Mortality due to Heart Failure: Extended Analysis and Temporal Trend in Three States of Brazil

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Abstract

Background: Heart failure (HF) is a chronic disease with high prevalence and mortality rates. The mortality due to HF in Brazil has been studied more frequently using hospitalization data.

Objective: To evaluate the mortality rates due to HF by sex and age range, in three states of Brazil, Rio de Janeiro, São Paulo and Rio Grande do Sul, from 1999 to 2005.

Methods: The data were obtained from death certificates assessed in the three states. The mortality due to HF was assessed in the restricted (underlying cause of death), comprehensive (mentioned in any line of the death certificate) and extended (all codes with the presence of HF) forms.

Results: The specific rates of mortality presented a clear decrease trend in the age groups, except in the group aged 80 years or older. The rates increased with age and were clearly higher among men up to 80 years of age. The rates of mortality due to HF were 3-fold higher in the comprehensive than in the restricted form of analysis. The extended form of analysis also added 20% of deaths in which HF was present.

Conclusion: The results of this study demonstrated a decrease trend in the mortality rates due to HF when considering the three states – around 43% of Brazil – from 1999 to 2005. The methodology of multiple causes of death, in addition to the underlying ones, allows us to present a more comprehensive dimension of the importance of HF as cause of death. The adequate selection of the codes of the International Classification of Diseases (ICD), which comprehend the totality of the HF phenomenon, remains a challenge for further studies. (Arq Bras Cardiol 2010; 94(1) : 52-58)

Key words: Heart Failure / mortality; International Classification of Diseases; Rio de Janeiro; São Paulo; Rio Grande do Sul; Brazil.

Introduction

Heart failure (HF) is a chronic disease with a high prevalence, which affects predominantly the elderly. It is the major cause of hospitalization due to cardiovascular disease in Brazil and the first cause of hospitalization in patients older than 65 years in Spain[1,2].

The decrease in mortality due to cardiovascular diseases, especially the ischemic cardiopathy, which has been observed for decades, as well as the recent advances in therapeutic management, did not result in the decrease of HF prevalence, a phenomenon also ascribed to the aging of the population[3]. HF remains presenting high rates of morbidity, mortality and lethality, which can reach up to 50% in the years following diagnosis[4].

In spite of this evidence, decrease trends regarding HF mortality have been demonstrated in some countries, through the analysis of death certificates. Goldacre et al[5], in England, when analyzing the population of Oxford from 1979 to 2003, concluded that the rates of mortality due to HF and ischemic heart disease presented very similar decreases in that region. Murdoch et al[6], studying HF in Scotland from 1979 to 1992, in addition to observing a decrease in mortality, verified that 30-40% of the deaths attributed to ischemic heart disease might have been related to HF, concluding that HF would be contributing even more than what had been perceived for total and premature mortality.

Martinez et al[3] showed that, similarly to other countries, the mortality due to HF had decreased in Spain, a condition that affected mostly elderly individuals, especially elderly women. Additionally, they showed that another difficulty in understanding the behavior of HF was the selection of different ICD (International Classification of Disease) codes to identify the disease as cause of death in the several studies published on the subject.

In Australia, Najafi et al[7] reported a decrease trend in mortality due to HF, from 1997 to 2003 and discussed the limitations of using official records of death due to HF, when considering only the selection of HF as the underlying cause of

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death, according to the modification rules in the 10th Revision of the International Classification of Diseases and Related Health Problems (ICD-10)[8].

Most of the publications on the importance of HF as the cause of death in Brazil are derived from cohort studies[9,10] or related to hospital mortality, based on the data available at the Brazilian Public Health System (SUS) regarding hospitalizations in public hospitals or those hired by the system[11,12]. In Brazil, HF was the third cause of hospitalization due to clinical causes through SUS/MH(Ministry of Health) from 1992 to 2002, with percentages of hospitalizations in relation to the total number of hospitalizations that varied from 3%-4%, with lethality rates of 5%-7% at hospital admissions[2].

The mortality trend due to HF in the metropolitan region of Salvador (Bahia), from 1979 to 1995, was assessed using the codes 428.0, 428.1 and 428.9 of ICD-9 to identify HF as the cause of death, but only as the underlying cause of death. This study showed a decrease in the mortality due to HF from 1979 to 1992, which subsequently stabilized until 1995[13].

