwarcwald CL, Oliveira MM, Gouveia E, Vieira M, Freitas MPS, et al. National Health Survey 2019: history, methods and perspectives. *Epidemiol Serv Saúde* 2020; 29:e2020315.
- Szwarcwald CL, Malta DC, Pereira CA, Vieira ML, Conde WL, Souza Junior PR, et al. Pesquisa Nacional de Saúde no Brasil: concepção e metodologia de aplicação. *Ciênc Saúde Colet* 2014; 19:333-42.
- Instituto Brasileiro de Geografia e Estatística. Informações referentes às tabelas da PNS 2013 e 2019. <https://biblioteca.ibge.gov.br/visualizacao/livros/liv101838.pdf> (accessed on 13/Jan/2022).
- Heeringa S, West BT, Berglund PA. *Applied survey data analysis*. 2nd Ed. Boca Raton: CRC Press/Taylor & Francis Group; 2017.
- Mullachery P, Silver D, Macinko J. Changes in health care inequity in Brazil between 2008 and 2013. *Int J Equity Health* 2016; 15:140.
- Mackenbach JP, Kunst AE. Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Soc Sci Med* 1997; 44:757-71.
- Regidor E. Measures of health inequalities: part 2. *J Epidemiol Community Health* 2004; 58:900-3.
- Silva ICM, Restrepo-Mendez MC, Costa JC, Ewerling F, Hellwig F, Ferreira LZ, et al. Measurement of social inequalities in health: concepts and methodological approaches in the Brazilian context. *Epidemiol Serv Saúde* 2018; 27:e000100017.
- Bandi P, Chang VW, Sherman SE, Silver D. 24-Year trends in educational inequalities in adult smoking prevalence in the context of a national tobacco control program: the case of Brazil. *Prev Med* 2020; 131:105957.
- Newson RB. Attributable and unattributable risks and fractions and other scenario comparisons. *Stata J* 2013; 13:672-98.
- Lago S, Cantarero D, Rivera B, Pascual M, Blazquez-Fernandez C, Casal B, et al. Socio-economic status, health inequalities and non-communicable diseases: a systematic review. *Z Gesundh Wiss* 2018; 26:1-14.

