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Mortality due to cardiorespiratory diseases in elderly people in Mato Grosso State, 1986 to 2006

ABSTRACT

OBJECTIVE: To describe time trends of mortality due to cardiorespiratory diseases in elderly people.

METHODS: Epidemiological descriptive study with an ecological time series approach conducted in the state of Mato Grosso, Central-West Brazil, between 1986 and 2006. Data were obtained from the Brazilian Ministry of Health Mortality Database. Linear regression models were adjusted to analyze trends in mortality rates by age groups (60 to 69; 70 to 79; and 80 or more) and gender.

RESULTS: There was an increase in proportion of deaths due to respiratory diseases and a decrease in proportion of deaths due to cardiovascular diseases. As for gender, cardiovascular rates were 15% lower in women than men and respiratory rates were similar in both men and women. High mortality rates for respiratory and cardiovascular diseases were observed with increasing trends among the oldest-old groups. The annual average increase for respiratory and cardiovascular diseases in those aged 80 years and older was 1.99 and 3.43 deaths, respectively.

CONCLUSIONS: The state of Mato Grosso shows high mortality rates due to cardiorespiratory disease among elderly people with increasing trends among the oldest-old groups.

DESCRIPTORS: Aged. Mortality, trends. Respiratory Tract Diseases. Cardiovascular Diseases. Epidemiology, Descriptive.

INTRODUCTION

Like in many developing countries, Brazilian people is aging at an accelerated pace, especially the population group comprising elderly people aged 60 or older. The growth of this population group has been much faster than in European countries.[15] Increased life expectancy has been progressively contributing to increase elderly population.[15] The elderly accounted for 6% of total population in 1980 and this proportion increased to 8.5% in 2000, corresponding to 14 million elderly.

At the same time with population aging there has been a change in the profile of deaths among the elderly, both in terms of proportional mortality by different causes and their related rates. According to data from the Brazilian Ministry of Health Mortality Database (SIM), in 1980, 38% of all deaths were among

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the elderly. In 1991 and 2000, they accounted for 50% and 55% of total deaths, respectively.[a]

Cardiovascular and respiratory diseases stand out as major causes of mortality among the elderly. Cardiovascular diseases were the leading cause of death in Brazilian elderly (38%, n = 231,540) in 2006, followed by cancer (16%, n = 100,743) and respiratory diseases (13%, n = 79,410).[a]

Mortality trends are influenced by several factors including improved data quality, access to health services, quality of health services, and individual variations in risk factors for cardiovascular and respiratory diseases.[2,6] Trend analyses may show the effect of these factors on the mortality profile of the elderly.

The elderly is a population group with specific characteristics due to lifetime accumulated disease burden, particularly cardiopulmonary diseases. Meeting the needs of this population group is a challenge to the Brazilian Health System. The objective of the present study was to analyze time trends in mortality rates due to cardiopulmonary diseases in elderly.

METHODS

Epidemiological study with an ecological time series approach of mortality data for the period 1986 to 2006 in people aged 60 or older in the state of Mato Grosso, Central-Western Brazil. Mato Grosso was the state of choice due to major social and environmental transformations that have occurred since early 1980s in the wake of the occupation of the Amazon region. Mato Grosso is a corridor for migration to the Northern states of Rondônia, Acre and Pará and 86 new towns were created between 1980 and 2006.[1,4]

Mortality data were obtained from SIM database. Data from the elderly population living in the state of Mato Grosso by gender and age were obtained from the Brazilian Institute of Geography and Statistics (IBGE).[b] The elderly were divided into three age groups: 60–69; 70–79; and 80 and more.

Although mortality rates from ill-defined causes in Mato Grosso are decreasing,[c] it was decided to correct reported cardiopulmonary deaths for ill-defined deaths in each disease group by gender and age. These corrections were made proportional to all deaths, excluding ill-defined causes. It was assumed that the distribution of causes of death among deaths from ill-defined causes is similar to that of deaths from defined causes. This procedure was applied for all years and can be summarized by the equation $Xc = X + M * X/(T - M)$, where X is the number of deaths due to a specific cause (pulmonary or cardiovascular), M is the number of deaths from ill-defined causes, T is the number of deaths from all causes, and Xc is the corrected number of deaths by a specific cause. After these corrections, adjustments were made for standardization resulting in mortality rates corrected for ill-defined causes and adjusted by gender and age.

