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Socioeconomic inequality in health in older adults in Brazil

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ABSTRACT

Objective: This study analyzed socioeconomic inequality in self-rated health for older adults (aged fifty or over) in Brazil.
Methods: Data from the 2015-2016 Brazilian Longitudinal Study of Aging (ELSI-Brazil). Socioeconomic inequality in self-rated health was measured using the concentration index, which was decomposed to analyze the contribution of different factors.
Results: This study revealed that 11.5% of the older adults interviewed reported their health as poor and very poor. For the complete sample, the estimated concentration index, −0.2434, indicated that there is a concentration of poor and very poor self-rated health among older and poorer adults. Income, education and having a private health insurance plan are the factors that contributed most to the observed inequality.
Discussion: The decomposition showed that there are avoidable inequalities in relation to socioeconomic status for older adults in Brazil. These factors can guide the formulation of social and health policies aimed at reducing health inequalities.

1. Introduction

The reduction of inequities and the possibility of a healthy life for all, regardless of age, are necessary intentions for a more prosperous future. These intentions are part of the United Nations' (UN) Sustainable Development Goals until 2030. Goal 3 is to ensure a healthy life and promote well-being for all, at all ages, while Goal 10 is to reduce inequality within and between countries, empowering and promoting the social, economic and political inclusion of all, ensuring equal opportunities and reducing inequalities [1].

Advances in medicine have improved quality of life and provided the world population with a longer lifespan. People have lived more and more lately. The population aged 60 years or older was almost 901 million in 2015 (almost 12% of the total population), and it should reach 2.1 billion by 2050 (21.5%) [2]. In the year 2018, individuals aged 65 or more for the first time surpassed the number of children under 5 years worldwide [3].

In biological terms, aging is characterized by the accumulation of molecular and cellular damage that leads to the impairment of many body functions, leaving individuals more vulnerable. Although the effects of aging may differ between individuals, some general trends are observed in terms of health, such as the gradual reduction of physiological reserves, an increase in the risk of diseases and a general decline in the individual's abilities [4–7].

Despite age being a crucial determinant of health, other factors are also important, such as socioeconomic status. Several approaches explain the impact of socioeconomic factors on health inequality based on psychosocial mechanisms, material factors, differences in health-related behavior and different access to health care [8,9]. Therefore, individuals from different socioeconomic status are expected to present differences in terms of health – the so-called socioeconomic-related health inequality[10,11].

There are three different views on what happens to socioeconomic health inequalities when looking at older adults. The first one, the Cumulative Dis/advantage (CAD) hypothesis, is based on the notion that the socioeconomic environment of the beginning of the life cycle is an important predictor of health outcomes. Thus, socioeconomic and health disadvantages would accumulate throughout the life cycle, resulting in greater inequality as the population ages [12–14]. This hypothesis was corroborated in studies for the United States and European countries [15–17], however, some evidence pointed out that inequalities would be smaller with aging, raising a second hypothesis, the so-called aging-as-leveler [18,19]. According to this hypothesis, there would be a reduction in socioeconomic inequalities in health with advancing age, since health problems, both physical and mental, would

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increase in all groups, thus acting as a leveler for health differences between socioeconomic groups. There is still a third hypothesis, which points out that inequality would be persistent regardless of age [20,21].

Brazil, the fifth most populous country in the world, with a continental dimension, is an interesting case for study. The country has made advances in health with universal and equal access represented by the Unified Health System (SUS), created in 1988, but it still faces problems in relation to access, which are exacerbated by large social inequalities [22,23]. Income inequality has remained extremely high and constant since the early 2000s, with the richest 10% of the population earning 55% of the national income, putting the country on the same level as sub-Saharan Africa and India [24]. Such considerable inequality in Brazil influences socioeconomic inequalities in health. On the other hand, Brazil is going through a rapid aging process: the percentage participation of the older adults group, those aged 60 or over under Brazilian law, represented 9.7% of the population in 2004 and 13.7% in 2014, and it is estimated that they will represent 18.6% of the population in 2030 and 33.7% in 2060 [25].

The literature that analyzes socioeconomic inequality in health in Brazil is extensive and uses different methods and health measures. Studies that analyzed income inequality through regression found, for adults aged 60 years and over, that the perception of poor health remained high and constant among the poorest [26–31]. The same pattern is observed when using education as a socioeconomic measure [26,31–33].

Some studies have addressed the issue by calculating inequality indices. Braga *et al.* [34] analyzed inequality using the Slope Index of Inequality (SII) and the Relative Index of Inequality (RII) and found that social inequality in self-rated health and functional limitations persisted among elderly people with less education in the city of Belo Horizonte, Brazil, for the years of 2003 and 2010. Other studies used the concentration index and found mixed results. Using different outcomes, Andrade *et al.* [35] showed a greater concentration of limitations in activities of daily living among the poorer elderly, while Andrade and López-Ortega [36] observed a greater concentration of chronic diseases among the richest elderly.

