

Incidence and mortality from colon and rectal cancer in Midwestern Brazil

Incidência e mortalidade por câncer de cólon e reto no Centro-Oeste do Brasil

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ABSTRACT: Objective: To describe the incidence and mortality rates from colon and rectal cancer in Midwestern Brazil. **Methods:** Data for the incidence rates were obtained from the Population-Based Cancer Registry (PBCR) according to the available period. Mortality data were obtained from the Mortality Information System (SIM) for the period between 1996 and 2008. Incidence and mortality rates were calculated by gender and age groups. Mortality trends were analyzed by the Joinpoint software. The age-period-cohort effects were calculated by the R software. **Results:** The incidence rates for colon cancer vary from 4.49 to 23.19/100,000, while mortality rates vary from 2.85 to 14.54/100,000. For rectal cancer, the incidence rates range from 1.25 to 11.18/100,000 and mortality rates range between 0.30 and 7.90/100,000. Colon cancer mortality trends showed an increase among males in Cuiabá, Campo Grande, and Goiânia. For those aged under 50 years, the increased rate was 13.2% in Campo Grande. For those aged over 50 years, there was a significant increase in the mortality in all capitals. In Goiânia, rectal cancer mortality in males increased 7.3%. For females below 50 years of age in the city of Brasília, there was an increase of 8.7%, while females over 50 years of age in Cuiabá showed an increase of 10%. **Conclusion:** There is limited data available on the incidence of colon and rectal cancer for the Midwest region of Brazil. Colon cancer mortality has generally increased for both genders, but similar data were not verified for rectal cancer. The findings presented herein demonstrate the necessity for organized screening programs for colon and rectal cancer in Midwestern Brazil.

Keywords: Rectal neoplasms. Colonic neoplasms. Incidence. Mortality. Trends. Brazil.

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RESUMO: *Objetivo:* Descrever o perfil do câncer de cólon e reto no Centro-Oeste do Brasil. *Métodos:* Os dados de incidência foram obtidos dos Registros de Câncer de Base Populacional (RCBP) de acordo com o período disponível. Dados sobre os óbitos foram obtidos do Sistema de Informação em Mortalidade (SIM). As taxas de incidência e mortalidade foram calculadas por gênero e grupos etários. As tendências de mortalidade foram analisadas pelo software Joinpoint. Os efeitos de idade-período-coorte foram calculados no software R. *Resultados:* As taxas de incidência do câncer de cólon variaram de 4,49 a 23,19/100.000, e a mortalidade, de 2,85 a 14,54/100.000. A incidência do câncer de reto variou de 1,25 a 11,18/100.000; a mortalidade, de 0,30 a 7,90/100.000. As tendências de mortalidade por câncer de cólon mostraram um aumento entre homens em Cuiabá, Campo Grande e Goiânia. Para aqueles abaixo dos 50 anos, o aumento foi de 13,2% em Campo Grande. Para aqueles acima dos 50 anos, houve um aumento significativo em todas as capitais. Em Goiânia, a mortalidade por câncer de reto em homens aumentou 7,3%. Para mulheres abaixo dos 50 anos em Brasília, o aumento foi de 8,7%, enquanto que para mulheres acima dos 50 anos em Cuiabá foi de 10%. *Conclusão:* Os dados de incidência do câncer de cólon e reto no Centro-Oeste do Brasil são limitados. A mortalidade por câncer de cólon tem aumentado para ambos os sexos, mas o mesmo não foi verificado para câncer de reto. Os resultados demonstram a necessidade de programas organizados de rastreamento para esta neoplasia no Centro-Oeste.

Palavras-chave: Neoplasias retais. Neoplasias do colo. Incidência. Mortalidade. Tendências. Brasil.

INTRODUCTION

Colon and rectal cancer is the third most common cancer in both genders worldwide, especially in more developed countries, with estimated incidences varying between 36.3 and 37.9 per 100,000 inhabitants^{1,2}. The lowest incidence rates were to be found in South Africa (1.70/100,000) and in India (2.0/100,000). In South American countries, rates vary between 5.0/100,000 (Cuenca – Ecuador) and 35.5/100,000 (São Paulo – Brazil) with the latter being comparable to rates in developed countries³. In European countries, there has been a significant increase in the incidence of colon and rectal cancer in males^{4,5}. However, these trends contrast with the standards encountered in the USA, where incidence trends have decreased in the last two decades. This decrease is attributed to organized screening programs⁶.

