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EVOLUTION OF MORTALITY FROM CIRCULATORY SYSTEM DISEASES IN A CITY OF THE STATE OF MINAS GERAIS

EVOLUÇÃO DA MORTALIDADE POR DOENÇAS DO APARELHO CIRCULATÓRIO EM UM MUNICÍPIO MINEIRO

EVOLUCIÓN DE LA MORTALIDAD POR ENFERMEDADES DEL APARATO CIRCULATORIO EN UN MUNICIPIO MINEIRO

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ABSTRACT

Objective: to analyze the mortality from circulatory system diseases in a municipality of the countryside of Minas Gerais. **Method**: This is an ecological and time series study considering the mortality coefficient and trend analysis. Death registries of chapter IX - Circulatory diseases (ICD-10: I00-I99) between 1996 and 2014, available in the Mortality Information System, were included. A descriptive exploratory analysis of the variables was conducted, as well as a temporal trend analysis. **Results**: male deaths (mean mortality coefficient: 82.2 x 10^4 inhabitants) and age group ≥ 80 years (mean mortality coefficient: 930.6 x 10^4 inhabitants) were more expressive. The global mortality coefficient ($p = 0.008$) and the coefficient by gender (male and female - $p < 0.001$) showed an increasing temporal evolution. **Conclusion**: It is important to recognize the mortality pattern due to diseases of the circulatory system as a public health problem as is the creation of actions to prevent these diseases through the adoption of healthy lifestyles.

Descriptors: Mortality; Cardiovascular System; Epidemiologic Studies; Time Series Studies.

RESUMO

Objetivo: analisar a mortalidade por doenças do aparelho circulatório em um município do interior mineiro. **Método:** Trata-se de estudo ecológico e série temporal por coeficiente de mortalidade e análise de tendência. Foram incluídos os registros de óbitos do capítulo IX – Doenças do aparelho circulatório (CID-10: I00-I99) entre 1996 a 2014, disponíveis no Sistema de Informação de Mortalidade, sendo empreendia análise exploratória descritiva das variáveis, além de análise de tendência temporal. **Resultados:** os óbitos para o sexo masculino (Coeficiente de mortalidade médio: 82,2 x 10^4 habitantes) e faixa etária ≥ 80 anos (Coeficiente de mortalidade médio: 930,6 x 10^4 habitantes) foram mais expressivos. O coeficiente de mortalidade geral ($p=0,008$) e por sexo (masculino e feminino – $p<0,001$) apresentaram evolução temporal crescente. **Conclusão**: Evidencia-se a importância do reconhecimento do padrão de mortalidade por doenças do aparelho circulatório como

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problema de saúde pública e a criação de ações de prevenção destes agravos com adoção de estilos de vida saudáveis.
Descritores: Mortalidade; Sistema Cardiovascular; Estudos Epidemiológicos; Estudos de Séries Temporais.

RESUMEN
Objetivo: analizar la mortalidad por enfermedades del aparato circulatorio en un municipio del interior minero. **Método**: Se trata de estudio ecológico y serie temporal por coeficiente de mortalidad y análisis de tendencia. Se incluyeron los registros de muertes del capítulo IX - Enfermedades del aparato circulatorio (CID-10: I00-I99) entre 1996 a 2014, disponibles en el Sistema de Información de Mortalidad, siendo emprendía análisis exploratorio descriptivo de las variables, además de análisis de tendencia temporal. **Resultados**: los fallecimientos para el sexo masculino (Coeficiente de mortalidad promedio: 82,2 x 10^4 habitantes) y grupo de edad ≥ 80 años (Coeficiente de mortalidad promedio: 930,6 x 10^4 habitantes) fueron más expresivos. El coeficiente de mortalidad general (p = 0,008) y por sexo (masculino y femenino - p <0,001) presentaron evolución temporal creciente. **Conclusión**: Se evidencia la importancia del reconocimiento del patrón de mortalidad por enfermedades del aparato circulatorio como problema de salud pública y la creación de acciones de prevención de estos agravios con adopción de estilos de vida saludables.
Descriptores: Mortalidad; Sistema Cardiovascular; Estudios Epidemiológicos; Estudios de Series Temporales.