Through a nationally representative database, this study aims to quantify socioeconomic-related inequality in self-rated poor health for adults aged 50 or over in Brazil. The choice of self-rated health (SRH) due to the fact that several studies have shown that it is a good predictor of morbidity and mortality, even after controlling for several confounding factors [27,37,38], and that it can capture multiple health aspects of adults aged 60 years and over [39]. Even when looking at different cultural contexts, Pérez-Zepeda *et al.* [12] show a significant linear association between a measure of physical performance, Physical Performance Battery (SPPB)[1], and SRH, demonstrating that SRH is a valid and effective global measurement tool for physical and health problems in this age group.

The present paper seeks to contribute to this literature in different ways: first, most of the studies reviewed use data from the elderly population, that is, individuals aged 60 years and over. This article includes data from a younger age group, 50 years or older, making it possible to make comparisons with the aging phase. Second, we analyze socioeconomic health inequality by age groups, which enables us to test the “aging-as-leveler”, “accumulation” and “persistent inequality” hypotheses. If we observe a tendency to reduce socioeconomic inequality in health for older age, we will have favorable evidence of the aging-as-leveler hypothesis, otherwise, if the trend is to increase inequalities, we will have a result favorable to the accumulation hypothesis. If the results are stable, we have an indication that inequality is persistent. Third, as far as we know, there is no work analyzing socioeconomic-related inequalities in the self-rated health of adults aged 50 and over in Brazil using the concentration index (CI) and performing the decomposition to identify the factors that contribute to the observed inequality. The CI provides a more accurate and detailed picture of socioeconomic inequality than the regression analyses found in the literature [40]. In addition, all these analyzes were stratified by gender to analyze the existence of heterogeneous standards. Through this analysis we seek a better understanding of the subject, aiming to provide important information to support public policies aimed at reducing inequities.

2. Methods

2.1. Sample

The data source was the first wave of the Brazilian Longitudinal Study of Aging (ELSI-BRAZIL). ELSI is a cohort study aimed at people aged 50 and over. Between 2015 and 2016, 9,412 individuals were interviewed, covering the five regions of Brazil segmented into 70 municipalities. This study consists of detailed in-home and individual interviews, with assessments of physical activities and blood tests. The study planning allows comparisons with other longitudinal studies of aging, mainly with HRS sister studies [41], and the interviews are scheduled to take place every 3 years. Details of the ELSI-Brazil study have been described elsewhere [dataset] [42].

2.2. Variables

The outcome used was the self-rated health of adults aged 50 and over. For comparability with other studies in Brazil for this age group, we chose to create a dichotomous variable with good health rating (regular, good, and very good), equal to "0" and poor health (poor and very poor) equal to "1" [31,34,43].

The socioeconomic status was measured by per capita household income (in natural logarithm). The independent variables were divided into three groups: socioeconomic factors, demographic characteristics, and health conditions. The selected socioeconomic factor was education in years of study, this variable was divided into five categories: the individual has no study (0 years); s/he completed some year of primary school (1-4 years); some year of middle school (5-8 years); some year of high school and adult education[2] (9-11 years) or began college or higher education (12 years or more). The criterion adopted was based on the classification of the ELSI questionnaire, which in turn was inspired by the old classification of the Brazilian educational system [44]. Demographic characteristics include age (50-59, 60-69, 70-79 and 80 or more), gender (female equal to "0" and male equal to "1"), and skin color. Regarding the latter, there was a division into two groups, non-white and white and yellow: the first comprised black, multiracial, and indigenous people, classified as equal to "1"; the second comprised white and Asian people, classified equal to “0”. This grouping is justified by the similarity of groups in relation to health and socioeconomic levels [45,46]. Other variables correspond to marital status (considering unmarried individuals: single, widowed, divorced, or separated equal to “0”; and married, cohabiting, or common-law marriage equal to “1”), region (North, Northeast, Southeast, South, Midwest), area (rural or urban) and paid work. The variable paid work was divided into three characteristics: individuals with paid employment (paid work in the last 30 days), without paid occupation (for being temporarily away from work, looking for a job, waiting to be called for a job, being a housewife, or other reason) and retirees or pensioners.

Four explanatory variables related to health and lifestyle conditions were used. The ELSI individual questionnaire considers nineteen diagnoses of chronic diseases, with the question of whether any doctor has already diagnosed a particular disease. Thus, the variable number of chronic diseases indicates whether the respondent has two or more chronic diseases. The habits of smoking and consuming alcoholic beverages were assessed in a dichotomous way: current or past smoker (yes/no) and consumption of alcoholic beverages (never equal to “0”; and less than once a month and once a month or more equal to “1”). Another variable observed whether the interviewees had health insurance.