In Brazil, colon and rectal cancers are among the five most diagnosed cancers, and are the third highest cause of cancer-related deaths⁷. Data from the Population-Based Cancer Registry (PBCR) for the period 2002 – 2010 indicate that the highest incidence rates for males and females occurred in Porto Alegre, São Paulo and Goiânia while the lowest rates were observed in Recife and João Pessoa⁸. According to the aforementioned data, colon and rectal cancer incidence rates have presented similar patterns in southern and southeastern Brazil, although there are no existing studies to assess these results or verify this profile in the Midwest.

Mortality rates are still showing an increasing trend in countries with more limited resources, including Brazil and Chile in South America^{9,10}. Colon and rectal cancer mortality trends in Brazilian state capitals, in both males and females, increased between 1980 and 2006¹¹. This was followed by a period of stability up to 2010, according to the data.

The number of deaths in Brazil decreased in the whole country with the exception of males in the Brazilian northern region¹².

This study aimed to describe the incidence and mortality rates from colon and rectal cancer in Midwestern Brazil.

METHODS

This is an observational, descriptive, population-based study. The incidence of cases of colon and rectal cancer was obtained from SisBasepop Web at the National Institute for Cancer (INCA/MS), in Brazil¹³. The available time periods for analysis were Brasília (DF) 1999 – 2002, Campo Grande (MS) 2000 – 2001, and Cuiabá (MT) 2000 – 2004. Data for Goiânia (GO) were obtained from the PBCR in Goiânia for the period 1988 – 2008. The variables were age, gender, and age groups (< 50 and ≥ 50).

Inclusion criteria for incident and mortality cases of colon and rectal cancer were based on codes C-18, C-19, and C-20 of the the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, (ICD-10)¹⁴.

Population estimates were taken from the data at the Brazilian Institute of Geography and Statistics (IBGE)¹⁵. The standard population, according to Segi¹⁶, was used to calculate standardized incidence and mortality rates.

Data on deaths due to colon and rectal cancer were obtained from the Mortality Information System (SIM/DATASUS) of the Brazilian Ministry of Health (MS)¹⁷. Mortality rates were calculated in the cities of Goiânia, Brasília, Cuiabá, and Campo Grande for the period 1996 – 2008.

Mortality trends were modeled using Linear Regression Analysis software Joinpoint (version 3.3.1)¹⁸. The age-period-cohort mathematical model was applied to study the effects of age, period, and birth cohort on mortality rates. Normally, a series trend is subject to consideration of these three effects: the age of the individual, the date of diagnosis or death (the so-called period), and the date of birth (or group). The age-period-cohort model allows for the consideration of the three effects simultaneously, although it is not possible to completely separate the effects of age, period, and cohort due to the linear combinations between them, as it causes an identification issue¹⁹. Analyses were carried out separately by gender and age group. Individuals over the age of 20 were also considered, grouped in both 10-year age groups and yearly, according to the year of death. The cohort was calculated as the difference between the year of death and the age of the individual, grouped in six- by ten-year age groups and four birth groups with 20-year overlaps in each. The statistically significant results were those with p-values inferior to 0.05, and all computations were made with R software (2.12.2 version). Input of the mortality data (deaths and population) by age and period followed. The results included age-specific effects, and cohort-period effects (RRS – Relative Risk and 95% confidence interval with RR = 1 for reference group, 1966). The analysis was carried out and deviation tables were built, comparing the four classic models (age, age-group, age-period, and age-period-cohort)^{19,20}.

RESULTS

There is a lack of continuous data on the incidence of colon and rectal cancer for the period 1988 – 2008 in Midwestern Brazil. According to the PBCR of this region, the rates for colon cancer incidence vary from 4.49 to 23.19/100,000. The highest incidence rates for colon cancer were observed in Cuiabá, with 23.19 and 22.39/100,000 in males and females, respectively. The incidence of rectal cancer ranged from 1.25 to 11.18/100,000, which is two times lower in comparison with colon cancer. The highest rectal cancer incidence rates were observed for males and females in Cuiabá and Goiânia, respectively (Table 1).

Table 1. Age-standardized incidence rates for colon and rectal cancer in males and females in Midwestern Brazil for the period 1988 – 2008.