It was then calculated the annual proportional mortality from pulmonary and cardiovascular diseases, by gender and age groups, to assess the weight of these diseases to total deaths[11] and by specific mortality rates according to the International Classification of Diseases (ICD): Diseases of the Respiratory System (Chapters VIII of ICD-9 and Chapter X of ICD-10) and Diseases of the Circulatory System (Chapters VII of ICD-9 and Chapter IX of ICD-10).

Mortality rates by gender and age groups were then estimated and standardized using a direct method, considering as standard population the harmonic mean of the population in each age group during the period studied. This standardization was necessary as age groups are decennial and there was an increase in population survival in the last 20 years.[8]

A trend analysis of mortality rates was performed using simple linear regression models. The construction of scatter plots of deaths and years of study showed that a linear evolution could be assumed in all cases, which supported the use of linear models.[3]

The statistical model considered each mortality rate as a dependent variable (Y) and the years studied as an independent variable (X). The linear regression models were adjusted for each time series. It was decided to make the independent variable central by subtracting the midpoint value of each series (X – 1996) to avoid autocorrelation between the terms of the regression equation.[10] Thus, the estimated model can be written as: $Y = \beta_0 + \beta_1(X - 1996)$ where Y is the mortality rate, β_0 is the mean rate in the period studied, β_1 is the average annual increment and X corresponds to each year studied in the series.

The residual analysis showed that the use of simple linear regression models was appropriate due to normal distribution, homoscedasticity and absence of outliers. The trend was significant when the adjusted model obtained $p<0.05$. The coefficient of determination (r^2) was used as a measure of accuracy of the models.

[a] Ministério da Saúde. Datasus. Mortalidade no Brasil: notas técnicas. [cited 2010 Sep 10]Available from: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obtuf.def

[b] Instituto Brasileiro de Geografia e Estatística. Sistema IBGE de Recuperação Automática. Banco de Dados Agregados. [cited 2010 Sep 10] Available from: http://www.sidra.ibge.gov.br/bda/acervo/default.asp?z=t&o=3&i=Phttp

[c] Ministério da Saúde. Rede Interagencial de Informações para a Saúde. Indicadores e dados básicos – Brasil 2008. [cited 2010 Sep 10] Available from: http://tabnet.datasus.gov.br/cgi/idb2008/matriz.htm#mort

Table 1. Proportional mortality (%) for pulmonary and cardiovascular diseases in elderly population. State of Mato Grosso. Central-Western Brazil. 1986–2006.

