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ORIGINAL ARTICLE

Mortality attributable to cardiovascular diseases in young adults residents in Brazil

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Abstract

Introduction: cardiovascular diseases are the leading causes of death in the world. Despite the reduction in CVD incidence and mortality in the 20th century, the values remain high in the 21st century. In Brazil, there is a gap in population studies that estimated standardized mortality rates from cardiovascular diseases in young adults.

Objective: to assess the trend in mortality from cardiovascular diseases in young adults, according to sex, age group and regions of Brazil.

Methods: ecological time series study using official secondary data from Mortality Information Systems (SIM). All deaths from cardiovascular diseases (I00-I-99) in young adults aged 20-49 years, residing in Brazil, in the period from January 1, 2008 to December 31, 2017, were considered. Data were extracted from the Department of Informatics of the SUS (DATASUS). The Prais-Winsten regression model was used and the Annual Percentage Variation (APV) was calculated. All analyzes were performed in STATA 14.0 software.

Results: during the period 2008-2017, 294,232 deaths (8.7%) from cardiovascular disease were identified in young adults aged 20-49 years. A reduction in CVD mortality was identified in all regions of Brazil, except for individuals aged 20-24 years, residing in the Northeast region, which showed an increase (APC: 2.45%) ($p<0.05$) 2013 -2017. The greatest variation in the mortality trend occurred in the South region (APC: -25.2%). While the smallest change in mortality trend occurred in the Northeast region (APC: -8.8%). The annual decline was smaller in the second quinquennium (2013-2017) compared to the first (2008-2012). Furthermore, the decline was more pronounced among women (APC: -2.51%) ($p<0.05$) 2008-2012 and in young adults aged 40-44 years (APC: -2.91%) ($p<0.05$) 2008-2012. Furthermore, the trend in CVD mortality stabilized from 2013 onwards in males ($p>0.05$).

Conclusion: the results demonstrate a decreasing trend in mortality from Cardiovascular Disease in young adults in Brazil, between 2008-2017. It is concluded that there is inequality in the trend of mortality from CVD according to sex, age group and regions of Brazil.

Keywords: cardiovascular diseases; epidemiology; mortality; young adult.

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Authors summary

Why was this study done?
Population-based epidemiological studies on cause-specific mortality allow directing public policies towards population risk. Few studies address how regional differences attributed to socioeconomic factors affect mortality from cardiovascular diseases in younger populations. Detailed analysis of CVD mortality trends can help to identify determinants and, therefore, highlight population subgroups, which are at risk for developing chronic diseases and which may benefit from targeted treatment and prevention.

What did the researchers do and find?
An ecological time series study was carried out using official secondary data from the Mortality Information Systems (SIM). 294,232 deaths from cardiovascular diseases were considered by the International Classification of Diseases (I00-I-99) in young adults aged between 20-49 years, residing in Brazil, in the period from 01/01/2008 to December 31, 2017. There are a decreasing trend in mortality from Cardiovascular Disease (CVD) in young adults in Brazil. In addition, a regional difference in mortality was identified according to regions of Brazil. In addition, mortality in females declined in both periods in the Central-West and South regions, while mortality remained stationary in the North, Northeast and Southeast regions in the period (2013-2017), where in this period the mortality trend stabilized to both sexes in the North and Northeast regions. There was an increase only in the Northeast region aged 20-24 years, period (2013-2017).

What do these findings mean?
The findings contribute to the planning and management of the Primary Health Care system. Young Brazilians should not progress to death from CVD, as their vital capacity is higher than that of the elderly. Measures for the early detection of causal factors will contribute to the reduction of deaths.

INTRODUCTION

Cardiovascular Diseases (CVD) are the leading causes of death in the world, especially in high- and middle-income countries, such as Brazil. According to the World Health Organization (WHO)[1], cardiovascular diseases recorded 15 million deaths in 2015, representing 26.5% of total deaths worldwide. It follows that 8.76 million (58.4%) were due to ischemic heart disease and 6.24 (41.6%) million were due to Cerebral Vascular Accident (CVA). These diseases remained the leading causes of death during the total period between the years 2008-2017.

Studies on temporal trends of the main risk factors for cardiovascular disease in Brazil have shown a reduction in the habit of smoking, but an increase in the prevalence of overweight, obesity, unhealthy eating habits and low physical activity in the general population[2]. However, the incidence of cardiovascular disease in young adults increased or remained stationary. Furthermore, there is a new epidemic of cardiovascular disease in younger populations, especially with heart failure[3].

Analyzing the trends in mortality from CVD, Ischemic Heart Disease (IHD) and Cerebral Vascular Accident (CVA), they found that in the period 1980-2012 there was a reduction in mortality from these three disease groups in men and women, while the trend in mortality from IHD stopped declining in Brazil in the period 2007-2012[4]. In addition, mortality adjusted for race, sex and socioeconomic factors tends to decline in individuals with black skin color and low income[2].

In Brazil, CVD also represents the main causes of death in the population, accounting for 27.6% in 2015. However, proportional mortality differs when analyzing specific regions of the country. The proportional mortality from CVD in the North region is 22.9%, while in the South region, these diseases accounted for 28% of all deaths[5]. Furthermore, the two main groups of deaths from CVD were Coronary Artery Disease (CAD) and Cerebral Vascular Accident (CVA), which is subdivided into two groups Hemorrhagic Cerebrovascular Accident (CVA) and Ischemic Cerebral Vascular Accident (CVA), totaling 31.9% and 28.7%, respectively, due to CVD in Brazil[3].

