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Cancer mortality trends in Brazilian state capitals and other municipalities between 1980 and 2006

ABSTRACT

OBJECTIVE: To analyze the corrected trend of overall cancer mortality and leading sites in the state capitals and other municipalities of Brazil between 1980 and 2006.

METHODS: Data on deaths (n = 2,585,012) caused by cancer between 1980 and 2006 were obtained from *Sistema de Informações sobre Mortalidade* (Mortality Information System), and demographic data were provided by *Instituto Brasileiro de Geografia e Estatística* (Brazilian Institute of Geography and Statistics). The rates of overall cancer mortality and major types were corrected by proportionally redistributing 50% of ill-defined causes of death and standardizing them by age according to the standard world population. Trend curves for Brazil and its major regions were calculated for state capitals and other municipalities according to sex, and were evaluated by means of simple linear regression.

RESULTS: Among men, ascending mortality rates were observed for lung, prostate and colorectal cancer; declining rates for stomach cancer; and stable rates for esophagus cancer. Among women, mortality from breast, lung and colorectal cancer increased, and the rates for cervical and stomach cancer declined. Mortality evolution varied across the regions of Brazil, with distinct patterns between state capitals and other municipalities.

CONCLUSIONS: The correction of mortality rates based on redistribution of ill-defined causes of death increased the magnitude of the overall cancer mortality in Brazil by approximately 10% in 1980 and 5% in 2006. In the inland municipalities no decrease or stability was identified, differently from what was observed in the state capitals. Limited scope of prevention actions and lower access to services of cancer diagnosis and treatment for the population living away from large urban centers may partly explain these differences.

DESCRIPTORS: Neoplasms. Mortality Registries. Mortality, trends. Temporal Distribution. Brazil.

INTRODUCTION

The rates of mortality caused by the main sites of cancer (including lung, colorectal, breast and prostate) have been decreasing since the 1990s[10] in many developed countries, even with the maintenance or increase in the incidence rates. In Brazil, cancer mortality rates adjusted by age for all types and for five major sites in men and women (except for stomach and cervical cancer) are still increasing, according to official statistics.

The ill-defined causes of death have also been declining in the last decades in all the Brazilian regions, mainly in inland municipalities. This indicates an

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improvement in the quality of the information registered in the *Sistema de Informações sobre Mortalidade* (SIM – Mortality Information System). However, there are still significant values of ill-defined causes of death in the North and Northeast regions.[a] Among the proposed correction techniques, the most commonly employed one, adopted by the World Health Organization (WHO), presupposes the proportional redistribution of the ill-defined causes considering the same distribution of the known natural causes.[b] Nevertheless, concerning cancer mortality, it is questioned whether the same correction strategy should be assumed.[9] It is possible that the percentage of neoplasms among the ill-defined causes of death is lower than the percentage corresponding to this group of diseases among the well-defined causes.[12] Therefore, when the redistribution of deaths without classification of the basic cause is adopted, this may artificially increase the mortality.

The quality of the information provided by the mortality information systems depends directly on filling out the death certificates (DC) correctly and reflects the diagnostic problem-solving capacity of the health services.

This study aimed to analyze the trend of overall cancer mortality and major sites in Brazil and large regions from 1980 to 2006 with proportional redistribution of ill-defined causes of death in the state capitals and other municipalities.

METHODS

A time series analysis of the overall cancer mortality and major sites was carried out among men and women in Brazil and regions in the period from 1980 to 2006. Data on deaths were obtained from the SIM (Ministry of Health), and demographic data, from *Instituto Brasileiro de Geografia e Estatística* (IBGE – Brazilian Institute of Geography and Statistics), available at the Datasus website. The files were extracted in the DBC format and expanded in the TabWin program.

