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Mortality Trends due to Circulatory System Diseases in Brazil: 1950 to 2000

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Summary

Background: The circulatory system diseases (CAD), one of the most important current health problems, have started to show a declining trend in mortality in several countries, although they are still proportionally the number one regarding the statistics of morbimortality.

Objective: To analyze the mortality trend due to CAD in Brazilian capital cities, during the period of 1950 to 2000.

Methods: Temporal series study, of Standardized Mortality Ratios by CAD. We used secondary data on death from the statistical annual reports from IBGE (the Brazilian Institute of Geography and Statistics) and from the Mortality Information System. We carried out a linear trend analysis of the Standardized Mortality Ratios due to CAD in the Brazilian capital cities that presented complete mortality series, considering the census years during the study period (1950 to 2000).

Results: Although proportionally the CAD represent the main cause of death in the Brazilian population, as well as presenting a proportional increase during the period of analysis of this study, the risk of death, represented by the Standardized Mortality Ratios, have been decreasing, particularly from the eighties onward. It is noteworthy the fact that Fortaleza, Salvador, Belo Horizonte, Rio de Janeiro and São Paulo presented elevated Standardized Mortality Ratios, however with a decreasing trend ($p < 0.05$ and $p < 0.10$), since the start of the analyzed period.

Conclusion: The behavior of the risk of death due to CAD suggests that this group of diseases is the first to be established, following the increase in industrialization observed from the thirties onward and after the Second World War in Brazil, as it occurred in Sao Paulo and Rio de Janeiro, cities that historically experienced a process of development and urbanization earlier and at a higher extent, when compared to the other capital cities. (Arq Bras Cardiol 2009; 93(5) : 454-460)

Palavras-chave: Cardiovascular diseases / mortality / epidemiology; vascular diseases / mortality / epidemiology; Brazil.

Introduction

The circulatory system diseases or coronary artery diseases (CAD), due to their importance and magnitude, constitute one of the most important current health problems, in both developed as well as developing countries, among the latter, Brazil[1]. The CAD correspond to the first cause of death in all regions of the country and in both sexes, being responsible for 31.8% of the total of deaths and for 10% of hospital admissions[2,3], as well as for the highest rate of premature death, followed by cancer[4]. However, after decades on the rise, a declining trend in mortality due to CAD has been observed in several countries. In the USA, the decline in mortality due to CAD has been observed since the end of the sixties, due to the declining behavior of the Ischemic Heart Diseases (IHD) and the Cerebrovascular Diseases (CVD). In Western Europe, declining trends in mortality due to CAD have also been observed in the same period[5]. In Brazil, declining trends have been described in the city and the state of Sao Paulo from the seventies onward, through studies that detected the decrease in mortality due to IHD and CVD. However, it is noteworthy the fact that the decrease in mortality has not been accompanied by the decrease in the occurrence of these diseases[6-10]. It is important to mention that between the 40s and the 60s, Sao Paulo experienced an increase in mortality due to this group of diseases, with the predominance of IHD[11]. In other states and capital cities, studies[12,13] also detected the decrease in mortality due to CAD and these studies were carried out based on information about death of recent decades, from 1980 to the present date.

Considering these facts, the aim of the present study was to analyze the mortality trend due to CAD in Brazilian capital cities, during the period of 1950 to 2000, in order to observe the changes in mortality trend due to this group of diseases.

Methodological procedures

A temporal series study was carried out. The study sample consisted of the known universe of deaths due to CAD in

Brazilian capital cities during the census years from 1950 to 2000 as well as in the year 1996, when the population was recounted. We chose to work with the death data from census years, as the complete mortality series for this group of deaths, considering the inter-census years between 1950 and 2000, could not be retrieved from the governmental organs in any of the Brazilian capitals. It is important to mention that complete mortality series for this group of deaths in the aforementioned census years could only be constructed for the capitals of the Northeast, Southeast and South regions.

The official death data published in the statistical annual reports of the country and published by IBGE[14] were used, as well as data from the Mortality Information System (MIS) of the Department of Informatics of the Brazilian Public Health System (DATASUS)/Ministry of Health (MH). In order to do that, we considered the groups of causes of death grouped by the International Classification of Diseases (ICD), which is currently in its 10th version and the reviews of this codification performed during the study period. The Brazilian Institute of Geography and Statistics (IBGE) was the primary source of the population census data.