[1] Evidence show that this test has a good predictive value for adverse outcomes such as mobility impairment, ADL disability, hospitalization, nursing home admission, frailty, and mortality [Cesari et al., 2009; Guralnik et al., 1995; Vasunilashorn et al., 2009; Mangani et al., 2008; Rolland et al., 2006; Guralnik et al. 1997].

[2] It is a mode of teaching intended for people who have not finished, have abandoned or did not have access to formal education at the appropriate age.

2.3. Statistical analysis

2.3.1. Inequality measurement

To measure the magnitude of socioeconomic-related health inequality among adults aged 50 and over, the concentration index was used (CI). The CI is the most suitable index to measure the magnitude of health-related socioeconomic inequality, as it synthesizes inequality in one index and considers the complete sample, from the poorest to the richest people [47–49]. A formula for calculating CI is:

$$IC = \frac{2}{n\mu}\sum_{i=1}^{n} y_i R_i - 1 \quad (1)$$

where y_i is the health outcome, μ is the mean of y_i, and R_i is the individual's fractional rank i ($i = 1, 2, \ldots, n$) in the distribution of socioeconomic status [50].

The index varies between -1 and 1. A value zero indicates that there is no inequality. Negative values indicate that health (health problem) is concentrated among economically disadvantaged individuals, while positive values indicate that health (health problem) is concentrated among economically favored individuals [47–49].

2.3.2. Correction of the concentration index

When the health outcome variable is binary, that is, when y_i has values of 0 or 1, the minimum and maximum values that the concentration index can take depend on the mean of the outcome. As the mean increases the range of possible values, the concentration index becomes smaller, and when the mean tends to one, the range of values tends to zero [51].

To correct this issue, CIs have been normalized using the correction of Wagstaff [51], which showed that given that the CI depends on the mean (μ) of the health variable, being between the upper limit of $1 - \mu$ and the minimum of $\mu - 1$, then the CI must be corrected by dividing it by $1 - \mu$.

2.3.3. Decomposition of the concentration index

Wagstaff *et al.* [50] present a method that makes it possible to calculate how socioeconomic inequalities in health can be explained by inequalities in their determinants. From the calculated CI, it is possible to analyze the factors that contributed to inequality through its decomposition. Consider the following linear regression model estimated by ordinary least squares:

$$y_i = \alpha + \sum_k \beta_k x_{ki} + \varepsilon_i, \quad (2)$$

where y_i is the health variable, β_k are coefficients, x_k is a set of k determinants, and ε_i is the error term. Wagstaff *et al.* [50], using equations (1) and (2), show that the CI can be decomposed as follows:

$$CI = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu}\right) C_k + \frac{GC_\varepsilon}{\mu} = \sum_k \eta_k C_k + \frac{GC_\varepsilon}{\mu} \quad (3)$$

where μ is the mean of y, $\bar{x}_k$ is the mean of x_k, C_k is the concentration index for the k determinants (defined as in equation (2)), and GC_ε is the generalized concentration index for ε_i, that incorporates all the characteristics that influence the CI, but that were not observed. The first part of equation (4) refers to the explained part, which consists of the elasticity $\left(\eta_k = \frac{\beta_k \bar{x}_k}{\mu}\right)$, which shows the sensitivity of the health outcome to k explanatory variables multiplied by C_k, which shows the degree of inequality related to socioeconomic status in each k determinant. The second part of equation (4) is the unexplained portion that reflects the inequality in health that cannot be explained by the systematic variations in income groups in x_k and which can be calculated as a residue [50].

The absolute contribution to the inequality of each explanatory variable is given by multiplying the elasticity by the CI of each k determinant, while the percentage contribution is obtained by dividing the absolute contribution by the CI. By using a normalization to calculate the CI, the decomposition still needs to be corrected, multiplying the decomposition by the Wagstaff correction. Therefore, we can observe that the contribution depends basically on two factors, the relationship between the outcome of health and its associated factors, measured in the regression. And if the explanatory factor is concentrated among the rich or poorer, for example, Education, it is expected that it positively affects self-assessment (+) and is concentrated among the richest (C_k>0), in this case the contribution would be positive.

To understand the CI decomposition, it is essential to highlight variables with positive percentages that contribute to the self-assessment concentration as poor, and the negative percentages attenuate with this concentration. The calculations of the outcome's CIs are measured by the conindex command, where differences between groups (male, female, and age) are performed through an F-test. The confidence intervals in CI and decomposition analysis are done using Bootstrap with 1000 replications.

All statistical analyses were performed with the Stata 15 program (Stata Corp., College Station, USA), using the svy command, which allows considering the complex design of the survey, including the survey weights.