The deaths for the period from 1980 to 1995 were obtained considering the codification of the Ninth Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-9); from 1996 to 2006, the Tenth Revision was used (ICD-10). The codes that were included were: malignant neoplasms (140-208, C00-C99), breast (174-175, C50), lung (162, C33-C34), prostate (185, C61), esophagus (150, C15), stomach (151, C16), colorectal (153, 154.0, 154.1, C18-C20), cervical (180, C53). Deaths caused by cervical cancer were corrected based on the redistribution of all deaths caused by uterine cancer, part unspecified (179, C55), maintaining the same proportion of deaths by cervix uteri and corpus uteri.[3]

Cancer mortality rates were corrected by proportionally redistributing the deaths whose basic cause was ill-defined, employing the methodology used by the WHO.[b] The correction factors were calculated to each five-year range, year and sex, according to capital cities and other municipalities of the federative units, using the following formula: Total deaths – deaths by external causes / Total deaths – deaths by external causes - deaths by ill-defined causes. Deaths by external causes refer to codes 800-999 and V01-Y98, and deaths by ill-defined causes to codes 780-799 and R00-R99 in ICD-9 and 10, respectively.

The correction factors were calculated according to the proportional redistribution of 50% of the ill-defined causes of death among the cancers. Our presupposition was that the representation of the deaths by cancer among the ill-defined causes would be lower, in view of the better classification of the deaths caused by cancer when compared to the other causes of death.[8,12] The criterion of distributing 50% of the deaths was based on the study of validation of the ill-defined causes of death conducted by Mello Jorge et al,[12] in which 9% of the ill-defined causes would be diagnoses of cancer; a percentage that is lower than the one verified in 2007, where 16.7% of the total number of deaths were registered as being caused by malignant neoplasms in 2007. The corrected deaths for state capital and other municipalities of the federative units, by five-year age groups, were added to compose the data by region and for the entire country.

Mortality rates for overall cancer and for major sites were calculated and standardized, with and without correction, by age group through the direct method, using the standard world population as reference.[15] Of the total of 2,599,226 deaths caused by cancer registered in the SIM between 1980 and 2006, 14,214 (0.6%) records with no information on sex, age and federative unit were excluded from the analysis.

The temporal trend of the standardized mortality rates was evaluated by simple linear regression. The year of the death was considered the independent variable and the standardized cancer mortality rates, the dependent variables, according to the following groupings: major regions, state capitals and other municipalities (inland), to each type of cancer included in the study.

The analyses were performed using the STATA programs,[16] version 9.

The research was approved by the Research Ethics Committee of the Social Medicine Institute of Universidade do Estado do Rio de Janeiro (Process no.: 00270250000-09) in 12/08/2009.

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[b] Mathers CD, Bernard C, Iburg KM, Inoue M, Fat DM, Shibuya K, et al. Global burden of disease in 2002: data sources, methods and results. Geneva: World Health Organization; 2003. (Global Programme on Evidence for Health Policy Discussion Paper, 54).

RESULTS

The standardized rates of mortality by ill-defined causes showed, between 1980 and 2006, significant decreases in the country (β=-5.264; p<0.001 and β=-3.883; p<0.001) and in the municipalities out of capitals (β=-6.858; p<0.001 and β=-5.255; p<0.001) among men and women, respectively. However, in the state capitals, stability among women was observed (β=0.002; p=0.984), as well as a slight increase among men (β=0.421; p=0.040).

The overall cancer mortality rate without correction in the evaluated period presented an increasing trend in Brazil among men (β=0.777; p<0.001) and among women (β=0.467; p<0.001). In the capital cities there was stability for men (β=-0.108; p=0.261) and reduction for women (β=-0.153; p=0.035); in the other municipalities there was an increase for both sexes (β=1.038; p<0.001 and β=0.713; p<0.001, in men and women, respectively). The correction increased the general magnitude of the rates. For the inland municipalities, the increase was of 16.8% for men and 16.4% for women in 1980; and it was minimal for the state capitals (1.6% for men and 1.7% for women). In 2006 the increase was of 5.1% for men and 4.2% for women in the entire country (inland: 6.0% in men and 5.0% in women; state capitals: 2.9% in men and 2.4% in women). However, the temporal trend of the rates changed only among state capital women: it was a declining trend and became stable after the correction (β=-0.080; p=0.279) (Figure 1).

