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TREND OF MORTALITY RATES FOR GASTRIC CANCER IN BRAZIL AND REGIONS IN THE PERIOD OF 30 YEARS (1980-2009)

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ABSTRACT – ***Context*** - The most recent global estimate revealed the presence of about one million new cases of stomach cancer for the year 2008, setting itself as the fourth most common cause of cancer. ***Objective*** - The present study aims to assess the trend of mortality from stomach cancer in Brazil according to regions between 1980 and 2009. ***Methods*** - Data on deaths from stomach cancer were obtained from the Mortality Information System, and the demographic data, from the Brazilian Institute of Geography and Statistics. The rates of mortality were standardized by age according to world population. The trend curves were calculated for Brazilian regions by sex. The technique used was polynomial regression and joinpoint. ***Results*** - The tendency for males and females is similar in all regions, although the magnitude is higher among men in all places. Regions Midwest, South, Southeast tended to decline, while the Northern region showed no significant trend, and the Northeast tended to increase. ***Conclusion*** - It is therefore a need to evaluate public health policies for gastric cancer aimed at the demographic transition (change of urbanization and lifestyle) that is occurring throughout the country.

HEADINGS – Stomach neoplasms, mortality. Stomach neoplasms, epidemiology. Brazil.

INTRODUCTION

Stomach cancer is a major contributor to mortality worldwide, but its incidence varies widely around the world in a way that our current understanding of etiology can not fully explain. According to GLOBOCAN 2008, about one million new cases of stomach cancer was estimated in 2008 (988,000 cases, 7.8% of total), making it currently the fourth most common malignancy in the world behind lung cancer, breast and colorectal[1]. Over 70% of cases (713,000 cases) occur in developing countries (467,000 men, 246,000 women), and half of the world total occurs in East Asia (especially China)[28].

Standardized incidence rates by age are twice as high in men as in women, ranging from 3.9 in North Africa to East Asia to 42.4 in men and 2.2 in South Africa to 18.3 in East Asia for women. Stomach cancer is the second leading cause of cancer death in both sexes worldwide (736,000 deaths, 9.7% of total). The highest mortality rates are estimated in East Asia (28.1 per 100,000 in men, 13.0 per 100,000 in women), the lowest in North America (2.8 and 1.5 respectively). High mortality rates are also present in both sexes in Central and Eastern Europe and Central and South America[13, 28].

In the year 2012, it is estimated, for Brazil, 12,670 new cases of stomach cancer in men and women in 7,420. These values correspond to an estimated risk of 13 new cases per 100,000 men and 7 women to every 100,000. Without considering the non-melanoma skin cancers, stomach cancer in men is the second most frequent in the North (11/100,000) and Northeastern (9/100,000) and fourth in the South (16/100,000), Southeast (15/100,000) and Midwest (14/100,000). For women, ranks fourth in the North (6/100,000), fifth in the Midwest (7/100,000) and sixth in the Southeast (9/100,000), Southern (8/100,000) and Northeast (6/100,000)[17].

Incidence data are scarce in Brazil, results inconsistent data records and population bases are few studies on the etiologic pathway of carcinogenesis. Thus, the best evidence for the study of the magnitude of the problem in Brazil is the study of mortality in the country[6]. Thus, this study aims to assess the trend of mortality from stomach cancer in Brazil according to regions between 1980 and 2009.

METHODS

We performed a time series analysis of mortality from stomach cancer among men and women in Brazil

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and regions in the period 1980 to 2009. Data on death were obtained from the SIM (Mortality System Information) from the Ministry of Health and the demographics of the Brazilian Institute of Geography and Statistics (IBGE), available at DATASUS. The files were extracted in DBC format[10].

The deaths for the period 1980 to 1995 were obtained considering the encoding of the Ninth Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-9), from 1996 to 2006, used the Tenth Revision (ICD-10). The codes are included, respectively, 151[8] and C16[9].

The trend of standardized mortality rates was assessed by polynomial regression, considering the rates standardized according to world population[6] mortality from stomach cancer, according to sex, and stratified by Brazilian regions (Midwest, Northeast, North, Southeast, and South).

Initially, we made scatter diagrams between mortality rates and years of study, to visualize the kind of relationship between them. After that, we started the process of modeling, considering the mortality rates as the dependent variable (Y) and years of study as an independent variable (X). To study the trend, we chose to estimate regression models. To avoid collinearity between the terms of the regression equation, we used time as a centered-variable[12].

