Mortality due to Cardiovascular Diseases in Women and Men in the Five Brazilian Regions, 1980-2012

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Abstract

Background: Studies have shown different mortalities due to cardiovascular diseases (CVD), ischemic heart disease (IHD) and cerebrovascular diseases (CbVD) in the five Brazilian regions. Socioeconomic conditions of those regions are frequently used to justify differences in mortality due to those diseases. In addition, studies have shown a reduction in the differences between the mortality rates of the five Brazilian regions.

Objective: To update CVD mortality data in women and men in the five Brazilian regions.

Methods: Mortality and population data were obtained from the Brazilian Institute of Geography and Statistics and Ministry of Health. Risk of death was adjusted by use of the direct method, with the 2000 world standard population as reference. We analyzed trends in mortality due to CVD, IHD and CbVD in women and men aged ≥ 30 years in the five Brazilian regions from 1980 to 2012.

Results: Mortality due to: 1) CVD: showed reduction in the Northern, West-Central, Southern and Southeastern regions; increase in the Northeastern region; 2) IHD: reduction in the Southeastern and Southern regions; increase in the Northeastern region; and unchanged in the Northern and West-Central regions; 3) CbVD: reduction in the Southern, Southeastern and West-Central regions; increase in the Northeastern region; and unchanged in Northern region. There was also a convergence in mortality trends due to CVD, IHD, and CbVD in the five regions.

Conclusion: The West-Central, Northern and Northeastern regions had the worst trends in CVD mortality as compared to the Southeastern and Southern regions. (Arq Bras Cardiol. 2016; 107(2):137-146)

Keywords: Cardiovascular Diseases; Mortality; Epidemiology; Brazil; Stroke; Myocardial Ischemia.

Introduction

Cardiovascular diseases (CVD) are the major cause of death in men and women in the five Brazilian geoeconomic regions. The Southeastern and Southern regions had the highest adjusted coefficients of mortality due to CVD, ischemic heart diseases (IHD) and cerebrovascular diseases (CbVD) as compared to the Northern, Northeastern and West-Central regions. Mortality due to CVD in the Southeastern and Southern regions has a pattern similar to that observed in more developed countries, where CVD have a greater participation in the population overall mortality, and mortality due to IHD is more frequent than that due to CbVD. Mortality due to CVD in the Northern, Northeastern and West-Central regions has a pattern similar to that observed in developing countries, where CVD have a proportionally smaller participation in the population overall mortality, and mortality due to CbVD is more frequent than that due to IHD. Similarly, the reduction in mortality due to CVD, IHD and CbVD was significantly higher in the Southeastern and Southern regions as compared to that in the Northern and West-Central regions, while the Northeastern region showed an increase in mortality due to those diseases. Those two studies have shown an approximation of the trends in mortality due to CVD in the five regions. However, Souza et al.1 have assessed the mortality data due to CVD only until 2006, and Baena et al.4 have reported mortality data in the five regions only for IHD until 2010. The present study aimed at assessing the trends in mortality due to CVD, IHD and CbVD, that is, if they are still maintained, in addition to updating data on mortality due to CVD in men and women in the five Brazilian regions from 1980 to 2012.

Methods

This ecological, retrospective study based on temporal series assessed mortality due to DC, IHD and CbVD in a population aged ≥ 30 years in the five Brazilian regions (Northern, Northeastern, West-Central, Southeastern and Southern) from 1980 to 2012. Mortality data were obtained from the Brazilian Ministry of Health web portal, www.datasus.gov.br. The population data of the Brazilian
Institute of Geography and Statistics (IBGE) were obtained from that same web portal. The deaths from 1990 to 1995 were classified according to the World Health Organization’s International Classification of Disease (ICD), Ninth Revision (ICD-9), 1975, and adopted by the 20th World Health Assembly. According to ICD-9, diseases of the circulatory system (DCS) were encoded as 390 - 459, IHD were encoded as 410 - 414, and CbVD were encoded as 430 – 438. Mortality data from the year 1996 onwards were obtained from the Tenth Revision of ICD, and classified as follows: DCS were encoded as 100 - 199; IHD were encoded as 120 - 125; and CbVD were encoded as 160 - 169. For comparison purposes, mortality (per 100,000 inhabitants) was adjusted by using the direct standardization method, using as reference the 2000 world standard population.4 Simple linear regression model was used to analyze and compare mortality trends. The dependent variables were DCS, IHD and CbVD, and the independent variable was year. The significance level adopted for the statistical tests was 5% (p < 0.05). The statistical program used was SAS (SAS Institute Inc., 1989-1996, Cary, NC, USA), 9.2 version.

