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ARTICLE

Socio-spatial inequalities in healthy life expectancy in the elderly, Brazil, 2013 and 2019

Desigualdades socioespaciais na esperança de vida saudável entre idosos, Brasil, 2013 e 2019

Desigualdades socioespaciales en la esperanza de vida saludable en ancianos, Brasil, 2013 y 2019

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Abstract

The growth in longevity in Brazil has drawn attention to more useful population health measures to complement mortality. In this paper, we investigate socio-spatial differences in life expectancy and healthy life expectancy based on information from the Brazilian National Health Survey *(PNS), 2013 and 2019. A three-stage cluster sampling with stratification of the primary sampling units and random selection in all stages was used in both PNS editions. Healthy life expectancy was estimated by Sullivan's method by sex, age, and Federated Units (UF). Severe limitations to at least one noncommunicable chronic disease (NCD) or poor self-rated health were used to define the unhealthy state. Inequality indicators and a Principal Component analysis were used to investigate socio-spatial inequalities. From 2013 to 2019, both life expectancy and healthy life expectancy increased. The analysis by UF show larger disparities in healthy life expectancy than in life expectancy, with healthy life expectancy at age 60 varying from 13.6 to 19.9 years, in 2013, and from 14.9 to 20.1, in 2019. Healthy life expectancy in the wealthiest quintile was 20% longer than for those living in the poorest quintile. Wide socio-spatial disparities were found with the worst indicators in the UF located in the North and Northeast regions, whether considering poverty concentration or health care utilization. The socio-spatial inequalities demonstrated the excess burden of poor health experienced by older adults living in the less developed UF. The development of strategies at subnational levels is essential not only to provide equal access to health care but also to reduce risk exposures and support prevention policies for adoption of health behaviors.*

Life Expectancy; Health Status Disparities; Health Surveys

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Introduction

Population aging is one of the most important social topics of the 2000s. Many changes in global demographic patterns follow historical processes of social and economic development and improvements in access to health care [1]. In Brazil, the number of people aged 60 years or over increases at a fast pace (3% annual growth) and is estimated to increase by more than 50% in the next 15 years [2], especially due to the intense socioeconomic developmental, urbanization, and health care transformations over the past 30 years [3].

Regarding health care, Brazil has evolved from a multiple system to a unified health system, with profound changes in public health policies [4]. The expansion of the Family Health Strategy (FHS) [5], the universalization of children immunization [6], along with the income transfer programs since the 2000s have contributed to dramatic decreases in infant and child mortality [7]. Recently, most public health efforts have focused on noncommunicable chronic diseases by promoting health behaviors and reducing risk factors [8], a strategy that has greatly improved the overall life expectancy.

However, with the increased population aging and a smaller proportion of the active population, the demographic shift is considered a social and health challenge, associated with an increasing demand on health and social benefit needs [9]. Furthermore, the older population tends to have multiple chronic health conditions that can overwhelm health budgets [10]. The increase in life expectancy in Brazil has come with the continuous growth of the noncommunicable chronic diseases (NCDs), generating more health care needs and limitations in daily living activities [11]. Currently, the NCDs are responsible for more than 70% of premature deaths and loss of quality of life, representing a substantial part of the total burden of diseases in older adults [12].

Questioning if rising longevity has led to additional life years spent in good or poor health is essential. The most common hypotheses on the relationship between longevity and healthy life have been proposed in the 1980s [13,14,15]. The compression hypothesis states that medical progress and healthy lifestyles are expected to result in poor health in fewer years. On the other hand, the expansion hypothesis states that medical progress is expected to lead to an increasing survival of people in poor health, resulting in the expansion of the number of years spent in poor health. The dynamic balance hypothesis, in turn, states that the increase in prevalence is balanced by the decrease in the severity of chronic diseases, resulting in a constant proportion of life spent in poor health.

The growth in longevity has generated the need for more useful measures of the aging process and different health indicators have been proposed to complement mortality by additionally accounting for morbidity, functional capacity, and disabilities [16]. In national health surveys, self-rated health and self-reported diagnosis of noncommunicable chronic diseases have been broadly used to establish differences in morbidity among population groups [17,18,19,20]. Health indicators that combine mortality data with morbidity or health status data have also been proposed for evaluating health care and prevention programs because they emphasize the quality of life in later years [21,22].

The disability adjusted life year (DALY) and the healthy life expectancy are composite indicators of disease burden in a population that combine healthy life lost from mortality and morbidity. Both indicators provide summary measures of health across geographic areas and time that can inform changes in epidemiological patterns and can contribute in setting health priorities, but the two measures have different formulations and meanings [23]. The DALY quantifies the burden of disease by combining years of life lost with years lived with disability due to a specific disease and is the most important indicator of the *Global Burden of Disease* group [24]. The healthy life expectancy quantifies the number of years that a person can expect to live in good health at a certain age and is useful for the empirical analysis of the morbidity compression hypothesis [25]. The most common approach to separate the total number of life years into those spent in good and poor health is the Sullivan method, which incorporates the health dimension to the classic life table [26]. Definitions of "healthy" are generally based on perceived health status, presence of chronic disease or disability, and functional or cognitive limitations [27,28,29].

