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Tendencies of mortality by prostate cancer in the states of the Central-West Region of Brazil, 1980 – 2011

Tendência de mortalidade por câncer de próstata nos Estados da Região Centro-Oeste do Brasil, 1980 – 2011

João Francisco Santos da Silva[I], Inês Echenique Mattos[II], Ricardo Dutra Aydos[III]

ABSTRACT: This study aimed at analyzing the pattern of prostate cancer mortality in the Central-West Region, in the period 1980 – 2011. The quadrennial and annual mortality rates, age-standardized by the world population, were calculated. Polynomial regression models were estimated to analyze trends of mortality in Brazilian regions and in the states of the Central-West Region. Throughout Brazil there was an increase in the magnitude of mortality rates during the study's period. In the Central-West Region, mortality rates from prostate cancer increased from 7.65/100,000 in the period 1980 – 1983, to 14.36/100,000 in the last four years, exceeding the national average. For Mato Grosso do Sul, an increased trend, although not constant, was observed for prostate mortality rates, while those rates showed stability for Mato Grosso and presented a constant trend of increment for Goiás along the studied period. There was a statistically significant negative correlation between mortality rates from prostate cancer and the proportional mortality from ill-defined causes of death in the three states, but no correlations were observed between these rates and the ratios of Prostate Specific Antigen (PSA) tests realized. Difficulties in the access to the health services network, better quality of death records with reduction of ill-defined causes and increased use of PSA may have contributed to the mortality pattern observed in the Central-West Region. Further studies are needed to investigate these relationships in order, to better understand the patterns of mortality from this cancer in the Central-West population.

Keywords: Neoplasms. Mortality. Trends. Brazil. Prostate. Epidemiology.

[I]State Coordination of Control, Evaluation and Auditing of the State Department of Health – Campo Grande (MS), Brazil.
[II]Department of Epidemiology of the Nationa School of Public Health of the *Fundação Oswaldo Cruz* – Campo Grande (MS), Brazil.
[III]School od Medicine of the *Universidade Federal de Mato Grosso do Sul* – Campo Grande (MS), Brazil.
Corresponding author: João Francisco Santos da Silva. Avenida Afonso Pena, 3547, CEP: 79002-072, Campo Grande, MS, Brazil. E-mail: joaofranciscosilva4@gmail.com
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RESUMO: Este estudo teve por objetivo analisar o padrão de mortalidade por câncer de próstata na Região Centro-Oeste, no período de 1980 – 2011. Foram calculadas as taxas de mortalidade quadrienais e anuais, padronizadas por idade pela população mundial. Modelos de regressão polinomiais foram estimados para análise da tendência nas Regiões brasileiras e Estados do Centro-Oeste. Em todo o Brasil observou-se aumento da magnitude das taxas no período estudado. Na Região Centro-Oeste, a taxa média quadrienal de mortalidade por este câncer passou de 7,65/100.00 no período de 1980 – 1983, para 14,36/100.000 no último quadriênio, sendo superior à média brasileira. Em Mato Grosso do Sul, a tendência foi crescente, porém não constante, enquanto em Mato Grosso se observou tendência de estabilidade no final do período, e em Goiás a tendência de incremento foi constante. Verificou-se correlação negativa e estatisticamente significativa entre as taxas de mortalidade por câncer de próstata e a proporção de óbitos por causas mal-definidas nos três Estados, porém não foram observadas correlações entre essas taxas e as razões de exames de Antígeno Prostático Específico (APE) realizados. Dificuldades de acesso à rede assistencial, melhor qualidade dos registros de óbitos com redução de mortes por causas mal-definidas e aumento da utilização de APE podem ter contribuído para o padrão de mortalidade observado na Região Centro-Oeste. São necessários outros estudos que investiguem essas relações, para a melhor compreensão do padrão de mortalidade por esta neoplasia na população dessa Região.

Palavras-chave: Câncer. Mortalidade. Tendência. Brasil. Próstata. Epidemiologia.

INTRODUCTION

Prostate cancer is the second most frequent one among men, and still, an important cause of mortality in male population[1-7].

Little is known about the role of the different risk factors involved in the development of prostate cancer and its etiology still needs to be clarified[8]. However, several studies have tried to demonstrate an association between prostate carcinogenesis and family history[9], environmental factors such as exposure to pesticides[10], and certain lifestyle habits, including physical inactivity[11] and dietary intake of fat and of red meat[12]. Recent studies showed an association between the exposure to pesticide and prostate cancer[9,13].