Results

Overall mortality rates for men and for women due to CVD, IHD and CbVD, as well as the results of the simple linear regression analysis, are shown in Tables 1, 2, 3 and 4, respectively.

Mortality due to CVD increased in the Northeastern region from 1980 to 2012, as follows: 27% in the total population, 33% in men, and 18% in women. In the other regions, a reduction in mortality was observed in the total population, in men and in women. The reductions were more significant in the Southern and Southeastern regions, being greater than 95% in mortality from 1980 to 2012 (Table 1, Figure 1).

The simple linear regression analysis showed: from 1980 to 2012, mortality due to IHD remained unaltered in the Northern (β = 0.02; R² = 0.045; p = 0.237) and West-Central (β = 0.01; R² = 0.016; p = 0.478) regions; increased in the Northeastern region (β = 1.98; R² = 0.897; p < 0.0001); and decreased in the Southeastern (β = -3.27; R² = 0.851; p < 0.0001) and Southern (β = -3.85; R² = 0.905; p < 0.0001) regions (Tables 2 and 4; Figure 2). In men, mortality due to IHD increased in the Northern (β = 0.45; R² = 0.160; p = 0.012), Northeastern (β = 2.41 (95%CI: 2.10-2.75); R² = 0.883; p < 0.0001) and West-Central (β = 0.43; R² = 0.131; p = 0.039) regions. The most important increase occurred in the Northeastern region (128%), followed by the West-Central (22%), and Northern (7%) regions (Tables 2 and 4, Figure 3). In women, mortality due to IHD increased in the Northeastern region (β = 1.54; R² = 0.900; p < 0.0001), and remained unaltered, but with a reduction trend, in the Northern (β = -0.17; R² = 0.071; p = 0.071) and West-Central (β = -0.76; R² = 0.061; p = 0.089) regions. The Northeastern region had the greatest increase in mortality due to IHD (55%) (Tables 2 and 4, Figure 3).

Simple linear regression analysis showed that, from 1980 to 2012, mortality due to CbVD remained unaltered, but with a reduction trend, in the Northern region (β = -0.24; R² = 0.840; p = 0.056), increased in the Northeastern region (β = 0.56; R² = 0.381; p < 0.0001), and had a significant reduction in the Southeastern (β = -7.5; R² = 0.924; p < 0.0001), Southern (β = -3.85; R² = 0.905; p < 0.0001) and West-Central (β = -1.81; R² = 0.562; p < 0.00) regions. Mortality due to CbVD increased in the Northeastern region by 15%, while significant reductions of 240% and 101% occurred in the Southeastern and Southern regions, respectively (Tables 2 and 4, Figure 2). In men, mortality due to CbVD increased in the Northeastern region (β = 0.95; R² = 0.616; p < 0.0001), remained unaltered in the Northern region (β = 0; R² = 0.020; p = 0.438), and decreased in the Southeastern (β = -8.27; R² = 0.911; p < 0.0001), Southern (β = -4.13; R² = 0.881; p < 0.0001) and West-Central (β = -1.72; R² = 0.455; p < 0.0001) regions. In men, mortality due to CbVD increased in the Northeastern region by 26%, the most significant reductions of 216% and 88% occurring in the Southeastern and Southern regions, respectively (Tables 3 and 4, Figure 4). In women, mortality due to CbVD remained unaltered in the Northeastern region (β = 0; R² = 0.044; p = 0.241), and decreased in the Northern (β = -0.60; R² = 0.470; p < 0.0001), Southeastern (β = -6.74; R² = 0.937; p < 0.0001), Southern (β = -3.56; R² = 0.921; p < 0.0001) and West-Central (β = -1.91; R² = 0.061; p < 0.0001) regions. In women, the reduction in mortality due to CbVD was more important in the Southeastern and Southern regions, 274% and 119%, respectively (Tables 3 and 4, Figure 4). The convergence of the trends in mortality due to IHD and CbVD observed in the five Brazilian regions resulted mainly from the reduction in mortality due to those diseases in the Southeastern and Southern regions. The convergence of mortality due to CbVD was significant from 1997 onwards, while, for IHD, that occurred only from 2007 onwards (Figure 5).

