

Comparative study on mortality due to cardiovascular diseases in São Caetano do Sul, São Paulo, Brazil, between 1980 and 2010

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Abstract *Analysis of the mortality due to cardiovascular diseases (CVD) can provide subsidies for preventive and control measures. The goal of this article is to compare CVD mortality rates in São Caetano do Sul, the state of São Paulo and the country as a whole. Standardized mortality and mortality due to CVD were calculated for the 1980-2010 period. We found a significant reduction in cardiovascular mortality in all three study units during this period, with the largest reduction in CVD in São Caetano do Sul. The largest mortality rate was found in the state of São Paulo. In adults 30 to 59, the CVD mortality rate in São Caetano do Sul was three times as high in men as in women, yet among adults 60 and older, CVD mortality was higher in women than in men. The lower rate is the result of implementing different healthcare policies. However, specific interventions are required that focus on changes in lifestyle, especially among adult men and the elderly.*
Key words *Cardiovascular disease, Mortality, Mortality rate, Epidemiology*

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Introduction

Political, economic and social transformations in Brazil and the world have resulted in complex demographic, epidemiologic and nutritional transition processes¹. These in turn have had a major impact on life expectancy. The nation has gone from high levels of infant mortality and a predominance of infectious and parasitic diseases, to higher mortality rates among those more advanced in age due to chronic, non-transmissible diseases and external causes². In the last 60 years of the 20th century, mortality due to all causes in Brazil dropped due to public health measures and preventive medicine techniques that, added to economic development, resulted in lower infant mortality and longer life-expectancy³⁻⁷.

The number of people over the age of 60 in our country increased 33.65% between 2000 and 2009, the result being that now chronic non-transmissible diseases (CNTD) predominate, in particular cardiovascular diseases (CVD), the main cause of death for both genders^{8,9}. Although the population in general is increasing and living longer, different studies report declining mortality due to CVD as the result of changes in lifestyle, improved technology for disease prevention and treatment, and the implementation of a range of public health policies⁸⁻¹². According to Lima Costa et al.¹, between 1996 and 2000, deaths due to cerebrovascular and ischemic heart diseases experienced the sharpest drops. Mathias et al.¹³ also found a proportional decrease in mortality due to CVD and ischemic heart disease, despite an increase in the incidence of high blood pressure.

The city of São Caetano do Sul is located in the state of São Paulo. It has 149,263 inhabitants living in a total of 15.3 sq. km¹⁴. It has the best UN Human Development Index (HDI) in Brazil (0.862)¹⁵, and is currently ranked #3 in the municipal development index¹⁶ published by FIRJAN, the State of Rio de Janeiro Federation of Industries. It has the 8th largest per capita GDP of the state of São Paulo¹⁶. 19.1% of the city's population is 60 or older¹⁴. Thus, understanding the health characteristics of the population living in a city with a high HDI by analyzing CVD mortality can provide subsidy for prevention and control measures.

The goal of this study was to compare CVD mortality by gender and age in the city of São Caetano do Sul with that of the rest of the state and the country, in the period between 1980 and 2010.

Methods

This is a trend study on CVD mortality. The analysis unit was the population residing in São Caetano do Sul (149,263 inhabitants), in the state of São Paulo (43,663,672 inhabitants) and Brazil (201,032,714 inhabitants)¹⁴.

This study used the basic causes of death due to circulatory disease between 1980 and 2010; death records were obtained from DATA-SUS (the Unified Healthcare System Database), and population data provided by the IBGE (the Brazilian Institute of Geography and Statistics). These analyses excluded all cases lacking data on the study variables. The variables analyzed in this study were age, gender and basic cause of death according to the International Classification of Diseases (ICD). Between 1980 and 1985, ICD-9 was used, where death due to circulatory diseases fell into Chapter VII, codes 390 – 459. Since 1996 ICD-10 has been used, which classifies CVD deaths as I00 to I99 (Chapter IV).