The first model to be tested was the simple linear regression ($Y = \beta_0 + \beta_1 X$) and then tested the models of higher order: second degree or parabolic ($Y = \beta_0 + \beta_1 X + \beta_2 X^2$) and third degree ($Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X^3$)[12]. It was considered as the best model, the one with the highest coefficient of determination (R^2). When two models were similar, the statistical point of view, to the same location, we chose the simplest model, i.e., the lower order. In the end, joinpoint analysis was performed in order to estimate the Average Annual Percent Change (AAPC) of the rates. Analyses were performed using SPSS® version 19 (Statistical Package for Social Sciences) for polynomial regression and SEER Joinpoint Regression Program® version 3.5.3 for joinpoint analysis.

RESULTS

Table 1 shows the rates of stomach cancer mortality adjusted for age (by the world's population), by sex, per

TABLE 1. Rates of stomach cancer mortality adjusted for age (by the world's population), by sex, per 100,000 people in Brazil, according to regions, between 1980 and 2009

Year	Midwest		Northeast		North		Southeast		South	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1980	10.2	6.35	4.69	2.57	14.35	6.24	24.51	10.58	21.73	9.38
1981	14.34	6.79	5.68	2.45	12.22	6.71	23.74	10.06	21.57	9.29
1982	13.17	6.69	5.41	2.65	14.52	6.46	22.56	10.1	20.95	8.01
1983	12.98	6.24	5.1	2.61	13.31	6.82	23.06	9.54	19.76	7.81
1984	14.84	4.86	5.53	2.6	12.77	6.61	21.29	9.11	19.82	7.71
1985	14.7	6.54	5.13	2.48	13.46	5.44	20.73	8.06	19.16	7.6
1986	12.97	4.58	5.08	2.41	14	6.35	20.05	8.27	17.96	7.63
1987	12.7	6.28	5.56	2.43	12.03	5.62	20.26	8.3	18.42	7.68
1988	14.25	5.82	5.23	2.6	13.38	5.89	19.45	7.86	17.29	7.72
1989	12.23	5.09	5.01	2.84	10.7	5.43	18.92	7.45	17.94	7.29
1990	10.68	4.16	5.09	2.41	10.97	4.95	18.58	7.47	17.77	6.79
1991	11.41	5.41	5.31	2.48	11	5.6	17.17	7.43	19.29	6.95
1992	12.55	5.21	5.59	2.68	9.99	4.93	17.7	7.24	18.09	6.89
1993	10.2	5.55	5.49	2.47	11.04	4.72	17.62	7.24	18.14	7.47
1994	13.9	5.59	5.36	2.47	11.02	4.51	16.83	7.22	17.1	7.03
1995	13.04	5.17	5.38	2.82	9.39	4.69	17.3	6.98	17.91	7.1
1996	10.26	4.57	5.17	2.71	10.45	5.71	16.48	6.51	15.4	6.35
1997	10.87	5.61	5.49	2.65	9.08	5.12	16	6.6	15.74	6.3
1998	10.71	4.88	5.72	2.98	9.74	5	15.74	6.07	16.84	6.3
1999	12.23	4.64	5.25	2.92	10.46	5.28	15.44	6.09	15.99	6.57
2000	10.31	4.97	5.72	2.71	10.03	4.47	13.58	5.42	14.06	5.65
2001	9.52	4.27	6.34	2.87	9.62	4.83	13.46	5.42	13.77	5.51
2002	10.74	4.56	6.66	2.9	9.67	4.83	13.47	5.36	14.88	5.46
2003	10.15	4.53	6.64	3.19	10.22	5.01	13.67	5.5	14.88	5.44
2004	12.15	4.79	6.58	3.34	10.39	4.96	13.67	5.42	15.34	5.88
2005	10.05	4.9	7.73	3.83	10.71	5.19	13.41	5.28	14.42	5.8
2006	10.83	5.13	8.58	4.19	11.96	5.96	12.58	5.32	13.7	5.53
2007	9.08	4.22	8.09	4.11	11.5	6.19	11.09	4.42	11.38	4.48
2008	8.3	3.6	8.09	3.88	11.51	5.18	10.49	4.38	11.04	4.25
2009	9.03	3.37	7.88	3.48	10.92	4.61	10.19	4.11	11.08	3.88

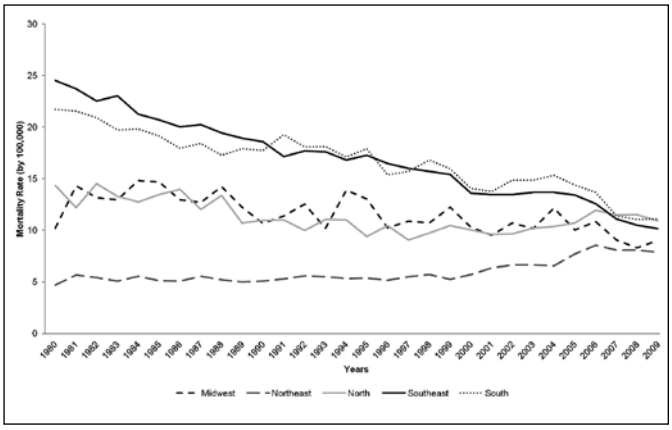

FIGURE 1. Time serie of mortality rates for stomach cancer in Brazil according to regions for males, 1980-2009