Year	Colon							
	Brasília		Campo Grande		Cuiabá		Goiânia	
	M ^a	F ^b	M	F	M	F	M	F
1988							9.09	10.37
1989							8.39	7.31
1990							9.05	11.09
1991							4.49	8.28
1992							6.57	6.56
1993							4.53	8.06
1994							7.60	10.34
1995							8.48	9.81
1996							9.26	8.04
1997							9.39	7.39
1998							13.92	11.88
1999	13.88	13.17					9.13	11.04
2000	15.19	11.90	5.79	6.27	13.28	12.47	8.63	10.86
2001	15.57	15.60	10.14	11.27	16.69	13.29	14.09	10.31
2002	8.86	12.07	9.94	14.37	10.71	12.01	10.89	12.59
2003			13.19	9.31	10.85	10.15	12.57	13.46
2004					18.44	22.39	16.68	17.36
2005					23.19	7.71	20.92	14.77
2006							17.69	16.65
2007							16.39	11.22
2008							17.12	12.65

Continue...

Table 1. Continue.

Year	Rectal							
	Brasília		Campo Grande		Cuiabá		Goiânia	
	M ^a	F ^b	M	F	M	F	M	F
1988							3.25	3.54
1989							3.45	2.01
1990							2.03	3.50
1991							2.52	1.88
1992							1.94	2.59
1993							3.20	4.36
1994							4.54	3.67
1995							5.61	3.77
1996							1.25	4.03
1997							2.50	3.99
1998							4.50	5.54
1999	5.54	4.87					5.10	6.10
2000	7.24	3.31	4.68	2.56	7.86	11.18	4.49	5.05
2001	5.26	5.22	5.68	2.32	7.86	8.63	6.60	3.98
2002	4.90	4.68	3.98	3.07	7.77	6.22	5.60	5.50
2003			1.73	2.47	6.70	5.29	5.18	6.01
2004					8.00	4.60	9.48	6.93
2005					7.52	6.88	8.81	8.69
2006							8.55	6.28
2007							6.27	6.35
2008							5.16	3.43

^aMales; ^bFemales. Source: Sisbasepop¹³.

The highest mortality rates for males with colon cancer were observed in Campo Grande (14.54/100,000), and for females, it reached 10.26/100,000 in Goiânia. Rectal mortality, however, was higher in Cuiabá for males (7.92/100,000) (Table 2).

Mortality trends increased for colon cancer in Midwestern Brazil for both genders. In males, it was significantly higher in Cuiabá at 8.1% (3.9; 12.5), while for females, there was an increase of 6.1% in Goiânia ($p < 0.05$). Rectal cancer mortality

Table 2. Age-standardized mortality rates for colon and rectal cancer in males and females in Midwestern Brazil for the period 1996–2008.

Year	Colon							
	Brasília		Campo Grande		Cuiabá		Goiânia	
	M ^a	F ^b	M	F	M	F	M	F
1996	5.14	4.65	7.46	3.72	2.85	4.96	5.66	5.18
1997	5.64	3.83	8.27	6.97	6.50	4.20	5.89	4.87
1998	3.59	7.63	4.31	5.72	5.07	3.84	6.49	4.87
1999	7.80	6.14	8.18	7.59	4.77	8.27	9.79	4.30
2000	7.26	4.84	3.94	6.61	4.66	5.29	6.79	6.18
2001	8.10	6.05	7.12	7.05	5.81	8.82	7.57	5.88
2002	7.25	7.64	7.25	8.26	9.94	5.42	6.91	6.61
2003	4.55	5.48	9.26	5.90	5.79	4.76	8.28	7.43
2004	7.99	8.30	10.20	8.48	8.04	5.01	9.68	8.35
2005	9.99	7.20	12.12	8.57	10.92	7.53	10.04	8.14
2006	9.42	9.72	11.65	9.40	9.95	6.97	11.44	10.26
2007	6.76	6.60	8.08	8.82	6.25	5.39	12.04	8.27
2008	6.67	6.47	14.54	6.41	11.05	7.97	9.18	7.65
Year	Rectal							
	Brasília		Campo Grande		Cuiabá		Goiânia	
	M ^a	F ^b	M	F	M	F	M	F
1996	3.80	1.43	2.62	4.36	4.26	1.34	1.97	3.02
1997	4.82	2.43	0.30	1.47	2.45	0.99	4.05	3.57
1998	3.59	2.19	5.11	2.44	7.92	4.10	3.75	3.17
1999	2.27	1.31	3.90	3.98	1.35	1.72	3.26	3.58
2000	3.20	1.57	1.91	2.05	0.34	2.42	3.19	3.33
2001	3.42	2.61	0.66	2.56	2.50	1.70	5.16	3.07
2002	2.30	3.10	4.45	3.07	1.17	2.32	4.87	3.13
2003	3.41	3.43	3.47	2.56	3.20	0.74	6.10	2.24
2004	4.15	3.06	2.07	2.99	5.53	3.75	6.87	5.02
2005	2.82	3.49	2.13	2.71	2.33	5.72	6.46	4.74
2006	2.57	3.51	4.14	2.29	3.03	2.82	5.81	4.60
2007	2.76	2.70	1.48	2.41	1.95	1.89	5.23	4.02
2008	3.36	3.42	1.85	2.11	7.90	4.88	5.40	2.86