3. Results

The characteristics of the sample are shown in Table 1. The data showed that 11.5% of respondents, aged 50 or over, rated their health as poor (equal to the sum of poor and very poor), being higher (12.4%) in the case of women. The sample has 53.9% of women and, being black, multiracial, and indigenous covers 56.1% of the total respondents. The predominant age group was 50-59 years, the most prevalent education level was 1-4 years of education.

Of the health-related variables, 62.6% of respondents declare having two or more chronic diseases, and when stratified by gender, 71.4% of women and 52.3% of men declare having 2 or more chronic diseases. Seventy point two percent of respondents did not consume alcoholic beverages, however, 42% of men reported drinking alcohol. The variable smoking showed that 65.5% of men admitted smoking in the past or at the time of the interview, while this proportion was 44.8% for women.

Table 2 shows the prevalence of self-rated health by age and sex. Among women aged 80 or over, there was the highest prevalence of poor self-rated health, 15%, whereas for men, the highest prevalence was for the age group 70-79 years, 12.7%. When observing the prevalence of poor self-rated health for the group of older people, individuals aged 60 or over, it was 11.7%.

Fig. 1 shows the prevalence of poor self-rated health, stratified by age group and income quintiles. There is a trend of increasing prevalence by age group. In the 50–59 and 60–69 age groups there is a clear downward trend in prevalence by income quintile. On the other hand, in the 70–79 years and 80 years and older groups, individuals showed a higher prevalence of poor self-rated health in the first quintile compared to the fifth, and the absolute difference between this prevalence is smaller when compared to the previous groups.

Table 3 shows the values of the Concentration Index with Wagstaff normalization for the total sample and by age groups. For the total sample, the value of normalized CI was statistically significant and showed a negative sign, indicating that a poor self-rated health is concentrated among poor Brazilians. In analysis by gender, inequality is higher for men, being the difference in the CI among the statistically significant sexes ($CI = -0.3031$ for men and $CI = -0.1696$ for women).

Table 3 also shows the results of the concentration index by age group. Normalized values show that, regarding individuals aged 50-59, there is a higher concentration of poor self-rated health among the poor ($CI = -0.2817$, $p < .001$). Concentration decreases for the 60-69 age group ($CI = -0.1987$, $p < .001$), slightly increases for the 70-79 age group ($CI =$ -0.2109, $p < .001$), and further decreases for the 80 or more age group ($CI = -0.1155$, $p = .119$). We tested the existence of differences between the groups using an F[3] test; we observed that there is a statistically significant difference in inequality between age groups (*F-stat* = 2.9848, $p = .0300$). All

[3] Null hypothesis: equality of the index values across groups.

Table 1
Descriptive analysis of the total sample, stratified by sex (ELSI-Brazil 2015-2016).

	Total (N = 8726)		Female (N = 4929)		Male (N = 3797)	
	N	%	N	%	N	%
Self-rated health						
Good	7722	88.5	4318	87.6	3399	89.5
Poor or very poor	1004	11.5	611	12.4	398	10.5
Per capita household income[1]	6.70	0.84	6.66	0.84	6.75	0.83
Age						
50-59	4197	48.1	2276	46.2	1911	50.3
60-69	2568	29.4	1460	29.6	1109	29.2
70-79	1355	15.5	802	16.3	557	14.7
80 or older	606	7.0	391	7.9	220	5.8
Skin color						
White/yellow	3835	43.9	2159	43.8	1675	44.1
Black/brown/Indigenous	4891	56.1	2770	56.2	2122	55.9
Education (years)						
None	1127	12.9	684	13.9	448	11.8
1-4	3287	37.7	1894	38.4	1396	36.8
5-8	1911	21.9	1032	20.9	875	23.0
9-11	1666	19.1	893	18.1	768	20.2
12 or more	735	8.4	426	8.7	310	8.2
Marital Status						
Unmarried	3147	36.1	2282	46.3	916	24.1
Married	5579	63.9	2647	53.7	2881	75.9
Paid work						
Has a job	2801	32.1	1225	24.8	1540	40.6
Has no job	2626	30.1	1887	38.3	780	20.5
Retired/pensioner	3299	37.8	1817	36.9	1477	38.9
Region						
North	487	5.6	251	5.1	234	6.2
Northeast	2107	24.1	1215	24.7	895	23.5
Southeast	4052	46.4	2309	46.8	1745	46.0
South	1482	17.0	825	16.7	655	17.2
Midwestern	598	6.9	329	6.7	268	7.1
Area						
Urban	7396	84.7	4169	84.6	3226	85.0
Rural	1.330	15.3	760	15.4	571	15.0
Chronic diseases						
0-1	3263	37.4	1409	28.6	1810	47.7
2 or more	5463	62.6	3520	71.4	1987	52.3
Alcoholic beverages						
No	6129	70.2	3980	80.7	2201	58.0
Yes	2597	29.8	949	19.3	1596	42.0
Smoking						
No	3984	45.7	2723	55.2	1308	34.5
Yes	4742	54.3	2206	44.8	2489	65.5
Health insurance						
No	6555	75.1	3661	74.3	2890	76.1
Yes	2171	24.9	1268	25.7	907	23.9