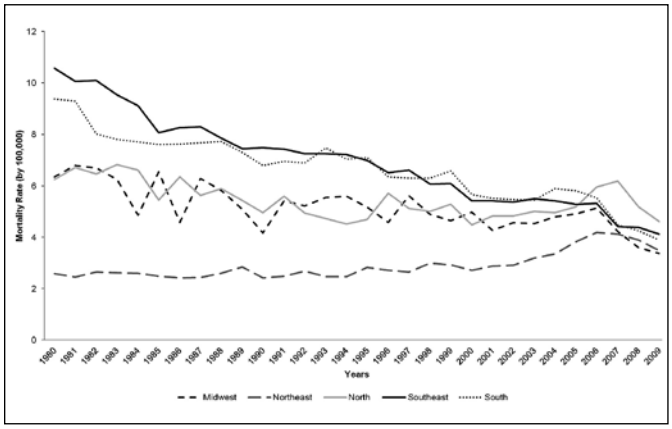

FIGURE 2. Time serie of mortality rates for stomach cancer in Brazil according to regions for females, 1980-2009

100,000 people in Brazil, according to regions, between 1980 and 2009. It is observed that, historically, the male rates are larger than females, in all of the regions.

Figures 1 and 2 shows, respectively, the time serie of mortality rates for stomach cancer in Brazil according to regions for males (Figure 1) and females (Figure 2) between 1980 and 2009. It was observed that the regions do not show the same trend. South, Southeast, and Midwest has a decreasing trend, for both sexes, while the Northern region shows relative stability in rates. On the other hand, the Northeast region has increased rates over the period, also for both sexes.

In fact, the linear trend was confirmed by joinpoint analysis. When testing the modeling period to assess any effect, or some event during the series to demarcate historical change in trend over the 30 years of observation, it was observed that the trend of declining rates remained relatively homogeneous, as can observe the data in Table 2, which shows a statistically significant decline for the South, Southeast and Midwest. For North, there is a non-statistically significant trend, and for Northeast a statistically significant increasing trend, for both sexes.

DISCUSSION

Malignant neoplasms are important contributors to mortality in Brazil, may be a magnitude greater than the official statistics and sometimes need to be corrected by 50% proportional redistribution of ill-defined deaths in SIM. With this fix, the increase for all types of cancer becomes greater than 10% in the early 1980s and around 5% in 2006. As expected, the increase in capital was less than 2% in 1980, and slightly larger end of the period, which can be explained by increasing proportion of the total deaths[21] by cancers.

This paper summarizes the most current secondary data on the descriptive epidemiology of stomach cancer mortality in Brazil. The main finding of this analysis of recent trends in mortality from stomach cancer is the presence of stable and persistent declines in both sexes, both in capital and in the general Brazilian population. This is confirmed by joinpoints analysis.

Regression analysis of trends in other parts of the world shows that the decline in gastric cancer shows no evidence of stabilization not only in Brazil but also in Europe and in other areas of world[32].

TABLE 2. Results from trend analysis for stomach cancer mortality. Brazilian regions, 1980-2009

Region	Sex	Model	R^2	*P* value (95% CI)	AAPC	Trend
Midwest	Male	y = -0.1463x + 13.881	0.5063	0.05	-1.3 (-1.7; -0.8)	Decreasing
	Female	y = -0.0759x + 6.3219	0.5827	0.07	-1.5 (- 2.0; -1.0)	Decreasing
Northeast	Male	y = 0.0993x + 4.413	0.6539	< 0.001	1.6 (1.1; 2.0)	Increasing
	Female	y = 0.047x + 2.162	0.6351	< 0.001	1.5 (1.1; 2.0)	Decreasing
North	Male	y = -0.1121x + 13.085	0.413	0.15	-0.9 (-1.4; 0.5)	Non significant
	Female	y = -0.0468x + 6.1683	0.3448	0.13	-0.8 (-1.3; 0.4)	Non significant
Southeast	Male	y = -0.4443x + 23.854	0.9747	0.001	-2.7 (-2.8; -2.5)	Decreasing
	Female	y = -0.1965x + 10.007	0.9565	0.009	-2.8 (-3.0; -2.6)	Decreasing
South	Male	y = -0.3123x + 21.555	0.8934	0.001	-1.9 (-2.2; -1.6)	Decreasing
	Female	y = -0.1422x + 8.8622	0.8973	< 0.001	-2.2 (-2.5; -1.9)	Decreasing

There is a predominance of cases in males, which is compatible with the natural history of disease and this pattern is also observed in the rest of the world[25].