Not considering non-melanocytic skin tumors, the prostate cancer is the most common malignancy in males in all Brazilian regions and over the past few years a tendency of increase in its incidence has been observed[14]. As to the mortality rate for this cancer, it is also observed a tendency for the increase of its occurrence, even though Brazil still presents one of the lowest rates in Latin America[2,6].

In some European countries and in the United States, epidemiological studies have shown a higher incidence of prostate cancer, particularly between the late 1980s and early 1990s, and a decline in mortality from mid 1990s[3,4]. On the other hand, in countries in Africa and Asia, the incidence rates are still low, however, proportionally more men die from the disease in these regions than in the more developed countries[8].

There are few studies which address the tendency of mortality by prostate cancer in Brazil. Most studies assess the pattern of mortality by various types of cancer, among which the prostate one, in certain Brazilian localities[3,5-7]. As far as it is known, none of them specifically analyzed the pattern of mortality by prostate cancer in the Central-West Region.

In 2002, Wunsh and Moncau[4], analyzing the evolution patterns of mortality in the five Brazilian regions in the period of 1980 – 1995, found that, in the Central-West region, prostate cancer represented the third leading cause of death among men and the upward evolution of mortality rates had been more intense than that observed for lung cancer, which, at the time, was the cancer of highest mortality in male population[4]. In Corumbá, Mato Grosso do Sul, it was observed that, from 1980 to 2006, mortality rates by prostate cancer had been increasing in most of the period. In that city, prostate cancer, which at the beginning of the studied period occupied the third place among the causes of death by cancer in men, went up to first position in the final period[5].

The continental dimensions of Brazil and its very heterogeneous population, in part, contribute to regional variations in the tendencies of mortality by a variation of tumors, including the prostate one[2,10,15]. In this sense, studies analyzing regional data can be useful to better understand the behavior of the disease in a given population. In the Central-West Region, the observed pattern of high mortality rates by this cancer and the tendency for increasing cases of it in the 1980s and 1990s[4], although in general terms, follows the behavior observed for the country, arouses the interest of conducting an evaluation of the mortality with updated data covering a longer period of time, in order to contribute to a better understanding of the problem.

Given the above, this study aimed at describing the tendency of mortality by prostate cancer in the states of the Central-West Region in the period of 1980 – 2011, as well as comparing it to other geographic regions and to Brazil.

METHODOLOGY

A descriptive study of the historical series of deaths from prostate cancer between 1980 and 2011, related to Brazil, to its regions and to the states in the Central-West Region was conducted.

All deaths that occurred in the population residing in the studied area, caused basically by prostate cancer, were selected in the Mortality Information System (SIM) of the Ministry of Health (MH). For the period of 1980-1995, there were considered the deaths codified in Chapter II (Neoplasms) with code 185 of the International Classification of Diseases and Related Health Problems (CID) – 9th Revision. Since 1996, deaths by basic cause coded as C61 in Chapter II of the 10th Revision of the CID were selected.

The population residing in Brazil, in the North, Northeast, South, Southeast and Central-West regions and in the states of this region, in the studied period, was obtained from the Computer Department of the Unified Health System (DATASUS)'s website and it is based on

the population censuses of 1980, 1991 and 2000, on the recount of 1996 and on the estimates for the years in between, of the Brazilian Institute of Geography and Statistics (IBGE).

The data of mortality by prostate cancer were analyzed in 8 quadrennial periods (1980 – 1983, 1984 – 1987, 1988 – 1991, 1992 – 1995, 1996 – 1999, 2000 – 2003 and 2004 – 2007 e 2008 – 2011) and grouped into the following age groups: under 40 years of age; 40 – 49 years of age; 50 – 59 years of age; 60 – 69 years of age; 70 – 79 years of age; and 80 or more years of age, with the goal of reducing random fluctuations possible, given the low frequency of the studied event studied. For comparison ends, the mortality rates were age-standardized by the direct method, using the world population as pattern. The variation percentage in mortality between the first and last quadrennium was calculated using the following formula:

$$\frac{\text{(Proportion of mortality of the initial quadrennium – proportion of mortlity of the final quadrennium) x 100}}{\text{(Proportion of mortality of the inictial quadrennium)}}$$

The proportional mortality from ill-defined causes of the male population in the states of the Central-West Region was calculated for each year of the studied period, for ends of comparison with the distribution of mortality rates by prostate cancer. For the analysis of the correlation between these variables in each state the Pearson correlation coefficient (r) was used, being considered statistically significant results with a $p \leq 0.05$.