28. World Bank. World Bank open data. <https://data.worldbank.org/country/BR> (accessed on 15/Jul/2021).
29. Mendonça H. "Toda semana os produtos ficam mais caros e corto a lista": viver com o pior salario minimo em 15 anos. *El País* 2021; 13 jan. <https://brasil.elpais.com/brasil/2021-01-13/toda-semana-os-produtos-ficam-mais-caros-e-corto-a-lista-viver-com-o-pior-salario-minimo-em-15-anos.html>.
30. Mullachery P, Macinko J, Silver D. Have health reforms in Brazil reduced inequities in access to cancer screenings for women? *J Ambul Care Manage* 2020; 43:257-66.
31. Russo LX. Effect of More Doctors (Mais Medicos) Program on geographic distribution of primary care physicians. *Ciênc Saúde Colet* 2021; 26:1585-94.
32. Oliveira NPD, Cancela MC, Martins LFL, de Souza DLB. Spatial distribution of advanced stage diagnosis and mortality of breast cancer: Socioeconomic and health service offer inequalities in Brazil. *PLoS One* 2021; 16:e0246333.
33. Renna Junior NL, Silva GAE. Temporal trend and associated factors to advanced stage at diagnosis of cervical cancer: analysis of data from hospital based cancer registries in Brazil, 2000-2012. *Epidemiol Serv Saúde* 2018; 27:e2017285.
34. Liu S, Jones RN, Glymour MM. Implications of lifecourse epidemiology for research on determinants of adult disease. *Public Health Rev* 2010; 32:489-511.
35. Hone T, Rasella D, Barreto ML, Majeed A, Millett C. Association between expansion of primary healthcare and racial inequalities in mortality amenable to primary care in Brazil: a national longitudinal analysis. *PLoS Med* 2017; 14:e1002306.
36. Hone T, Rasella D, Barreto M, Atun R, Majeed A, Millett C. Large reductions in amenable mortality associated with Brazil's primary care expansion and strong health governance. *Health Aff (Millwood)* 2017; 36:149-58.
37. Macinko J, Oliveira VB, Turci MA, Guanais FC, Bonolo PF, Lima-Costa MF. The influence of primary care and hospital supply on ambulatory care-sensitive hospitalizations among adults in Brazil, 1999-2007. *Am J Public Health* 2011; 101:1963-70.
38. Lynch J, Smith GD. A life course approach to chronic disease epidemiology. *Annu Rev Public Health* 2005; 26:1-35.
39. Chen W-Y. On the relationship between economic conditions around the time of birth and late life cognitive abilities: evidence from Taiwan. *Econ Hum Biol* 2016; 22:126-39.
40. Black MM, Walker SP, Fernald LCH, Andersen CT, DiGirolamo AM, Lu C, et al. Early childhood development coming of age: science through the life course. *Lancet* 2017; 389:77-90.
41. Neves JA, Vasconcelos FAG, Machado ML, Reicine E, Garcia GS, Medeiros MAT. The Brazilian cash transfer program (Bolsa Familia): a tool for reducing inequalities and achieving social rights in Brazil. *Glob Public Health* 2022; 17:26-42.
42. Ministério da Saúde. Resolução RDC nº 332, de 23 de dezembro de 2019. Define os requisitos para uso de gorduras trans industriais em alimentos. *Diário Oficial da União* 2019; 26 dec.
43. Capewell S, Graham H. Will cardiovascular disease prevention widen health inequalities? *PLoS Med* 2010; 7:e1000320-e.
44. Block JM, Ariseto-Bragotto AP, Feltes MMC. Current policies in Brazil for ensuring nutritional quality. *Food Quality and Safety* 2017; 1:275-88.
45. Jaime PC, Figueiredo IC, Moura EC, Malta DC. Factors associated with fruit and vegetable consumption in Brazil, 2006. *Rev Saúde Pública* 2009; 43 Suppl 2:57-64.
46. Phelan JC, Link BG. Controlling disease and creating disparities: a fundamental cause perspective. *J Gerontol B Psychol Sci Soc Sci* 2005; 60 Spec No 2:27-33.
47. Higgins S, Lustig N, Ruble W, Smeeding TM. Comparing the incidence of taxes and social spending in Brazil and the United States. Washington DC: Center for Global Development; 2014. (CGD Working Paper, 360).
48. Owens LA, Pedulla DS. Material welfare and changing political preferences: the case of support for redistributive social policies. *Social Forces* 2013; 92:1087-113.
49. Gollust SE, Barry CL, Niederdeppe J. Partisan responses to public health messages: motivated reasoning and sugary drink taxes. *J Health Polit Policy Law* 2017; 42:1005-37.
50. Gollust SE, Cappella JN. Understanding public resistance to messages about health disparities. *J Health Commun* 2014; 19:493-510.
51. Mielke GI, Malta DC, de Sa GB, Reis RS, Hallal PC. Regional differences and correlates of leisure time physical activity in Brazil: results from the Brazilian National Health Survey-2013. *Rev Bras Epidemiol* 2015; 18 Suppl 2:158-69.
52. Borges GM. Health transition in Brazil: regional variations and divergence/convergence in mortality. *Cad Saúde Pública* 2017; 33:e00080316.
53. Bunker SG. Modes of extraction, unequal exchange, and the progressive underdevelopment of an extreme periphery: the Brazilian Amazon, 1600-1980. *Am J Sociol* 1984; 89:1017-64.
54. Goldsmith WW, Wilson R. Poverty and distorted industrialization in the Brazilian Northeast. *World Dev* 1991; 19:435-55.
55. McAuley A, Denny C, Taulbut M, Mitchell R, Fischbacher C, Graham B, et al. Informing investment to reduce inequalities: a modelling approach. *PLoS One* 2016; 11:e0159256.