To quantify mortality and make comparisons, certified CVD deaths in Brazil, the state of São Paulo and the city of São Caetano do Sul were offset by part of the deaths due to poorly defined causes by age and gender in the study period. This was done in the same proportion as CVD deaths excluding poorly defined causes. For standardization adjustments, and to arrive at standardized mortality rates we used the formula $X_c = X + M * X / (T - M)$, where X is the number of CVD deaths, M the number of deaths due to poorly defined causes, and T the number of deaths for all causes. This resulted in standardized rates for death due to CVD (X_c)¹⁷. We also estimated the annual means and differences in standard mortality rates using linear regression models. To analyze statistically significant differences we used the Wilcoxon Signed Rank test for the mortality variable adjusted using the Bonferroni Correction to identify differing regions when compared peer to peer. This test was also applied to check for possible differences between genders for the mortality variable. To look at the trend of death due to CVD we used a simple linear regression model using the adjusted mortality rate as the dependent variable, and the year of death as the independent variable. The independent regression coefficient () is the mean annual increase in mortality rate. To check if the assumption is reasonable the coefficient of determination (R^2)¹⁸ was calculated. For statistical analyses we used SPSS (v.14; SPSS Inc., Chicago, IL USA).

Results

By comparing deaths due to CVD in 2010 (Table 1), we found that the state of São Paulo had the highest standardized mortality among people aged 30 or over, followed by Brazil and the city of São Caetano do Sul. However, SCS has the lowest mortality rate for all ages. Comparing mortality rates by age and gender in São Caetano do Sul shows that in the 30 to 59 age bracket, men had a higher mortality rate than women, whereas among adults over 60, the mortality rate was higher among women than men. When analyzed in proportion, people aged 60 and over the city of São Caetano do Sul had the highest proportional mortality compared to other analysis units.

Table 2 shows the mean mortality rates in the three analysis units between 1980 and 2010. These vary quite significantly. For this reason, it is fair to say that mean CVD mortality in Brazil is lower than it is in the state of São Paulo, which has a lower rate than São Caetano do Sul. It is also fair to say that the rate is statistically similar for both genders, but with is a trend towards lower CVD mortality among women than men.

CVD mortality rates (Figure 1) have been coming down in Brazil -0.18 (95% CI: -0.21 to -0.15), in the state of São Paulo -0.15 (95% CI - 0.16 to 0.14), and especially in São Caetano do Sul -0.15 (95% CI - 0.16 to - 0.14), which at the end of the period was lower than the other units analyzed.

In a gender comparison, in the city of São Caetano do Sul mortality due to CVD (Figure 2) is declining among men -0.09 (95% CI -0.11 to -0.08), and especially among women -0.09 (95% CI -0.10 to -0.07)

Discussion

As the population ages due to the demographic transition underway, especially in the Southeast of the country, the incidence of CVD is not homogeneous across the nation. Although some studies show a decrease in CVD deaths^{1,3-8,11,19-21}, possibly due to accelerated economic development, bringing with it better living conditions and less exposure to infections during the perinatal period⁴, such deaths may present themselves in a non-homogeneous manner within the population groups of a given country, as mentioned by Frank et al.²². Reinforcing these findings, Mansur et al.¹⁹ found an increase in the risk of death due to these diseases in the less developed states of the country, which agrees with the study by Farias et al.²³, which suggests that despite a decrease in recent years, these deaths may show different patterns in the different socioeconomic groups.

In comparing the cause of death in the city of São Caetano do Sul, the state of São Paulo and Brazil, this study found significantly different mortality rates, with the state of São Paulo

Table 1. CVD mortality in 2010 in Brazil, the state of São Paulo and São Caetano do Sul.