The annual number of tests for the measurement of Prostate Specific Antigen (PSA) for the period from 2000 to 2009 was obtained in DATASUS. It was calculated a PSA ratio for each state in the Central-West Region by dividing the total number of annual tests by the number of males aged 50 years or more in the population of these States, in the corresponding period. It was used the Pearson correlation coefficient (r) for the analysis of the relations between the PSA ratio and the mortality rates by prostate cancer in the states, considering $p \leq 0.05$ as statistically significant.

Due to the variation in mortality from poorly defined causes during the studied period, it was decided it would be fixed the deaths recorded as by prostate cancer with part of the deaths by poorly defined causes in each group, as well as the ones by cancer of unspecified location, according to age range and year. These corrections were made initially in the same proportion of deaths by cancer, except for the poorly defined causes, and later on, in the same proportion of deaths by prostate cancer, except for deaths by cancer of unspecified location. It was assumed that the distribution of poorly defined death causes is similar to that of deaths by defined causes, the same occurring on the distribution of deaths due to unspecified location cancer. This procedure, adopted for all years of the study, can be summarized by the formula $Xc = X + M * X/(T - M)$, where: X is the number of deaths by specific cause; M is the number of deaths by poorly defined causes; T is the number of deaths by all causes; and Xc is the corrected number of deaths by specific cause.

After these corrections, for analyzing the tendency of mortality, the annual mortality rates were calculated, age-standardized by the world population, by Brazil, by each Brazilian region and by the states of the Central-West region. Polynomial regression models were used, with the dependent variable (y) the mortality rate and the independent variable (x) the year of the study. In order to avoid collinearity, the time variable was centered at the midpoint of the historical series. Models of first, second and third order were tested and considered statistically significant those with $p \leq 0.05$[15,16].

Data analysis was performed with the SPSS software for Windows, version 17.0.

This research followed the ethical principles in the Declaration of Helsinki. The research protocols were evaluated and approved by the Ethics Committee for Research in Humans of the Universidade Federal do Mato Grosso do Sul, Brazil (Protocol No. 2169 CAAE 0263.0.049.000-11 of August 18th, 2011).

RESULTS

In Table 1, the behavior of mortality by prostate cancer can be observed, adjusted by age, for Brazil, the five Brazilian regions and states in the Central-West Region and the variation in the proportion of mortality. In general, one can observe the increase of the magnitude of these rates in the studied period. Mortality rates in the Central-West Region, which, in the first six quadrennium periods analyzed corresponded to the third highest one among Brazilian regions, came to occupy the second position in the last quadrennium period and always showed values higher than the Brazilian average. It can be observed the growth of mortality rates in the states of the Central-West Region, being the highest value of the period observed in Mato Grosso do Sul, in the quadrennium from 2004 – 2007. The state of Mato Grosso showed variation in the proportion of mortality between the first and last quadrennium of 180.48%, while in Brazil this variation was 84.37%.

In Figure 1, it is presented the distribution of mortality in proportion to the poorly defined causes and to the rates of death by prostate cancer in the states of the Central-West Region during the studied period. It was verified the existence of a negative and statistically significant correlation between these rates and the proportion of deaths by poorly defined causes in the three states. However, while strong correlations between the two variables were observed in Mato Grosso ($r = -0.882$; $p < 0.01$) and Goiás ($r = -0.770$; $p < 0.01$), the correlation was moderate in Mato Grosso do Sul ($r = -0.586$; $p = 0.01$).

The comparison between the ratio of PSA tests and mortality rates by prostate cancer are found in Figure 2. In all three states weak and not statistically significant correlations were observed among these distributions: Mato Grosso do Sul ($r = 0.224$; $p = 0.553$); Mato Grosso ($r = -0.175$; $p = 0.628$); and Goiás ($r = 0.137$; $p = 0.707$).

In Table 2, the results of the tendency analysis are presented. Although with variations, it was observed an increasing tendency in all Brazilian regions. Regarding the states of the Central-West Region, it was also verified a tendency of growth in mortality

Table 1. Mortality rates from prostate cancer and percent of variation of mortality in the study period in Brazil, its geographic regions and states of the Central-West Region, 1980 – 2011.