The Brazilian study identified a decline in stroke hospitalizations and mortality and a stationary trend for stroke for the developed regions of Brazil. The period (2011–2018) showed an increase in hospitalizations for stroke in both regions and genders. Mortality for stroke and stroke decreased between 2008–2018 in southeastern and southern Brazil for both gender[6].

Data on all deaths in Brazil are recorded in the Mortality Information System (SIM), which provides the calculation for mortality statistics, including causes of death, contained in the International Classification of Diseases in its tenth revision (ICD-10) since 1996. National coverage is estimated at 96% of all deaths in the country. In addition, the reliability and completeness of information are favorably analyzed in the national context[7].

Worldwide, the reduction in mortality from CVD was described from the 50's onwards[8]. However, the values still remain high in industrialized countries at the beginning of the 21st century. In Brazil, this reduction has been observed since the 70s[9]. An analytical study of time series of mortality ratios for Chronic Noncommunicable Diseases (NCDs) showed a significant reduction in CVD mortality in men in the southern states, while a small reduction was found in the states of the North region of Brazil[8-10].

Although there is a significant increase in CVD studies in developed countries, there is still a gap on how regional differences attributed to socioeconomic factors affect mortality from cardiovascular diseases in younger populations. Detailed analyzes of CVD mortality trends can help to identify determinants and, therefore, highlight population subgroups, which are at risk for developing chronic diseases and which may benefit from targeted treatment and prevention.

Evidence for researchers who addressed and considered socioeconomic factors and interurban differences showed a high mortality ratio for CVD in populations with low socioeconomic status[11,12]. In addition, higher education is related to quality of life and is capable of improving health promotion, with a better response to educational campaigns[12].

Countries with a population of at least 100 million inhabitants are: China, India, USA, Indonesia, Brazil, Pakistan, Nigeria, Bangladesh, Russia, Japan and Mexico, with significant social inequalities representing more than 60% of the world population. Everyone is facing an epidemic of chronic non-communicable diseases (NCDs), where high cholesterol, obesity, diabetes and cardiovascular diseases are becoming major public health problems[13].

In an analysis of morbidity and mortality from Cerebral Vascular Accident (CVA) (a subtype of cardiovascular disease) among young Brazilian adults, using secondary data from the Hospital and Mortality Information Systems, they identified a decrease in mortality, mainly in individuals over 30 years, and incidence stability; and also regional variation in stroke-related morbidity and mortality among young Brazilian adults in the period 2008-2012[14].

Population-based epidemiological studies on cause-specific mortality allow directing public policies towards population risk. In addition, in Brazil, Health Information Systems have been used as a tool for health diagnosis to address the epidemiological profile, identifying priorities, planning and refining actions[15].

Thus, the objective is to evaluate the trend in mortality from Cardiovascular Diseases, in individuals aged between 20 and 49 years, and to estimate the annual percentage change in mortality rates, according to sex, age group and regions of Brazil, in the period 2008-2017.

METHODS

Study Design

This is an ecological study with a time series design using secondary data on deaths from Cardiovascular Diseases of residents in Brazil, from the Mortality Information System (SIM).

Study Location and Period

Secondary data correspond to the period from January 1, 2008 to December 31, 2017. The information came from Brazil with an estimated population of 211 million inhabitants and an estimated population of 88 million inhabitants aged between 20 and 49 years (2008-2017) – Brazilian Institute of Geography and Statistics (IBGE 2020)[16]. It covers 8.5 million km^2, occupying 47% of the territory of South America and the 6th place in the world in terms of population. Brazil is a federative republic with continental dimensions and social and regional inequalities. The country has a high Human Development Index (HDI) of 0.755, 75th in the world ranking (Human Development Report 2015) and is considered one of the four main emerging economies that will dominate in the 21st century[17].

Study Population and Eligibility Criteria

Mortality was accounted for by deaths due to Cardiovascular Disease, which were recorded by SIM, according to age groups defined by a previous study that described the Epidemiology of Cardiovascular Disease in young adults, considering the age group between 18-45 years[3]. In addition, the World Health Organization (WHO) has not found adolescents aged between 10-19 years. Thus, for this study, we considered the population aged between 20-49 years as young adults[18].

Data Collection

All data were collected by place of residence through files provided by the Department of Informatics of the Unified Health System (DATASUS)7 and maintained by the Brazilian Ministry of Health. We considered all deaths in individuals aged between 20 and 49 years in Brazil, whose underlying cause was classified as Cardiovascular Disease according to the tenth Revision of the International Classification of Diseases (ICD-10), I00 - I99.

Developed and implemented by the Brazilian Ministry of Health, the Health Information System (SIS) has made it necessary to increase regional management tools and gradually consolidate and qualify them[19,20].

SIM was implemented in 1977 and death data have been in the public domain since 1979, with important and necessary information for mortality statistics, including underlying cause of death[21]. The causes of death declared by physicians were coded according to the standards established by the World Health Organization by the ICD-10. An increase in coverage and confidence was observed in the years 2008 to 2017[22,23].

The mortality rate was based on data collected by the population residing in Brazil provided by the Brazilian Demographic Census 2010 and also on intercensus projections for the other years (2008-2017), according to information provided by DATASUS.

Data Analysis

We use compressed files to extract the information tabulated in TABNET. This System provides information contained in the Death Certificate (DO) (standardized instrument through the collection of information from the SIM). In addition, we use the TABWIN software that allows tabulation and processing of data.

For the mortality time series, two-time intervals of 5 consecutive years were used (2008-2012 and 2013-2017), according to sex, age group and regions using the Prais-Winsten regression model. This stratification procedure of 2 consecutive 5-year periods ensured a sufficient number of deaths providing stability to identify statistically significant differences. In addition, the Durbin-Watson test was used, which allows scaling the existence of first-order autocorrelation of the time series composed of annual rates. Furthermore, the following were estimated: angular coefficient (β) respective probability (p); Annual Percentage Change (APC), and the 95% Confidence Interval (CI).