The adjusted mortality rates for stomach cancer in men in Brazil is considered as an intermediate pattern, similar to Argentina, Colombia and Venezuela[14, 29]. There are differences among Brazilian regions and states. In a Brazilian study it was observed that, in Belém[13] rates found in men were similar to that of Brazil[20] and in rural area of the state of Rio de Janeiro[16]. On the other hand, they were higher than those observed for the state of Rio Grande do Sul[26]. This finding shows that there are regional differences in mortality from stomach cancer, which may be due to cultural factors in eating patterns, the socio-economic status and access to health services. Several factors are in explaining the differential reduction rates as a more accurate diagnosis and possibly earlier, the standardized surgical technique with high level teams in tertiary hospitals; support more specialized anesthetic, intensive care units with trained personnel and modern; nutritional assessment preoperative monitoring and more suitable food, and frequent monitoring of patients[3], and many of these associated conditions for access and resolution of the health service, which is very heterogeneous among Brazilian regions.

With regard to women, the rates can also be classified in the intermediate pattern and are similar to those found in the Americas, Mexico, and Venezuela[29]. The Brazilian rates are higher than in developed countries such as Australia, Canada, United States, Spain, Germany and France[15, 30].

Following the global trend, Brazil showed a decrease in adjusted mortality rates of stomach cancer in both men and women on the last 30 years. This decrease was also observed in much of Europe: Italy, the interior and Northern Spain[15], France[2], China[35], and Russia, Japan, South Korea, USA, and Australia[34].

The reasons for the general decline in rates of gastric cancer are complex and not fully understood. Almost certainly, these include a more varied diet and better food conservation, including refrigeration, as well as control of infection by *Helicobacter pylori* (*H pylori*)[22, 23], decreasing of risk factors exposure, such as consumption of salt and salty foods, which can lead to damage of the protective layer of the mucosa of stomach[11, 22] and smoking[18].

In conclusion, despite the encouraging trends on mortality, stomach cancer remains a leading cause of death worldwide, but further declines are likely. The decision-making by health managers should be based on the best approach that SIM data and other information systems that the Health System can provide. Assume the growth or decline in cancer mortality has implications for the assessment of health and may influence the review of strategies for prevention and control. The data presented allow to draw a profile of cancer mortality in Brazil, markedly influenced by unequal conditions of risk and access to services. Overcoming these inequalities necessarily the best measurement of a problem, which allows the construction of an effective policy for cancer control in different regions.

Primary prevention of stomach cancer through diet is feasible, encouraging high-risk populations to reduce the consumption of meat and canned foods with salt, and increasing consumption of vegetables and fruits. Prevention may also be feasible through the eradication of *H pylori* infection, especially in childhood and adolescence.

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RESUMO – ***Contexto*** - A mais recente estimativa mundial apontou a ocorrência de cerca de um milhão de casos novos de câncer do estômago para o ano de 2008, configurando-se como a quarta causa mais comum de câncer. ***Objetivo*** - O presente estudo tem por objetivo avaliar a tendência da mortalidade por câncer de estômago no Brasil entre 1980 e 2009. ***Método*** - Os dados sobre óbitos decorrentes de câncer de estômago foram obtidos no Sistema de Informações sobre Mortalidade e os demográficos, no Instituto Brasileiro de Geografia e Estatística. As taxas de mortalidade foram padronizadas por idade segundo população mundial. As curvas de tendência para o Brasil foram calculadas para regiões brasileiras de acordo com o sexo. A técnica utilizada foi a de regressão polinomial e por "joinpoint". ***Resultados*** - A tendência para os sexos masculino e feminino é semelhante nas regiões, embora a magnitude seja maior entre homens em todos os locais. As regiões Centro-Oeste, Sul, Sudeste apresentaram tendência de declínio, enquanto a região Norte não apresentou tendência significativa e a região Nordeste apresentou tendência ao aumento. ***Conclusão*** - Conclui-se, pois, sobre a necessidade de avaliar as políticas de saúde pública para câncer de estômago com vistas à transição demográfica (mudanças de urbanização e estilos de vida) que está ocorrendo em todo o país.

DESCRITORES – Neoplasias gástricas, mortalidade. Neoplasias gástricas, epidemiologia. Brasil.

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