Discussion

This study showed the highest reductions in mortality due to CVD, IHD and CbVD in the Southeastern and Southern regions, while the Northeastern region had mortality due to those diseases increased. The results varied in the Northern and West-Central regions. Therefore, the Southeastern and Southern regions behaved similarly to the most developed countries, with a persistent trend of reduction in mortality due to CVD.7,8

On the other hand, the mortality trends of the other regions behaved similarly to those of developing countries. The population’s more limited access to a more appropriate health care system, in addition to socioeconomic and cultural aspects, might justify those trends. For example, the control of risk factors accounted for at least a 50% reduction in mortality due to those diseases in the Southeastern and Southern regions. The convergence of mortality due to CbVD was significant from 1997 onwards, while, for IHD, that occurred only from 2007 onwards (Figure 5).
consumption of fruits and vegetables and greater practice of physical activity in the Southeastern and Southern regions. Regarding risk factors [systemic arterial hypertension (SAH), dyslipidemia and diabetes], the Southeastern and Southern regions showed: greater proportion of individuals aged ≥ 18 years measuring blood pressure; higher use of antihypertensive drugs; greater access to at least one medication obtained from the Popular Pharmacy Program; and more frequent measurement of serum glucose, total cholesterol and triglyceride levels. Briefly, the population’s access to the health care system was better in the Southeastern and Southern regions.
Similarly, regarding risk factor assessment, that PNS report showed that women performed better as compared to men, which can even intensify the already existing natural protection of women against the atherosclerotic process, and, thus, against cardiovascular events.

In addition, the better access to the health care system in the Southeastern and Southern regions can justify the greater reduction in mortality due to CVD as compared to IHD. That results from the fact that the logistics involved in the diagnosis and treatment of SAH, the major risk factor...
for CbVD, is significantly less complex than that required for IHD. Ischemic heart diseases involve more risk factors, such as dyslipidemia, smoking habit, diabetes and SAH, and their diagnosis depend on more complex complementary tests.

In addition to the drug treatment complexity, there is limited availability of the intervention treatment, restricted to large urban centers. Such diagnostic and therapeutic limitations can justify the heterogeneity in the risk of death due to acute myocardial infarction in the different Brazilian regions.\(^1\)

Similarly, social inequalities and low educational level are additional conditions associated with higher mortality due to CVD.\(^12-14\) The Southern and Southeastern regions have the
Table 4 – Simple linear regression model for mortality due to cardiovascular diseases (CVD), ischemic heart diseases (IHD) and cerebrovascular diseases (CbVD) in men and women in the period studied (1980-2012) in the five Brazilian regions

|                | Total | Men | Women |
|----------------|-------|-----|-------|
|                | Raj²  | β   | 95%CI| P    | Raj² | β   | 95%CI| P    | Raj² | β   | 95%CI| P    |
| CVD Northern   | 0.23  | -1.56 | -2.53 – -0.59 | 0.003 | 0.02 | -0.68 | -1.78 – -0.42 | 0.220 | 0.51 | -2.45 | -3.30 – -1.60 | < 0.0001 |
| CVD Northeastern| 0.70  | 3.72 | 2.65 – 6.60 | < 0.0001 | 0.76 | 4.75 | 3.89 – 5.82 | < 0.0001 | 0.57 | 2.58 | 1.78 – 3.39 | < 0.0001 |
| CVD Southeastern| 0.97  | -15.30 | -16.18 – -14.43 | < 0.0001 | 0.97 | -17.22 | -18.23 – -16.20 | < 0.0001 | 0.97 | -13.38 | -14.17 – -12.60 | < 0.0001 |
| CVD Southern   | 0.93  | -12.12 | -13.32 – -10.92 | < 0.0001 | 0.93 | -13.53 | -14.84 – -12.21 | < 0.0001 | 0.92 | -10.70 | -11.81 – -9.57 | < 0.0001 |
| CVD West-Central| 0.63  | -5.17 | -6.59 – -3.76 | < 0.0001 | 0.50 | -4.70 | -6.37 – -3.03 | < 0.0001 | 0.74 | -5.64 | -6.86 – -4.44 | < 0.0001 |
| IHD Northern   | 0.14  | 0.14 | -0.10 – 0.38 | 0.238 | 0.16 | 0.45 | 0.11 – 0.80 | 0.012 | 0.07 | -0.17 | -0.35 – 0.02 | 0.072 |
| IHD Northeastern| 0.90  | 1.97 | 1.73 – 2.22 | < 0.0001 | 0.88 | 2.41 | 2.10 – 2.73 | < 0.0001 | 0.90 | 1.54 | 1.36 – 1.73 | < 0.0001 |
| IHD Southeastern| 0.97  | -4.64 | -4.92 – -4.36 | < 0.0001 | 0.97 | -5.47 | -5.83 – -5.12 | < 0.0001 | 0.97 | -3.81 | -4.03 – -3.60 | < 0.0001 |
| IHD Southern   | 0.86  | -3.27 | -3.76 – -2.78 | < 0.0001 | 0.87 | -3.92 | -4.47 – -3.37 | < 0.0001 | 0.82 | -2.62 | -3.10 – -2.17 | < 0.0001 |
| CbVD Northern  | 0.08  | -0.24 | -0.49 – 0.01 | 0.056 | 0.01 | 0.11 | -0.17 – -0.39 | 0.440 | 0.45 | -0.60 | -0.84 – -0.37 | < 0.0001 |
| CbVD Northeastern| 0.38  | 0.56 | 0.31 – 0.81 | < 0.0001 | 0.62 | 0.95 | 0.68 – 1.22 | < 0.0001 | 0.01 | 0.14 | -0.10 – 0.38 | 0.234 |
| CbVD Southeastern| 0.92  | -7.51 | -8.29 – -6.74 | < 0.0001 | 0.91 | -8.27 | -9.20 – -7.34 | < 0.0001 | 0.94 | -6.74 | -7.37 – -6.11 | < 0.0001 |
| CbVD Southern  | 0.90  | -3.84 | -4.38 – -3.40 | < 0.0001 | 0.88 | -4.13 | -4.68 – -3.59 | < 0.0001 | 0.92 | -3.56 | -3.94 – -3.18 | < 0.0001 |
| CbVD West-Central| 0.56  | -1.81 | -2.38 – -1.24 | < 0.0001 | 0.45 | -1.72 | -2.39 – -1.05 | < 0.0001 | 0.67 | -1.91 | -2.39 – -1.43 | < 0.0001 |