The statistical analysis process included data processing, transforming the standardized rates into a logarithmic function of base 10. The Annual Percentage Variation (APV), according to age group and geographic groups, were calculated with the respective confidence interval (CI 95%). With this procedure it is possible to classify the increasing, decreasing or stationary trend. The trend was considered stationary when the coefficient was not significantly different from zero ($p<0.05$)[24]. In order to visualize the trends, a graph was built to present the

historical series according to regions of Brazil. All analyzes were used using Stata 14.0 software (CollegeStation, TX, 2013).

Ethical and Legal Aspects of the Research

The present study only involves the description and analysis of secondary data: from the population, not being obtained information that identifies the individuals. In addition, all information collected is in the public domain. Therefore, this study does not require approval from the Ethics and Research Committee (CEP), in accordance with Resolution no. 510/2016, of April 7, 2016, of the National Health Council, pursuant to Law no. 2011.

RESULTS

During the period 2008-2017, 294,232 deaths from cardiovascular disease were identified in young Brazilian adults aged 20-49 years, corresponding to 8.9% of deaths from CAD. It was evidenced that deaths from cardiovascular diseases in men were higher (60.4%) than in women (39.6%). The highest mortality trend was found in the 40-49 age group (66.2%), with 4 to 7 years of schooling (25.3%). Non-white race/color (ie, black and brown) corresponded to 54.8% of total deaths. The highest mortality trend was found in single marital status (48.5%) (table 1).

There is a trend towards a reduction in mortality from CVD in all regions of Brazil between the period 2008-2017. The greatest variation in mortality occurred in the South region (APC: -25.2%). While the smallest variation in mortality occurred in the Northeast region (APC: -8.8%). In addition, in 2017, the mortality trends of the Northeast and Southeast regions were higher than the national mortality (30.5 x 100,000 inhabitants), while the North, South and Center-West regions presented lower rates (table 2).

Table 1: Distribution of Mortality from Cardiovascular Diseases (x 100,000 inhabitants), in young adults aged between 20 and 49 years, Brazil, 2008-2017

Demographic characteristics	Deaths (N= 294232)	Proportional Mortality (%)
Gender		
Male	177602	60.36
Female	116612	39.64
Total	294214	100
Age group (years old)		
20 a 24	10201	3.43
25 a 29	15736	5.28
30 a 34	26630	8.94
35 a 39	44553	14.96
40 a 44	75486	25.35
45 a 49	121626	40.85
Total	294232	100
Schooling		
None	22043	7.43
1-3	54590	18.34
4-7	75296	25.30
8-11	58245	19.56
≥ 12	17214	5.78
Total	227537	100
Race		
White	118043	39.84
Black	34574	11.54
Brown	128619	43.24
Yellow skin	821	0.28
Indigenous	641	0.21
Total	279852	100
Marital status		
Single	142.768	48.49
Married	93.396	31.72
Widower	6.258	2.11
Divorced	17.657	6.00
Others	12.452	4.23
Total	272338	100

N- Represents the absolute number of deaths and (%) represents the proportion; Source: Sistema de Informações sobre Mortalidade (SIM/SUS); Available at: http://datasus.saude.gov.br/; Viewed: 02/09/2019.

Table 2: Trends in Mortality from Cardiovascular Disease in Young Adults, according to macro-regions of Brazil, year by year, in the period 2008-2017

Mortality		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Mean
Brazil	Deaths	30485	29665	29796	30053	29350	29306	29013	29100	29525	27921	33.49
	Population	87449343	88560402	88825414	89597095	90356812	91122511	91888210	92653909	93419608	94185307	
	Mortality	36,6	35,0	34,5	34,5	33,4	33,1	32,5	32,3	32,5	30,5	
North	Deaths	1660	1696	1706	1661	1687	1707	1811	1808	1834	1777	27.13
	Population	6687018	6843630	7091313	7200621	7309928	7419236	7528543	7637851	7747158	7856466	
	Mortality	29,1	28,6	27,3	26,4	26,2	26,3	27,4	27,1	27,0	25,9	
Northeast	Deaths	7889	7809	7795	8113	8040	7942	7969	7979	8190	8016	35,33
	Population	23775948	23931900	24087852	24243805	24399757	24555709	24711661	24867614	25023566	25179518	
	Mortality	37,4	36,3	34,9	36,1	35,5	34,8	34,7	34,4	35,1	34,1	
Southeast	Deaths	14670	14149	14311	14249	13879	13833	13600	13836	13969	12948	35,83
	Population	37737283	37972083	38206884	38441684	38676485	38911285	39146086	39380886	39615686	39850487	
	Mortality	39,1	37,2	37,4	37,0	35,8	35,4	34,5	34,9	35,0	32,2	
South	Deaths	3920	3793	3719	3793	3496	3538	3339	3323	3376	3100	27,39
	Population	12777738	12805140	12832542	12859944	12887346	12914748	12942150	12969551	12996953	13024355	
	Mortality	30,1	28,8	28,2	28,5	26,2	26,3	24,7	24,4	24,7	22,5	
Midwest	Deaths	2346	2218	2266	2239	2249	2287	2299	2159	2157	2082	32,88
	Population	6590578	6705837	6821096	6936354	7051613	7166872	7282131	7397389	7512648	7627907	
	Mortality	37,5	34,4	34,1	33,1	33,1	33,1	32,9	30,9	30,6	29,1	

Source: Sistema de Informações sobre Mortalidade (SIM/SUS) – Available at: http://datasus.saude.gov.br/ - Viewed: 15/01/2020

We identified that in the North region 2008-2017 there was a reduction from 29.1 to 25.9; in the Northeast region, there was a reduction from 37.4 to 34.1; in the Southeast region 2008-2017 there was a reduction from 39.1 to 32.2; in the South region 2008-2017 there was a reduction from 30.1 to 22.5; in the Midwest region 2008-2017 there was a reduction from 37.5 to 29.1. However, the decline observed in all years, in all regions, did not occur between 2010-2011, only in the South region. In this period, mortality trends ranged from 28.2 to 28.5 x 100,000 inhabitants (table 2).

