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ORIGINAL ARTICLE

Mortality Trend Due to Cerebrovascular Accident in the City of Maringá, Paraná between the Years of 2005 to 2015

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Abstract

Background: Stroke is the second largest cause of death in the world, responsible for 6.7 million deaths in 2012. In Brazil, among the leading causes of death, cerebrovascular diseases occupy the first place.

Objective: to analyze the trend of deaths from cerebrovascular accident (CVA) in the city of Maringá, Paraná, Brazil, between the years of 2005 and 2015.

Methods: Cross-sectional study of time series performed at the Municipal Health Department of Maringá. Secondary data on death certificates for stroke in the city of Maringá between 2005 and 2015, selected according to the specific MC for CID-10 presented with few variations in the time interval studied. The coefficient for ICD-10 - I69.4 was higher in 2011. The lowest coefficient for the whole period was I61.9. The trend of total mortality coefficients reached peak in the years 2007 and 2008, small variations occurred after this period until 2015. (Figure 1) (ICD-10) from I60 to I69 were used. For trend verification, the polynomial regression model was used. Mortality Coefficients (MC) by main cause of death were calculated using the total number of people who died of stroke divided by the population exposed to the risk, multiplied by one hundred thousand. The trends were analyzed using the Polynomial Regression model, considered significant when $p < 0.05$. Population data were obtained from the database of the Brazilian Institute of Geography and Statistics.

Results: Stroke was responsible for 1,843 deaths in the study period, with ICD- 10 - I64, I69.4 and I61.9 being the most frequent. The years with the highest number of deaths from the disease were 2007 and 2008. 52% of deaths occurred in males and 74% in individuals over 65 years.

Conclusions: The trend of general mortality was constant, but there was an increasing trend of deaths among white married males. (Int J Cardiovasc Sci. 2018;31(1)56-62)

Keywords: Stroke / mortality; Epidemiology; Mortality; Risk Factors.

Introduction

the Stroke is the second largest cause of death in the world, responsible for 6.7 million deaths in 2012.[1] In Brazil, among the main causes of death, cerebrovascular diseases are in first place, followed by the acute myocardial infarction. In 2014, the 80-year-old or older group accounted for approximately 37% of the deaths and the incidence was similar in both genders, 50.1% of the cases in men.[2]

The World Health Organization (WHO) estimates that by 2030, stroke will remain as the world's second-leading cause of death, accounting for 12.2% of deaths predicted for the year.[3]

In the State of Paraná, in 2012, there were more than 6 thousand deaths from the disease, most of them of people over 50 years old. Data indicate that only in the first half of 2013 the State had already registered 6.3 thousand people hospitalized for stroke.[4]

Cerebral Vascular Accident has high levels of morbidity and mortality, and in those cases when the individuals affected by the disease do not die, functional

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impairment may be generated and will be presented as provisional or permanent.[5] The stroke can manifest itself in two ways: (obstruction of the vessel, making it difficult to supply oxygen and substrates to brain tissue - a result of atherosclerotic or embolic processes) and hemorrhagic (extravasation of blood into or around central nervous system structures - intraparenchymal and subarachnoid, respectively).[6] The major risk factors for the disease are divided into unchangeable and changeable. The unchangeable factors are: old age, males and race. The changeable ones are, mainly, systemic arterial hypertension, diabetes mellitus and smoking.[7]

Although a lot of literature related to this disease is available, as far as we know there is no current research related to the trend of stroke mortality in the city of Maringá, therefore this study exposes data that allow the reflection on measures to be elaborated in the early recognition of cerebrovascular accident, and then improve the mortality indicators of the municipality.

Therefore, the objective of this research was to analyze the trend of deaths due to stroke in Maringá, Paraná, Brazil.

Methods

A cross-sectional study of time series of deaths from stroke, recorded in the death certificates of men and women of all age groups and ethnicities, living in a medium-sized municipality in the south of Brazil, with a population of 397,437 inhabitants.[8] The study was conducted at the Municipal Health Secretariat of Maringá through Epidemiological Surveillance, from 2005 to 2015.

The information obtained was collected from a structured instrument presenting the following variables: year of death, age, sex, ethnicity, civil status, and International Classification of Diseases (ICD-10) related to stroke (I60 to I69).

Statistical analysis

Data were compiled in the Microsoft Office Excel® program and later analyzed using simple descriptive statistics through the calculation of summary measures, line graphs, polynomial trend analyzes and scatter plot.

The inferential analyzes used to confirm or refute evidence found in the descriptive analysis were the Pearson's Chi-square test or Fisher's Exact test extension. For the conclusion obtained through the inferential analysis was used the level of significance α equal to 5%.