Trienniums	Mortality rates*								Variation (%)
	1980 – 1983	1984 – 1987	1988 – 1991	1992 – 1995	1996 – 1999	2000 – 2003	2004 – 2007	2008 – 2011	
Brazil	7.26	7.85	8.63	10.20	11.99	12.24	14.17	13.39	84.37
Southeast	9.96	10.26	11.01	12.92	14.86	14.33	15.06	13.13	31.88
South	10.47	10.64	11.49	13.84	15.89	16.25	17.45	15.22	45.40
Northeast	3.43	3.67	4.53	4.70	6.83	7.83	11.84	13.13	283.19
North	4.90	4.84	4.98	6.01	6.89	7.75	9.52	10.53	114.91
Central-West	7.65	8.17	9.11	10.47	13.83	13.99	15.27	14.36	87.67
Mato Grosso do Sul	8.24	8.02	12.05	12.42	14.05	14.88	18.01	14.38	74.43
Mato Grosso	4.74	5.23	7.07	7.06	12.12	14.84	16.12	13.28	180.48
Goiás	6.74	7.78	7.23	8.99	12.46	11.95	12.67	12.50	85.48

*Four-years mortality rates per 100,000 habitants, adjusted by the worldwide population.

Table 2. Trends of mortality rates* from prostate cancer in Brazil, in its geographic regions and in states of the Central-West region, 1980 – 2011.

Location	Model	R^2 (%)	p-value	Tendency
Brazil	$y = 13.969 + 0.376x - 0.006x^2 - 0.001x^3$	90.7	< 0.001	Increasing, not constant
Southeast Region	$y = 16.118 + 0.366x - 0.012x^2 - 0.001x^3$	80.6	< 0.001	Increasing, not constant
South Region	$y = 17.217 + 0.426x - 0.009x^2 - 0.001x^3$	79.1	< 0.001	Increasing, not constant
Northeast Region	$y = 10.770 + 0.285x + 0.009x^2$	89.9	< 0.001	Increasing, most of the time, but stable at the end
North Region	$y = 10.275 + 0.398x - 0.002x^3$	62.0	< 0.001	Increasing, most of the time, but stable at the end
Central-West Region	$y = 15.304 + 0.435x + 0.13x^2 - 0.002x^3$	76.6	< 0.001	Increasing, not constant
Mato Grosso do Sul	$y = 16.573 + 0.515x - 0.0.18x^2 - 0.001x^3$	68.2	0.045	Increasing, not constant
Mato Grosso	$y = 13.416 + 0.816x - 0.003x^3$	76.7	0.002	Increasing, most of the time, but stable at the end
Goiás	$y = 13.238 + 0.125x$	25.3	0.003	Constantly increasing

*Annual mortality rates (for 100.000) adjusted by ill-defined causes of mortality and age-standardized by the worldwide population.