Initially, the Proportional Mortality (PM) due to CAD in the Brazilian capitals was calculated, regarding the census years from 1950 to 2000 and the year of 1996, in relation to the total deaths that occurred in the referred capitals during the study period. Subsequently, the calculation of the Proportional Variation due to CAD in the Brazilian capitals was performed, based on the Proportional Mortality in the last year of analysis (2000) and the Proportional Mortality in the first year of analysis (1950) in the capitals, considering the equation:

Proportional Variation = (PM 2000/PM 1950) – 1.

With the objective of estimating the risk of death due to CAD in the capitals, the Gross Coefficient of Mortality (GCM) per 100,000 inhabitants, in the Brazilian capitals, within the same period.

To control the effect of different age structures of the Brazilian capitals during the period of analysis, we carried out the standardization of the Gross Coefficients of Mortality due to CAD per 100,000 inhabitants. To do that, we used the indirect standardization technique in the sense of verifying whether the number of expected deaths was different (higher or lower) than the one observed without the elimination of the "age" effect on the populations of the study capitals.

The pattern used was the age structure of Brazil in the year 2000 and the distribution of its gross rates for the CAD group. Subsequently, the Standardized Mortality Ratio (SMR) was calculated based on the ratio between the observed deaths (ObD) and the expected deaths (ExD) in the capital cities of the country.

Thus, we emphasize that the Gross Coefficients of Mortality represent the expression of the intensity at which deaths occur due a specific cause in a population, during a certain time interval. Its use for comparative purposes is limited, particularly when populations with different age structures are involved.

To verify the temporal trend of mortality due to CAD, the linear trend analysis of the SMR was performed. Simple linear regression models were estimated, defined as: $Y = \alpha + \beta$ YEAR, with α being the mean coefficient in the analyzed period and β the mean increment (increase or decrease) in the period.

The following explicative values of the linear regression were defined: the value of β concerning the increment of deaths (increase or decrease); the degree of statistical significance ($p < 0.05$ and $p < 0.10$); and the Coefficient of Correlation (R^2) that measures the strength of the linear correlation (the higher R^2, the more intense is the linear correlation).

To implement and analyze the database, the software packages TabWin 32, Statistical Package for the Social Sciences (SPSS) 8.0 and Excel 2000 were used. The present study does not have ethical/moral implications, as it uses secondary and grouped data, which do not have information through which the individuals can be identified. However, the original project of this thesis was submitted to and approved by the Ethics Committee in Research (CER) of CPqAM/FIOCRUZ/Recife/PE, Brazil.

Results

Table 1 shows the Proportional Mortality and the Proportional Variation due to DAC, in Brazilian capitals, in the period from 1950 to 2000. In spite of the fluctuation of data, the Proportional Mortality due to CAD increased throughout the analysis period. In many of the capitals, it was possible to observe that the PM due to CAD increased until the year 1991 and then decreased until the end of the series. The most expressive Proportional Mortalities were observed in the capitals of the Southeast and South regions; however, the highest proportional variations were observed in the capitals of the North, Northeast and Midwest regions. The highest PM was verified in the capital city of Natal (10.7%).

The results concerning the behavior of the Standardized Mortality Ratios and the analysis of the temporal trend of the mortality due to CAD in the Brazilian capitals in the period from 1950 to 2000 are shown in Table 2.

We observed that most of the capitals presented higher Standardized Mortality Ratios between the years 1970 and 1980. In the North region, only the cities of Manaus and Belem presented complete curves of mortality. In both, the Standardized Mortality Ratios increased until the middle of the period, being more expressive between the years of 1960 and 1980, with a posterior decrease (Figure 1).

Thus, in the Northeast region, the capitals presented higher Standardized Mortality Ratios between the years 1970 and 1980, with a posterior decrease. However, Fortaleza and Salvador presented high and decreasing Standardized Mortality Ratios since the beginning of the analyzed period (Figure 2). In the Southeast region, the capital city Vitoria presented a similar pattern to the other capitals. However, Sao Paulo, Rio de Janeiro and Belo Horizonte showed more expressive and decreasing Standardized Mortality Ratios since the beginning of the analyzed period (Figure 3).