^aMales; ^bFemales. Source: Mortality Information System/DATASUS¹⁷.

increased for males in Goiânia to 7.3% (3.8; 11.0) and for females in Brasília to 6.9% ($p < 0.05$) (Table 3).

The highest trends for mortality from colon cancer in males aged under 50 years occurred in Campo Grande, at 13.2% (3.4; 24.0), and reached 11.5% (3.7; 19.9) in Cuiabá; however, mortality increased in all cities for those aged over 50 years, from 4.9% (0.5; 9.6) to 8.2% (2.4; 14.3). Rectal cancer mortality trends increased by 7.4% (3.1; 11.8) in males over 50 years of age in Goiânia, while in females under 50 years of age, the increase reached 8.7% (1.3; 6.7) in Brasília (Table 4).

Mortality trends analysis of the age-period-cohort model, for the period 1996 – 2008 revealed a significant increase among the male population in Brasília ($p = 0.01$; Figure 1A) and among the female population in Campo Grande ($p < 0.05$; Figure 1B). The relative risk for colon cancer mortality increased three times in patients born before 1966 ($p = 0.01$), particularly among the male subjects studied in Brasília and the females in Campo Grande ($p < 0.01$). In the other cities, no changes were observed. Non-significant data were not shown for these analyses.

Table 3. Mortality trends for colon and rectal cancer, in males and females, in Midwestern Brazil, for the period 1996 – 2008.

	Colon				
	Year	APC ^a (95%CI ^b)	p-value	APC ^a (95%CI ^b)	p-value
		Males		Females	
Brasília	1996-2008	3,7 (-0.6, 8.3)	0.0882	4,0 (0.4, 7.7)	0.0320
Campo Grande	1996-2008	6,4 (1.3, 11.6)	0.0173	4,0 (0.6, 7.5)	0.0249
Cuiabá	1996-2008	8,1 (3.4, 13.1)	0.0027	3,1 (-1.2, 7.4)	0.1405
Goiânia	1996-2008	5,4 (2.9, 8.0)	0.0004	6,1 (3.8, 8.4)	0.0000
	Rectal				
	Year	APC ^a (95%CI ^b)	p-value	APC ^a (95%CI ^b)	p-value
		Males		Females	
Brasília	1996-2008	-2.0 (-5.4, 1.6)	0.2366	6,9 (2.7, 11.3)	0.0036
Campo Grande	1996-2008	2,8 (-10.2, 17.8)	0.6615	-1.4 (-5.9, 3.4)	0.5278
Cuiabá	1996-2008	3,5 (-10.3, 19.4)	0.6113	7,5 (-2.0, 17.9)	0.1148
Goiânia	1996-2008	7,3 (3.3, 11.4)	0.0017	1,7 (-2.0, 5.6)	0.3327

^aAnnual Percentage Change; ^bConfidence interval. Source: Mortality Information System/DATASUS¹⁷.

DISCUSSION

The Midwestern Brazil region presented heterogeneous incidence pattern rates for colon and rectal cancer in the period analyzed. The highest incidence rates for colon in both genders were observed in Goiânia and Cuiabá and were comparable to that of Southern and Southeastern Brazil⁸. It is acknowledged that the factors associated with colon cancer are a low-fiber diet, obesity, and a sedentary lifestyle^{21,22}. In the Midwest region, the standard

Table 4. Mortality trends for colon and rectal cancer, according to age groups for males and females in Midwestern Brazil, for the period 1996 – 2008.