In Brazil, the healthy life expectancy has been estimated before for the total adult population according to sex and age group [22,28] and major regions [30,31]. Other studies have analyzed the healthy life expectancy geographic inequalities at subnational levels [32,33]. This study investigates changes in healthy life expectancy in older adults from 2013 to 2019 and how population socioeconomic level

and use of health care services are associated with this summary population health outcome using a cross-sectional ecological design with Brazilian Federated Units (UF – States) as the units of analysis.

Methods

Study design

In this article, the main outcome was the healthy life expectancy. The indicator was estimated by Sullivan's method [26] according to sex, age (60, 65 and 70 years old) and UFs, in 2013 and 2019. The approach is an adaptation of the traditional life table method using two independent measures of health: the rate of being healthy by age group and the mortality component given by age-specific life expectancy provided by the Brazilian Institute of Geography and Statistics [34]. The method consists of removing the proportion of time lived in poor health from the total expected lifespan of a given cohort [28]. To establish the "healthy/unhealthy state" for the Brazilian older population in 2013 and 2019, we used survey data from the two editions of the *Brazilian National Health Survey* (PNS) as the sources of information [35].

The PNS is a nationwide household-based survey carried out by the Brazilian Ministry of Health in partnership with the Brazilian Institute of Geography and Statistics (IBGE) in 2013 and 2019 aimed at assessing health conditions and health system performance of Brazilian states and regions. The 2013 PNS was approved by the Brazilian National Ethics Research Committe (CONEP) in June 2013 (n. 328,159) and the 2019 PNS in August 2019 (n. 3,529,376).

Sampling

In the two PNS editions, the surveyed population includes Brazilian residents of private households, except those located in special census tracts. A three-stage cluster sampling (census tracts, households, and individuals) was used with stratification of the primary sampling units and random selection in each stage. Details of the sampling process are available in another publication [36]. In 2013, 60,202 individual interviews were held and, in 2019, the number increased to 94,114 [35].

The expansion factors were estimated by the inverse of the selection probability product at each stage. IBGE recalibrated the expansion factors of the 2013 PNS to allow the comparison between the two editions of the PNS [37].

Data analysis

In this study, we used self-reported information from the household resident randomly selected to answer the individual questionnaire.

The self-reported diagnoses of the following chronic diseases were considered: hypertension, diabetes, heart disease, stroke, asthma, arthritis, chronic backpain problem, work-related musculoskeletal disorder (WMSD), depression, other mental illness, lung disease, cancer, and chronic kidney disease. For each NCD, the analysis of the degree of limitations in usual activities due to the disease was based on the following PNS question: "In general, to what degree does the disease or any complication of the disease limit your usual activities?" with five possible response options (no limitation; little; moderate; severe; very severe). The two last options were aggregated to define the presence of severe limitation due to each NCD.

For each one of the NCDs, we estimated the NCD prevalence and the proportion of people with severe limitations due to the disease. Estimates were compared between 2013 and 2019, using prevalence ratios to test the significance of the differences at the 5% level. Since the PNS design used stratification of census tracts and multiple stage cluster selection, the complex sample design was considered in the statistical analysis.

To establish the "unhealthy state", two measures were used: self-rated health and severe limitations in usual activities due to noncommunicable chronic diseases. The analysis of the self-rated health was based on the following PNS question from the individual questionnaire: "In general, how would you

rate your health?" with five possible answers (very good, good, moderate, bad, very bad). The first three options were aggregated to define "good health" and the two last categories to define "poor self-rated health". Severe limitation to at least one NCD or poor self-rated health were used for defining the unhealthy state.

The age and sex specific rates of being unhealthy were estimated by the proportion of people reporting poor self-rated health or having severe limitations due to at least one NCD in each of the age-groups (60 or over, 65 or over, 70 or over) by sex. Proportions of unhealthy state and the corresponding 95% confidence intervals (95%CI) were estimated by sex and age for 2013 and 2019. Prevalence ratios were used to test the significance of the differences at the 5% level.

The Sullivan's method consists of removing the proportion of time lived in unhealthy state from the total number years of life expectancy at each age 60, 65, and 70, thus transforming the life expectancy indicator into the healthy life expectancy indicator by subtracting the number of years lived in an unhealthy state [26].

To analyze the socio-spatial health inequalities in Brazil, we estimated the healthy life expectancy by UF. In the analysis of the subnational data, the summary population outcomes were life expectancy at 60 years old and healthy life expectancy at age 60, estimated in 2013 and 2019. The measures of geographical inequalities were the range and the inequality ratio, given by the difference and the ratio between the UF maximum and the minimum estimates, respectively.

To investigate the life expectancy and healthy life expectancy inequalities, we used the indicator of poverty "proportion of people with monthly per capita income ≤ 1 minimum wage". As inequality measures, we used the quintile inequality ratio between the average life expectancy and healthy life expectancy estimates in the wealthiest and poorest quintiles. Under the supposition that part of the overall outcome variability is explained by the socioeconomic variable, we also used the slope index of inequalities, corresponding to the regression slope of each outcome with the poverty indicator [38].