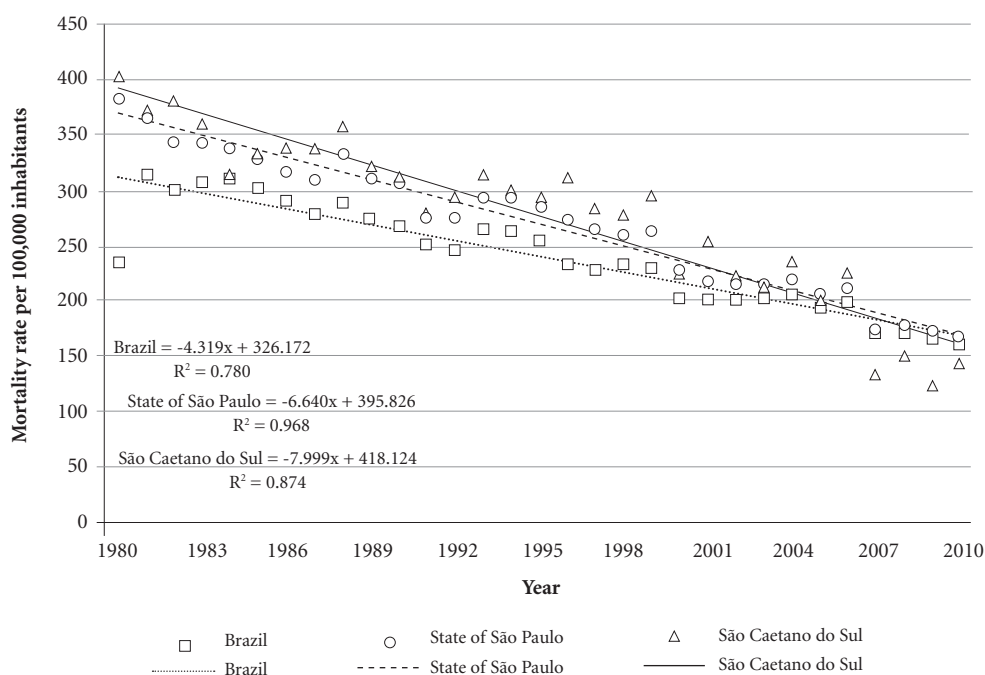
Age group	Brazil			State of São Paulo		
	Deaths	TM	M (%)	Deaths	TM	M (%)
0 to 29 years old	3,592	2.0	1.2	828	2.1	1.2
30 to 59 years old	73,001	35.1	21.8	18493	37.7	22.3
60 or older	380,869	123.6	76.9	65566	129.2	76.4
Total	457,461	160.7	100.0	84.887	169.0	100.0

Age group	São Caetano do Sul								
	Both genders			Men			Women		
	Deaths	TM	M (%)	Deaths	TM	M (%)	Deaths	TM	M (%)
0 to 29 years old	2	1.5	1.0	2	2.6	1.5	-	-	-
30 to 59 years old	62	29.5	20.4	45	46.2	26.0	17	14.5	8.0
60 or older	403	113.7	78.6	159	128.6	72.5	244	167.8	92.0
Total	467	144.7	100.0	206	177.4	100.0	261	182.3	100.0

TM (0/0000): Age-adjusted mortality per 100 thousand inhabitants; M (%): standardized mortality.

Table 2. Mean CVD mortality rates (1980 - 2010) in Brazil, the state of São Paulo and São Caetano do Sul.

Study Units	n	Mean	Standard Deviation	Minimum	Maximum	25 percentile	50 percentile (median)	75 percentile	Sig. (p)
Brazil	31	257.1	44.5	180.4	330.1	221.6	250.0	291.7	
State of São Paulo	31	289.6	61.4	188.4	403.6	235.1	293.5	334.8	<0.001
São Caetano do Sul	31	290.1	77.8	131.5	407.5	231.3	310.1	342.3	
Men	31	350.4	84.5	171.7	475.7	289.5	371.6	405.3	0.057
Women	31	334.1	93.0	139.5	467.9	265.5	357.6	401.0	

**Figure 1.** Evolution in CVD mortality rates (1980 - 2010) in Brazil, the state of São Paulo and São Caetano do Sul.

having the highest mortality rates. It is likely that this difference is related to the HDI for the city of São Caetano do Sul compared to the rest of the country. In other words, [one would expect] longer life expectancy but higher rates of CVD mortality. However, the results of this study in São Caetano do Sul seem not to follow this rule, as of the three units analyzed, it had the highest HDI and the lowest mortality due to CVD, even in age groups where death due to CVD is considered premature death. Ishitani et al.²⁴ and Godoy et al.⁵ showed a negative association between CVD

mortality in Brazil and the socioeconomic situation (income, years of schooling and housing), in particular schooling. On the other hand, Muller et al.⁶ found no relationship between unfavorable socioeconomic conditions and CVD mortality in the state of Paraná, possibly due to the heterogeneous socioeconomic profile of each macro-region. In Rio de Janeiro, we found an inverse linear relationship between mortality due to cerebrovascular disease and the HDI. For each 0.05 point reduction in HDI, the risk of death due to cerebrovascular causes increased 65% (95% CI:

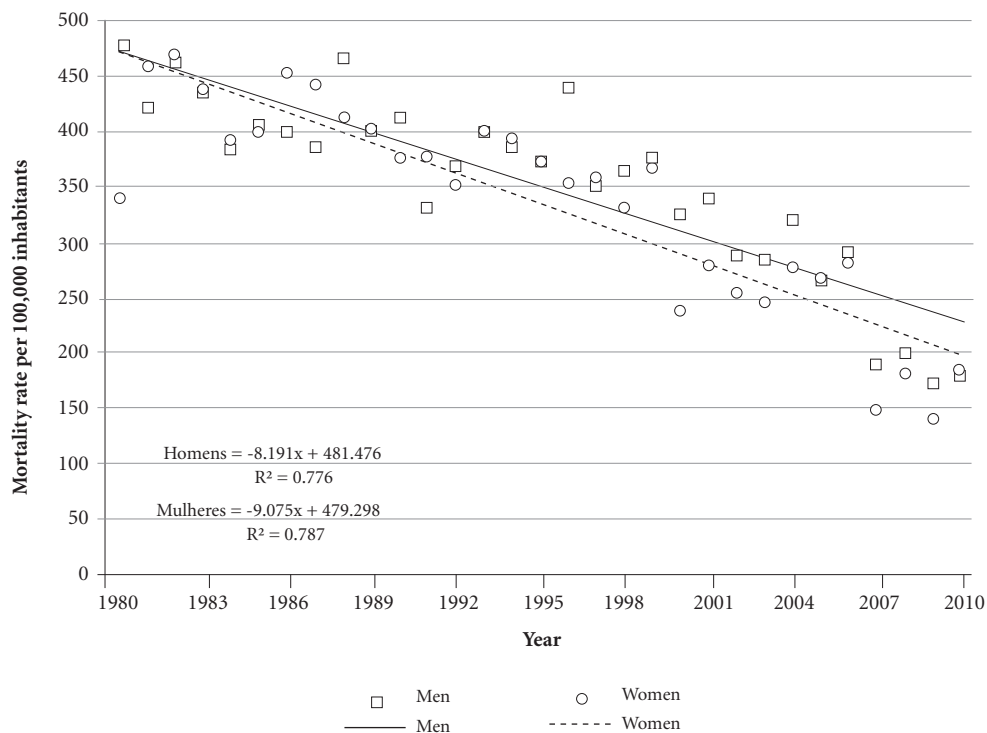


Figure 2. Evolution in CVD mortality rates (1980 - 2010) in Brazil, the state of São Paulo and São Caetano do Sul by gender.

1.63 - 1.66). The risk due to cerebrovascular disease was 10 times larger in the regions with lower HDI (Campo Grande and Santa Cruz: HDI = 0.74) than in the region with the highest HDI (Gavea: HDI = 0.97)²⁵. According to Kaplan and Keil²⁶, higher income means easier access to better goods and services, including quality education and healthcare. Studies show that inequality in education is the more harmful as it has a direct effect on adopting healthy lifestyles, which minimize the effects of the risks for cardiovascular disease^{5,27-29}. Factors increasing the risk of CVD, such as high blood pressure, high cholesterol, tobacco use and a sedentary lifestyle are more frequent among those with less schooling^{30,31}. The simultaneous existence of two or more of these factors has also been found in people with fewer years of schooling³⁰. Cerebrovascular and ischemic heart diseases remain the leading causes of death, but are declining as cardiovascular risk factors are controlled, socioeconomic conditions improve and new medical technology procedures advance, especially in the more developed areas of the country³².

The lower mortality rate found in the city of São Caetano do Sul, possibly the result of an interaction between biological, social and behavioral factors, make this city a natural object for further and deeper studies, especially in terms of group health. However, if we analyze the results for São Caetano do Sul by gender, we find that the calculated significance value of 0.057 shows a “strong tendency” to different CVD mortality rates (Table 2) for men and women, however we stress that this is merely a “tendency”. A “strong tendency to find a difference” is indicated by the calculated significance (the value of p) between 0.050 (5%) and 0.100 (10%). On the other hand, in the 30 to 59 age group, [CVD] mortality was three times larger in men than in women, yet among those 60 and over [CVD] mortality is higher in women than in men, a fact also found by Lima-Costa et al.¹. Previous studies have shown that men are more subject to risk factors such as tobacco and alcohol use, and more often exposed to occupational hazards. They also tend to resort to healthcare services less often than women. Men and women seek healthcare ser-