95% CI: 95% confidence interval.

Figure 1 – Simple linear regression analysis of mortality due to cardiovascular diseases (CVD) in individuals aged ≥ 30 years in the five Brazilian regions from 1980 to 2012.
The highest urban developing indices, which is assessed by the progress of the regions in three basic dimensions: income, educational level and health. Half of the mortality due to CVD before the age of 65 years can be attributed to poverty. Similarly, the educational level has an inverse relationship with mortality due to CVD. Inadequate feeding, insufficient physical activity, alcohol consumption and smoking are important risk factors for DVC and more prevalent in the least favored social levels. Therefore, primary and secondary prevention programs aimed at those population strata can significantly impact morbidity and mortality due to CVD. For example, the “Family Health Strategy” program facilitated actions for health promotion and perfected the process of prevention and early diagnosis of the major risk factors for CVD.

Another important point observed in our study was the convergence of the trends in mortality due to IHD and CbVD in the Brazilian regions. The convergence of the trends in mortality due to IHD occurred from 2007 onwards, while that due to CbVD occurred 10 years earlier. That behavior reflects in the earlier and steepest drop in mortality due to CbVD, resulting in the epidemiological transition phenomenon, which is predominance of mortality due to IHD over that due to CbVD.
This study’s major limitations relates to the quality of Brazilian mortality data, such as errors related to the diagnosis and accuracy of death certificates, ill-defined causes of deaths and data inputting errors. The number of death certificates with symptoms, signs and ill-defined health conditions reported as cause of death is an indirect indicator of the data quality pattern. Despite the progressive improvement, the number of death certificates with those characteristics in the Northeastern, Northern and West-Central regions is still significant.20,21

In addition, validation studies for mortality rate data are not available in most Brazilian states or cities. Thus, the reduction in the number of death certificates with symptoms, signs and ill-defined health conditions reported as cause of death can redirect to the increase in the number of death certificates due to CVD, and consequently, artificially reflect as an increase in mortality due to CVD in the Northeastern, Northern and West-Central regions.

Conclusion

The persistence of those mortality trends in the five Brazilian regions will lead, in a few years, to an inversion in the risk of death in the regions, making the Northeastern region, and to a lesser extent, the Northern and West-Central regions, those with the highest coefficients of mortality due to CVD. Thus, intensification of preventive public health policies for CVD and improvement in socioeconomic conditions, especially in the Northeastern region, might result in similar coefficients of mortality in the five Brazilian regions.
Author contributions

Conception and design of the research, Statistical analysis and Writing of the manuscript: Mansur AP; Acquisition of data: Favarato D; Analysis and interpretation of the data and Critical revision of the manuscript for intellectual content: Mansur AP, Favarato D.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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