The objectives of the present study were to analyze the rates of mortality due to HF by sex and age range, in three states of Brazil, namely Rio de Janeiro, São Paulo and Rio Grande do Sul, from 1999 to 2005. The rates were assessed in the restricted form, when HF was stated as the underlying cause of death; in the comprehensive form, when HF was mentioned in any line of the death certificate; and in the extended form, when all diagnoses with the presence with HF were included.

Methods

The data concerning the deaths and populations refer to the period of 1999 to 2005, in the group formed by the states of Rio de Janeiro (RJ), São Paulo (SP) and Rio Grande do Sul (RS). The information on the deaths were obtained from the computer databases of death certificate records of the Mortality Information System (MIS) of the Ministry of Health (MH)[14].

The population data were obtained from the Brazilian Institute of Geography and Statistics (IBGE) and distributed by sex and age ranges[15]. The age ranges were defined as follows: below 40 years of age and then, plus 10 years until 79 years of age and 80 years or older. The criteria used for the selection of these three states were the older age profile of the populations (with a higher probability of HF occurrence), the good quality of death certificate completion, information inferred through lower rates of proportional mortality due to poorly-defined causes of death and the higher number of affections recorded per certificate[16], as well as the possibility of comparison with previously known data on cardiovascular mortality[17].

The computerized recording of the death certificates used the classification of mortality in the 10th Revision of the Statistical International Classification of Diseases and Related Health Problems of the World Health Organization (ICD-10)[18], from which we selected the HF codes.

The types of HF occurrence were divided in three groups:

A - Restricted: with HF considered as the underlying cause of death, according to the rules and dispositions for the codification of mortality and morbidity found in the instruction manual of the ICD-10, with the codes I50.0 (congestive heart failure), I50.1 (left ventricular failure) and I50.9 (unspecified heart failure).

B - Comprehensive: the same codes of the restricted group, when listed as the underlying cause or mentioned in any line of the death certificate.

C - Extended: subdivided in two groups:

C1 - Extended 1: added the codes

I11.0 (hypertensive heart disease with congestive heart failure),

I13.0 (hypertensive heart and kidney disease with congestive heart failure),

I13.2 (hypertensive heart and kidney disease with congestive heart failure and kidney failure) and

P29.0 (neonatal heart failure) to the comprehensive group, which clearly identified the presence of HF in their account.

C2 - Extended 2: added the codes

I09.9 (unspecified rheumatic heart disease),

I97.1 (other functional disorders subsequent to heart surgery),

I25.5 (ischemic cardiomyopathy),

I31.1 (chronic constrictive pericarditis),

I42.0 (dilated cardiomyopathy),

I42.6 (alcoholic cardiomyopathy),

B57.0 (acute form of Chagas disease, with cardiac involvement) and

B57.2 (chronic Chagas disease with cardiac involvement) to the comprehensive group 1, which clearly identified the presence of HF in their account or involved conditions that could present symptoms and signs of HF during their clinical evolution, although not named or described together with the code in the ICD-10 manual[18].

Proportional and specific mortality rates and their ratios between the sexes were constructed. The proportional mortality rates due to HF were estimated based on the ratio between the deaths and the total number of deaths. The specific mortality rates were calculated through the ratio of the corresponding deaths for each one of the four groups of HF and the total population from each age range. The statistical analysis was carried out using the Stata program[19].

Results

A total of 2,960,857 death certificates were assessed, with 56.4% being from the state of Sao Paulo, 27.2% from the state of Rio de Janeiro and 16.4% from the state of Rio Grande do Sul. In Brazil, 43% of the deaths occurred in these three states in the period between 1999 and 2005.

The percentages of death due to HF, which can be seen in Table 1, present a decrease trend throughout the period, more evident in group **A,** with a slight one in the others. The highest difference was observed between groups **A** and **B**, being three-fold higher in **B** when compared to **A**. It must be

emphasized that the difference observed between groups **B** and **C1** was, in fact, not relevant. Therefore, group **B** was not included in the charts of the specific mortality rates by sex and age range.

The specific mortality rates by sex and age range in the groups **A**, **C1** and **C2,** presented in Figures 1A to 1F, show the decrease trend in the mortality rates in all age ranges throughout the 7-year period, except in the 80-year-old age range, where it remains relatively stable during almost the entire period. The decrease trend in mortality was lower in group **A**, at all age ranges of both sexes.