Year of death	Males				Females				Total			
	60-69	70-79	80 and +	Total	60-69	70-79	80 and +	Total	60-69	70-79	80 and +	Total
Cardiovascular diseases												
1986	6.2	5.8	9.1	6.6	5.1	6.9	8.9	7.0	5.8	6.2	9.0	6.8
1987	7.1	6.6	7.1	6.9	4.7	5.7	7.9	6.0	6.4	6.3	7.5	6.6
1988	4.3	7.5	9.4	6.6	4.2	7.3	7.4	6.3	4.3	7.4	8.4	6.5
1989	3.9	7.5	8.5	6.3	4.3	7.4	7.5	6.5	4.0	7.4	8.0	6.4
1990	5.7	7.4	6.9	6.6	6.8	5.0	5.7	5.8	6.1	6.6	6.4	6.3
1991	5.7	5.2	8.3	6.1	4.7	10.7	9.1	8.2	5.3	7.4	8.7	7.0
1992	7.6	8.7	11.7	9.0	4.7	6.1	9.0	6.6	6.6	7.7	10.5	8.1
1993	6.4	8.7	9.6	8.0	8.5	6.3	9.8	8.1	7.1	7.7	9.7	8.0
1994	7.1	8.2	11.3	8.5	5.3	9.3	9.6	8.2	6.5	8.6	10.5	8.4
1995	7.3	10.1	10.3	9.0	8.4	10.7	8.1	9.1	7.7	10.3	9.2	9.0
1996	6.1	12.3	11.8	9.7	4.7	7.8	8.3	7.0	5.6	10.6	10.1	8.6
1997	8.0	10.6	14.1	10.5	8.3	10.3	12.2	10.2	8.1	10.5	13.2	10.4
1998	8.0	10.8	15.1	10.8	8.7	10.9	14.8	11.4	8.3	10.8	15.0	11.1
1999	10.1	11.8	16.9	12.5	10.2	12.5	17.1	13.3	10.1	12.1	17.0	12.8
2000	8.8	12.9	15.0	11.9	10.5	11.4	13.4	11.8	9.4	12.3	14.2	11.8
2001	7.1	11.6	13.9	10.5	8.2	10.4	14.7	11.2	7.5	11.1	14.3	10.8
2002	8.1	11.5	14.6	11.0	8.4	9.1	13.0	10.3	8.2	10.6	13.8	10.7
2003	8.2	12.3	15.6	11.5	10.0	11.0	12.4	11.2	8.8	11.8	14.0	11.4
2004	8.8	12.5	15.9	12.1	9.1	11.3	16.2	12.3	8.9	12.1	16.0	12.2
2005	10.5	14.3	19.0	14.1	8.4	14.2	18.6	14.0	9.7	14.2	18.8	14.1
2006	9.7	14.3	17.9	13.7	10.4	12.4	17.4	13.6	10.0	13.6	17.6	13.7
Pulmonary diseases												
1986	40.3	41.9	34.9	39.8	39.8	44.7	48.0	44.3	39.8	44.7	48.0	44.3
1987	39.9	44.9	42.3	42.3	46.2	44.3	39.7	43.5	46.2	44.3	39.7	43.5
1988	40.0	41.2	45.5	41.7	48.5	46.0	45.1	46.5	48.5	46.0	45.1	46.5
1989	42.4	44.9	44.0	43.8	48.8	44.2	45.4	46.0	48.8	44.2	45.4	46.0
1990	38.5	43.8	42.3	41.4	41.7	41.7	46.7	43.2	41.7	41.7	46.7	43.2
1991	39.8	45.2	40.1	41.9	42.5	43.1	41.4	42.4	42.5	43.1	41.4	42.4
1992	36.3	35.1	35.2	35.6	37.8	39.8	41.9	39.9	37.8	39.8	41.9	39.9
1993	36.8	39.3	35.2	37.3	35.6	48.6	37.0	40.8	35.6	48.6	37.0	40.8
1994	34.3	37.7	34.7	35.7	34.5	43.2	41.3	39.8	34.5	43.2	41.3	39.8
1995	34.3	39.9	36.2	36.8	39.5	39.5	37.7	38.9	39.5	39.5	37.7	38.9
1996	34.0	37.4	38.4	36.3	40.2	42.0	43.2	41.8	40.2	42.0	43.2	41.8
1997	37.4	36.8	41.3	38.2	40.1	40.2	39.7	40.0	40.1	40.2	39.7	40.0
1998	37.0	42.3	40.5	39.8	42.0	44.2	46.6	44.3	42.0	44.2	46.6	44.3
1999	35.4	39.6	41.0	38.4	38.0	42.5	38.0	39.5	38.0	42.5	38.0	39.5
2000	37.7	39.4	40.4	39.0	40.8	45.5	44.0	43.5	40.8	45.5	44.0	43.5
2001	38.0	38.3	38.9	38.3	40.4	40.4	41.7	40.8	40.4	40.4	41.7	40.8
2002	37.6	39.8	41.3	39.4	37.1	43.4	40.8	40.5	37.1	43.4	40.8	40.5
2003	36.2	39.1	39.4	38.1	36.5	39.0	40.0	38.6	36.5	39.0	40.0	38.6
2004	37.1	38.1	42.0	38.8	39.5	42.0	43.3	41.7	39.5	42.0	43.3	41.7
2005	33.3	37.2	37.3	35.8	34.0	40.2	36.6	37.0	34.0	40.2	36.6	37.0
2006	34.3	38.3	37.9	36.8	35.8	40.1	39.4	38.5	35.8	40.1	39.4	38.5