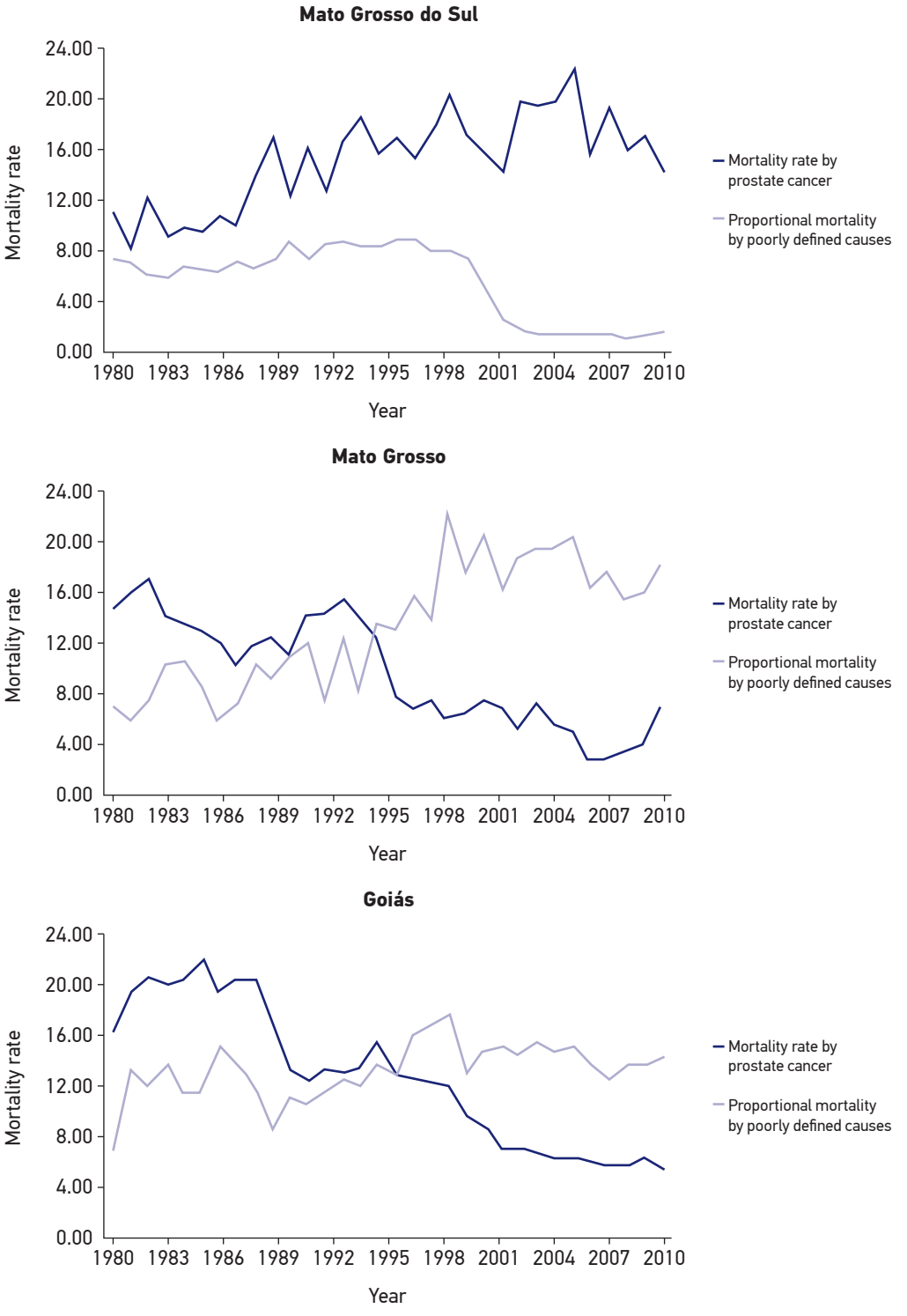

Figure 1. Distribution of prostate cancer mortality rates and proportional mortality for ill-defined causes in states of the Central-West Region, 1980 – 2011.