Figure 1 shows the distribution curves of mortality from CVD in young adults, according to regions of Brazil, 2008-2017.

The mortality trends of the Northeast and Southeast regions showed similar behavior in the second period (2013-2017), with small variations during the global period. Furthermore, between the years 2016-2017, it is noted that in the Southeast region there is a reduction in this trend, compared to the Northeast region (35.0 to 32.2 x 100,000 inhabitants) (table 2).

Mortality trends in the North and South regions showed similar behavior in the first period (2008-2012), except between 2010-2011 when there was a slight increase in the South region. In addition, in the second period, there was also a reduction in the mortality trend in the South region, ranging from 24.7 to 22.5 x 100,000 inhabitants (table 2).

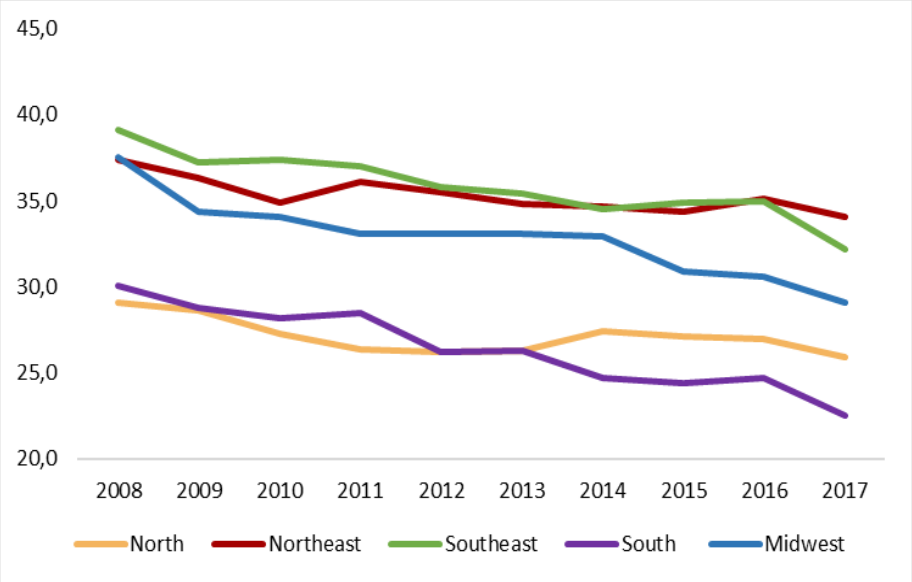

Figure 1: Mortality from Cardiovascular Diseases in young adults, according to macro-regions in Brazil, in the period 2008-2017

Source: author himself.

In Brazil, a reduction in mortality trends was identified for men with APC of -1.48% and for women of -2.51% in the first five years (2008-2012). In the second five-year period (2013-2017) with a APC of 1.40% for men and 1.93% for women. When analyzing the age group variable in individuals aged 35-49 years in the first five-year period (2008-2012), the APC ranged from 1.74% to 2.91%. During the second five-year period (2013-2017) in the age group between individuals aged 25-29 years, there was a reduction in the mortality trend with APV of 0.99% and for the age group of 40-49 years it varied between APV of 1.84 % and 2.23% and in all other variables not mentioned, remained stationary (table 3).

In the first five years (2008-2012), for the gender variable, the North Region showed a reduction in the mortality trend for men with APC of -2.95%; the Northeast Region in women with a APC of -2.12%. When analyzing the age group variable, the North Region in individuals aged 35-49 years with APC ranging from -1.53% to -4.50%; the Northeast Region among individuals aged 40-44 years with a APC of -2.85%. During the second five-year period (2013-2017), the Northeast Region in individuals aged 20-24 years, there was a significant increase of +2.45% and in all other variables not mentioned, they remained stationary (table 4).

In the first five years (2008-2012) for the gender variable, the Southeast region showed a reduction in the mortality trend among men with APV of -1.48% and in women with APV of -2.10%; the South and Center-West regions with APC of -3.61% and -4.62% in women, respectively. When analyzing the age group variable, there was a reduction in mortality trends, the Southeast region among individuals aged 35-39 years with a APC of -1.69% and for individuals between 40-44 it was -2.51; the South region in individuals aged 40-44 with a APC of -3.21% and of 45-49 was -3.92% and the Midwest region in individuals aged 35-39 with a APC of -4.85% and aged 40-44 years, the reduction was -5.16% and in all other variables not mentioned, they remained stationary (table 4).