Figure 2 shows the trend for the leading sites of cancer among men after correction, for Brazil, state capitals and other municipalities. For the entire country, lung cancer (β=0.088; p<0.001), prostate cancer (β=0.286; p<0.001) and colorectal cancer (β=0.096; p<0.001) showed ascending rates. For stomach cancer, an important reduction was observed (β=-0.278; p<0.001) and for esophagus cancer, stability (β=0.002; p=0.766). The trend of the mortality rates for cancers of inland municipalities was similar to the one verified for the aggregated data for Brazil. Nevertheless, in the case of esophagus cancer, unlike the national rates, a slight increase was observed (β=0.016; p=0.026).

In the state capitals, beside stomach cancer (β=-0.399; p<0.001), lung (β=-0.111; p<0.001) and esophagus cancer (β=-0.047; p<0.001) showed decreasing trends. However, lung cancer presented the highest mortality rates in the entire period (higher than 20/100,000 year).

Among women (Figure 3), breast cancer (β=0.115; p<0.001), lung cancer (β=0.137; p<0.001) and colorectal cancer (β=0.060; p<0.001) showed increasing trends, while cervical cancer (β=-0.077; p<0.001) and stomach cancer (β=-0.124; p<0.001) showed a decline in the entire country. The mortality trend practically did not differ in the state capitals and inland municipalities. In the state capitals, however, breast cancer, which was the major type in the entire period, with rates above 16/100,000 year, started to present a statistically significant ascending trend (β=0.297; p<0.001) from 2001 onwards. In the other municipalities, mortality caused by this type of cancer surpassed that of cervical cancer only from the 1990s onwards.

Mortality by lung cancer, which presented in the state capitals the lowest rate (6.1/100,000 year) in 1980, started to rank second among the major female cancers in 2003, with a 67.1% increase in the entire period. A similar situation was observed in the inland municipalities: it became the third cause of death by cancer in 1997 with a 99.7% increase. Colorectal cancer occupied the third position up to 2004 in the state capitals, when it surpassed cervical cancer. In the other municipalities, however, it remained in the fourth position. Stomach cancer presented a reduction both in the state capitals (43.9%) and in the other municipalities (34.6%). Nevertheless, this decrease was faster in the state capitals, which had been presenting lower rates in relation to the other analyzed cancers since 1993; a situation that only occurred after ten years in the inland municipalities.

The analysis of mortality evolution for the two most frequent sites according to sex (lung and prostate cancer in men and breast and cervical cancer in women), disaggregated by major Brazilian regions, comparing data of the populations residing in the state capitals and in the other municipalities, assumed different patterns (data not presented).

Lung cancer in men showed a decline in all the state capitals, except for those located in the Northeast region, where an increase of approximately 20% was verified; differently from what happened in the other municipalities, where the variations were also ascendant and positive, with rates that tripled in the North region and doubled in the Northeast region.

Prostate cancer increased in all regions, both in the inland municipalities and in the state capitals, but the South region showed a different pattern, since the inland rates surpassed the state capitals' rates at the end of the period. Inland municipalities of the North, Northeast and Central-West regions presented increases two times higher or more than the one observed in the capitals.

The increasing trend of mortality from breast cancer was similar in all regions of the country, but always with higher rates in the state capitals.

