Objective - To assess the trends of the risk of death due to circulatory (CD), cerebrovascular (CVD), and ischemic heart diseases (IHD) in 11 Brazilian capitals from 1980 to 1998.

Methods - Data on mortality due to CD, CVD and IHD were obtained from the Brazilian Health Ministry, and the population estimates were calculated by interpolation with the Lagrange method based on census data from 1980 and 1991 and the population count of 1996. The trends were analyzed with the multiple linear regression method.

Results - CD showed a trend towards a decrease in most capitals, except for Brasília, where a mild increase was observed. The cities of Porto Alegre, Curitiba, Rio de Janeiro, Cuiabá, Goiânia, Belém, and Manaus showed a decrease in the risk of death due to CVD and IHD, while the city of Brasilia showed an increase in CVD and IHD. The city of São Paulo showed a mild increase in IHD for individuals of both sexes aged 30 to 39 years and for females aged 40 to 59 years. In the cities of Recife and Salvador, a reduction in CD was observed for all ages and both sexes. In the city of Recife, however, an increase in IHD was observed at younger ages (30 to 49 years), and this trend decreased until a mild reduction (-4%) was observed in males ≥ 70 years.

Conclusion - In general, a reduction in the risk of death due to CD and an increase in IHD were observed, mainly in the cities of Recife and Brasília.

Keywords: epidemiology, circulatory diseases, mortality
Methods

The 11 most populated capitals of 5 Brazilian regions were chosen as follows: in the Northern region, Manaus and Belém; in the Northeastern region, Recife and Salvador; in the West Central region, Brasília and Cuiabá; in the Southeastern region, São Paulo and Rio de Janeiro; and in the Southern region, Curitiba and Porto Alegre.

Data on mortality due to circulatory, cerebrovascular, and ischemic heart diseases were obtained in the Brazilian Ministry of Health from 1980 to 1998. The estimates of the populations on the 1st of July from 1980 to 1998 in the 5 Brazilian regions were calculated by interpolation with the Lagrange method based on census data from 1980 and 1991 and a population count from 1996 for each age group and sex.

The statistical model of multiple linear regression was used. Information on mortality due to all circulatory diseases was modeled, and, then, data on mortality due to cerebrovascular and ischemic heart diseases were as well. The natural logarithm of the raw coefficient (number of deaths/population estimated on the 1st of July) was used as a dependent variable, and the cerebrovascular and ischemic heart diseases, the 11 Brazilian capitals, sex, years of the study calendar (from 1980 to 1996), age brackets (30-39, 40-49, 50-59, 60-69, and from 70 years onward), and their respective interactions were used as independent variables. The partial F test was used to remove the nonsignificant interactions for the models. The objective was to reach the end of the modeling process with the lowest number of possible interactions. The adjustment of the models was tested by analyzing residuals and the correlation coefficient. The analysis of residuals was performed with envelope-type graphs and graphs of the residuals of the model versus values adjusted to assess the adjustment of the models adopted.

Results

The trends of the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases are shown in figures 1 to 10. The coefficients are presented as natural logarithms according to age and sex and in 2 tables with the raw coefficients for the years 1980, 1989, and 1998 of the series, and the percentage variation between the years 1980 and 1998. The analysis of residuals showed a good adjustment of the multiple linear regression model.

The coefficients and percentages of variations in mortality due to circulatory, cerebrovascular, and ischemic heart diseases are shown in tables I and II. The following trends were observed: 1) in the cities of Porto Alegre and Curitiba (Southern region) - a trend towards a decrease in circulatory, cerebrovascular, and ischemic heart diseases was observed for all age groups and both sexes from 1980 to 1998. The greatest reduction occurred in the cerebrovascular diseases in all age groups and both sexes; however, it was more marked in the males of the city of Porto Alegre; 2) in the cities of Rio de Janeiro and São Paulo (Southeastern region) - a trend towards a decrease in circulatory diseases occurred and
was more marked in the city of Rio de Janeiro. In the city of São Paulo, a mild increase in ischemic heart diseases was observed in individuals of both sexes aged 30 to 39 years and in females aged 40 to 59 years. In the remaining age groups,
a mild reduction in the risk of death was observed, except for individuals aged 70 years or more, in whom the reduction was greater, being 32% and 23% for males and females, respectively. In a different way, a marked reduction in the
The risk of death due to cerebrovascular diseases was observed. In the city of Rio de Janeiro, the reduction in the risk of death due to cerebrovascular and ischemic heart diseases was significant in all age groups and both sexes; 3) in the cities of Brasília, Cuiabá, and Goiânia (Central West region) - a trend towards a decrease in circulatory diseases in the cities of Cuiabá and Goiânia was observed in all age groups and both sexes. In the city of Brasília, a mild reduction and stabilization in circulatory diseases was observed in males and females in the age groups of 30 to 59 years and ≥ 70 years.
### Table II - Coefficient of mortality due to cerebrovascular and ischemic heart diseases per 100,000 inhabitants estimated in 11 Brazilian capitals according to sex and age group in the years 1980, 1989, and 1998.