Finally, using PNS 2019 data, we conducted a principal component analysis using the UFs as the units of analysis and considering the following indicators: healthy life expectancy; proportion of people aged 18 or over with incomplete high school; proportion of people aged 18 or over with per capita income smaller or equal to one minimum wage; proportion of people living in urban areas; proportion of people with at least one medical consultation in the last 12 months prior to the survey; proportion of people who had at least one dental appointment in the last 12 months prior to the survey; proportion of people who sought health care due to illness or health problem in the last two weeks prior to the survey; and proportion of people who sought preventive care in the last two weeks prior to the survey. We used the two principal components that maximize the variance of the projected data with varimax rotation and analyzed the UF location points on the scatterplot composed by the two orthogonal dimensions representing socioeconomic status and the use of health care.

Results

Table 1 shows the NCD prevalence estimates and the limitations of the usual activities resulting from NCDs in older adults, in 2013 and 2019. In general, an increase in the NCD prevalence from 2013 to 2019 was observed. The highest prevalence estimates corresponded to hypertension increasing from 50.7 to 55% (PR = 1.08, $p < 0.001$); chronic backpain, from 28.2 to 31.1% (PR = 1.10, $p = 0.002$); diabetes, from 18.1 to 20.2% (PR = 1.11, $p = 0.008$); arthritis, from 16.5 to 18.2% (PR = 1.10, $p = 0.030$); heart disease, from 11.3 to 13.1% (PR = 1.16, $p = 0.008$); and depression, from 9.5 to 11.8% (PR = 1.25, $p < 0.001$). Prevalence of having one or more NCDs was 75.3% in 2013, significantly increasing to 79.6% in 2019 (PR = 1.06, $p < 0.001$).

Analysis of the limitations in usual activities due to NCDs in 2013 and 2019 shows high NCD limitation estimates for stroke, heart disease, lung disease, arthritis, chronic backpain, work-related musculoskeletal disorder, and mental illness other than depression. A significant increase from 2013 to 2019 was found only for arthritis, from 14.9 to 20.9% (PR = 1.41, $p = 0.008$) while significant decreases were found for hypertension, asthma, and other mental illness. No significant difference was found for the proportion of older adults with severe limitations due to the presence of one or

Table 1

Prevalence (%) of each noncommunicable chronic disease (NCD), proportion (%) of people with limitations in usual activities due to each NCD, and proportion of people with poor/very poor self-rated health among people aged 60 or over and corresponding prevalence ratios between 2019 and 2013 estimates. Brazil, 2013 and 2019.

NCD	NCD				Limitations due to NCD			
	Prevalence (%)		Prevalence ratio		Prevalence (%)		Prevalence ratio	
	2013	2019	%	p-value	2013	2019	%	p-value
Hypertension	50.7	55.0	1.08	< 0.001	4.8	2.9	0.60	< 0.001
Diabetes	18.1	20.2	1.11	0.008	6.5	5.2	0.80	0.196
Heart disease	11.3	13.1	1.16	0.008	12.5	13.9	1.11	0.474
Stroke	5.0	5.6	1.12	0.185	28.3	22.8	0.81	0.185
Asthma	4.8	4.6	0.95	0.585	20.1	8.5	0.42	0.023
Arthritis	16.5	18.2	1.10	0.030	14.9	20.9	1.41	< 0.001
Chronic backpain	28.2	31.1	1.10	0.002	18.1	18.5	1.02	0.751
WMSD	1.5	2.2	1.48	0.029	17.5	31.0	1.77	0.058
Depression	9.5	11.8	1.25	0.002	9.5	9.7	1.02	0.894
Other mental disease	0.4	0.8	1.81	0.009	37.8	17.7	0.47	0.013
Lung disease	3.8	2.9	0.76	0.027	14.1	20.2	1.43	0.158
Cancer	5.5	6.8	1.23	0.010	8.8	7.0	0.79	0.407
Kidney disease	2.8	2.6	0.92	0.506	10.0	10.5	1.05	0.897
At least one NCD	75.3	79.6	1.06	< 0.001	15.5	15.8	1.02	0.680
Poor self-rated health	-	-	-	-	12.1	11.2	0.93	0.154

WMSD: work-related musculoskeletal disorder.

more NCDs, remaining around 16%. The proportion of people with poor/very poor self-rated health was 12.1% in 2013 and 11.2% in 2019, with no significant variation as well (Table 1).

Table 2 shows the life expectancy and healthy life expectancy indicators at ages of 60, 65 and 70 years old by sex, in 2013 and 2019. In 2013, the life expectancy at 60 was 21.7 years and the healthy life expectancy was 17.6 years (95%CI: 17.3-17.9), corresponding to the unhealthy life proportion of 18.9% (95%CI: 17.7-20.2). In 2019, the life expectancy at 60 years old increased to 22.6 years and the healthy life expectancy to 18.4 years (95%CI: 18.2-18.6). The number of years of unhealthy living was 4.2, and the unhealthy live proportion of 18.7% (95%CI: 17.9-19.6) remains statistically unchanged. Regarding the healthy life expectancy variation by age, the number of years of healthy life decreases as people get older. At age 65, the proportion of unhealthy life was 20.3% (95%CI: 18.8-21.9) in 2013, decreasing to 19.7% (95%CI: 18.6-20.7) in 2019. At age 70, the proportion of unhealthy life decreased from 22.3% (95%CI: 20.3-24.5) to 20.9% (95%CI: 19.6-22.3), between 2013 and 2019. However, no statistically significant variation was found in the proportion of unhealthy state across all ages from 2013 to 2019.