The capitals of the South and the Midwest regions also presented patterns similar to the one verified in most capitals. It is worth mentioning that in the Midwest region, the analysis was impaired by the same problem identified in the North region, i.e., due to fact that it presented incomplete series of

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Table 1 – Proportional mortality and proportional variation due to Circulatory System Diseases in Brazilian capital cities, from 1950 to 2000

Region	Capital	1950	1960	1970	1980	1991	1996	2000	Proportional variation
Northeast	Manaus	3.38	11.40	15.18	19.67	16.31	15.33	15.37	3.5
	Belem	10.30	8.10	20.71	24.61	30.40	27.80	26.86	1.6
	Sao Luis	11.45	8.31	21.80	31.98	28.52	23.17	23.27	1.0
	Teresina	5.64	10.58	13.45	21.74	27.63	30.97	30.92	4.5
	Fortaleza	6.86	7.38	6.15	20.14	31.16	23.40	22.30	2.3
	Natal	2.62	5.92	13.40	24.29	28.99	28.91	30.58	10.7
	João Pessoa	8.02	5.81	14.66	16.74	25.56	23.81	21.19	1.6
	Recife	5.15	8.69	16.36	26.47	32.54	31.21	31.78	5.2
	Maceio	7.37	9.58	15.57	23.04	31.20	29.21	28.10	2.8
	Aracaju	11.49	7.68	15.86	21.74	21.64	20.58	24.99	1.2
	Salvador	11.80	13.79	21.39	24.11	28.72	28.89	26.92	1.3
Southeast	Belo Horizonte	19.21	18.11	22.64	26.73	32.64	32.96	33.97	0.8
	Vitoria	14.61	8.64	19.76	36.15	30.15	29.34	34.25	1.3
	Rio de Janeiro	17.41	22.81	34.17	40.60	36.07	30.79	29.15	0.7
	São Paulo	19.99	20.71	30.11	33.66	32.64	31.92	32.84	0.6
South	Curitiba	13.73	16.28	22.90	33.73	34.56	34.22	32.84	1.4
	Florianopolis	8.43	16.47	24.32	32.46	31.10	27.22	30.78	2.7
	Porto Alegre	14.73	14.59	34.39	37.48	34.93	32.04	33.07	1.2
Midwest	Cuiaba	9.96	14.74	15.46	25.00	23.60	20.96	22.58	1.3
	Goiania	5.51	17.13	14.03	22.79	27.71	25.74	30.23	4.5

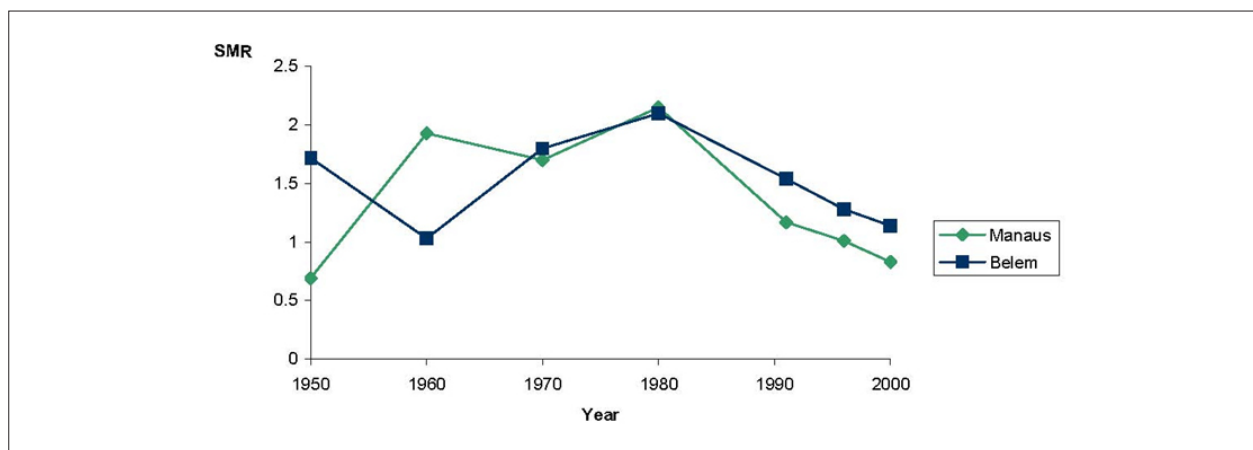*Source: Author's work based on data from IBGE and DATASUS/MS.*