In the second five-year period (2013-2017) for the gender variable, a reduction in the mortality trend in men with APC of -2.07% was identified in the Southeast region; the South Region with APC of -2.91% in men and APC of -2.46% in women and for the North Region there was a reduction of -4.62% in women, men remained stationary. When analyzing the age group variable, there was a reduction in mortality trends for individuals aged 20-24 and 45-49 years for both groups, with APC of -2.07% and the South region in individuals aged 45-49 years with APC of -4.35%; the Midwest region in individuals aged

Table 3: Mortality trends from Cardiovascular Disease in young adults aged between 20-49 years, according to sex and age groups in Brazil (2008-2017)

Types of Cardiovascular Disease	β	APC % (CI 95%)	Trend	β	APC % (CI 95%)	Trend	β	APC % (CI 95%)	Trend
		Period of 2008-2012			Period of 2008-2017			Period of 2008-2017	
Brazil (Gender)									
Male	-0,01	-1,48 (-2,82 : -0,12)	Decreasing	-0,01	-1,68 (-3,41 : 0,08)	Stationary	-0,01	-1,40(-1,77 : -1,03)	Decreasing
Female	-0,01	-2,51 (-3,64 : -1,36)	Decreasing	-0,01	-1.20 (-3,55)	Decreasing	-0,01	-1,93 (-2,46 : -1,40)	Decreasing
Total	-0,01	-1,37 (-2,95 : -0,69)	Decreasing	-0,01	-2,28 (-3,17 : 0,20)	Stationary	-0,01	-1,37 (-1,83 : -1,14)	Decreasing
Brazil (Age group - years old)									
20 – 24	-0,01	-0,69 (-3,48 : 2,19)	Stationary	0,01	0,71 (-0,85 : 2,30)	Stationary	-0,01	-0,30 (-0,89 : 0,29)	Stationary
25 – 29	0,00	0,07 (-2,16 : 2,36)	Stationary	-0,01	-1,56 (-5,71 : 2,78)	Stationary	-0,01	-0,99 (-1,88 : -0,10)	Decreasing
30 – 34	-0,01	-0,31 (-2,03 : 1,43)	Stationary	-0,01	-2,96 (-8,51 : 2,92)	Stationary	-0,01	-1,04 (-2,54 : 0,48)	Stationary
35 – 39	-0,01	-1,86 (-3,67 : -0,02)	Decreasing	-0,01	-0,50 (-3,48 : 2,58)	Stationary	-0,01	-0,75 (-1,54 : 0,04)	Stationary
40 – 44	-0,01	-2,91 (-4,80 : -0,98)	Decreasing	-0,01	-1,03 (-2,28 : 0,24)	Stationary	-0,01	-2,23 (-2,90 : -1,56)	Decreasing
45 – 49	-0,01	-1,74 (-3,13 : -0,33)	Decreasing	-0,01	-1,96 (-2,88 : -1,04)	Decreasing	-0,01	-1,84 (-2,08 : -1,60)	Decreasing

β - regression coefficient; APC - Annual Percent Change (%); – Confidence Interval 95%; p Value – probability of statistics signific.

Source: Sistema de Informações sobre Mortalidade (SIM) e Sistema de Informações Hospitalares (SIH / SUS). Data from the Departamento de Informática do Sistema Nacional de Saúde (DATASUS - www.datasus.gov.br). Ministry of Health. Brazil

Table 4: Trends in mortality from Cardiovascular Disease, in young adults, according to selected variables, macro-regions of Brazil, 2008-2017

Types of Cardiovascular Disease	Beta (CI 95%)	APC % (IC 95%)	Trend	Beta (CI 95%)	APC % (IC 95%)	Trend
	Period of 2008-2012			Period of 2013-2017		
North (Gender)						
Homens	-0,01 (-0,03 : -0,01)	-2,95 (-5,79 : -0,03)	Decreasing	-0,01 (-0,02 : 0,01)	-1,08 (-5,15 : 3,18)	Stationary
Mulheres	-0,01 (-0,04 : 0,01)	-2,69 (-8,14 : 3,09)	Stationary	0,01 (-0,01 : 0,01)	0,02 (-1,77 : 1,85)	Stationary
North (Age group - years old)						
20-24	-0,01 (-0,02 : 0,01)	-0,69 (-3,48 : 2,19)	Stationary	0,00 (-0,01 : 0,00)	0,71 (-0,85 : 2,30)	Stationary
25-29	0,00 (-0,01 : 0,01)	0,07 (-2,16 : 2,36)	Stationary	-0,01 (-0,03 : 0,01)	-1,56 (-5,71 : 2,78)	Stationary
30-34	0,01 (-0,01 : 0,02)	1,93 (-1,78 : 5,79)	Stationary	-0,01(-0,06 : 0,05)	-1,58 (-13,23: 11,64)	Stationary

Continuation - Table 4. Trends in mortality from Cardiovascular Disease, in young adults, according to selected variables, macro-regions of Brazil, 2008-2017