INTRODUCTION

The health conditions of the population are influenced by several factors, related in a complex way. At a global level it can be observed that there is an improvement in people's lives and health conditions, with a reduction in mortality rates and an increase in longevity.[1] In this context, the epidemiological transition emerges, characterized by a change in the morbidity and mortality pattern from communicable diseases to chronic noncommunicable ones, including especially the Circulatory System Diseases (CSD).[1,2]

The CSD is the leading cause of death worldwide. According to the World Health Organization (WHO), diseases of the circulatory system represented around 15.2 million deaths worldwide, with ischemic heart diseases and strokes being the most important among them.[3]

In Brazil, CSD had a high representation in death causes, accounting for about 28% of all causes of death in the year 2011.[4] A study that evaluated the mortality trend in the adult population of a city of Minas Gerais, between 1996 and 2013, identified the CSD as the main cause of death, with a mean age of death for these cases of 59.7 years.[5]

Although CSD is one of the leading causes of death in Brazil, the trend analysis of these deaths points to a reduction since the 1970s. Despite this reduction, these diseases still have a great impact on the

country's public health, with high hospitalization costs and significant death rates.[1,4-5]

In this sense, the use of epidemiological health indicators, such as mortality by groups of specific causes and trend analysis of the deaths, allows for a review of health conditions capable of predicting the risk of illness and situations of vulnerability in health, whose outcome may be death. In addition, studies aimed at knowing the morbidity and mortality profile are important for the development of health diagnoses that allow the creation and re-adaptation of actions aimed at the prevention of these diseases. A recent review indicates knowledge gaps regarding studies that address the use of epidemiological indicators in the evaluation of mortality.[2]

Thus, the present study aims to analyze the mortality of the circulatory system diseases in a municipality of the countryside of Minas Gerais, from 1996 to 2014.

METHOD

This is an ecological study that analyzed the CSD mortality in the adult population living in the city of Uberaba/MG, from 1996 to 2014.

This municipality is a reference for the Health Macro-region of Triângulo Sul, with an estimated population of 330.361 inhabitants in 2018. Estimated data from the Department of Informatics of the Unified Health System (DATASUS) indicate that the proportion of the adult population (equal to or greater than 20 years) of this municipality for the year 2012 was 72.29%, these results indicate the need for studies aimed at this population.[6]

The data were obtained through information available in the Mortality Information System (SIM) public database,[7] part of the DATASUS online system.

Data collection occurred between September and October 2018. The period of time considered took into account the current data available in DATASUS, according to the International Classification of Diseases in its 10th Revision (ICD-10).[8] The intercensal projections provided by DATASUS were used and the standard population considered for the calculation of the indicators was of the year 2010.[6] The data classified as ignored in the system was not part of the data collection carried out by this research.

A database was organized in Excel®, and a descriptive exploratory statistical analysis of the variables using

central tendency and dispersion measures, as well as an analysis of the indicators and temporal trend were performed using the software Statistical Package for the Social Sciences (SPSS) version 21.0 .

The variables where classified according to gender and age group and considered the diseases classification groups of chapter IX of ICD-10: I00-I02 Acute rheumatic fever; I05-I09 Chronic rheumatic heart diseases; I10-I15 Hypertensive diseases; I20-I25 Ischemic heart diseases; I26-I28 Pulmonary heart disease and pulmonary circulation disease; I30-I52 Other forms of heart disease; I60-I69 Cerebrovascular diseases; I70-I79 Diseases of arteries, arterioles and capillaries; I80-I89 Diseases of the veins, lymphatic vessels and lymph nodes, not classified elsewhere; I95-I99 Other and unspecified disorders of the circulatory system.

The Mortality Coefficient (CM) was analyzed using the expression: *Total deaths by CSD of residents in a certain area, in the year considered/Standard population resident in the area * 10*.000.[9] After, the information was analyzed for the specific CM (10^4): gender (male and female) and age group as used by DATASUS (20 |-| 29 years, 30 | - | 39 years, 40 | - | 49 years, 50 | - | 59 years; 60 | - | 69 years, 70 | - | 79 years and 80 years or more). The specific CM crude results over the period were considered. The rates were standardized according to the standard population of this study. The results were presented according to annual and triennial averages, with 95% confidence intervals (95% CI) for CM (total and specific) in the period.

The trend analysis used the linear regression model ($Y = \beta0 + \beta1x + \Sigma$) in which the values of the CM series (total and specific) were considered as dependent variables (y), and the considered periods (years) as independent variables (x). This modeling option is justified by its simplicity of elaboration, interpretation, and statistical power. To avoid autocorrelation between the terms of the regression equation, the artifice of centering the year variable was used, turning it into calendar year minus the midpoint of the historical series. The trend analysis presented the coefficient of determination (R^2) and the Pearson correlation(r) as measurements of precision. The analysis of the time series could assume an increasing, decreasing or stationary trend, considering a statistically significant linear trend with a value of $p \leq 0.05$. The classification of the trend as increasing or decreasing was according to the sign of $\beta1$ (positive or negative) and direction of the line.