Regarding gender differences, both life expectancy and healthy life expectancy are higher for females at all ages. However, the proportions of unhealthy living are always higher for females. In 2013, among women, the life expectancy at age 60 was 23.4, and among men, 19.9. In 2019, a similar increase of approximately 3.6 years for both sexes was identified. Healthy life expectancy at 60 years old increased 0.6 years from 2013 to 2019, among females, and 0.9 years among males. From 2013 to 2019, among women, the proportions of unhealthy life increased from 21.2% (95%CI: 19.5-23.0) to 21.8% (95%CI: 20.5-23.1), and among men, a reduction from 16% (95%CI: 14.3-17.9) to 14.7% (95%CI: 13.7-15.8), was observed, although not statistically significant. With aging, the proportion of unhealthy life for both males and females reduced. From 2013 to 2019, increases in healthy life expectancy at ages 65 and 70 of about 10 months were found, but not statistically significant (Table 2).

Table 2

Life expectancy, proportion (%) of people in unhealthy state * and 95% confidence intervals (95%CI), healthy life expectancy at ages 60, 65, and 70 years and 95%CI by sex. Brazil, 2013 and 2019.

Indicator	2013			2019		
	Females	Males	Total	Females	Males	Total
Life expectancy at 60 years	23.4	19.9	21.7	24.4	20.7	22.6
% Unhealthy state at 60 years	21.2	16.0	18.9	21.8	14.7	18.7
95%CI (%)	19.5-23.0	14.3-17.9	17.7-20.2	20.5-23.1	13.7-15.8	17.9-19.6
Healthy life expectancy at 60 years	18.5	16.7	17.6	19.1	17.6	18.4
95%CI (years)	18.0-18.8	16.3-17.0	17.3-17.9	18.8-19.4	17.4-17.9	18.2-18.6
Life expectancy at 65 years	19.5	16.4	18.1	20.4	17.1	18.9
% Unhealthy state at 65 years	23.2	16.6	20.3	22.8	15.5	19.7
95%CI (%)	21.1-25.5	14.4-18.9	18.8-21.9	21.3-24.3	14.2-16.8	18.6-20.7
Healthy life expectancy at 65 years	15.0	13.7	14.4	15.7	14.5	15.2
95%CI (years)	14.5-15.4	13.3-14.0	14.1-14.7	15.4-16.0	14.3-14.7	15.0-15.4
Life expectancy at 70 years	15.9	13.3	14.7	16.7	13.9	15.4
% Unhealthy state at 70 years	25.5	18.2	22.3	24.0	16.6	20.9
95%CI (%)	22.8-28.4	15.3-21.4	20.3-24.5	22.1-25.9	15.0-18.4	19.6-22.3
Healthy life expectancy at 70 years	11.8	10.9	11.4	12.7	11.6	12.2
95%CI (years)	11.4-12.2	10.4-11.2	11.1-11.7	12.3-13.0	11.3-11.8	12.0-12.4

* Limitations in usual activities due to NCDs or poor/very poor self-rated health.

In Table 3, the life expectancy and healthy life expectancy at age 60 and the poverty indicator are presented by UF in 2013 and 2019. Regarding geographic inequalities, the life expectancy at 60 years ranged from 19.1 to 23.5 years, in 2013, and from 19.7 to 24.4 years, in 2019 and increasing trends were found in all UFs. The healthy life expectancy ranged from 13.6 to 19.9, in 2013, and from 14.1 to 20.1, in 2019, with an increase in 22 UFs. The poverty indicator varied from 27.8% to 77.1%, in 2013, and from 18.2% to 48.3% in 2019, showing clear improvements in socioeconomic inequalities by UF.

Table 3 shows the indicators of geographic and socioeconomic inequalities. The differences between the highest and lowest life expectancy value by UF were 4.4 years, in 2013, and 4.7 years, in 2019. The inequality ratio was 1.23 in 2013 and 1.24 in 2019. The differences in healthy life expectancy were more pronounced, 6.4 years, in 2013, and 5.3 years, in 2019 as well as the inequality ratio of 1.46, in 2013, and 1.35, in 2019. Regarding inequalities by quintile of the socioeconomic indicator, in 2013, the average life expectancy ranged from 20.2 to 22.5 years, while the average healthy life expectancy ranged from 15.0 to 18.6 years, from the poorest to the wealthiest quintile. In 2019, average life expectancy estimates ranged from 21.0 to 22.8 years, and the average healthy life expectancy, from 15.9 to 19.1 years, indicating larger socioeconomic inequalities in healthy life expectancy than in life expectancy in 2013 and 2019. The life expectancy income inequality ratio varied from 1.11 to 1.08, from 2013 to 2019, and the healthy life expectancy ratio from 1.24 to 1.20, showing a decreasing trend in both life expectancy and healthy life expectancy socioeconomic inequalities.