Cervical cancer rates were higher in the state capitals of the North, Northeast and Central-West regions than in the other regions. Although a decline in the mortality from this type of cancer was observed in Brazil as a

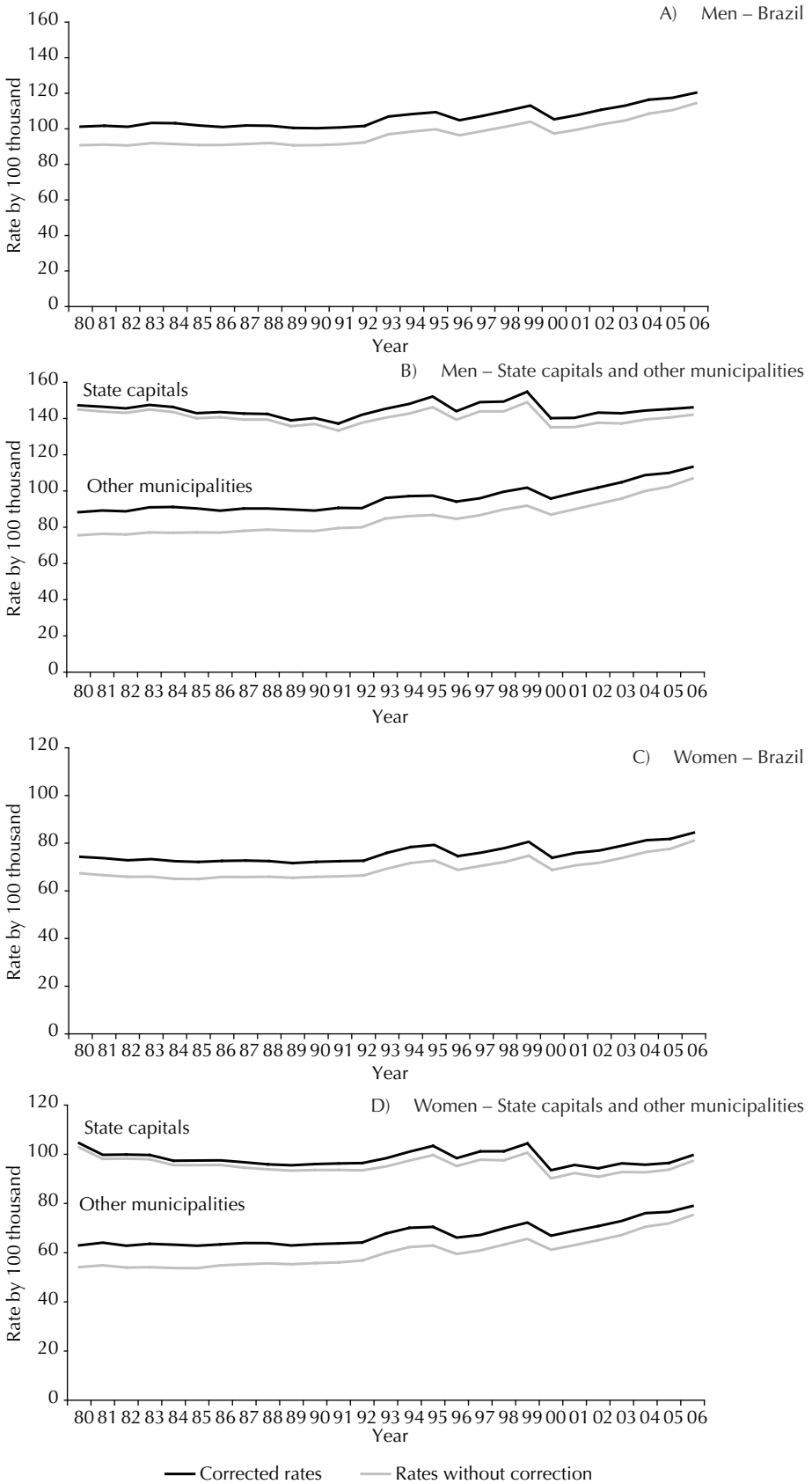

Figure 1. Cancer mortality rates, all sites, without correction and corrected, for men and women. Brazil, state capitals and other municipalities, 1980 to 2006.

whole, there was a 200% increase in the inland municipalities of the North region, and an 80% increase in those of the Northeast region.