vices for different reasons. Women use them as a preventive measure, and thus the likelihood that the disease will be followed is higher. Men tend to use healthcare services more in emergencies, and are hospitalized more frequently³³. Chor et al.³⁴ found that, among adults aged 35 to 44, the risk of dying from acute myocardial infarction in Brazilian state capitals was three times higher than it is in the United States for men, and about four times higher for women. Regarding the risk of death due to cerebrovascular disease in Brazil and the US, men aged 35 to 44 were five times more likely to die, and women six times more likely. Lotufo³⁵ compared mortality due to cardiac and coronary artery disease in adults 45 to 64 in 8 Brazilian state capitals (Belém, Recife, São Paulo, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre) and in other countries between 1984 and 1987. He found that death due to coronary disease in Brazilian cities is as high, or even higher, than in the US and Europe, especially among women. According to the author, even though male mortality is present in Brazil, compared to other countries, the chance of a Brazilian woman dying of coronary disease is larger than of a Brazilian man of the same age. In part, these results can be explained by factors such as the increased lethality of coronary disease in women, the absence of a medical culture that values cardiac symptoms in this gender, increased tobacco use and less care during menopause.

Cesse et al.¹¹ found a reduction in mortality due to circulatory system diseases in Brazil between 1950 and 2000, and that the pattern of reduction differed among the various state capitals. According to the authors, the highest risks and the biggest decreases since the start of the study period were found in Fortaleza, Salvador, Belo Horizonte, Rio de Janeiro and São Paulo, possibly due to significant urban development and industrialization in the first half of the 20th Century, influencing the emergence of circulatory diseases earlier in life. In state capitals such as Manaus, Belém and Vitória, and the state capitals of the Northeast, South and Middle-West, where urbanization and industrialization really only took off in the second half of the century, an increase in the risk of death due to circulatory disease also increased only after 1950.

Lower CVD mortality has been found in several countries in the developed world¹² due to changes in lifestyle and improved disease prevention and treatment technology. According to Lima Costa et al.¹, between 1996 and 2000, cerebrovascular and ischemic heart diseases showed the sharpest drops in the cause of mortality in Brazil, in particular among women^{6,8}. Mathias et al.¹³ also found a proportional decrease in mortality due to CVD and ischemic heart disease, despite an increase in the incidence of hypertension. Mansur and Faverato¹⁰ also noted a reduction in death due to ischemic heart and cerebrovascular disease in Brazil and in metropolitan São Paulo. In fact, Brazil is focusing more on chronic non-transmissible diseases. Public policies have expanded the traditional scope of medical care to include prevention, health promotion and inter-sectoral activities, among which we would mention the National Plan to Reorganize Attention to Hypertension and Diabetes Mellitus, the Stop Smoking Program, easier access to immediate care units (UPA), programs to distribute drugs for chronic diseases, such as *Farmácia Popular*, expanded support to Family Health Strategy teams by other healthcare professionals such as nutritionist, Physical Education teachers, psychologists and psychiatrists. Other possible causes that may have contributed to this outcome are the use of anti-hypertensive, hypolipidemic and hypoglycemic drugs, the increased use of polyunsaturated fats, less ingestion of cholesterol and a decline in smoking⁵. According to a study performed by Unal et al.³⁶, over half of the CVD deaths in the UK between 1981 and 2000 was due to a reduction in risk factors, especially smoking.

This study, based on secondary studies, has limitations resulting from problems registering CVD deaths, and may underestimate CVD mortality rates in the state of São Paulo and especially in Brazil.

This study shows that, over the past 30 years, CVD mortality in the city of São Caetano do Sul has gone down faster than it has in the rest of the state and the country, especially among women. However, rates are still high for women over 60 and men between the ages of 30 and 59. The lower rate is the result of implementing different healthcare policies. However, specific interventions are required that focus on changes in lifestyle, especially among adult men and the elderly.

Collaborations

FE Luz took part in study design, data collection and article writing. BRM Santos took part in data analysis and article writing. W Sabino coordinated study design, data collection and analysis and article writing.

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