As foreseen by resolution 510/2016 of the National Research Council, as the

data used are in the public domain there is no need for evaluation by the Research Ethics Committee involving human beings.

RESULTS

In the period from 1996 to 2014, there were 10.111 deaths related to CSD in the age group equal to or greater than 20 years, in Uberaba. The male population (Average CM: 82.2 x 10^4 inh.; CI95%: 69.3; 95.0) and the age group ≥ 80 years (Average CM: 930.6 2 x 10^4 inh.; CI95%: 760.3; 1101.0) presented the highest CM means of the variables analyzed (Table 1).

Table 1 Distribution of Mortality Coefficients (10^4 inhabitants) due to diseases of the circulatory system (ICD-10: I00 to I99) according to demographic variables, from 1996 to 2014, in Uberaba-MG, Brazil, 2018.

Demographics variables	Crude CM results from 1996 to 2014						Mean	CI 95%
	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2014		
Global CM	69.6	73.7	67.9	73.5	79.0	103.5	77.9	67.4; 88.4
Gender								
Female	66.6	69.9	65.5	70.3	76.5	93.7	73.7	65.4; 82.1
Male	72.5	77.4	70.5	77.0	81.7	113.9	82.2	69.3; 95.0
Age group (years)								
20 |-| 29	2.3	1.9	1.2	2.1	3.4	1.8	2.1	1.6; 2.7
30 |-| 39	11.2	10.0	7.9	7.5	8.1	8.9	8.9	7.8; 10.1
40 |-| 49	29.5	30.2	27.6	26.0	25.0	32.6	28.5	26.2; 30.8
50 |-| 59	62.0	63.8	54.6	64.1	66.5	81.8	65.5	58.3; 72.7
60 |-| 69	165.4	175.6	145.6	187.3	172.1	240.3	181.1	155.4; 206.8
70 |-| 79	352.3	388.0	358.5	390.7	411.3	559.7	410.1	348.9; 471.3
≥ 80	757.5	812.2	857.1	808.3	1026.9	1321.7	930.6	760.3; 1101.0

Source: SIM (DATASUS).

Regarding the causes, according to ICD-10, the following groups presented higher mean values: I60 - I69 cerebrovascular diseases (average CM: 23.0 x 10^4 inh., 95% CI: 20.5; 25.5), I20-I25 ischemic heart disease (average CM: 22.5 x 10^4 inh.; 95% CI: 16.5; 28.5), I30-I52 other forms of heart disease (average CM: 19.0 x 10^4 inh.;95% IC: 17.6; 19.3) and I10-I15 hypertensive diseases (average CM: 7.0 x 10^4 inh.; 95% CI: 5.5; 8.5) (Table 2).

Table 2 Distribution of Mortality Coefficients (10^4 inhabitants) according to ICD-10 (ICD-10: I00 to I99) from 1996 to 2014, in Uberaba-MG, Brazil, 2018.

Groups of causes	Crude CM results from 1996 to 2014						Mean	CI 95%
	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2014		
I00-I02	-	0.1	-	-	0.1	0.1	0.0	0.0; 0.1
I05-I09	1.5	0.4	0.4	0.9	0.6	1.0	0.8	0.4; 1.1
I10-I15	4.9	5.5	5.6	9.1	8.7	8.2	7.0	5.5; 8.5
I20-I25	20.4	18.8	16.8	19.2	22.4	37.3	22.5	16.5; 28.5
I26-I28	1.8	1.4	0.8	1.4	1.9	3.1	1.7	1.1; 2.3
I30-I52	18.5	20.1	17.1	17.9	18.1	19.0	19.0	17.6; 19.3
I60-I69	19.4	24.1	21.4	21.4	23.2	28.5	23.0	20.5; 25.5
I70-I79	2.6	2.6	4.9	3.1	3.3	4.4	3.5	2.7; 4.3
I80-I89	0.4	0.6	0.8	0.6	0.8	1.8	0.8	0.4; 1.3
I95-I99	-	0.1	-	-	-	-	0.0	0.0; 0.1

Source: SIM (DATASUS).

Regarding the temporal evolution of deaths due to diseases of the circulatory system during the analyzed period, the first-order polynomial linear regression presented a coefficient of determination ≥ 70% for the CM of both genders and for the age group 70 | 79 years and 80 years or more. The result for the global CM trend of the analyzed deaths showed an increasing tendency (r = 0.5), representing a moderate correlation (Table 3).

Table 3 Analysis of the trend regression model of the global CM x 10^4 and the variables gender and age, considering deaths from diseases of the circulatory system, according to ICD-10 (ICD-10: I00 to I99), from 1996 to 2014, in Uberaba-MG, Brazil, 2018.