[1] In the case of per capita household income, we present the mean and standard deviation.

age groups showed a higher concentration among males when compared to women, with the highest concentration being among men aged 70-79 years (CI = -0.3394, $p < .001$). The values found for women aged 70-79 and 80 years old or more indicate that the CIs are statistically equal to zero, that is, there is no inequality for these age groups.

Table 2
Prevalence of self-rated health by age group (ELSI-Brazil 2015-2016).

		Total (N = 8726)		Female (N = 4929)		Male (N = 3797)	
Self-rated health		N	%	N	%	N	%
50-59 years	Good	3300	88.7	1681	87.6	1619	90
	Poor	419	11.3	238	12.4	181	10
60-69 years	Good	2381	89.6	1405	89.3	976	89.9
	Poor	278	10.4	168	10.7	110	10.1
70-79 years	Good	1418	86.5	863	85.8	554	87.3
	Poor	222	13.5	143	14.2	80	12.7
80 years or older	Good	615	86.8	366	85.0	249	89.7
	Poor	93	13.2	65	15.0	28	10.3
60 years or older	Good	4419	88.3	2637	87.6	1779	89.1
	Poor	588	11.7	373	12.4	218	10.9

Table 4 and Fig. 2 show the decomposition of the CI with Wagstaff normalization. Table 4 consists of elasticity, concentration index, contribution and percentage contribution for the observed variables that contributed to the inequality in poor self-rated health. Fig. 2 shows the relative percentage contribution for each independent variable.

The variable that most contributed to the concentration of poor self-rated health among the poor was income (41.72%), followed by education (24.99%) and having private health insurance (9.85%). Of the lifestyle characteristics, consuming alcoholic beverages (8.64%) was the variable that most increased with concentration. Other demographic variables that contributed to the concentration were work (6.04%), region (5.20%), and age (4.34%). The residual value was -0.91%, showing that there was some omission of variables that explain the concentration of poor self-rated health among poor older adults.

The decomposition also showed the existence of variables that reduced the inequality in poor self-rated health, however, its contribution was small. Living in the urban area was the factor that most contributed to the reduction of inequality, with -3.18% (elasticity: -0.2074; CI: -0.0311), followed by having 2 or more chronic diseases, with -2.43% (elasticity: -0.5745; CI: 0.0085), and being male, with -1.12 % (elasticity: 0.0667; CI:0.0341).

4. Discussion

In this study, using data from ELSI-2015, a representative population sample, it was possible to estimate that 11.5% of Brazilian adults aged 50 and over consider their health to be poor. In age stratification, in the group aged 60 or over, the prevalence of poor and very poor rated health for the sample was 11.7%. Using a different database of Brazilians aged 60 or over, Lima-Costa *et al.*[43] found a prevalence rate of 16.5% in the year 1998 and 13.6% in the year 2008, and Lima-Costa *et al.* [31] found a prevalence rate adjusted for age and gender of 11.1% in the year 2008. With data for the year 2013, it was estimated that 12.1% of individuals aged 60 and over considered their health to be poor or very poor [52].

Our results indicate that there is an important concentration of poor self-rated health among the poorest individuals. We did not find other studies measuring socioeconomic inequality in the self-rated health of individuals aged 50 or over in Brazil using the concentration index and its decomposition. However, other studies that analyze self-rated health using the CI find that there is a concentration of good and very good health among wealthy older adults in China [53], in Greece, in Italy and in Spain [54].

In relation to sex and age stratifications, the results of the CI show that there is a greater inequality of in men and in the age group of 50-59 years (considering men and women). An important finding of the present study, as far as we know not described in previous studies using concentration indices, was analysis of aging-as-leveler hypotheses, "Accumulation" and "Persistent Inequality." Age stratified results showed that inequality among women, despite being concentrated among the poorest in all age groups, is reduced as the female population ages, supporting the aging as-leveler hypothesis. However, the results do not show a clear pattern for men – we observed small variations in inequality, with a drop in inequality for the age group of 60-69 years, followed by an increase for the 70-79 years group. This fluctuation gives us indications that inequality is persistent among men.

Although we do not observe in the literature studies that have made this analysis, differences between sexes in socioeconomic inequalities in health are documented. In China, for individuals aged 60 and over, it was found that the average good or very good self-rated health is lower among the female older adults than among the male older adults, however, there is less inequality among the female older adults than among the male older adults [53].