DISCUSSION

The malignant neoplasms contribute strongly to the Brazilians' mortality, and the magnitude may be higher than the official statistics if corrected by the proportional redistribution of 50% of the ill-defined causes of death in the SIM. With this correction, the increase for all types of cancer becomes higher than 10% in the beginning of the 1980s and around 5% in 2006. As was expected, the increase in the state capitals was lower than 2% in 1980 and a little higher at the end of the period, which may be explained by the growing proportional increase in cancers within the total number of deaths.

Besides the increase in the magnitude of the rates, remarkably higher for the inland municipalities, the present study shows that the trends are not maintained when the Brazilian cities are divided into state capitals and other municipalities.

The international projections of cancer incidence and mortality have declined for the majority of sites (lung, colorectal, breast and prostate) in the United States and other developed countries; at the same time, they tend to increase in many developing and underdeveloped countries. This may be explained by the adoption of unhealthy lifestyles like smoking, sedentariness and inadequate eating habits,[10,18] in addition to greater exposure to environmental and individual risk factors, population growth and aging. All of this leads to the forecast that the occurrence of cancer will reach dramatic increases, especially in low income countries. The investment in control policies should prioritize the constant monitoring of incidence, mortality and survival, enabled by high-quality information systems.[9]

The correction of the SIM data performed in this study took into account the same distribution of the well-defined natural causes as recommended by the WHO.[b] In a more conservative attempt, aiming not to overestimate the amount of deaths by malignant neoplasms, we assumed a correction of only 50% of the total deaths classified as ill-defined. This procedure was adopted because we understand that, with regard to malignant neoplasms, the quality of the information on basic causes registered in the SIM may be better than for other types of causes.[12] Although this decision may be questioned, there are no recent studies about the composition of the deaths registered as ill-defined causes in all the regions of the country. For this reason, the correction factors were calculated by five-year age groups, sex, state and area of residence (state capital or other municipalities). In this way, the estimates tend to be closer to how the cancer profile would be in each state. After the correction, it is observed that the disparities between state capitals and other municipalities are intensified and seem to be more coherent with the diagnostic problem-solving conditions of the services located in needy regions. Many Brazilian authors have proposed methodologies for correction not only of the under-register of deaths but also of the quality of the information of the SIM.[5,14,17] Until a standardized methodology for the correction of the SIM for the entire country is developed, relativizing each group of causes, it will be necessary to establish simple correction methods that do not inflate exaggeratedly the cancer statistics in trends analyzes. As the quality of the information on basic causes of deaths improves in all regions of Brazil, the future contribution of this correction will gradually decrease. However, it is necessary to ensure comparability with data from previous years.

The present study confirms other recent research,[6] showing that the magnitude of the cancer mortality rates in Brazil is, in general, lower than that of developed countries. Nonetheless, the overall trends and the trends for the leading sites do not indicate reduction, except for stomach and cervical cancer which, despite being on the decline, can be considered high in relation to the trends found in other countries. The international comparison of the mortality rates for cervical cancer in the years of 1998 to 2002 varies: from 0.6/100,000 year in Italy to 13.1/100,000 year in South Africa; in Brazil it is 4.9/100,000 year.[10] In relation to stomach cancer, among 63 studied countries, the highest death rates in 2004 were observed in the Republic of Korea (31/100,000 year in men and 11/100,000 year in women) and the lowest in Australia (4/100,000 year and 2/100,000 in men and women, respectively). Also for 2004, the mortality rates from stomach cancer in Brazil were estimated at 11.4/100,000 in men and 4.5/100,000 among women, characterizing them in an intermediate-high pattern.