Types of Cardiovascular Disease	Beta (CI 95%)	APC % (IC 95%)	Trend	Beta (CI 95%)	APC % (IC 95%)	Trend
	Period of 2008-2012			Period of 2013-2017		
35-39	-0,02 (-0,03 : -0,01)	-4,50 (-6,83 : -2,11)	Decreasing	-0,01 (-0,02 : 0,02)	-0,29 (-4,08 : 3,64)	Stationary
40-44	-0,01 (-0,01 : -0,01)	-1,53 (-2,85 : -0,19)	Decreasing	0,00 (-0,01 : 0,02)	1,61 (-1,79 : 5,12)	Stationary
45-49	-0,02 (-0,03 : -0,01)	-4,30 (-6,43 : -2,11)	Decreasing	-0,01 (-0,02 : 0,01)	-1,35 (-4,77 : 2,20)	Stationary
Northeast (Gender)						
Male	-0,01 (-0,01 : 0,01)	-0,38 (-3,19 : 2,51)	Stationary	0,00 (-0,01 : 0,01)	0,21 (-1,74 : 2,19)	Stationary
Female	-0,01 (-0,01 : 0,01)	-2,12 (-3,33 : -0,88)	Decreasing	-0,01 (-0,02 : 0,01)	-0,60 (-4,00 : 2,92)	Stationary
Northeast (Age group - years old)						
20-24	-0,01 (-0,03 : 0,02)	-0,76 (-5,65 : 4,38)	Stationary	0,01 (0,00 : 0,02)	2,45 (0,13 : 4,84)	Increasing
25-29	0,01 (-0,01 : 0,03)	2,75 (-1,46 : 7,15)	Stationary	-0,01 (-0,03 : 0,01)	-1,59 (-5,70 : 2,71)	Stationary
30-34	0,01 (-0,01 : 0,02)	1,26 (-2,79 : 5,49)	Stationary	-0,01 (-0,05 : 0,02)	-3,26 (-10,09 : 4,08)	Stationary
35-39	-0,01 (-0,02 : 0,01)	-0,98 (-4,39 : 2,56)	Stationary	0,00 (-0,01 : 0,02)	1,03 (-2,06 : 4,21)	Stationary
40-44	-0,01 (-0,02 : -0,01)	-2,85 (-4,66 : -1,02)	Decreasing	0,00 (-0,01 : 0,01)	0,15 (-3,00 : 3,40)	Stationary
Southeast (Gender)						
Male	-0,01 (-0,01 : -0,01)	-1,48 (-2,24 : -0,71)	Decreasing	-0,01 (-0,02: -0,01)	-2,07 (-4,07 : -0,03)	Decreasing
Female	-0,01 (-0,02 : -0,01)	-2,10 (-3,92 : -0,25)	Decreasing	-0,01(-0,02 : 0,01)	-1,15 (-5,17 : 3,04)	Stationary
Southeast (Age group - years old)						
20-24	-0,01 (-0,03 : 0,03)	-0,03 (-5,95 : 6,27)	Stationary	0,01 (-0,03 : -0,03)	-2,07 (-4,07 : -0,03)	Decreasing
25-29	-0,01 (-0,01 : 0,00)	-0,95 (-2,94 : 1,08)	Stationary	-0,01 (-0,03 : 0,02)	-1,22 (-7,07 : 5,00)	Stationary
30-34	-0,01 (-0,02 : 0,01)	-1,62 (-4,68 : 1,54)	Stationary	-0,01 (-0,03 : 0,01)	-1,22 (-7,07 : 5,00)	Stationary
35-39	-0,01 (-0,01 : -0,01)	-1,69 (-3,33 : -0,02)	Decreasing	-0,01 (-0,02 : 0,01)	-1,14 (-4,43 : 2,27)	Stationary
40-44	-0,01 (-0,02 : -0,01)	-2,51 (-4,34 : -0,64)	Decreasing	-0,01 (-0,02 : 0,01)	-1,51 (-4,42 : 1,50)	Stationary
45-49	-0,01 (-0,02 : 0,00)	-1,39 (-3,70 : 0,98)	Stationary	-0,01 (-0,02 -0,01)	-2,07 (-3,43 : -0,69)	Decreasing
South (Gender)						
Male	-0,01 (-0,02 : 0,00)	-1,89 (-4,15 : 0,43)	Stationary	-0,01 (-0,02: -0,01)	-2,91 (-5,56 : -0,20)	Decreasing
Female	-0,02 (-0,03 : -0,01)	-3,61 (-6,45 : -0,69)	Decreasing	-0,01 (-0,02: -0,01	-2,46 (-4,14 : -0,76)	Decreasing
South (Age group - years old)						
20-24	0,02 (-0,02 : 0,07)	5,73 (-4,60 : 17,17)	Stationary	-0,01 (-0,02: 0,01)	-1,21 (-4,61 : 2,32)	Stationary
25-29	-0,01 (-0,07 : 0,05)	-2,20 (-14,83: 12,31)	Stationary	0,00 (-0,02 : 0,03)	1,07 (-5,19 : 7,75)	Stationary

Continuation - Table 4. Trends in mortality from Cardiovascular Disease, in young adults, according to selected variables, macro-regions of Brazil, 2008-2017

Types of Cardiovascular Disease	Beta (CI 95%)	APC % (IC 95%)	Trend	Beta (CI 95%)	APC % (IC 95%)	Trend
	Period of 2008-2012			Period of 2013-2017		
30-34	0,01 (-0,00 : 0,01)	1,20 (-0,04 : 2,46)	Stationary	-0,02 (-0,04 : 0,01)	-3,62 (-9,56 : 2,71)	Stationary
35-39	-0,00 (-0,01 : 0,00)	-0,94 (-1.89 : 0,02)	Stationary	-0,00 (-0,02 : 0,02)	-0,01 (-3,90 : 4,03)	Stationary
40-44	-0,01 (-0,02 : -0,00)	-3,21 (-5,55 : -0,80)	Decreasing	-0,01 (-0,03 : 0,02)	-1,95 (-7,20 : 3,59)	Stationary
45-49	-0,02 (-0,03 : -0.00)	-3,92 (-6,78 : -0,98)	Decreasing	-0,02 (-0,02 :-0,02)	-4,35 (-5,24 : -3,45)	Decreasing
Midwest (Sexo)						
Homens	-0,01 (-0,02 : 0,00)	-1,79 (-4,40 : 0,89)	Stationary	-0,01 (-0,02: -0,00)	-3,15 (-5,56 : -0,67)	Decreasing
Mulheres	-0,02 (-0,03 : -0,01)	-4,62 (-7,10 : -2,08)	Decreasing	-0,02 (-0,03:-0,00)	-4,28 (-7,45 : -1,00)	Decreasing
Midwest (Age group - years old)						
20-24	-0,01 (-0,06 : 0,05)	-1,84 (-13,33: 11,17)	Stationary	-0,02 (-0,12 : 0,07)	-5,02 (-23,39: 17,74)	Stationary
25-29	-0,00 (-0,05 : 0,05)	-0,50 (-11,28: 11,59)	Stationary	-0,04 (-0,10 : 0,02)	-9,04 (-21,09 : 4,85)	Stationary
30-34	-0,00 (-0,03 : 0,02)	-0,79 (-6,28 : 5,03)	Stationary	-0,03 (-0,05 -0,01)	-6,36 (-11,11 :-1,35)	Decreasing
35-39	-0,02 (-0,03 : -0,02)	-4,85 (-6,04 : -3,65)	Decreasing	-0,01 (-0,02 : 0,01)	- 1,47 (-4,95 : 2,13)	Stationary
40-44	-0,02 (-0,04 : -0,00)	-5,16 (-9,14 : -1,01)	Decreasing	-0,02 (-0,03: -0,01)	-4,05 (-6,12 : -1,94)	Decreasing
45-49	-0,01 (-0,02 : 0,01)	-1,37 (-4,87 : 2,26)	Stationary	-0,01 (-0,02 -0,01)	-2,88 (-3,96 : -1,79)	Decreasing