Source: Brazilian National Health System Mortality Database (SIM/SUS)

RESULTS

The proportion of deaths from pulmonary diseases increased among the elderly compared to all deaths, with higher rates seen among the oldest group. There was a decrease of percentage increment in almost all age groups and by gender for cardiovascular disease (Table 1).

The percent change in proportional mortality varied by causes of death, age groups and gender. There was around 100% growth in deaths from pulmonary diseases in all age groups and both genders. For deaths related to cardiovascular diseases, almost all age groups showed a decrease of approximately 10% in both males and females.

The annual mortality rates due to pulmonary and cardiovascular diseases showed an increasing trend in both genders (Figure 1). However, death rates from cardiovascular disease were four times higher than those of pulmonary diseases. When comparing rates between genders, cardiovascular rates were 15% lower in women and pulmonary rates were similar in both males and females. An increase in mortality rates was also seen by age group (Figure 2). Those aged 60–69 showed the lowest rate increment for both causes. The highest mortality rates were seen among the oldest males.

Table 2 shows the results of the trend analysis of mortality rates for both genders, by age group. There was a statistically significant increasing trend in all

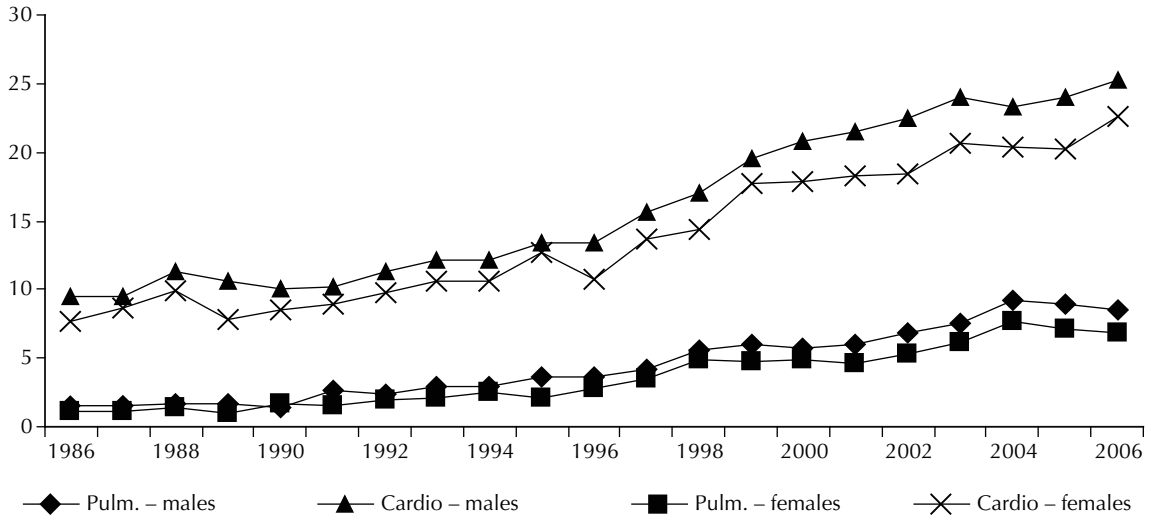

Figure 1. Standardized mortality rates for respiratory and cardiovascular diseases (per 1,000 inhabitants) in elderly population, by gender. State of Mato Grosso, Central-Western Brazil, 1986–2006.