The mortality rates due to HF increased with age. In the 40 to 49-year-old age range, and most significantly, at the age ranges 50 to 59 and 60 to 69 years of age, the rates, considering the three states, were markedly higher among males. From then on, the differences between the sexes were not so clear, becoming similar at the 80-year-old or older age range. The ratios between the specific mortality rates of the sexes per HF group and by age range, considering the 7-year period in the three states can be seen in Table 2. We observed that the ratios of male/female mortality rates decreased with age. The highest ratios were seen in the 40 to 49 year-old age range. At the 80-year-old or older age range, the ratios were close to 1.0 in all HF groups. At any age range, the ratios were similar among the HF groups.

Discussion

The present study shows a clear decrease trend in mortality rates due to HF considering the three states of Rio de Janeiro, São Paulo and Rio Grande do Sul, from 1999 to 2005, at all age ranges below 80 years of age and older.

Table 1- Percentages of deaths due to heart failure (HF), by year of occurrence and according to the HF groups in the three Brazilian states (Rio de Janeiro, São Paulo and Rio Grande do Sul), from 1999 to 2005

Year of occurrence	HF groups			
	A*	B**	C1***	C2****
1999	3.0	9.2	9.3	11.1
2000	2.7	9.6	9.7	11.5
2001	2.6	9.1	9.2	11.1
2002	2.5	8.9	9.0	10.9
2003	2.4	8.7	8.8	10.8
2004	2.4	9.0	9.0	11.1
2005	2.4	8.6	8.7	10.8

**A: Code ICD-10 I50 as the underlying cause; **B: A + I50 mentioned; ***C1: B + I11.0, I13.0, I13.2 or P29.0 mentioned; ****C2: C1 + I09.9, I97.1, I25.5, I31.1, I42.0, I42.6, B57.0 or B57.2 mentioned.*

At the elderly age range, the decrease was perceptible only in the beginning of the period. These findings are in agreement with others, previously published in Brazil[13,20] and in other countries[1,5-7], which analyzed mortality due to HF in death certificates. The same has been observed with in-hospital mortality rates due to HF. It is believed that this behavior can be explained by the advances attained in the last years regarding the HF approach, such as earlier diagnoses, more aggressive management during hospitalizations due to decompensations and the broader use of angiotensin-converting enzyme inhibitors and beta-blockers[21,22].

Recently, published reports have also demonstrated a decrease in mortality rates due to cardiovascular diseases in general, with examples in Brazil[23,24] and in other countries[25,26]. This fact can also justify what has been occurring with HF, as the latter is the terminal consequence of most cardiopathies.

Oliveira et al[27] observed a decrease in the mortality rates due to ischemic heart diseases in the populations of the same three states, in the two decades before the present study was carried out. The findings observed in our study must be ascribed to the association between ischemic heart diseases and their natural evolution to HF. The present study also shows that the mortality rates are higher among men than among women, at all age ranges up to 80 years old and that the mortality rate differences between the sexes decrease and become similar as age increases.

This phenomenon can be observed when we analyze the mortality due to HF, when selected as the underlying cause of death (group **A**), or when notified as an associated cause (groups **B, C1** and **C2**) in the death certificate. The higher incidence of the disease among men, as demonstrated by other studies[28-30], corroborates our findings.

Among individuals aged 80 years or older, it is necessary to consider that, at this age range, which does not have a higher age limit, women are usually older as they live longer than men. Figure 1F shows that the differences observed between the sexes in groups **A** and **C1** seem to disappear, but one can still presume a higher relative occurrence in men, when disregarding the age factor. In group **C2**, the men's

Table 2 - Ratios between mortality rates due to HF of men/women. by age range. according to the HF groups. in the three Brazilian states (Rio de Janeiro. São Paulo and Rio Grande do Sul). from 1999 to 2005

Age ranges (in years)	HF groups			
	A*	B**	C1***	C2****
< 40	1.5	1.3	1.3	1.4
40 a 49	1.8	1.7	1.7	1.9
50 a 59	1.6	1.6	1.6	1.7
60 a 69	1.5	1.5	1.5	1.6
70 a 79	1.3	1.3	1.3	1.4
80 ou mais	0.9	1.0	1.0	1.1

**A: Code ICD-10 I50 as the underlying cause; **B: A + I50 mentioned; ***C1: B + I11.0. I13.0. I13.2 or P29.0 mentioned; ****C2: C1 + I09.9. I97.1. I25.5. I31.1. I42.0. I42.6. B57.0 or B57.2 mentioned.*