The analysis also highlighted the main factors that contribute to this inequality in health. Income inequality was the factor that most influenced the concentration of poor self-rated health among the poor. The impact of income exists even controlling for education, another important measure

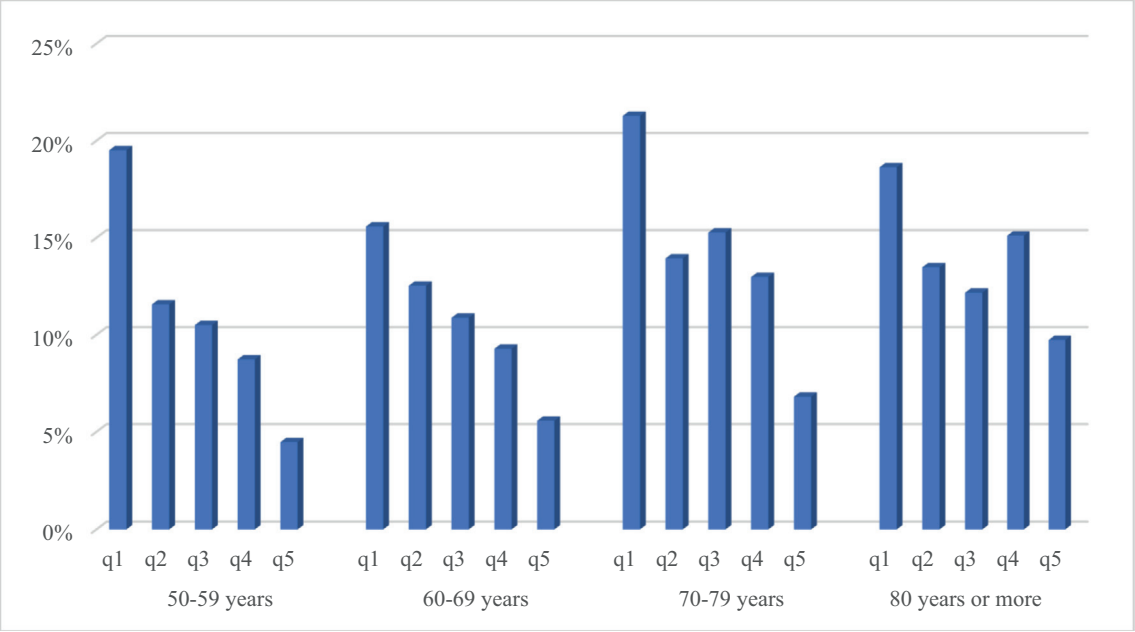

Fig. 1. Prevalence of poor self-rated health by income quintiles, stratified by age group (ELSI-Brazil 2015-2016).

Table 3
Estimates of the concentration index (CI) and concentration index with Wagstaff normalization for total sample and age groups (ELSI-Brazil 2015-2016).

	Total	Female	Male
Total sample CI	-0.2292***	-0.1697***	-0.3031***
Confidence Interval of CI	(-0.2726; -0.1859)	(-0.2263; -0.1131)	(-0.3646; -0.2416)
p-value	[0.000]	[0.000]	[0.000]
N	8726	4929	3797
50-59 years	-0.2817***	-0.2433***	-0.3239***
Confidence Interval of CI	(-0.3454; -0.2180)	(-0.3308; -0.1559)	(-0.4152; -0.2326)
p-value	[0.000]	[0.000]	[0.000]
N	3719	1919	1800
60-69 years	-0.1987***	-0.1295**	-0.2808***
Confidence Interval of CI	(-0.2797; -0.1177)	(-0.2378; -0.0213)	(-0.3968; -0.1647)
p-value	[0.000]	[0.019]	[0.000]
N	2659	1573	1086
70-79 years	-0.2109***	-0.1198*	-0.3394***
Confidence Interval of CI	(-0.3090; -0.1129)	(-0.2530; 0.0132)	(-0.4742; -0.2046)
p-value	[0.000]	[0.078]	[0.000]
N	1640	1006	634
80 years or older	-0.1155	-0.0342	-0.3032**
Confidence Interval of CI	(-0.2608; 0.0296)	(-0.2015; 0.1330)	(-0.5639; -0.0425)
p-value	[0.119]	[0.688]	[0.023]
N	708	431	277

P-value related to Wald test * <0.1, ** <0.05, ***<0.01.

of socioeconomic level, with contributions to inequality of 41.72% and 24.99%, respectively. Previous studies come to a similar conclusion. Income inequality was the main factor that contributed to the concentration of good health among the wealthy older adults in China [53], in Ghana [55], and in Greece, Italy and Spain [54]. In the case of Brazil, studies show that for individuals aged 60 or over there is an inverse relationship between socioeconomic status (measured by household assets and education) and the limitations of daily living [28], between socioeconomic level (measured by education level) and the risk of having health problems, [33] and between income and self-rated health [56]. Differences in terms of income can result in differences in other health determinants, such as food consumption, lifestyle, and the use of health care [57,58]. Although Brazil has a universal health system (Unified Health System (SUS)), evidence shows that there is a great difference in access to health care among individuals who have and do not have health insurance, which makes low-income individuals face difficulties to receive the necessary care [59,60].