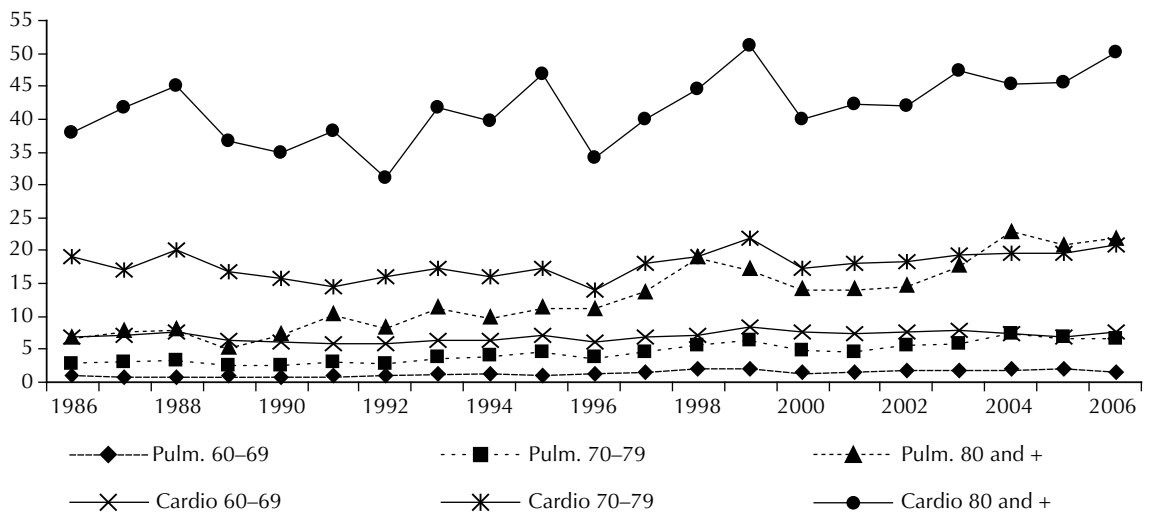

Figure 2. Specific mortality rates for respiratory and cardiovascular diseases in elderly population, by age. State of Mato Grosso, Central-Western Brazil, 1986–2006.

Tabela 2. Estimates from the linear regression equation, by gender and age groups. State of Mato Grosso, Central-Western Brazil, 1986–2006.

Gender/age group	Pulmonary diseases				
	$\hat{\beta}_0$	$\hat{\beta}_1$	p-value (model)	r^2	Trend
Pulmonary diseases					
Males					
60 to 69 years	2.09	0.15	<0.001	0.908	↑
70 to 79 years	6.76	0.55	<0.001	0.930	↑
80 years and more	21.16	1.99	<0.001	0.941	↑
60 years and more	4.87	0.41	<0.001	0.945	↑
Females					
60 to 69 years	1.39	0.11	<0.001	0.86	↑
70 to 79 years	4.72	0.36	<0.001	0.878	↑
80 years and more	17.62	1.76	<0.001	0.896	↑
60 years and more	3.19	0.28	<0.001	0.923	↑
Cardiovascular diseases					
Males					
60 to 69 years	9.78	0.42	<0.001	0.899	↑
70 to 79 years	24.26	1.03	<0.001	0.891	↑
80 years and more	59.54	3.43	<0.001	0.952	↑
60 years and more	17.68	0.83	<0.001	0.932	↑
Females					
60 to 69 years	7.01	0.30	<0.001	0.903	↑
70 to 79 years	19.76	0.83	<0.001	0.868	↑
80 years and more	55.58	3.08	<0.001	0.925	↑
60 years and more	15.25	0.72	<0.001	0.923	↑

$\hat{\beta}_0$: estimate of the average rate for the study period (per 1,000 inhabitants).
$\hat{\beta}_1$: estimate of the average annual increment.

age groups of both genders for both pulmonary and cardiovascular deaths.

For both causes of deaths, the mean rate for the time period ($\hat{\beta}_0$) was higher in those aged 80 or more in both genders and mean rates were higher in males than females. The highest average annual increases ($\hat{\beta}_1$) seen in both male and female elderly aged 80 or more were: +1.99 and +1.76 for pulmonary and +3.43 and + 3.08 for cardiovascular deaths, respectively. The average annual increments for those males and females aged 60–69 years were 0.15 and 0.11 for pulmonary and 0.42 and 0.30 for cardiovascular rates, respectively.