Variables	Model	*p*	R^2	Trend	r
Global	y = 0.1889x + 24.598	**0.008**	0.3	Increasing	0.5
Female	y = 0.1295x + 23.288	< **0.001**	0.8	Increasing	0.8
Male	y = 0.2599x + 25.948	< **0.001**	0.7	Increasing	0.9
20 |-| 29 Group age	y = -0.005x + 0.703	0.06	0.2	Decreasing	0.4
30 |-| 39 Group age	y = -0.0809x + 2.819	0.19	0.4	Decreasing	0.2
40 |-| 49 Group age	y = -0.1119x + 9.0032	0.13	0.2	Decreasing	0.3
50 |-| 59 Group age	y = 0.02x + 20.682	**0.01**	0.3	Increasing	0.5
60 |-| 69 Group age	y = 0.301x + 57.176	**0.01**	0.4	Increasing	0.6
70 |-| 79 Group age	y = 1.3615x + 129.5	< **0.001**	0.7	Increasing	0.8
≥ 80 years	y = 5.4598x + 293.88	**0.002**	0.7	Increasing	0.6

Source: SIM (DATASUS).

DISCUSSION

The global CM of the CSD in Uberaba during the analyzed period presented a tendency of growth, with emphasis on the male population since they presented the highest mean of CM for the whole analyzed period. Mortality rates for males in Brazil between 1990 and 2015 were more significant (524.8 and 315.8, respectively) than for females (358.3 and 210.7, respectively).[10]

A study that evaluated long-term predictive models of patients with cardiovascular disease with risk of death, identified a higher chance of death with age.[11] In the present study there as a higher CM means in older age groups. Similar results were also found in a study comparing mortality rates by CSD in São Caetano do Sul, São Paulo State, Brazil, between 1980 and 2010,when higher rates were found for older age groups especially in males older than 60 y/o.[12]

Such situation may be related to factors such as improvement in the quality of health information systems in Brazil, with emphasis on the fulfillment of the death certificate, the decrease in undefined causes and an increase in the prevalence of arterial hypertension, due to the better access for identification of the problem and control by the health services.[13]

The most representative group of causes (cerebrovascular diseases, ischemic heart diseases and hypertensive diseases) found in the results of this study corroborate with another study[13] that evaluated the temporal evolution of CSD mortality rates in Brazil between 1980 and 2012.

Regarding temporal evolution, the trend of deaths from diseases of the circulatory system showed a tendency for growth, which diverges from the results found in the literature regarding the trend of these causes of death in recent years in Brazil[10,14,15], in the state of Acre[16] and in some municipalities of the state of Rio de Janeiro[4,17].

The recognition of the morbidity and mortality patterns of the population is paramount for the analysis of the behavior and tendency of certain diseases, as well as for the analysis of health situations by public managers, especially regarding the evaluation, planning, and management of the promotion of health and prevention of diseases by health services, in addition to allowing redirections of public health policies.[2,3]

Morbidity and mortality due to chronic non-communicable diseases, especially CSD, should be considered important health indicators regarding the effectiveness of health services in Brazil,

especially in Primary Health Care (PHC) services.[18,19] The use of the strategy of matrix support for primary care services has been highlighted as innovative and as having the potential to address the problem of chronic diseases in the country. A recent experience in the implementation of matrix support in cardiology to PHC services in the southern region of the country, showed a greater solvability of health problems by PHC physicians, with consequent reduction and qualification of referrals to cardiologists, faster access to specialists and exams and an important reduction of the queue for attendance of this specialty.[20]

Considering the limitations of this study, as it is a research that used secondary public data from the SIM database, the accuracy of the information should be taken into account. Another aspect of the chosen methodology is related to the ecological design, which does not allow the analysis of individual risks. It is also important to highlight the non-redistribution of deaths due to poorly defined causes for the CSD group and the generalization of the results due to a local cut-off point, which even when dealing with specific realities, can be an important source of information as a diagnosis of the population health situation.

CONCLUSION

The results of this study reiterate the importance of recognizing the mortality patterns due to CSD as a public health problem. These groups of diseases present an expressive mortality pattern among males for those who are older and a temporal evolution with an increasing linear distribution of CM x 10^4 for the variables gender and age group for those 50 years old or older.

For health services, more than measuring the profile of CSD deaths, it is necessary to encourage the creation of actions that prevent these diseases and promote health through the adoption of healthy lifestyles. Therefore, studies with epidemiological approaches emerge as a low cost and fast execution strategy in the identification of this problem, that affect the health of the individuals, and with that, contribute to the adoption of effective strategies to reduce avoidable deaths by CSD.

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