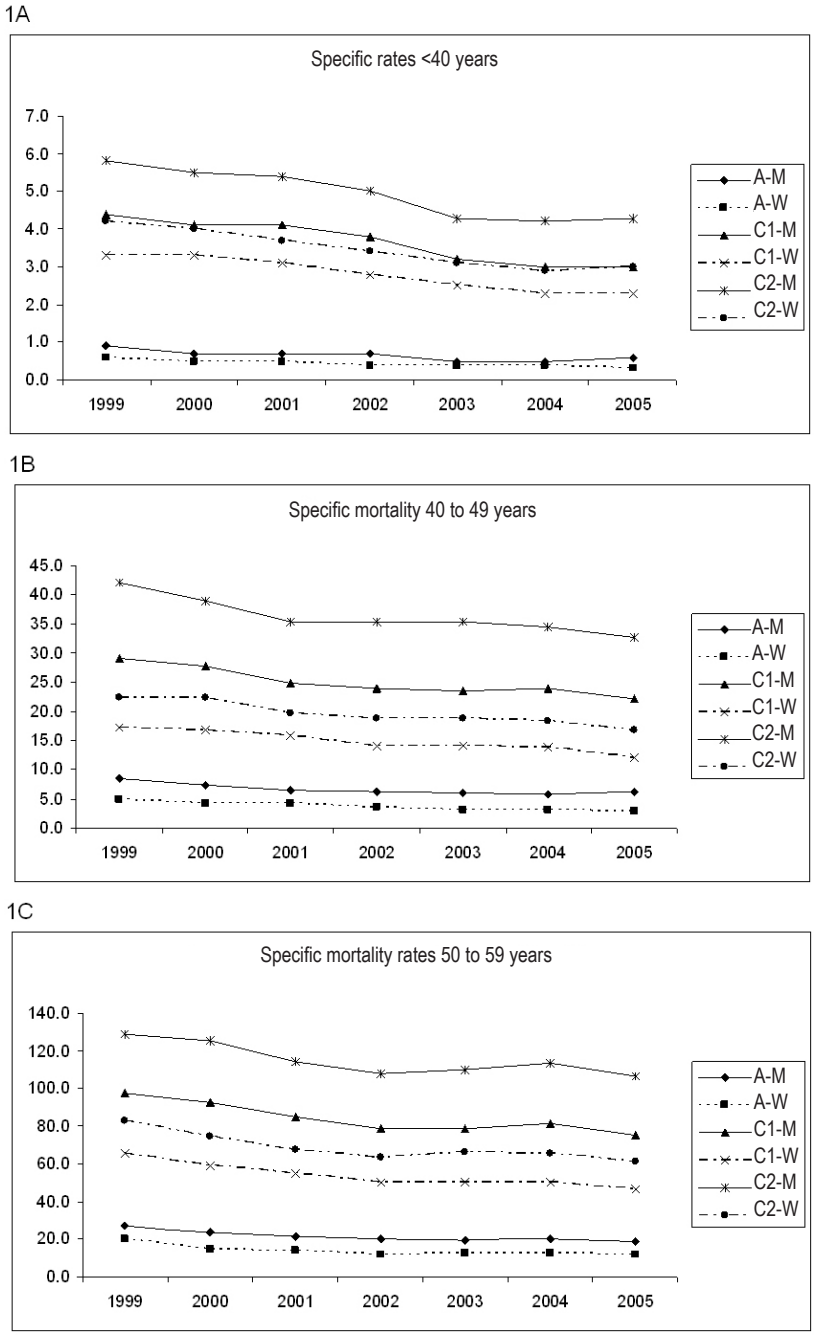

Figure 1A to 1F (Continued on next page)- *Mortality rates (per 100,000 inhabitants) due to heart failure in men (M) and women (W), per year of occurrence, per HF group (A, C1 and C2), according to age ranges, in the three Brazilian states (Rio de Janeiro, São Paulo and Rio Grande do Sul), from 1999 to 2005; M - Men; W - Women; A - Code I50 of ICD-10 as the underlying cause; C1 - I50 as the underlying cause or mentioned; or I11.0, I13.0, I13.2 or P29.0 mentioned; C2 - C1 codes or I09.9, I97.1, I25.5, I42.0, I42.6, B57.0 or B57.2 mentioned.*

disadvantageous condition remained evident, probably due to a higher occurrence of ischemic myocardiopathy and dilated or alcoholic cardiomyopathy in men.