Furthermore, several studies show consistent evidence of a negative association between education and health in older adults [28,31,34,35]. Education was the second factor that most influenced the inequality of poor self-rated health for Brazilians aged 50 or over. Although the elasticity value is relatively low (for example, for the group aged 12 or over the elasticity is -0.0657), the high values of inequality in schooling (for the same group the CI is 0.5359) considerably increase its impact on health inequality among the older adults. Also, for Brazil and through the CI and its decomposition, Andrade and López-Ortega [36] found, for elderly, that the level of education was the second factor that most contributed to inequality in health for five diseases (obesity, abdominal obesity, diabetes, hypertension, and heart disease). For Europe, schooling was the factor that most impacted the health of adults aged 50 and over [54]. For Chinese aged 50 or over, completing high school or completing undergraduate school has been associated with reports of some morbidity. The percentage of the total contribution to education was 17.27% [55]. A review shows that education is one of the main determinants of health in adult life. More educated individuals have better jobs and higher income, which can lead to a greater investment in health resources, leading to better health at more advanced ages. Similarly, the highest schooling increases the propension to have health-related knowledge and to worry more with harmful behavior and the prevention of diseases [61,62].

Access to a private health insurance was the third factor that most influenced the inequality of poor self-rated health. Evidence in the literature already indicated a positive association between socioeconomic status and access to private health insurance [63–65]. In analyzes similar to our study, Andrade and López-Ortega [36] found that the second most important contributing factor to inequality in the health of older adults Brazilians was the health insurance. In China, it was found that private health insurance was the main factor that contributed to the inequality of self-rated health of the older adults [53]. As previously mentioned, despite SUS being available to all Brazilians, and the obvious improvements this has represented over time, the Brazilian health system is still underfunded and presents a series of weaknesses that generate disparities in the use of

Table 4
Decomposition of the normalized concentration index (ELSI-Brazil 2015 - 2016).

Variable	Elasticity	CI	Contribution	95% Conf. Inter. of contribution	%
Per capita household income	–1.2442	0.0680	–0.0956***	(–0.1439;–0.0474)	41.72
Age					
60-69	–0.0978	0.0385	–0.0042**	(–0.0076;–0.0009)	1.86
70-79	–0.0416	0.0546	–0.0025*	(–0.0054;0.0002)	1.12
80 or older	–0.0260	0.1055	–0.0031**	(–0.0062;–0.0000)	1.36
Male	0.0667	0.0341	0.0025	(–0.0005;0.0057)	–1.12
Black/Brown/Indigenous	0.0623	–0.1209	–0.0085	(–0.0199;0.0028)	3.72
Education (years)					
1-4	–0.1318	–0.1190	0.0177***	(0.0046;0.0309)	–7.73
5-8	–0.1620	–0.0096	0.0017	(–0.0034;0.0069)	–0.77
9-11	–0.1566	0.2088	–0.0369***	(–0.0502; –0.0238)	16.12
12 years or more	–0.0657	0.5359	–0.0398***	(–0.0558;–0.0238)	17.37
Married	–0.0416	0.0165	–0.0007	(–0.0027; 0.0011)	0.34
Paid work					
Has no job	0.1233	–0.2148	–0.0299***	(–0.0436;–0.0163)	13.07
Retired/pensioner	0.1426	0.0999	0.0161***	(0.0082;0.0240)	–7.03
Region					
Northeast	–0.0264	–0.2818	0.0084	(–0.0148;0.0317)	–3.68
Southeast	–0.1373	0.1041	–0.0161*	(–0.0328; 0.0005)	7.05
South	–0.0172	0.1864	–0.0036	(–0.0162; 0.0089)	1.58
Midwestern	–0.0118	0.0423	–0.0005	(–0.0019;0.0008)	0.25
Living in the urban area	–0.2074	–0.0311	0.0072	(–0.0015;0.0161)	–3.18
Having chronic diseases	0.5745	0.0085	0.0055	(–0.0023;0.0135)	–2.43
Consuming alcoholic beverages	–0.1099	0.1593	–0.0198***	(–0.0278;–0.0118)	8.64
Smoking	0.1232	–0.0461	–0.0064***	(–0.0109;–0.0019)	2.80
Having private health insurance	–0.0593	0.3369	–0.0225***	(–0.0359;–0.0093)	9.85
Residual value			0.0020	(–0.0374;0.0415)	–0.91

P-value related to Wald test * <0.1, ** <0.05, ***<0.01.