<table>
<thead>
<tr>
<th>Age groups and capitals</th>
<th>Ischemic heart diseases</th>
<th>Cerebrovascular diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brasília 40-49 years</td>
<td>41.15 44.63</td>
<td>43.66 45.67</td>
</tr>
<tr>
<td>Brasília 50-59 years</td>
<td>37.86 38.67</td>
<td>40.16 41.57</td>
</tr>
<tr>
<td>Brasília 60-69 years</td>
<td>36.94 37.86</td>
<td>39.54 41.15</td>
</tr>
<tr>
<td>Brasília &gt;70 years</td>
<td>32.95 33.86</td>
<td>35.65 37.45</td>
</tr>
<tr>
<td>Brasília 5-14 years</td>
<td>32.95 33.86</td>
<td>35.65 37.45</td>
</tr>
<tr>
<td>Brasília 15-24 years</td>
<td>32.95 33.86</td>
<td>35.65 37.45</td>
</tr>
<tr>
<td>Brasília 25-34 years</td>
<td>32.95 33.86</td>
<td>35.65 37.45</td>
</tr>
</tbody>
</table>

### Reference
Mansur et al. 2002; 79: 277-84.
respectively, and a mild increase in the age group of 60 to 69 years. However, a significant increase in the risk of death due to cerebrovascular and ischemic heart diseases was observed in both sexes and in almost all age groups, except for ischemic heart diseases in males ≥ 70 years and cerebrovascular diseases in males and females aged 30 to 39 years. The greatest increase in the risk of death due to cerebrovascular diseases was observed in the city of Brasília (78% and 97% for males and females, respectively, aged 50 to 59 years), where the greatest decrease in the risk of death due to ischemic heart diseases occurred in males aged 70 years or more. In the city of Cuiabá, a significant reduction in the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases was observed in males and females, except for a mild increase in ischemic heart diseases in females older than 60 years and a marked increase in cerebrovascular diseases in males and females older than 50 years. The greatest reduction in the risk of death due to ischemic heart diseases was observed in females aged 30 to 39 years in the city of Cuiabá (-82%). A significant reduction in the risk of death due to cerebrovascular diseases was observed in all age groups and both sexes in the city of Goiânia. However, a discrete increase in ischemic heart diseases was observed in males aged 30 to 49 years and females aged 50 to 69 years. A greater increase was observed in females aged 30 to 49 years and ≥ 70 years. The greatest reduction in the risk of death due to cerebrovascular diseases was observed in the city of Goiânia, -72% and -73%, respectively, in males and females aged 30 to 39 years; 4) in the cities of Recife and Salvador (Northeastern region) - a trend towards a decrease in circulatory diseases was observed in the cities of Recife and Salvador in all age groups and both sexes. In Recife, however, a significant increase in the risk of death due to ischemic heart diseases was observed, mainly in the younger groups (30 to 49 years), and this risk progressively decreased until a discrete reduction (-4%) was observed in males ≥ 70 years. A significant reduction in the risk of death due to cerebrovascular diseases was observed in all age groups and both sexes. The greatest increase in the risk of death due to ischemic heart diseases occurred in the city of Recife, 85% and 108% for males and females, respectively, aged 40 to 49 years. In the city of Salvador, a significant reduction in the risk of death due to ischemic heart diseases was observed, except for males and females aged 60 to 69 years. An increase in cerebrovascular diseases in females aged 50 years or more was observed, as was a significant reduction in those diseases in males of all ages; 5) in the cities of Belém and Manaus (Northern region) - a trend towards a decrease in circulatory, cerebrovascular, and ischemic heart diseases was observed in the cities of Belém and Manaus in all age groups and both sexes.