In Brazil, some published reports have evaluated the mortality due to circulatory, cerebrovascular and ischemic heart diseases, based on the analysis of death certificates[30,41,42], but only two of them had mortality due to HF as the object of study[20].

Latado et al[13] used the HF only when it was selected as the underlying cause of death in the metropolitan region of Salvador, from 1979 to 1995. Gaui et al[36], in addition, also evaluated the occurrence of HF when it was mentioned in any line of the death certificate, in the states of Rio de Janeiro, São Paulo and Rio Grande do Sul, from 1999 to 2004. Both groups concluded that there was a decrease in the mortality rates due

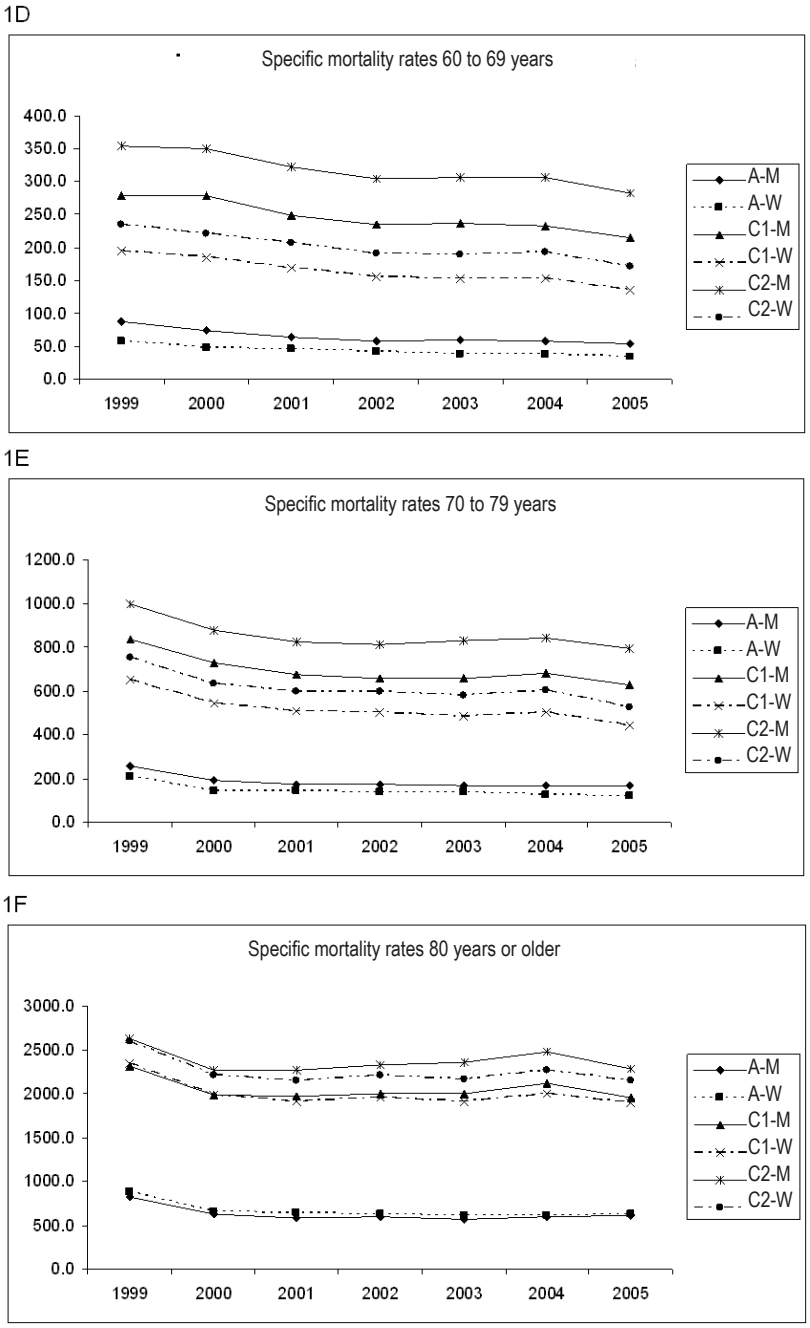

Figure 1A to 1F - *Mortality rates (per 100,000 inhabitants) due to heart failure in men (M) and women (W), per year of occurrence, per HF group (A, C1 and C2), according to age ranges, in the three Brazilian states (Rio de Janeiro, São Paulo and Rio Grande do Sul), from 1999 to 2005; M - Men; W - Women; A - Code I50 of ICD-10 as the underlying cause; C1 - I50 as the underlying cause or mentioned; or I11.0, I13.0, I13.2 or P29.0 mentioned; C2 - C1 codes or I09.9, I97.1, I25.5, I42.0, I42.6, B57.0 or B57.2 mentioned.*

to HF in the two periods; however, the second showed that the importance of HF can be underestimated when evaluated solely as the underlying cause of death.