The correction maintained, for the cancers in the male population, the same trends of the non-corrected data: stable for the state capitals and ascendant for the other municipalities. To women from municipalities out of capitals, the trends are ascendant (without and with correction), but there was an alteration in the inclination of the trend curve in the state capitals. Without correction, the cancer mortality rates adjusted by age based on the standard world population showed a consistent reduction in the state capitals, which had been previously identified by Fonseca et al,[7] for the period from 1980 to 2004. With the correction, the evolution of the rates among women remained stable. However, the correction that was carried out redistributed proportionally the total deaths caused by uterine cancer, "non-specified portion", and 50% of the deaths with ill-defined basic causes. As this correction took into account the age groups and origin (inland and state capital), the effect may have

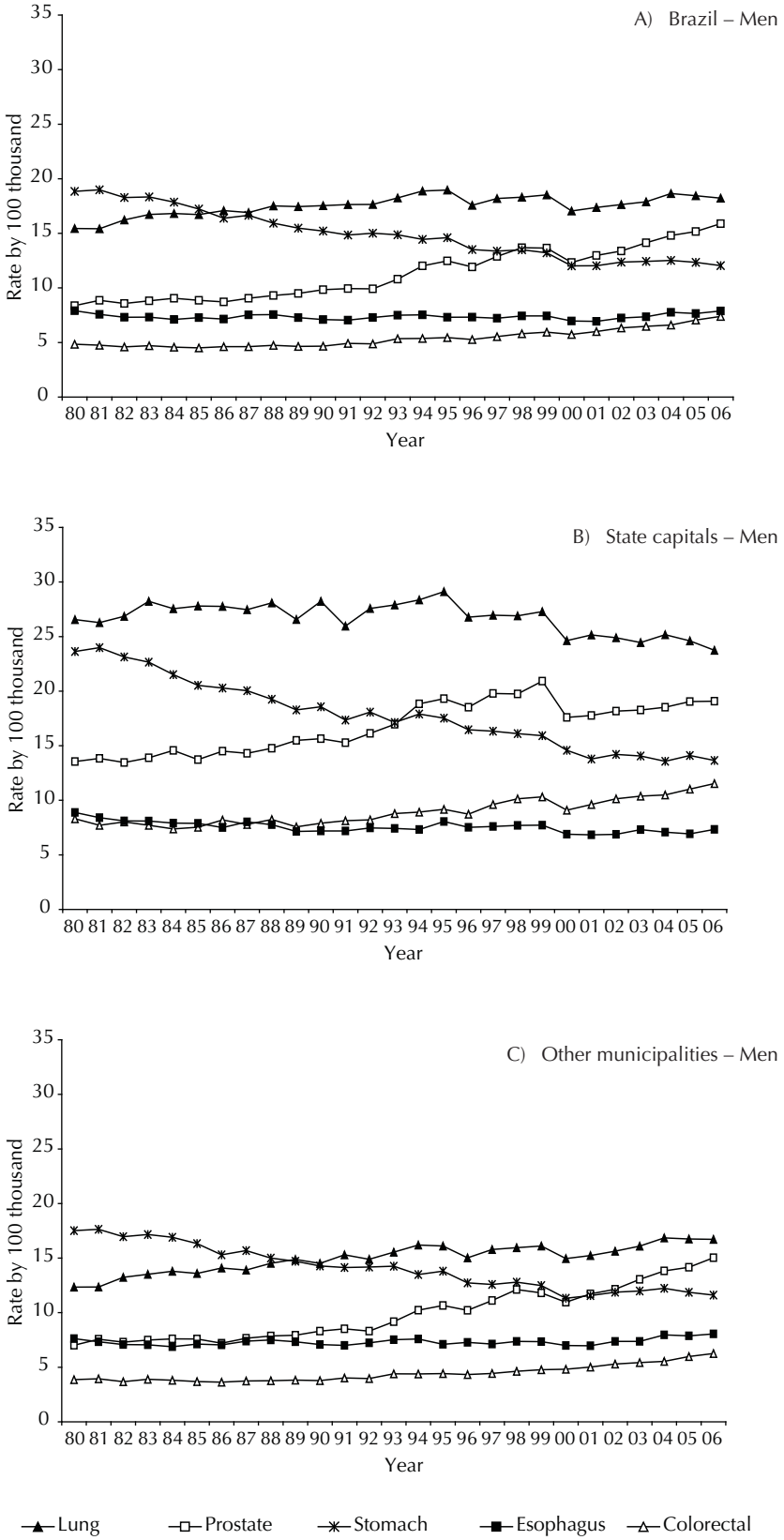

Figure 2. Corrected cancer mortality for the leading sites in males. Brazil, state capitals and other municipalities, 1980 to 2006.