## Resumo

O artigo avalia mudanças na prevalência e distribuição de doenças crônicas não transmissíveis (DCNTs) e fatores de risco associados entre adultos brasileiros nas edições de 2013 e 2019 da Pesquisa Nacional de Saúde (PNS), com base na hipótese de que a piora das condições socioeconômicas durante o período tenha levado a um aumento das DCNTs entre as populações mais vulneráveis. Estimamos razões de prevalência ajustadas por categoria de escolaridade e três medidas de desigualdade – índice de desigualdade absoluta (SII), índice relativo de desigualdade (RII) e fração atribuível à população (PAF) – para obesidade, hipertensão, artrite, asma, câncer, depressão, diabetes, doenças cardíacas, qualquer condição crônica e multimorbidade, por ano da pesquisa. Para as 27 Unidades da Federação, estimamos também as taxas de prevalência de diabetes e de multimorbidade por ano e cotejamos os RII com as taxas de prevalência por ano. Os resultados mostram que todas as DCNTs aumentaram ao longo do período de observação, desde um aumento de 8% na prevalência ajustada de artrite a um aumento de 24% na prevalência ajustada de obesidade. As medidas de desigualdade revelam que a maioria das DCNTs mostrou inequidades significativas em relação à escolaridade, tanto em 2013 quanto em 2019. Entretanto, em média, as inequidades com base na escolaridade não mudaram entre os dois períodos. Devido à deterioração das condições socioeconômicas para a maioria dos brasileiros, à erosão das proteções sociais e à continuação das crises econômica, política e sanitária enfrentadas pela nação, há necessidade urgente de um debate sobre as melhores políticas e programas de saúde para promover a equidade e reduzir desigualdades socioeconômicas e geográficas das DCNTs em todo o país.

*Iniquidades em Saúde; Doenças Não Transmissíveis; Educação; Fatores Socioeconômicos*

## Resumen

Este trabajo evalúa los cambios en la prevalencia y distribución de las enfermedades no transmisibles (ENT) y factores de riesgo relacionados entre adultos brasileños en las Encuestas Nacionales de Salud (PNS) de 2013 y 2019, basadas en la hipótesis de que las condiciones económicas en deterioro durante este período conducirían a ENTs entre los grupos de población menos favorecidos. Estimamos los ratios de prevalencia ajustados por categoría de educación y tres medidas de desigualdad -la curva del índice de desigualdad (SII), el índice relativo de desigualdad (RII), y la fracción atribuible de población (PAF)- para obesidad, hipertensión, artritis, asma, cáncer, depresión, diabetes, enfermedad cardiovascular, padeciendo alguna condición crónica, y multimorbilidad por año de encuesta. También estimamos 27 estados de RII y tasas de prevalencia para la diabetes y multimorbilidad por año, y se plantearon los RII frente a la prevalencia por año. Los resultados muestran que todas las ENTs se incrementaron durante el período observado, yendo desde un 8% de incremento en la prevalencia ajustada por artritis hasta un 24% de incremento en la prevalencia ajustada por obesidad. Las medidas de desigualdad muestran que la mayoría de las condiciones expuestas presentan inequidades educacionales significativas, tanto en 2013, como en 2019. No obstante, como promedio, las inequidades relacionadas con la educación no cambiaban significativamente durante los dos períodos. Debido al deterioro de las condiciones socioeconómicas de la mayoría de los brasileños, la erosión de la protección social, y las continuas crisis económicas, políticas, y de salud, que enfrenta la nación, existe una urgente necesidad de debatir sobre el mejor camino para adoptar medidas que promuevan la equidad en las políticas de salud y sus programas, así como acciones para conseguir reducciones en las desigualdades socioeconómicas y geográficas en las ENTs en todo el país.

*Inequidad en la Salud; Enfermedades No Transmisibles; Educación; Factores Socioeconómicos*

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