Figure 1 shows the regression results of life expectancy and healthy life expectancy with the poverty indicator, in 2013 and 2019, using the UFs as the units of analysis. Both summary health indicators showed a downward trend as the percentage of poverty increases, but the healthy life expectancy presents a markedly greater inequality than the life expectancy. The slope life expectancy inequality coefficients were -0,054, in 2013, and -0.080 in 2019. Slope inequality coefficients of higher magnitude were found for the healthy life expectancy, of -0.083 in 2013, and -0.146 in 2019, meaning that for each 10% increase in the poverty ratio, the life expectancy decreases by 0.5 and the healthy life expectancy by 0.8 years, in 2013, and by 0.83 years and 1.46 years, in 2019, respectively.

Table 3

Life expectancy, healthy life expectancy at age 60 and proportion (%) of people aged 18 years or over with household per capita income ≤ 1 minimum wage (MW) by Federated Units (UF). Brazil, 2013 and 2019.

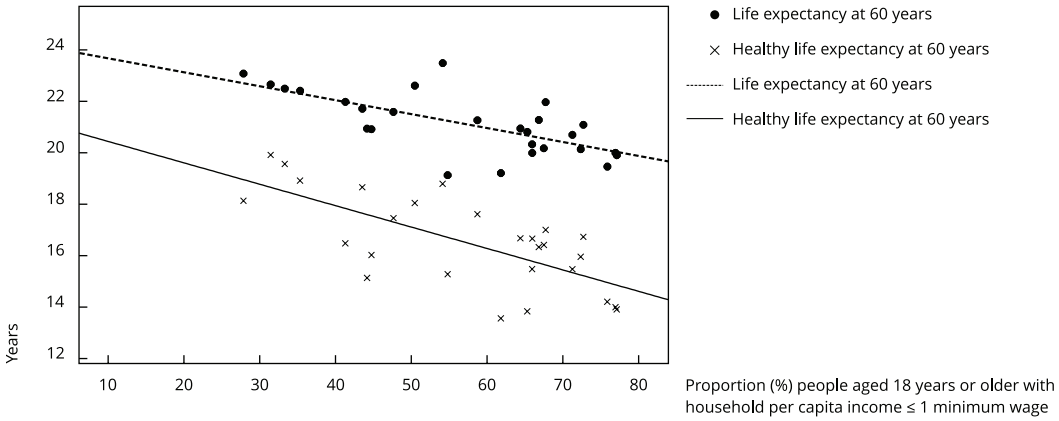
UF	2013			2019		
	Life expectancy at 60 years	Healthy life expectancy at 60 years	% income ≤ 1 MW	Life expectancy at 60 years	Healthy life expectancy at 60 years	% income ≤ 1 MW
Rondônia	19.1	15.3	54.8	19.7	15.1	40.8
Acre	20.9	16.7	64.4	21.9	17.1	37.7
Amazonas	20.0	16.7	65.9	20.7	17.4	31.8
Roraima	19.2	13.6	61.8	20.2	16.7	27.0
Pará	20.1	16.0	72.3	20.7	16.8	39.8
Amapá	21.3	17.6	58.7	22.1	17.7	30.5
Tocantins	20.8	13.8	65.3	21.6	17.1	39.3
Maranhão	19.9	13.9	77.1	20.6	14.9	45.2
Piauí	19.5	14.2	75.8	20.0	14.9	46.5
Ceará	21.1	16.7	72.7	21.7	16.6	42.8
Rio Grande do Norte	22.0	17.0	67.7	22.6	17.7	42.5
Paraíba	20.7	15.5	71.2	21.5	16.6	48.3
Pernambuco	20.3	15.5	65.9	21.6	17.3	41.2
Alagoas	20.0	14.0	76.9	20.9	16.0	47.6
Sergipe	20.2	16.4	67.5	20.9	14.9	45.4
Bahia	21.3	16.3	66.8	21.9	17.2	47.6
Minas Gerais	22.6	18.1	50.4	23.4	18.6	37.6
Espírito Santo	23.5	18.8	54.1	24.4	20.1	35.6
Rio de Janeiro	21.7	18.7	43.5	22.7	19.0	24.6
São Paulo	22.5	19.6	33.3	23.5	19.9	26.5
Paraná	22.0	16.5	41.3	23.0	19.1	33.1
Santa Catarina	23.1	18.1	27.8	24.2	20.0	30.1
Rio Grande do Sul	22.4	18.9	35.3	23.4	18.8	34.3
Mato Grosso Sul	21.6	17.5	47.6	22.4	18.1	36.3
Mato Grosso	20.9	16.0	44.7	21.7	18.2	34.4
Goiás	20.9	15.1	44.1	21.5	17.7	35.5
Distrito Federal	22.7	19.9	31.4	23.6	19.7	18.2
Range	19.1-23.5	13.6-19.9	27.8-77.1	19.7-24.4	14.9-20.1	18.2-48.3
Inequality difference	4.4	6.4	49.3	4.7	5.3	30.1
UF inequality ratio	1.23	1.46	0.36	1.24	1.35	0.38
Quintile inequality ratio	1.11	1.24	-	1.08	1.20	-