Discussion

This study showed the same trend towards a decrease in circulatory diseases in the Brazilian population. Only the city of Brasília showed a discrete increase in the trend of the risk of death. A previous study of the Brazilian regions also showed a trend towards a decrease in circulatory diseases in the Southeastern, Southern, and Northern regions in all age groups and both sexes from 1979 to 1996, but, in the Northeastern and West Central regions, a trend towards an increase in the risk of death was observed in almost all age groups analyzed. The increase was significantly greater in males aged 40 to 69 years in the Northeastern region. It is worth noting that the risk of death due to ischemic heart diseases was twice that due to cerebrovascular diseases. Previous studies, mainly of the younger Brazilian population, showed a greater participation of ischemic heart diseases in the risk of death due to circulatory diseases in males and cerebrovascular diseases in females, despite the reports on greater mortality due to acute myocardial infarction in females.

In regard to the capitals, the city of Recife showed a greater increase in the risk of death due to ischemic heart diseases than due to cerebrovascular diseases; the city of Brasília showed a similar increase in the cerebrovascular and ischemic heart diseases; and the city of Cuiabá showed an increase in cerebrovascular diseases in the population older than 50 years. The increase in the risk of death in those capitals may have been influenced by the following: 1) an improvement in the diagnosis of the cause of death; 2) an increase in urbanization; 3) worsening of the socioeconomic conditions in the region; 4) low educational level; and 5) other still controversial reasons, such as weight at birth and cultural aspects. The improvement in the quality of death certificates is an interesting hypothesis, because the circulatory diseases may comprise the greatest part of the ill-defined deaths. Therefore, the reduction observed in ill-defined deaths in the period studied may explain the increase in the risk of death due to circulatory diseases in these capitals and confirm the trend toward a decrease in most capitals, ie, an artificial increase and a smaller reduction in the trends of the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases, respectively. These results may cause distortions in opinion or myths about circulatory diseases in the area of epidemiology.

Worsening of socioeconomic conditions, urbanization, and low educational level are also attractive hypotheses, because worsening of the quality of life is associated with a reduction in the risk of death due to circulatory diseases. The reason for the greater participation of cerebrovascular or ischemic heart diseases in the risk of death due to circulatory diseases in the above-cited capitals is unknown. Regional cultural aspects and risk factors may play a role. However, an analysis of the temporal behavior of the major risk factors for circulatory diseases, such as smoking, arterial hypertension, dyslipidemia, and diabetes, should be initially performed to detect the most significant factor for specific regions and cities. This information will facilitate the institution of adequate control programs aiming at reversing the trends towards an increase observed for circulatory diseases.

Our study showed the importance of the analysis of
the trends of the risk of death in specific small regions and cities, because they may not reflect the national trends or the trends in large regions. These trends also serve to rank the priorities in local primary and secondary prevention, as, for example, in the city of São Paulo, where a mild increase in ischemic heart diseases was observed in specific age groups, males and females aged 30 to 39 years and females aged 40 to 59 years. Individuals in these age groups are under the influence of important mechanisms responsible for the etiopathology of the atherosclerotic process, and therefore, constitute a group at early risk for circulatory diseases, and will influence morbidity and mortality of subsequent age groups.

Our study also showed important aspects of the risk of death due to circulatory diseases in Brazil. Despite the trend towards a decrease in the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases in Brazil, the regional analysis showed distinct realities intensified by the analysis of the capitals. The magnitude of the differences was even greater when the risks of death due to cerebrovascular and ischemic heart diseases in the capitals were analyzed separately. Males and females also showed some peculiarities in regard to the risk of death due to circulatory diseases. Therefore, this study showed the need for and the importance of sector analyses of mortality due to circulatory diseases in the Brazilian population, facilitating the implantation of health care policies in the cardiovascular area.

Data on mortality of the Ministry of Health are prone to problems, such as diagnosis errors, deficiencies in filling out death certificates, the proportion of deaths with unknown causes, and typing errors. Studies validating the information on mortality do not exist for most states and cities in the country. However, an indirect indicator of the quality of the information provided by death certificates is the proportion of death certificates with symptoms, signs, and ill-defined affections as the diagnosis of the cause of death, which is still significant in most Brazilian cities of the Northeastern, Northern, and West Central regions.

References