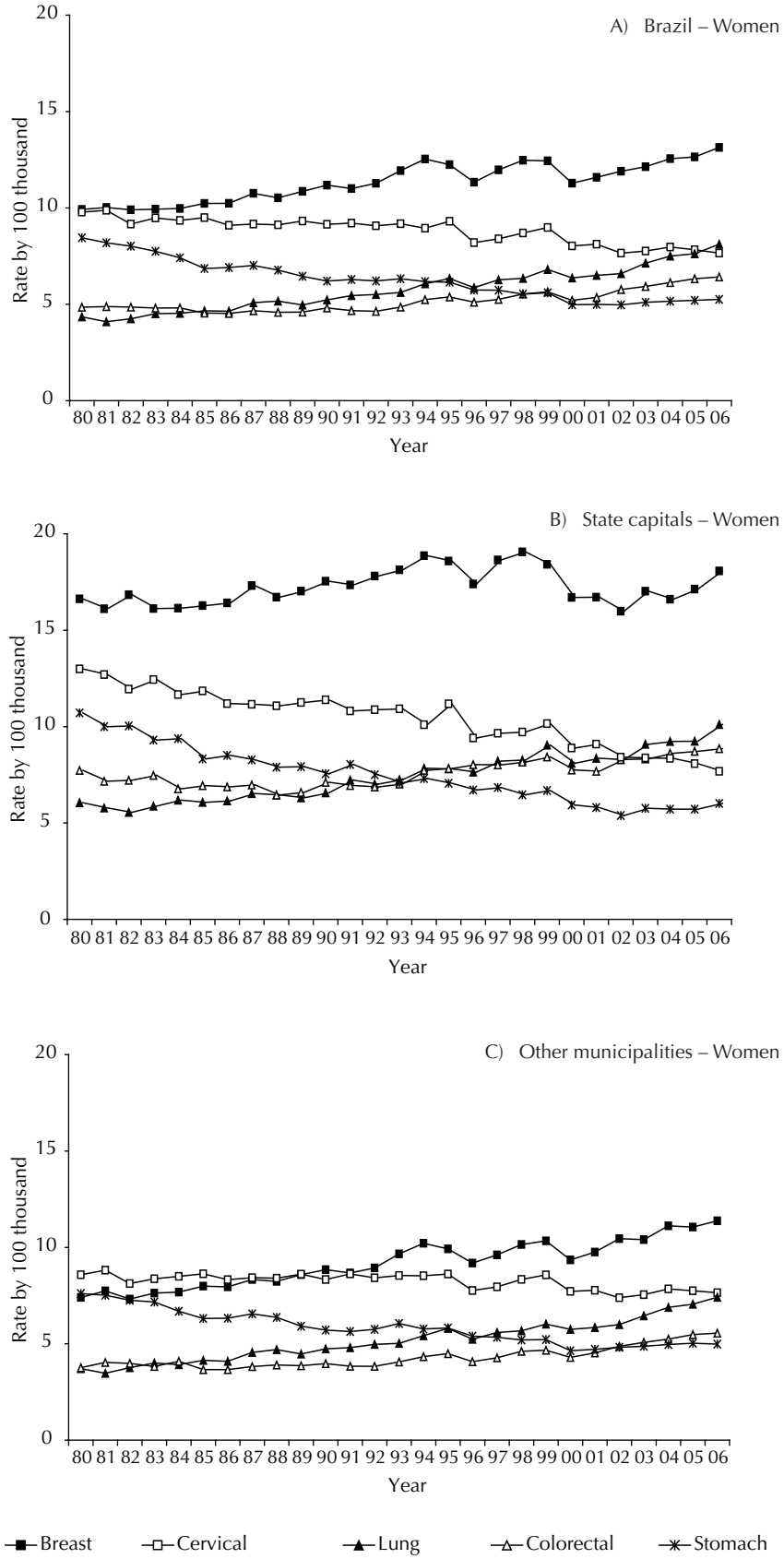

Figure 3. Corrected cancer mortality for the leading sites in females. Brazil, state capitals and other municipalities, 1980 to 2006.

been higher in the beginning of the studied period and, with this, the rates became stable.

Remarkably, the inland municipalities present quite a differentiated evolution pattern and indicate neither decrease nor stability. This may be partly explained by the lower reach of the prevention actions in the interior of the states and by the difficulty in accessing cancer diagnosis and treatment services that the population that lives outside large urban centers has. It is known that the greater offer of chemotherapy and radiotherapy services is concentrated on the state capitals of the Southeastern and Southern regions.[c]

The decline in lung cancer among men that has been occurring since 1995 in the state capitals (except for the Northeastern ones) and its ascension in the other municipalities between 1980 and 2006 may suggest that the decrease in the prevalence of male smokers must have happened previously and in a more marked way in the state capitals, and in a differentiated way according to socioeconomic level. Associations between higher prevalence and lower level of schooling have been shown.[2] In fact, the present study identified increasing trends in the interior of the states, tripling in the North region and doubling in the Northeast.

Mortality from lung cancer among women has not been decreasing yet, following what has been observed in other countries. In the Brazilian state capitals, from 2003 onwards, lung cancer has reached the second position among deaths caused by cancer among women and has been increasing fast in the other municipalities since 1997, with an increment of almost 100%.

The increase by more than 100% in the mortality caused by prostate cancer among inland men from all regions of the country may be explained by the differentiated access to the health services: those residing in the state capitals showed a lower increase (40.8%). It is possible that the men who live in the state capitals have had more access to diagnostic services in early stages of the disease and, consequently, benefitted from better therapeutic options.