Figure 1 -*Temporal curve of mortality due to CAD, Manaus and Belém, 1950 to 2000; SMR - Standardized mortality ratio.*

mortality during the analyzed period, with the exception of Cuiaba and Goiania, which presented complete and larger series of Standardized Mortality Ratios in 1960 and 1980.

Regarding the analysis of the trend of the historical series due to CAD in the Brazilian capital cities, we observed that three capitals showed significant decreasing trends at the level of significance of 5%: Salvador, Belo Horizonte and Rio de Janeiro.

These capitals presented measurements of the linear correlation strength (R^2) of 71.9%, 89.6% and 59.1%, respectively, which demonstrated a good explanation of the trend model.

Fortaleza and Sao Paulo presented decreasing trends at the level of significance of 10%, with R^2 of 46.9% and 51.2%, demonstrating that the regression model was only partially explained (Table 2).
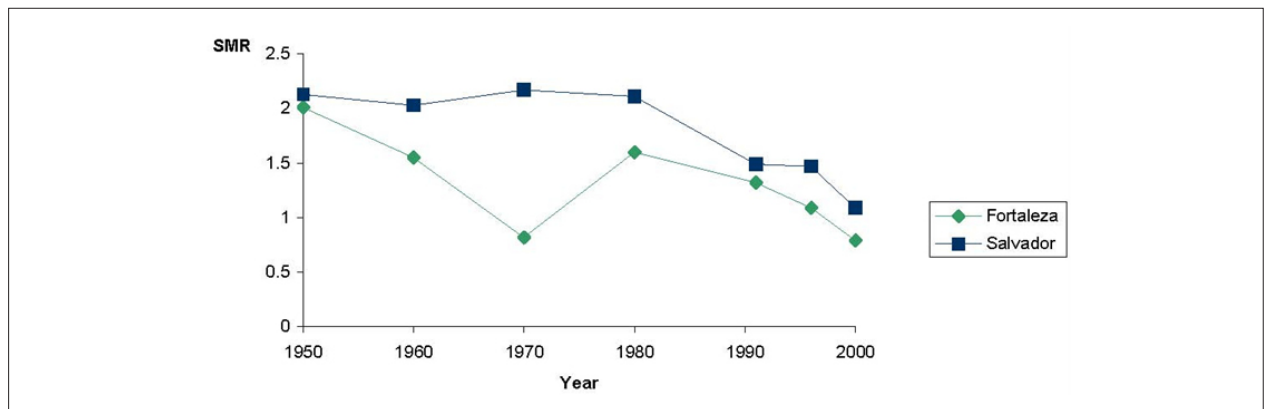
Figure 2 -*Temporal curve of mortality due to CAD; Fortaleza and Salvador; 1950 to 2000; SMR - Standardized mortality ratio.*

Discussion

The understanding of the pattern of disease and death of a population is useful for the proposition of public policies and for the evaluation, management and planning of actions to promote health and prevent disease carried out by the healthcare services. In order to do that, it is necessary to develop studies that focus on the historical trend of morbimortality. One of the main challenges for the performance of these studies is the scarcity of continuous and systematized data throughout decades, particularly regarding the morbidity due to non-transmissible chronic diseases (NTCD), as there is no systematic monitoring for these diseases at a national level. Therefore, the option for the analysis of the mortality trend due to CAD was motivated by the absence of data to construct a historical series of morbidity due to this group of diseases in the Brazilian capitals. However, it is important to mention

Table 2 – Standardized mortality ratios and analysis of temporal trend due to Circulatory System Diseases in Brazilian capitals, from 1950 to 2000