APC: Variação Percentual Anual (%); IC95% - confidence interval 95%. Source: Sistema de Informações sobre Mortalidade (SIM). Dados do Departamento de Informática do Sistema Único de Saúde (DATASUS - www.datasus.gov.br). Ministry of Health. Brazil

30-34 years old with a APC of -6.36%, 40-44 years old with a APC of -4.05%, 45-49 years old was -2.88% % and in all other variables not mentioned remained stationary (table 4).

DISCUSSION

Mortality from Cardiovascular Disease (CVD) in young adults had a decreasing trend in Brazil, between 2008-2017. However, the annual decline was smaller in the second period (2013-2017) compared to the first period (2008-2012). In addition, mortality from CVD has stabilized since 2013 in the total population and in males. Differences in trends were identified between men and women, age groups and regions in Brazil, with a more accentuated decline among women and in young adults with more advanced age. Similar results were found in previous studies[25].

The present study identified regional variation in mortality trends from cardiovascular diseases in young adults. Our results agree with the results of a study carried out in Brazil26 that evaluated the incidence and mortality from cerebrovascular diseases, an important subtype of cardiovascular disease, in the population of young adults (*ie.* 15-49 years) and also observed a reduction in mortality in individuals above of 30 years with regional variation in the period between 2008-2012.

Chronic Non-Communicable Diseases (NCDs) are a major health problem and accounted for 72% of the causes of death in Brazil in 2007. Although still high, there was a 20% reduction in mortality rates due to diseases of the circulatory system and chronic respiratory system, between 1996-2007. The reduction in NCDs can be, in part, attributed to the expansion of Primary Care, improved care and reduced smoking in the last two decades[27].

Early detection of hypertension and constant blood pressure measurements in the young population can inhibit the risk for coronary artery disease.

Adherence to healthy lifestyle behaviors is associated with a 66% reduction in the risk of CVD compared with none or a single behavior[28].

Prospective cohort studies and randomized clinical trials have not demonstrated a benefit in the consumption of vitamin supplementation for the prevention of cardiovascular disease (CVD)[29]. On the other hand, increased consumption of nutrient-rich fruits and vegetables should be recommended.

Korean young adults with stage 1 and 2 hypertension compared with normal blood pressure were associated with increased risk of cardiovascular disease and subsequent events. Young adults may be at increased risk for cardiovascular disease[30].

There is a need to update large prospective studies involving Brazil and other low- and middle-income countries.

Previous epidemiological studies (PURE) linking risk factors with cardiovascular disease and mortality were limited to populations from mostly high-income countries, North America, western Europe, or China. There are few forward-looking data from other low- and middle-income countries, or from other regions of the world. The Global Burden of Disease Study is a compilation of results from existing studies, but is limited by the fact that estimates are derived by combining data from multiple studies with different data collection methods and analyses, performed over different time periods. (may not reflect current patterns of risk factors) and with relatively little data from low- and middle-income countries. These are currently the best data available, but the reliability of some estimates could be improved in large prospective studies involving several countries from different continents and at different economic levels, carried out in a standardized way and simultaneously evaluating the associations of various risk factors. with incidence and mortality[31].

The early control of diabetes also helps in the survival of patients, thus reducing mortality from CAD.

Factor age at onset of type 1 diabetes is an important determinant of survival as well for all cardiovascular disease and increased risk in women. The greater focus on protection is justified in people with early-onset type 1 diabetes[32].

Several interventions help with smoking cessation: mass media campaigns targeting youth and adults, advice from health professionals in both primary care and hospitals, self-help programs, group therapy, telephone counseling, workplace, nicotine replacement, bupropion and varenicline. Mass media campaigns targeting established adult smokers appeared to have similar effects regardless of age, gender, ethnicity, or education[33].

Chronic non-communicable diseases (NCDs) have a high mortality burden and CVD is part of this group of diseases. Individuals with low education and vulnerable are the population most affected by CVD.

Study in rural northern Ethiopia indicates that the dual mortality burden of NCDs and communicable diseases was evident. Public health intervention measures that prioritize disadvantaged NCD patients, such as those who cannot read and write, the elderly, family and non-family co-residents, can significantly reduce NCD mortality in the adult population[34].

Excess fat in the liver is a concern for doctors and healthcare professionals, as unhealthy eating habits and intake of processed foods increase the chance of developing CVD.

The incidence of non-alcoholic fatty liver disease (NAFLD) diagnosis in the community of Olmsted County, Minnesota, between 1997 and 2014 increased 5-fold, primarily in young adults. NAFLD is a consequence but also a precursor of metabolic comorbidities. The incident of metabolic comorbidities attenuates the impact of NAFLD on death and cancels its impact on cardiovascular disease[35].