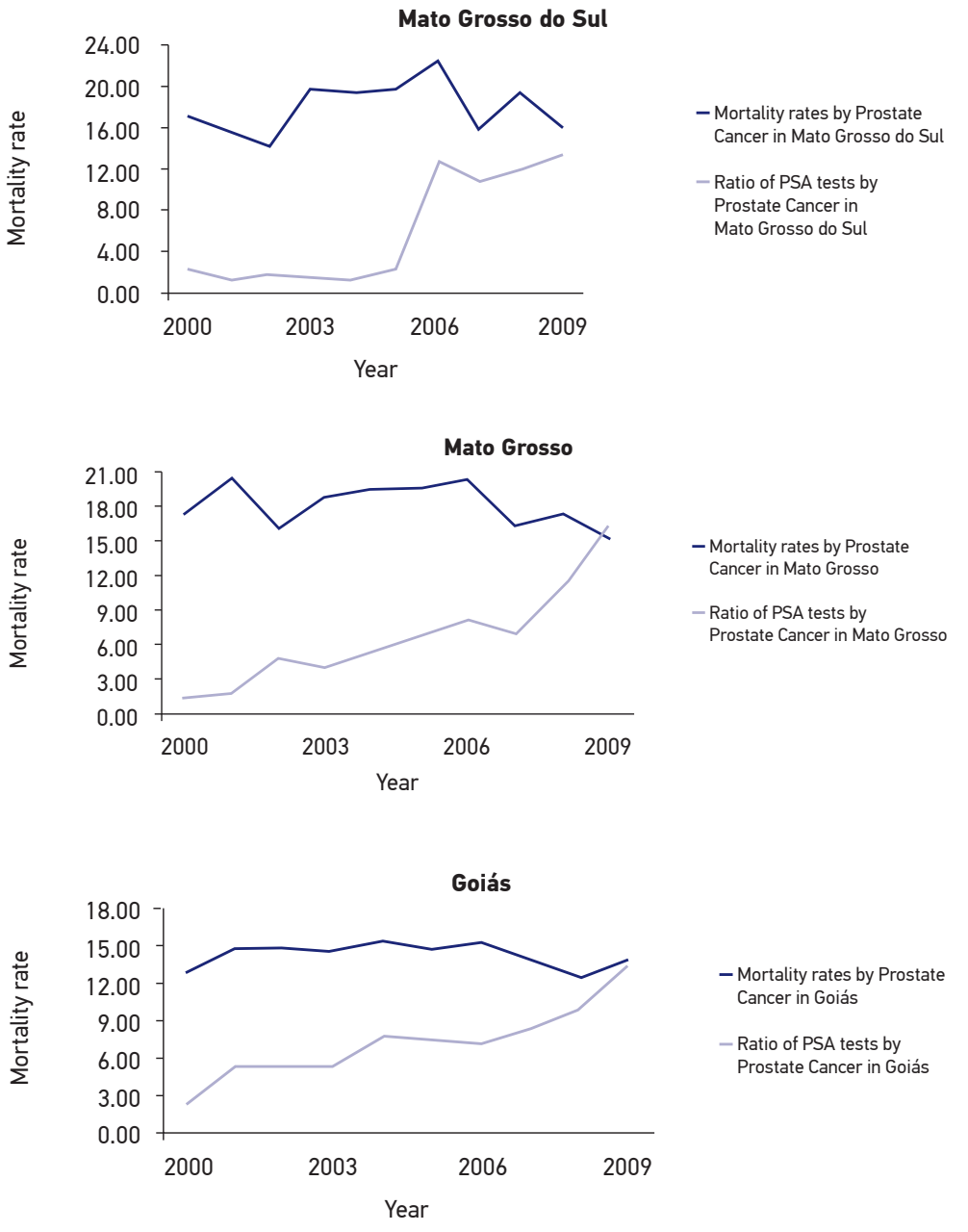

Figure 2. Distribution of prostate cancer mortality rates and PSA tests ratio in states of the Central-West region, 2000 – 2009.

rates by prostate cancer during the studied period. In Mato Grosso do Sul, the trend was increasing, but not constant, while in Mato Grosso the distribution of these rates showed a tendency to stabilize at the end of the period, and in Goiás a tendency for increase was constant.

DISCUSSION

The incidence and mortality of prostate cancer vary among the regions of the world[3]. In the last decades, it was observed a tendency for moderate increase of the mortality by prostate cancer in all countries of Latin America[2].

Prostate cancer is a disease of often slow evolution and some less aggressive tumors may evolve over a period of 15 to 20 years, during which time, although the disease is already histologically present, it does not present important clinical manifestations[3]. Men with prostate cancer are, in general, of groups of higher age range and may have other comorbidities that hinder the accuracy of the underlying cause of death.

The results of this study show that mortality by prostate cancer is still increasing throughout Brazil, but unevenly between Brazilian regions. While in the early 1980s the South and Southeast regions held rates higher than the rest of Brazil, at the end of the study period all Brazilian regions showed patterns of mortality by prostate cancer at higher levels and with values slightly closer to each other's.

In the Central-West Region, mortality by prostate cancer nearly doubled in the last 30 years, making this the second Brazilian region with the highest rate of mortality from this neoplasm. Geographical and socioeconomic factors, inherent to the different regions of the country, may make the access to specialized care services to cancer rather difficult, as well as it may contribute so that the time intervals for the diagnosis and treatment present significant local variation[17].

In this sense, the difficulties of access to the diagnosis and treatment and the precarious health care system, among other factors, may have contributed to the mortality pattern in the Central-West region observed in this study, with many cases being diagnosed in advanced stages, when there is no possibility of treatment. On the other hand, in countries where the incidence of prostate cancer has shown increase in recent decades, while mortality is decreasing, this behavior has been associated to the improving of survival, caused by early diagnosis and better quality treatment[2,18].

In a study from 2001, analyzing cancer care based on estimates of need for specialized oncology units, it was found that high complexity cancer care in the Central-West Region in deficient due to the low utilization of its installed capacity[19]. The same way, in a study which has estimated the coverage of high complexity care received by the population of Corumbá in Mato Grosso do Sul, the estimated percentage of coverage of surgery ranged between 12.1 and 14.6%, the radio therapy corresponding to 24.3% and chemotherapy at 39.1%[20].