Region	Capital	1950	1960	1970	1980	1991	1996	2000	β	p-valor	R² (%)
Northeast Northeast	Manaus	0.69	1.93	1.70	2.15	1.17	1.01	0.83	-0.006	0.665	4.1
	Belem	1.72	1.03	1.80	2.10	1.54	1.28	1.14	-0.001	0.958	0.2
	São Luis	1.37	1.02	2.07	2.27	1.65	1.21	0.99	-0.002	0.846	0.8
	Teresina	0.73	1.31	1.36	1.69	0.91	1.03	1.28	0.003	0.732	2.6
	Fortaleza	2.01	1.55	0.82	1.60	1.32	1.09	0.79	-0.016	0.089	46.9
	Natal	0.63	0.91	1.53	1.49	1.14	1.22	1.02	0.007	0.362	16.7
	João Pessoa	1.18	0.60	1.73	0.96	1.20	1.15	0.78	-0.002	0.861	0.7
	Recife	1.15	1.31	1.80	1.94	1.75	1.50	1.36	0.005	0.432	12.7
	Maceio	1.33	1.51	2.33	2.21	1.97	1.51	1.35	0.001	0.925	0.2
	Aracaju	1.73	0.93	0.86	2.11	1.06	1.09	1.10	-0.005	0.640	4.7
	Salvador	2.13	2.03	2.17	2.11	1.49	1.47	1.09	-0.019	0.016	71.9
Southeast	Belo Horizonte	2.99	2.12	2.36	2.02	1.60	1.43	1.16	-0.031	0.001	89.6
	Vitoria	1.86	0.78	2.28	2.13	1.70	1.36	1.28	-0.003	0.802	1.4
	Rio de Janeiro	2.10	1.90	2.21	2.17	1.66	1.43	1.08	-0.017	0.043	59.1
	Sao Paulo	2.02	1.61	2.02	1.97	1.50	1.54	1.27	-0.011	0.071	51.2
South	Curitiba	1.60	1.74	2.27	2.23	1.64	1.52	1.22	-0.007	0.413	13.8
	Florianopolis	0.87	1.38	1.51	1.73	1.06	1.12	0.95	-0.002	0.802	0.014
	Porto Alegre	1.60	1.18	1.81	1.87	1.42	1.31	1.15	-0.005	0.469	10.9
Midwest	Cuiaba	0.86	2.15	1.67	1.91	1.31	1.07	1.13	-0.006	0.615	5.4
	Goiania	0.90	2.44	1.17	1.90	1.27	1.18	1.12	-0.006	0.632	4.9

Source: Author's work based on data from IBGE and DATASUS/MS.
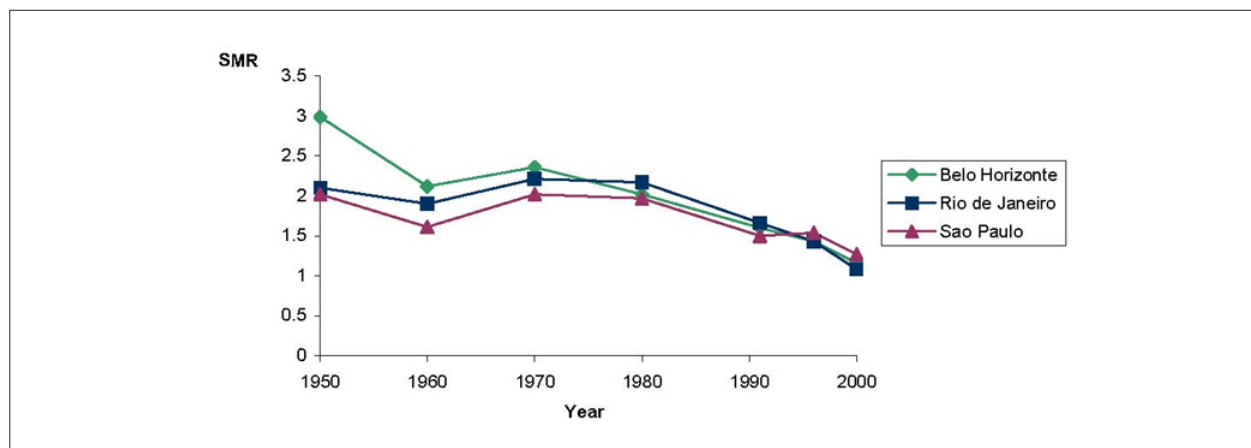
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Figure 3 - *Temporal curve of mortality due to CAD; Belo Horizonte, Rio de Janeiro and São Paulo; 1950 to 2000; SMR - Standardized mortality ratio.*