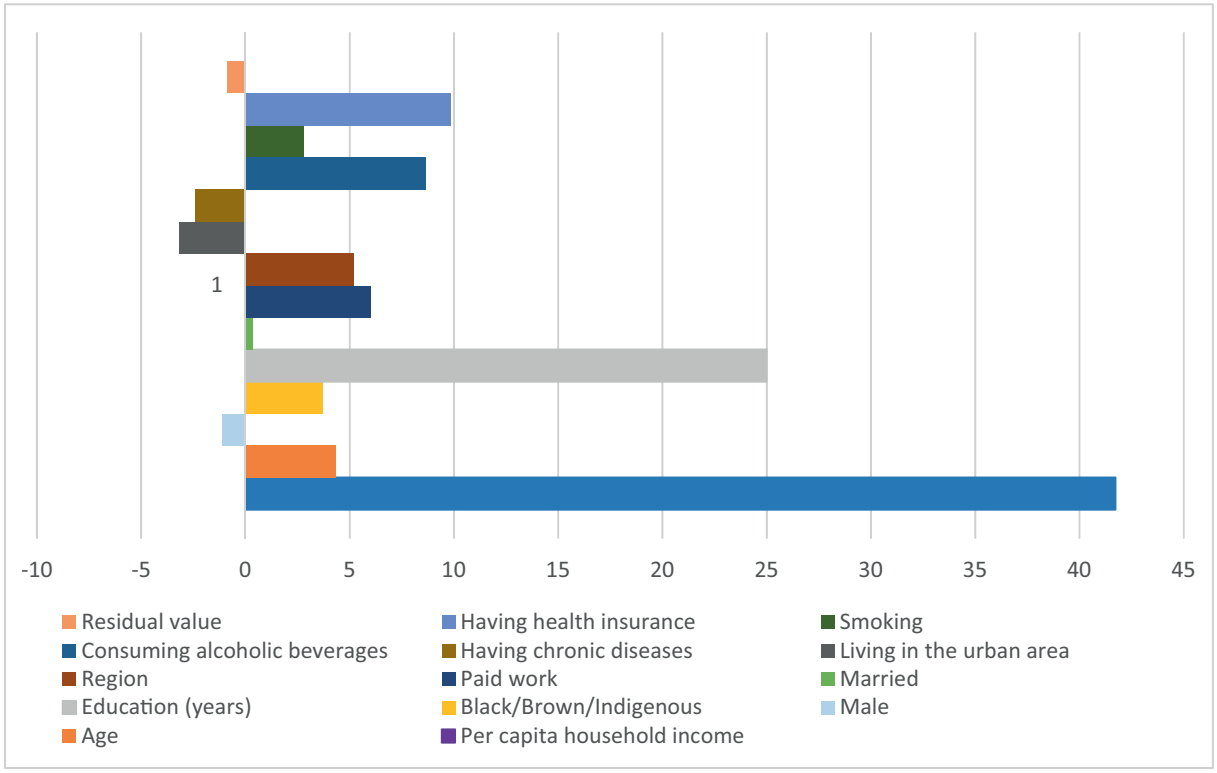

Fig. 2. Decomposition of the normalized concentration index. Percentage contribution (%) of the variables to the CI. (ELSI-Brazil 2015 – 2016).

services. Individuals who exclusively use these public services usually wait longer for the necessary treatments than individuals who have access to private insurance [56,66].

The present study has limitations. Although self-rated health is characterized as a good predictor of mortality for the older adults [67], it is a subjective measure; comparisons with clinical examinations could produce different results. Regarding decomposition, other variables not included in the analysis may contribute to the observed inequalities, however they were not considered due to database restrictions. The method also has the limitation of not inferring causality, so the results must be interpreted as

associations. Finally, the data are transversal, so we could not analyze changes in socioeconomic inequality. Longitudinal data would further support the study, to follow the evolution of the magnitude of inequality in Brazilian aging and helped us better understand if the effect we are observing comes from an age or a cohort effect, but these data are not yet available.

In short, this study broadens our knowledge about socioeconomic inequality in health among older adults in Brazil, revealing the existence of pro-rich inequalities in self-rated health and pointing to the main contributing factors for the observed inequality. These findings may have significant policy implications as they help clarify the extent of the problem and provide information that can support the elaboration of public policies aimed at reducing health inequalities. The results found in the decomposition analysis show us that actions aimed at reducing income differences and improving the poorest population's economic situation has the potential to reduce inequality. Investments in basic education and programs that strengthen health education, as well as the improvement of SUS, also appear to be important factors in the pursuit of equality and equity in health.

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Declaration of Competing Interest

None.

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