The principal component analysis resulted in two main axes, labeled poverty concentration and health care use, which explained 86% of the total variance. The healthy life expectancy correlated negatively with the axis of poverty concentration (-0.73) and positively with the axis of health care use (0.56). After the varimax rotation procedure, the UFs were displayed on the graph composed by the two orthogonal axes, poverty concentration (horizontal axis) and health care use (vertical axis). In quadrant I, representing better socioeconomic status and greater use of health services, are the UFs located in the South, Southeast and Central-West regions. All UFs located in the Northeast Region are in quadrants II or III, indicating the high concentration of poverty in these UFs. The Northern Region UFs are distributed in quadrants III and IV, indicating the inadequate use of health services. The Federal District is at the far left of quadrant III, with the lowest concentration of poverty among all UFs (Figure 2).

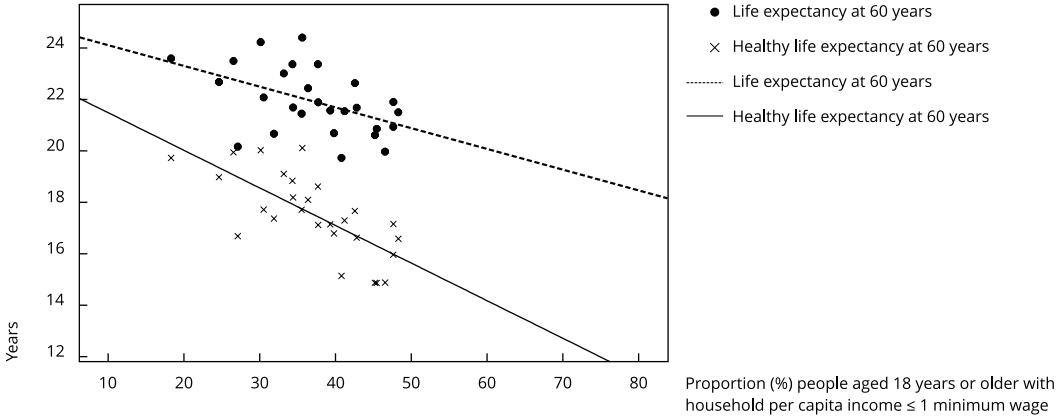
Figure 1

Regression of the life expectancy and healthy life expectancy at 60 years with the poverty indicator by Federated Unit. Brazil, 2013 and 2019.

1a) 2013



1b) 2019

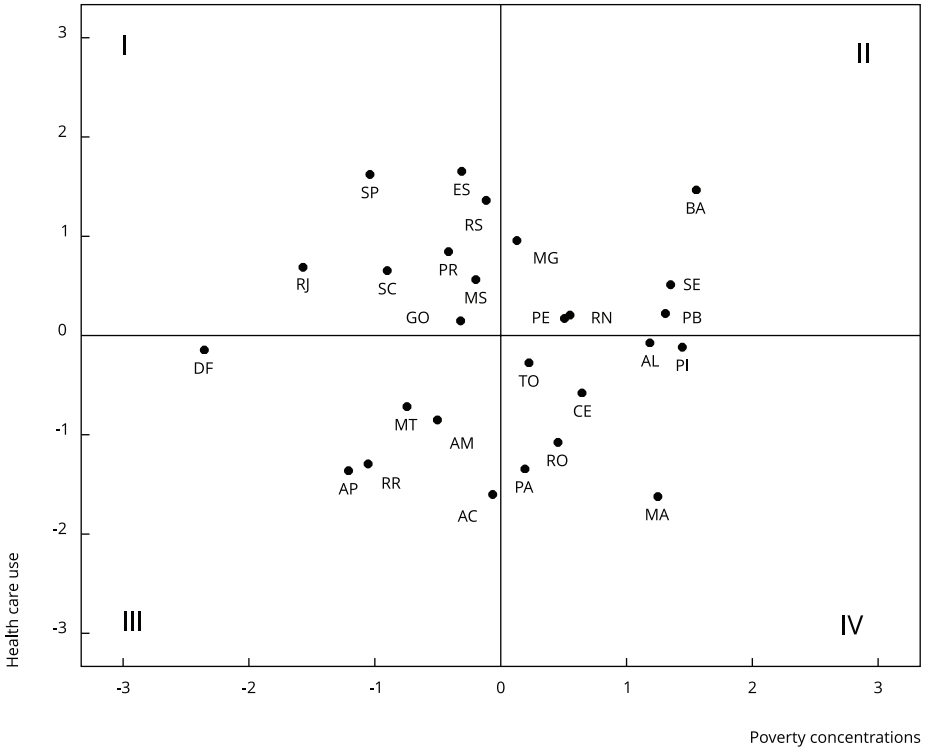


2013			
Life expectancy slope inequality		Healthy life expectancy slope inequality	
Slope	R	Slope	R
-0.054	0.684	-0.083	0.696
2019			
Life expectancy slope inequality		Healthy life expectancy slope inequality	
Slope	R	Slope	R
-0.080	0.485	-0.416	0.716

R: multiple correlation coefficient.

Figure 2

Principal component result: Federated Units (UF) according to poverty concentration and health service use. Brazil, 2019.