the lack of information of the structure of mortality per age range, especially concerning the death data per groups and causes of IHD in the Brazilian capitals, in the period from 1950 to 1970, as well as the problems with the censuses carried out during the analyzed period (1950 to 2000), which impair the quality of the population data. As a consequence, we verified the existence of few and restricted studies of the historical trend of mortality due to CAD, with data analyzed beyond the period already made available by the Ministry of Health from 1980 onward, being practically inexistent those that show the pattern of occurrence considering the collection of the Brazilian capitals. As emphatically reported by several authors, due to their importance and magnitude, the CAD constitute the most important health problem in the 20th century in western countries and, in the last decades, it has been presenting the same trend in the developing countries. In Brazil, the CAD currently represent the main cause of mortality among all of them, a trend that has been demonstrated in most Brazilian capitals since the 60s[15] and, in cities such as Sao Paulo and Rio de Janeiro, since the end of the 40s[11,16].

Based on the reconstitution of the historical series of mortality due to CAD during a 50-year period, it was possible to observe that, in spite of the fluctuation of the data, the Proportional Mortality due to this group of causes of death continued to grow during the second half of the 20th century. However, the analysis period allowed the verification that also in many of the capitals, the Proportional Mortality is slightly more expressive halfway through the period, between 1970 and 1991 (Table 1). The results obtained in this study also showed that the Proportional Mortality, although more expressive, in general, for the capital cities of the South and Southeast regions, presented a higher proportional variation in the capital cities of the Northeast region and in Manaus and Goiania, in the North and Midwest regions, respectively.

Lessa[17], in a study carried out between 1950 and 1988, on the trend of mortality due to CAD in the country, observed an increase in Proportional Mortalities due to CVD in all Brazilian capitals, stressing that this cause of death is noteworthy in the group of CAD.

Regarding this trend per region, the author observed

higher Proportional Mortalities in the capitals of the South and Southeast regions; however, the highest increase of this indicator was observed in the North, Northeast and Midwest regions. As explanations for these regional differences the author already pointed out, at that moment, among others, the improvement in the death certificate issuing and the health statistics, with a decrease in poorly-defined causes in all the capitals, particularly the less developed ones, with an important impact on the CVD: bad-quality medical assistance regarding the detection, treatment and control of other risk factors for CVD, such as for diabetes mellitus; poorer access to medical attention in the less developed regions, mainly regarding hospitalization.

In spite of the importance of these findings, comparisons between the higher or lower magnitude of the Proportional Mortality among the Brazilian capitals or geographic regions do not provide information on population risk of dying due to a specific cause. Additionally, a trend, whether increasing or decreasing, even when observed proportionally, is not accompanied by a similar trend in the risk of dying due to the cause. It is worth mentioning that this risk is measured from the Coefficient of Mortality, which correlates the occurrence of death to the population. Therefore, we sought to analyze the risk of death due to CAD based on the Standardized Mortality Ratios obtained from the Gross Coefficients of Mortality.

In general, we found decreasing risks for the aforementioned group, particularly after the year of 1980. The high fluctuation suggests the influence of the uncertain quality of death and population data, especially in the first three decades of the series. The highest fluctuations correspond to the information on the North and Midwest regions and it is known that in these regions, the quality of the information is poorer.

The identified pattern demystifies the thesis that the mortality due to this group of diseases is actually increasing in the group of the Brazilian capital cities. In fact, this trend has undergone modifications, even if they were late and differentiated, following a world pattern, although with its own characteristics. Such pattern probably follows the regional characteristics of the country that were historically organized and characterized by large inequalities[18].

Following a different pattern, we highlight the capital cities of Fortaleza, Salvador, Belo Horizonte, Rio de Janeiro and Sao Paulo, which present the highest risk and significantly decreasing trends (p>0.05; p>0.10) since the beginning of the analyzed period (1950). These findings suggest that, possibly, a set of characteristics associated to the processes of urbanization and industrialization took place, even more expressively in the first half of the 20th century, which influenced the onset of CAD, also an earlier one.