Despite the high rates, breast cancer in the state capitals presented an increasing trend, but with marginal statistical significance for the entire studied period. The estimates of mammography coverage, calculated from self-report information in population-based inquiries, varied between 64% and 82% in the state capitals of the Southeastern and Southern regions, while in the North region it remained between 41% to 63%.[19] In the inland municipalities, mortality from this cancer has been increasing in all regions since the 1990s; it is possible that, women living in cities out of capitals, have less access to mammography than those residing in the state capitals.

Cervical cancer among inland women has not reached yet the same reduction observed in women from the state capitals, which once again strengthens the hypothesis of inequality of access to healthcare services in Brazil. It is possible that women from state capitals are more benefitted by the tracking actions that have been occurring in the country since the end of the 1990s. It is known that the coverage of the preventive gynecological exam in Brazil has increased a lot in the last two decades; however, there is still a difference in access due to socioeconomic level.[1,11] Novaes et al,[13] analyzing data from the National Household Sample Survey 2003, showed differences in the coverage of preventive gynecological exams between women living in urban areas (78%) and rural areas (60%).

The decision-making by health managers must be based on the best estimate that data from SIM and other health information systems of the Unified Health System can provide. Assuming the increase or decrease in cancer mortality has implications for health assessment and can influence the review of the prevention and control strategies. The data presented here allow outlining a profile of cancer mortality in Brazil, which is markedly influenced by unequal conditions of risk and access to services. The overcoming of these inequalities necessarily begins with a better measurement of the problem, which enables the construction of an effective policy of cancer control in the different Brazilian regions.

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