The statistics of mortality are traditionally presented by means of the underlying cause, which is considered as the "cause or injury that initiated the chain of pathological events that led directly to the death or to the circumstances of the accident or violence that produced the fatal injury"[8].

The underlying cause is selected among the codes of diseases mentioned in the death certificate, by applying the rules of codification defined in the 10th Revision of the International Classification of Diseases and Related Health

Problems (ICD-10), and as a result, some "specific affections have preference as the underlying cause of death in relation to generalized injuries"[16]. Diabetes mellitus is one example of this preference. A death certificate that has line A filled in with code J81 (pulmonary edema, not specified in any other way), line B with code I50.1 (left ventricular failure) and line C with E14.9 (non-specified diabetes mellitus without complications), will have the latter selected as the underlying cause of death.

In the present study, when we compared the **restricted** (**A**) and **comprehensive** (**B**) forms, we observed that the occurrence of HF was three-fold higher in the second group, coincidentally the same findings observed by Santo et al[30].

The sole use of the underlying cause to characterize the mortality due to HF does not provide the actual perspective of the problem represented by HF. The same occurs with other chronic-degenerative conditions common in the elderly, in whom more than one pathological condition might contribute to death. The use of multiple causes of death, by mentioning them in the death certificates and models of multidimensional analysis in order to establish associations among them has been proposed as an additional tool for the statistics of mortality[31].

The mortality due to HF can also be underestimated by the choice of the ICD-10 codes used for its definition. Most of the studies, in addition to using only the underlying cause of death, also select only the codes I50 of ICD to define HF, which corresponds to our groups **A** and **B**. Two previously reported studies[15] defined HF as a set of codes that state in their description the presence of heart failure or involve conditions that can present, during its clinical evolution, signs and symptoms of HF.

In our study, in addition to the codes selected in the aforementioned studies, we added neonatal heart failure to **C1** and acute and chronic Chagas' disease with cardiac involvement and rheumatic disease to **C2**.

Observing the percentages of deaths due to HF per group (Table I), it can be observed that the difference between groups **B** and **C1** was not significant; however, group **C2** has an increase of approximately 20% of deaths due to HF in relation to group **B**. Therefore, the codes added to group **B**, for the configuring of group **C1**, did not contribute more than the I50 codes for the assessment of the actual dimension of mortality due to HF. However, the same cannot be said of the codes that, added to the group **C1**, configured group **C2**, namely I09.9 (unspecified rheumatic heart disease), B57.0 (acute form of Chagas disease, with cardiac involvement) and B57.2 (chronic Chagas disease with cardiac involvement), which also occurred in our country and were not considered by other authors[7].

The comprehensiveness of diagnostic information, the quality of death certificate completion and the use of codes that transcribe the original information contained in the declaration of death are limiting factors of our study. It must also be mentioned that the diastolic HF, also called HF with preserved left ventricular function, can represent up to 50% of the cases of hospitalizations due to HF[10,30] and it is not represented by any code in the ICD-10.

The results of the present study show a decrease trend in the rates of mortality due to HF in the three analyzed Brazilian states, i.e., Rio de Janeiro, São Paulo and Rio Grande do Sul, from 1999 to 2005, which represent a little less than half of Brazil. Nevertheless, the findings obtained with the three states cannot be used as an estimate of what occurred in the country as a whole, which constitutes one of the limitations of the present study. On the other hand, the comprehensiveness of the information on the deaths is faulty in many states. These findings are in agreement with other previously published data in Brazil and in other countries and might be related to the previously reported decreases in mortality rates due to ischemic diseases.

The use of the methodology of multiple causes of death associated with the concept of the underlying cause of death provides a more comprehensive analysis of the study of mortality. Additionally, the adequate selection of the ICD codes that comprehend the totality of the HF phenomenon, represented in the present study by the more extended group (group C2), remains a challenge for future studies.

Potential Conflict of Interest

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

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Study Association

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