The highest proportion of deaths by poorly defined causes in the elderly is a relatively common phenomenon in developing countries, due to the difficulties in accurate determination of basic cause of death[21]. In a study which analyzed the trend of deaths from poorly defined causes between 1979 and 2009 in the Northeast of Brazil, it was observed that the population aged over 60 years had the highest ratio of deaths by unknown cause at the beginning of the period, and it was also the one which presented the highest proportional reduction of those at the end of the study period[22].

In the last few decades, the Central-West Region, following a national trend, presented a decrease on deaths due to poorly defined causes[23]. In the early 1980s, Goiás and Mato Grosso showed a percentage of deaths by poorly defined causes of over 15%, which, according to the classification proposed by Chakiel, represents a level of information considered to be inappropriate[24], while Mato Grosso do Sul showed good quality of information contained in declarations of deaths during the study period. At the end of the studied period, the three states of the Central-West region showed a percentage of deaths by poorly defined causes of less than 10%, considered as an appropriate level of information, based on that same classification. Thus, it is possible that the increase in the mortality by prostate cancer observed in Mato Grosso and Goiás had been influenced, in part, by the improvement of the quality of death certificates over the studied period, while for Mato Grosso do Sul that would have been a rather more limited effect.

In this study, a negative correlation between mortality rates by prostate cancer and the ones of poorly defined causes. As the quality of mortality data is still very heterogeneous among Brazilian regions, this could influence the generalization and validity of results of mortality studies[25]. Thus, the setting of annual mortality rates for prostate cancer by the proportion of poorly defined causes was performed, allowing a better comparison of the results between the different regions studied. Mortality trends, both based on rates set by the proportion of poorly defined causes as on the unadjusted ones (results not shown), were slightly divergent and, in all regions, continued the tendency to increment.

The availability and the wide usage of the PSA test, initiated in the late 1980s and early 1990s in the United States and later on in Europe, enabled greater detection of cases and, in part, could explain the increase incidence of prostate cancer in the last few decades[8]. In countries that have been performing PSA testing for longer and using it for screening for prostate cancer, there is no consensus on the factors which determined the mortality decline tendency that has been observed these past few years[26]. In the United States, some researchers believe that early detection of prostate cancer through PSA in men after 50 years of age, and the institution of radical treatment could explain the behavior of mortality[27]. However, in that same country, in a systematic review in which 6 controlled and randomized essays were analyzed, including more than 300,000 participants, no evidence was found to support that the screening with PSA only, or associated with rectal touch, has had an impact in reducing mortality[28]. The same way, in the UK and Wales, it was found that the trend of reduced mortality by prostate cancer in patients from 55 to 74 years of age was prior to the establishment of large scale PSA testing and could, therefore, not be explained by the it[29].

FINAL CONSIDERATIONS

There was an increase in mortality rates by prostate cancer in all Brazilian regions. The Central-West region showed a trend of increasing mortality, with stabilization at the end of the analyzed period.

The mortality pattern observed in this study suggests that there was an increase in the number of diagnosed prostate tumors, value which can be a result from both the increased incidence of disease and the improvement in diagnostic accuracy and quality of death statistics.

It was not yet established whether the routine performance of the PSA testing can influence the reduction of mortality from prostate cancer. In this sense, the results found in this study showed no correlation between the clinical use of PSA and the trend of mortality from prostate cancer, observed in the states of the Central-West Region.

The improvement in the diagnosis of this cancer is related, in part, to the increased coverage of the health care system and to the availability of diagnostic resources. However, the assistencial service, specially the public one, still presents structural problems, which makes its access by the population rather difficult, determining the delay in the diagnosis and, consequently, on its treatment. Thus, although the diagnosis of prostate cancer is each time more frequent and accurate, it may not be made in time to allow an appropriate treatment of the individuals, which could explain, in part, the trend of the increase of the mortality observed in this study.

Given the specificities of the Central-West Region, regarding the sociodemographic and economic context, other studies that deepen the research on the role of these factors in the trends observed are needed. In this sense, it is also important to investigate factors associated to a possible increase of the incidence of prostate cancer in the population of this region. A line of research that has emerged in the literature in recent years consists in the relations between the incidence of prostate cancer and the expansion of agricultural activity, accompanied by the growth of the consumption of pesticides.

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