DISCUSSION

The present study is one of the first trend analyses of mortality from pulmonary and cardiovascular diseases in elderly people outside large Brazilian urban centers such as the city of São Paulo, Southeastern Brazil. Campos & Rodrigues[2] studied mortality trends in elderly people in Southeastern Brazilian states during 1980 to 2000 and found a reduction in mortality rates from all causes in both men and women. Similar results to ours were reported in studies of mortality trends from pulmonary diseases among the elderly in the state of São Paulo between 1980 and 1998: increasing rate trend in both genders, especially in those aged 80 or more.[5,8] However, the average increments in the mortality of elderly in the state of Mato Grosso are higher than those found in São Paulo.[5,8]

Since death rates from cardiovascular disease increased in all age groups, this finding is likely to be affected by diagnosis quality and access to complementary exams. Lolio[13] claimed that the risk of cardiovascular death has been significantly reduced due to improved diagnosis quality and emergency care.

A comparison of raw mortality data due to pulmonary or cardiovascular disease among elderly people available from SIM and the Inter-Agency Health Information Network (RIPSA) showed differences across the entire time series, from more than 20% to 6.5% in the last year. This difference arises from the correction of the number

of deaths from ill-defined cause made by RIPSA, especially in the elderly group. We estimated corrected mortality rates, adjusted by age and gender, before examining our data to reduce the effect of mortality from ill-defined in the state of Mato Grosso.

Duarte et al[6] stressed the weakness of mortality data in Northern and Central-Western Brazilian states, especially for small cities and remote years. For this reason we chose to analyze aggregated data for the state as a whole and without specifying diagnostic groups of pulmonary and cardiovascular diseases in an attempt to reduce differential systematic errors between years and municipalities.

The significant increase in pulmonary and cardiovascular deaths found in this study corroborates other similar studies, even when controlling for the effect of changes in population age distribution during the study period. Although an increased mortality was seen in all age groups and both genders, this increase was more remarkable in cardiovascular deaths, especially in elderly men and in those aged 80 and older.

For pulmonary deaths, the average annual rate in males aged 80 years and more was 10 times higher than that seen in those aged 60–69 years. A similar trend was seen among females. The same was found for cardiovascular deaths: the average annual rate in males and females aged 80 and more was eight and nine times greater than that seen in those aged 60–69 years, respectively.

Besides population aging and consequent increase in the proportion of people aged 60 years or more, it is believed that this population cohort has experienced different prior occupational and environmental exposures that might also affect mortality rates. Mato Grosso is a state located in the Amazônia Legal region and has distinctive characteristics compared to the rest of Brazil such as land use practices with environmental and social impact and health risks such as cardiopulmonary disease.[7,9]

The trend of mortality rates for cardiopulmonary diseases in the elderly in Mato Grosso can be partially explained by higher susceptibility of the elderly, especially to pulmonary and cardiovascular infections and their associated complications.[8,12] There is a progressive decrease of pulmonary and cardiovascular functions with reduced lung elasticity, vital capacity and forced expiratory volume, as well as reduced ciliary function and cough reflex. Frail elderly, when exposed to some factors such as air pollution, may develop pulmonary and cardiovascular conditions that require constant care.[14]

Because the elderly is a population segment more vulnerable to cardiopulmonary conditions, the analysis of mortality rates in the elderly could be used to identify variations in the rates of these conditions. A comparison with similar analyses conducted in other Brazilian regions would allow to formulating hypotheses about the effect of external factors that can contribute to increased mortality rates over time and provide input for a more detailed assessment of the evolution of mortality rates. Further studies are needed to better understand the determinants of these trends.

In conclusion, Mato Grosso was found to have high mortality rates for pulmonary and cardiovascular diseases in the elderly with significant increasing trends among the oldest-old groups.

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