Period	Colon							
	< 50 years				≥ 50 years			
	APC ^a (CI ^b)	p-value						
	Males		Females		Males		Females	
Brasília 1996–2008	4.4 (-4.9; 14.6)	0.332	5.7 (1.5; 10.0)	0.014	4.9 (0.5; 9.6)	0.033	4.2 (0.5; 8.1)	0.032
Campo Grande 1996–2008	13.2 (3.4; 24.0)	0.012	13.2 (-0.7; 29.0)	0.061	5.8 (1.1; 10.8)	0.012	2.9 (-0.3; 8.7)	0.082
Cuiabá 1996–2008	11.5 (3.7; 19.9)	0.007	6.0 (-5.1; 18.4)	0.269	8.2 (2.4; 14.3)	0.009	2.2 (-2.8; 7.5)	0.354
Goiânia 1996–2008	4.2 (-2.0; 10.7)	0.169	4.3 (-2.4; 11.4)	0.193	6.2 (3.6; 8.9)	<0.001	6.6 (3.4; 10.0)	0.001
Period	Rectal							
	< 50 years				≥ 50 years			
	APC ^a (CI ^b)	p-value						
	Males		Females		Males		Females	
Brasília 1996–2008	6.4 (-0.4; 3.7)	0.062	8.7 (1.3; 6.7)	0.024	-2.5 (-6.3; 1.5)	0.193	7.8 (2.6; 13.3)	0.007
Campo Grande 1996–2008	-3.4 (-13.2; 7.6)	0.484	-3.8 (-12.1; 5.2)	0.356	4 (-6.9; 16.0)	0.454	-0.2 (-5.8; 5.8)	0.95
Cuiabá 1996–2008	2.0 (-12.4; 18.8)	0.764	-3.5 (-14.9; 9.3)	0.519	1.1 (-10.8; 14.6)	0.846	10.0 (1.1; 19.6)	0.03
Goiânia 1996–2008	5.6 (-1.9; 14.8)	0.176	7.8 (-5.1; 22.4)	0.217	7.4 (3.1; 11.8)	0.003	0.4 (-3.7; 4.8)	0.822

^aAnnual Percentage Change; ^bConfidence Interval = 95%. Source: Mortality Information System /DATASUS¹⁷.

diet of the population tends to include the consumption of red meat and is accompanied by a low intake of vegetables, a dietary profile similar to that of the southern region²³.

The Midwest region has experienced an increase of 33.5% in immigration flows since the 1960s, with the formation and expansion of new residential areas, especially in the proximities of the Federal District^{24,25}. At the same time, the agricultural frontiers also expanded and contributed to the large-scale migration from the South during the 1970s and 1980s, particularly to Cuiabá and Campo Grande. In the 1980s, most states had population decreases, but Mato Grosso continued to show a growth rate above 5% per year^{26,27}.