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.

Discussion

The results of this study showed an increase in prevalence of noncommunicable chronic diseases in the older population in Brazil from 2013 to 2019, but the proportions of older people with limitations in their usual activities due to NCDs decreased or did not change significantly, with exception of limitations due to arthritis. Between 2013 and 2019, an increase in both life expectancy and healthy life expectancy at 60, 65 and 70 years old was observed, and as people get older, the greater the proportion of life in an unhealthy state. Differences by sex are in accordance with national and international literature [39,40,41], with higher life expectancy among women, but higher proportions of unhealthy lives.

In this study, we included the self-perception of health in the definition of unhealthy state firstly because a broader definition of health transcends the absence of death, disease and disability and incorporates concepts of well-being and quality of life [42,43]. Secondly, unhealthy state definitions based only on diagnosed morbidity could be underestimated, since they depend on access to diagnosis, admittedly uneven by region, area of residence (urban/rural), and socioeconomic status [44,45]. Besides, not all NCDs are included in the PNS questionnaire.

The increase in the prevalence of several NCDs from 2013 to 2019 reflects the epidemiologic transition in Brazil [24,46]. Additionally, the decline in undernutrition in children and adults occurred with an increasing obesity trend across the 2000s [47], influencing premature mortality and disabilities

[48,49]. Findings of this study indicate increasing trends in obesity-related diseases such as diabetes and cardiovascular diseases from 2013 to 2019, but no significant increase in daily activity limitations due to those diseases were found. Also, a high prevalence of musculoskeletal conditions in the Brazilian older population was found, with growing trends in limitations due to arthritis from 2013 to 2019. As has been evidenced before, this is a group of diseases that greatly affects functional disabilities [50].

According to the criterion that combines limitations due to NCDs with poor self-rated health, both healthy life expectancy and the ratio of healthy years to life expectancy increased between 2013 and 2019, except for females at age 60. With an average decrease of 10 months of unhealthy life in the period 2013-2019, ill health seems to be more compressed into the later years of life, despite the non-statistically significant relative reductions in unhealthy state. Regarding differences by gender, our results show that life expectancy is always higher among females but the proportions of people living in an unhealthy state are smaller among males, resulting in greater improvements in healthy life expectancy among men and a decrease in the healthy life expectancy gender gap. One possible reason is that women are in general more willing to admit health problems and to seek medical care than men [40]. Another explanation is based on gender differences in morbidity. While women are more likely to have non-lethal conditions and functioning problems, men are more likely to have acute severe conditions [51].

In the analysis by UFs, both geographic inequality indicators (the difference and the ratio) show larger disparities in healthy life expectancy than in life expectancy. The inequality ratio reached 1.46 in 2013 and decreased to 1.35 in 2019, meaning that the expected number of years lived in good health by the older population of a given state is up to 35% higher than that of another state in Brazil. Despite the narrowing of healthy life expectancy inequalities among Brazilian states, the geographic inequality remains high. These findings are in accordance with previous national [11,32] and international studies [52,53], which show large healthy life expectancy heterogeneity at subnational levels.

Regarding socioeconomic inequality, the results suggest that healthy life expectancy is a more sensitive indicator than life expectancy. The healthy life expectancy slope index of inequality in 2019 indicates a 10% decrease in poverty concentration means an increase of nearly one year and six months of healthy life at age 60 [38]. Evidence of the effects of socioeconomic inequalities on healthy longevity are increasingly available, with results invariably unfavorable to the disadvantaged groups [54,55,56]. In Brazil, a recent study showed the influence of poverty on the years of life with multimorbidity [33]. A study in the city of Rio de Janeiro showed huge healthy life expectancy differences in the older population and showed the importance of considering community-level socioeconomic conditions as key correlates of survival [57]. A study in European countries showed large and increasing inequalities in healthy life expectancy at age 50 from 2005 to 2010, partly explained by worsening of material deprivation and long-term unemployment [58] while a study conducted in Spain emphasizes the importance of the education level on extending the proportion of years spent in good health [59].

The regional and the socioeconomic inequality in the access and utilization of health services is another issue of concern [60]. The principal component analysis shows that all UFs located in the less developed regions are represented in the worst quadrants, while the states located in the Southeast and South regions are in the best quadrant. Results from a study in Japan indicated that health examination results, including attitude toward improving health habits, were positively associated with healthy life expectancy [61].

By showing that not only mortality indicators are associated with living conditions, but also that inequalities are even more pronounced when morbidity is considered, this study draws attention to the demand for more useful population health measures to complement mortality. The socio-spatial inequalities demonstrated the excess burden of severe NCD limitations and poor health experienced by the older population living in the less developed Brazilian regions. To mitigate the effects of social exclusion, the development of strategies at subnational levels is essential not only to provide equal access to health care, but also to reduce risk exposures, prioritizing the disadvantaged population groups that will have the greater impact of interventions.