On the other hand, the capitals that only after the second half of the 20th century experienced the characteristics associated with the processes of urbanization and more accelerated industrialization, also started to present an increase in the risk of death due to CAD from this moment on.

These cities, subsequently, presented increasing risk up to the 80s and then started to experience the decrease in this risk, following a current world trend. In general, the capitals of the Northeast, Southeast and South regions presented more complete and defined trends when compared to the capitals of the North and Midwest regions, a fact that is related to the conditions of the capitals' structure and process improvement concerning the quality of the data.

Corroborating the hypothesis that large urban centers started to experiment the increase in these diseases at an earlier time than other capital cities where the process of industrialization and urbanization took place later, Bodstein[19] and Lotufo[20] reported the importance of circulatory system pathologies and cancer among the main causes of mortality since the beginning of the 20th century in some of the more developed capital cities, such as Sao Paulo, Rio de Janeiro, Belo Horizonte, Vitoria, Curitiba and Porto Alegre, similarly to what had been observed in England, Germany and the United States. Analyses by Laurenti and Fonseca[11] showed the expressive increase in mortality due to CAD in Sao Paulo, with a predominance of IHD at the immediate post-war period, between the decades of the 40s and 60s. In common, these studies indicate the onset and more expressive increase in chronic diseases, at an earlier time, in capitals where the process of development was established first; additionally, the demographic transformations with the increase in life expectancy accompanied this process.

A study of the mortality rates due to IHD and CVD in 8 capital cities (Belem, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre) adjusted by age, in the period of 1984 to 1987, comparatively to other countries, showed that, in spite of the mortality trend decline, which had been observed before, the analyzed Brazilian cities presented high mortality rates for heart diseases, mainly among women, with values that are as high or higher than those observed in Europe and in the United States, as well as the fact that in Brazil, the mortality occurs at younger age ranges[21].

Souza et al[22], analyzing the trend of the risk of death due to CAD in Brazilian geographic regions in the period of 1979 to 1996, verified that the risk of death due to CVD and IHD decreased in some regions and increased in others. In the South and Southeast regions, the most developed ones, the risk decreased and in the less developed regions, particularly in the Northeast and Midwest, the risk increased.

Godoy et al[23], in a study carried out in the town of Sao Jose do Rio Preto, in the state of Sao Paulo, in the period of 1980 to 2002, showed that the coefficient of mortality due to CVD has decreased throughout the years, with higher values among the population older than 50 years and for those residing in areas with the worst socioeconomic levels.

Oliveira et al[12], in a study carried out in the states of Rio de Janeiro, Sao Paulo and Rio Grande do Sul and their respective capital cities, in the period of 1980 to 1999, showed decline in the balanced and adjusted mortality rates due to CAD, IHD and CVD, in the three states and the capitals In No Rio de Janeiro, state and city, the decline in the IHD were clear from 1990 on, whereas the CVD showed decline throughout the entire period. Based on this and other studies[13,18], the authors observed the need to adopt strategies that can improve the conditions of life of the population, in order to reduce the huge social inequalities, as well as to have an effect on the decrease of the cardiovascular morbimortality associated to the control of the classic risk factors.

Conclusions

The analysis of the temporal trend of mortality due to CAD in the period from 1950 to 2000 showed that, although proportionally this group of diseases represent the first cause of death in the Brazilian population, in all capitals, as well as presenting proportional growth during the period of analysis of this study, the risk of death, represented by the Standardized Mortality Ratios showed to be in decline, particularly from the 80s on. Hence, the behavior of the risk of death due to CAD in the period considered in the study, suggests that this group of diseases is the first that augmented, accompanying the increase in industrialization verified from the 30s onward and the post-Second World War period in Brazil, such as in Sao Paulo and Rio de Janeiro, which greatly influenced the conditions of life and lifestyle of the population.

The results of this study suggest that the geographic regions of Brazil and their respective capital cities, due to their cultural, demographic, socioeconomic and political heterogeneity, have populations that are submitted to different risk factors. The healthcare quality, the diagnostic capacity and the quality of the provided information are also different in the several regions.

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