Therefore, all these factors contribute to the planning and direction of public policies in health systems.

CVD mortality in people under 70 years of age is a concern, as they are reported as premature deaths with years of life lost annually in Brazil and Europe[36].

Up-to-date information on disease trends and how it varies across countries is essential for planning an adequate health system response[37].

It is necessary to consider the limitation of the use of secondary data in mortality studies, as there is some inaccuracy in the identification and recording of the

underlying cause of death. We also do not have individual data, we do not know who is the case and who belongs to the control group or who has or does not have the disease, so with only statistical data we cannot make the mistake of ecological fallacy; misinterpretation that assigns responses to individual levels. However, it should be considered that the present study, concerning a developing, middle-income country with 204 million inhabitants, is one of the first studies in Brazil to use the Prais-Winsten regression model, which allows for correction of first-order autocorrelation in the analysis of series of values organized in time and allowed to evaluate the trend of mortality from ardiovascular Diseases in the younger population, in both sexes, age groups, regions in two periods of five consecutive years.

The study of mortality represents a way of understanding the Epidemiology of Cardiovascular Diseases. The data obtained from the information systems maintained by the Ministry of Health are reliable, allowing their use as a feasible tool to establish accurate data on mortality from Cardiovascular Diseases in specific populations (young adults).

The Family Health Program, launched in 1994, is an important initiative of the national strategy to reduce CVD mortality based on primary health care, covering almost 123 million individuals (63% of the Brazilian population) in 2015[38].

The study carried out on the increasing mortality trend in Minnesota by the US Centers for Disease Control and Prevention (CDC) from the United States in younger populations only reinforces the need to maintain surveillance at the municipal, state and national levels[39].

The metabolic risk factor was responsible for 52.4% of cardiovascular outcomes in Chinese young adults, with hypertension being the biggest risk factor[40].

CONCLUSION

The results demonstrate a decreasing trend in mortality from Cardiovascular Disease (CVD) in young adults in Brazil, between 2008-2017. However, the annual decline occurred only in the first period (2008-2012), while from 2013 onwards, the trend remained stationary only for males.

In addition, a regional difference in CVD mortality was identified according to regions of Brazil. Furthermore, mortality in females declined in both periods in the Central-West and South regions, while mortality remained stationary in the North, Northeast and Southeast regions in the most recent period. In the most recent period (2013-2017) the mortality trend has stabilized for both sexes in the North and Northeast regions.

Cardiovascular disease increased only in the Northeast region, in individuals aged 20-24 years in the second five-year period (2013-2017).

The results suggest that the Brazilian epidemiological transition is not homogeneous for CVD mortality. Young Brazilians should not be hospitalized and progress to death from CVD, as their vital capacity is higher than that of the elderly, a population that is more susceptible to developing CVD. Early detection measures in the causal factors: physical activity practice; weight and overweight measurements; waist-hip measurement; blood pressure control; control of Diabetes Mellitus; diet and life habits will contribute to the reduction of deaths. These findings contribute to the planning and management of the health care system in the country, being the great challenge of Public Health for the next generations.

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Resumo

Introdução: doenças Cardiovasculares são as principais causas de morte no mundo. Apesar da redução da incidência e mortalidade por DCV no século XX, os valores permanecem elevados no século XXI. No Brasil, há lacuna de estudos populacionais que estimaram as taxas padronizadas de mortalidade por doenças cardiovasculares em adultos jovens.

Objetivo: avaliar a tendência da mortalidade por doenças cardiovasculares em adultos jovens, segundo sexo, faixa etária e regiões do Brasil.

Método: estudo de séries temporais com uso de dados secundários oficiais dos Sistemas de Informações sobre Mortalidade (SIM). Foram consideradas todas as mortes por doenças cardiovasculares (I00-I-99) em adultos jovens faixa etária 20-49 anos, residentes no Brasil, no período de 01 de janeiro de 2008 a 31 de dezembro de 2017. Os dados foram extraídos do Departamento de Informática do SUS (DATASUS). Foi utilizado o modelo de regressão Prais-Winsten e calculada a Variação Percentual Anual (VPA). Todas as análises foram realizadas no software STATA 14.0.

Resultados: durante período 2008-2017, foram identificadas 294.232 mortes (8,7%) por doença cardiovascular em adultos jovens com idade entre 20-49 anos. Identificou-se a redução da mortalidade por DCV em todas as regiões do Brasil, exceto nos indivíduos de 20-24 anos, residentes na região Nordeste, a qual apresentou aumento (VPA: 2,45%) ($p<0,05$) 2013-2017. A maior variação da tendência de mortalidade ocorreu na região Sul (VPA: -25,2%). Enquanto a menor variação de tendência da mortalidade ocorreu na região Nordeste (VPA: -8,8%). O declínio anual foi menor no segundo quinquênio (2013-2017) em comparação ao primeiro (2008-2012). Além disso, o declínio foi mais acentuado entre as mulheres (VPA: -2,51%) ($p<0,05$) 2008-2012 e em adultos jovens com idade entre 40-44 anos (VPA: -2,91%) ($p<0,05$) 2008-2012. Ademais, a tendência de mortalidade por DCV se estabilizou a partir de 2013 no sexo masculino ($p>0,05$).

Conclusão: os resultados demonstram tendência decrescente da mortalidade por Doença Cardiovascular em adultos jovens no Brasil, entre 2008-2017. Conclui-se que existe desigualdade na tendência de mortalidade por DCV segundo sexo, faixa etária e regiões do Brasil.

Palavras-chave: doenças cardiovasculares, epidemiologia, mortalidade, adulto jovem.