One limitation of the Sullivan's method stems from the that it combines the flow variable "mortality" to estimate the life expectancy, and the stock variable "prevalence" to estimate the unhealthy number of years [62]. To correct this inconsistency, two other procedures have been proposed: the double decrement method, in which the birth cohort is subjected to both disease incidence probabilities and

disease specific mortality; the multi-state method, in which one or more disease states (for example, recovery or cure) are allowed. Nevertheless, previous discussions support the conclusion the Sullivan's method is adequate and useful for monitoring population health in which transition rates and mortality rates evolve without sudden and substantial change [63].

A constraint of this study is that life expectancy uncertainties derived from the IBGE mortality projections could not be considered in the statistical analysis. Also, data on functional limitations of daily living activities in the elderly are not yet available for the PNS 2019. Finally, disabilities and severe limitations due to other diseases not considered in PNS have not been included.

Contributors

C. L. Szwarcwald contributed in the study conception and planning, data analysis and interpretation, and manuscript writing. W. S. Almeida and P. R. B. Souza Júnior contributed in the data analysis and interpretation, and manuscript writing. J. M. Rodrigues and D. E. Romero contributed in the data discussion and manuscript writing. All authors approved the final version of the manuscript for publication.

Additional informations

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Resumo

O aumento da longevidade no Brasil tem chamado atenção para a necessidade de medidas mais úteis de saúde populacional, para complementar o índice de mortalidade. Os autores investigam diferenças socioespaciais na expectativa de vida e na esperança de vida saudável, com base em dados da Pesquisa Nacional de Saúde *(PNS), edições de 2013 e 2019. Em ambas as edições da PNS, foi utilizada amostragem de clusters em três estágios, com estratificação das unidades amostrais primárias e seleção randômica em todos os estágios. A esperança de vida saudável foi estimada pelo método de Sullivan, de acordo com o sexo, idade e Unidade da Federação (UF). Limitações graves em função de pelo menos uma doença crônica não transmissível (DCNT) ou autoavaliação de saúde ruim foram utilizadas para definir o estado não saudável. Foram usados indicadores de desigualdade e análises de componentes principais para investigar as desigualdades socioespaciais. Entre 2013 e 2019, houve aumento na expectativa de vida e na esperança de vida saudável. A análise por UF mostrou disparidades maiores na esperança de vida saudável comparada com a expectativa de vida, onde a esperança de vida saudável aos 60 anos variava de 13,6 a 19,9 anos em 2013, e de 14,9 a 20,1 em 2019. A esperança de vida saudável no quintil mais rico foi 20% maior, comparado com o quintil mais pobre. Foram identificadas disparidades socioespaciais grandes, com os piores indicadores nas UFs localizadas nas regiões Norte e Nordeste, tanto de acordo com a concentração de pobreza ou pela utilização de serviços de saúde. As desigualdades socioespaciais demonstraram o excesso de carga de vida não saudável vivenciada por idosos vivendo nas UFs brasileiras menos desenvolvidas. O desenvolvimento de estratégias nos níveis subnacionais é essencial, não apenas para prover acesso igualitário aos cuidados de saúde, como também, para reduzir a exposição aos riscos e para apoiar políticas de prevenção, voltadas para a adoção de comportamentos de saúde.*

Expectativa de Vida; Disparidades nos Níveis de Saúde; Inquéritos Epidemiológicos

Resumen

El crecimiento de la longevidad en Brasil ha atraído la atención sobre medidas de salud más útiles para la población, con el fin de complementar la mortalidad. En este trabajo, investigamos diferencias socioespaciales en la esperanza de vida y esperanza de vida saludable, basadas en la información de la Encuesta Nacional de Salud *(PNS), de 2013 y 2019. Se utilizó en ambas ediciones de la PNS un muestreo por conglomerados en 3 etapas con estratificación de las unidades de muestreo primarias y una selección aleatoria en todas las etapas. La esperanza de vida saludable se estimó por el método de Sullivan por sexo, edad, y Unidades Federadas (UF). Se usaron limitaciones graves para al menos una enfermedad crónica no transmisible (ECNT) o mala salud autoevaluada para definir un estado de mala salud. Los indicadores de Desigualdad y el análisis de Componente Principal se usaron para investigar desigualdades socioespaciales. De 2013 a 2019, hubo un incremento tanto en la esperanza de vida, como en la esperanza de vida saludable. El análisis por UF mostró disparidades mayores en la esperanza de vida saludable que en la esperanza de vida, con una esperanza de vida saludable a la edad de 60 años, variando desde los 13.6 a los 19.9 años, en 2013, y desde los 14.9 a los 20.1, en 2019. La esperanza de una vida saludable en el quintil más rico fue un 20% más larga que aquellos que vivían en el quintil más pobre. Se encontraron grandes disparidades socioespaciales con los peores indicadores en las UF localizadas en las regiones Norte y Nordeste, teniendo en consideración concentración de la pobreza o utilización de los servicios de salud. Las desigualdades socioespaciales demostraron la carga excesiva de la mala salud vivida por los ancianos que vivían en UF menos desarrolladas. El desarrollo de estrategias a niveles subnacionales es esencial no solo para proporcionar un acceso igualitario a la salud, pero también para reducir el riesgo de exposición y apoyar las políticas de prevención para la adopción de comportamiento de salud.*

Expectativa de Vida; Disparidades en el Estado de Salud; Encuestas Epidemiológicas

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