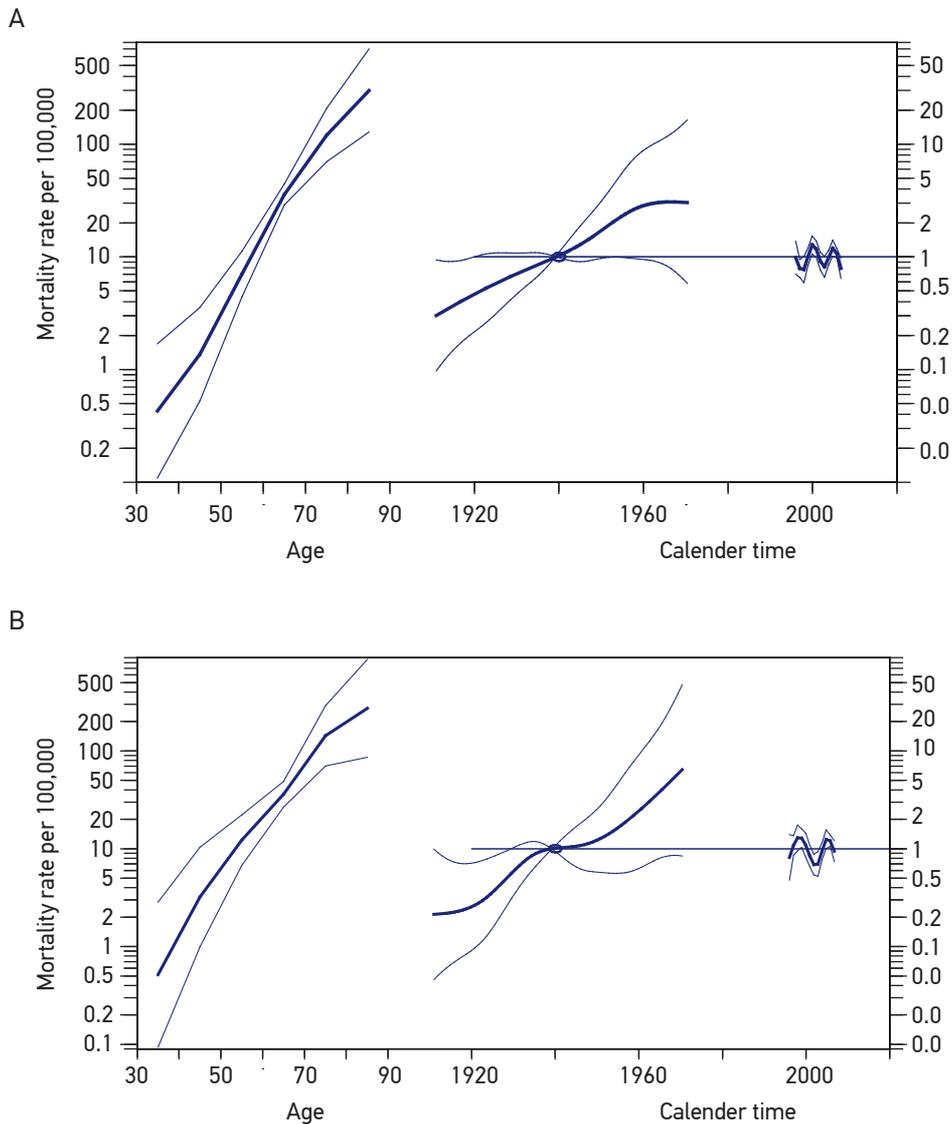


Figure 1. Age-period-cohort effect on colon cancer mortality rates between 1996 and 2008, in Brasília, for the male population (A), and in Campo Grande, for the female population (B).

One characteristic of migrant groups is that they tend to maintain the typical eating habits and customs of their region of origin, and these eating habits persist for long periods²⁸. Thus, the immigrant population from Southern Brazil most likely retained typical habits, such as the consumption of herb tea, alcoholic beverages, smoking tobacco, and other dietary habits, such as eating barbecue weekly^{21,29}. Preserving these habits could have contributed to the higher incidence of colon and rectal cancer identified in this study, particularly in Cuiabá and Goiânia.

The mortality rates in Midwestern Brazil for colon and rectal cancer presented herein have increased throughout the years, although they were unstable. Despite the fact that colon and rectal mortality rates decreased in developed countries, such as the UK, France, and the USA^{2,30}, increases have been documented in Asia, particularly in Japan, China, and Korea^{1,31} and also among US immigrants in general²⁹. As such, our results remain similar to those found in Asia, Eastern Europe, Colombia, and Costa Rica^{32,33}. Trends for colon cancer mortality showed an increase in the last decade, among both genders, although the rate of increase is more pronounced among the male population¹⁰.

In Midwestern Brazil, significant increases in colon cancer mortality were found among males under 50 years of age, specifically in Campo Grande and Cuiabá, while rectal cancer increased within the same age group for females in Brasília. However, for adults under the age of 50, increases were recorded in all the cities studied. Recent studies have found that the mortality rates from colon and rectal cancer have been decreasing in adults over 50 years of age. However, these rates have been increasing in adults under 50³⁴.

In the age-period-cohort analysis, there was a significant effect of group on mortality, among the male population of Brasília ($p = 0.01$) and the female population of Campo Grande ($p < 0.05$). This result demonstrates that the increase in mortality rates is still connected to the lifestyle of the population, as it corresponds to a birth cohort effect³⁵. Therefore, if adopted, organized screening programs can change this profile in Midwestern Brazil^{36,37}.

The results obtained herein present two main limitations. The first is the low level of historical incidence data available from the registries in the Midwest region. Data discontinuity in cancer registries hinders a more accurate analysis of rates. Another limitation is the quality of the data in the registries, with Campo Grande for example registering approximately 20% of its cases only on the basis of death certificates, which demonstrates a lack of completeness in abstracting the incident cases there.

CONCLUSION

There is a lack of continuous data on the incidence of colon and rectal cancer for the period of 1988 – 2008 in Midwestern Brazil. Colon cancer mortality has increased for both genders and among a younger population; however, the same was not verified for rectal cancer. We would argue, therefore, that the findings presented herein demonstrate the necessity for an organized screening program for colon and rectal cancer in Midwestern Brazil.

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