For trend verification, the polynomial regression model was used, in which the coefficients of mortality were considered as dependent variables (y) and the years of study as independent variables (x). The year variable was transformed into the year-center variable (x-2009) and the series were smoothed by means of a three-point moving average. The models of linear polynomial regression ($y = \beta0+\beta1x1$), quadratic ($y = \beta0+\beta1x1+\beta2x2$), and cubic ($y = \beta0+\beta1x1+\beta2x2+\beta3x3$) were tested. It was considered a significant trend, the one which estimated model obtained p value < 0.05. For the choice of the best model, the analysis of the dispersion diagram, the coefficient of determination (r^2) and residue analysis (true homoscedasticity assumption) were also considered. When all criteria were significant for more than one model and the coefficient of determination was similar, we chose the simpler model. The analyzes were performed using *Microsoft Excel* (version 2013), *Epi Info* 2005 and *SPSS*, version 20.1.

The mortality coefficients (MC) by main cause of death were calculated using the numerator the total number of people who died due to stroke, and in the denominator the population exposed to the risk, multiplied by one hundred thousand. Subsequently, calculations of the mortality coefficient by International Classification of Diseases (ICD) for each age group were made, using as the numerator the total number of deaths in a given age group, and in the denominator the population of the same age group, multiplied by one hundred thousand. Population data were obtained from the database of the Brazilian Institute of Geography and Statistics.

The ethical aspects involved in the present research were based on the guidelines and norms of research involving human beings of the National Health Council (Resolution CNS 466/2012). The research does not require the Consent Form because it is secondary data, however the attached Risk and Confidentiality Statement was signed. The project was submitted to the Ethics Committee O projeto foi submetido à apreciação do Comitê de Ética do Centro Universitário de Maringá - Unicesumar, com parecer positivo n. 1.745.904.

Results

During the period of this study, were recorded 20,387 deaths in total. Cerebral vascular accident was responsible for 1,843 of the deaths, and ICD-10 - I64 (Stroke not specified as hemorrhagic or ischemic), I69.4 (Sequelae of stroke not specified as hemorrhagic or ischemic) and I61.

9 (Unspecified intracerebral hemorrhage) were the most found, corresponding to 536, 535 and 268 cases respectively.

After that, it was sought to identify the behavior of the mortality coefficients (MC), according to clinical and sociodemographic variables, comparing to the general coefficient of mortality due to stroke and those specific to the ICD-10 found most frequently (I61.9, I64 and I69.4). Table 1 shows a higher coefficient of general mortality due to stroke between 2007 and 2008. The mortality coefficients for males, white and marital status were the ones that stood out the most during the majority of the studied period.

The specific MC for ICD-10 presented few variations during the studied interval of time. The coefficient for ICD-10 I69.4 was higher in 2011. The lowest coefficient for the whole period was I61.9. The trend of total mortality coefficients reached peak in the years 2007 and 2008, small variations occurred after this period until 2015. (Figure 1)

Table 2 shows, from the MC shown above, that the trend of mortality in males was increasing, with mean MC of 25.07, and increase of 0.73 per year ($r^2 = 0.5347$). There was also an increasing tendency of coefficients in the white race, with an average coefficient of 37.94 and an increase of 0.94 per year ($r^2 = 0.51$). The data also show that there was an increasing trend in married

Table 1 – Mortality coefficients according to clinical and sociodemographic variables. Maringá-PR, 2005 to 2015

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
General MC	48.6	47.16	54	53.71	43.2	46.49	49.4	45.18	47.4	43.4	43.3
Kind of stoke											
I61.9	6.58	8.01	7.06	9.05	8.64	6.44	4.69	7.08	7	5.87	5.79
I64	12.5	15.1	16.6	16.6	11.3	14	13.5	12.25	13	11.49	15.4
I69.4	15.4	10.48	16	12.67	11	12.6	18.8	15.79	14.5	12	11.8
Gender											
Male	28.8	24.7	25.5	30.2	25.6	24.4	22.9	24.8	23.8	20.4	22.6
Female	19.8	22.5	28.5	23.5	17.6	22.1	26.5	20.4	23.6	23.0	20.6
Age group											
0 - 29 y.a.	0.3	0.6	0.0	0.6	0.0	0.0	0.0	0.3	0.3	0.0	0.8
30 - 49 y.a.	4.7	4.3	4.0	3.3	1.2	3.1	4.4	2.4	3.4	3.3	1.0
50 - 65 y.a.	7.5	8.3	10.4	12.4	10.4	8.4	7.5	11.4	8.3	6.4	7.3
> 65 y.a.	36.1	33.9	39.6	37.4	31.6	35.0	37.5	31.0	35.5	33.7	34.2
Race / color											
White	40.4	38.8	47.2	41.9	34.9	37.0	39.5	35.1	37.6	32.9	32.0
Black	4.7	3.4	4.0	6.3	4.8	6.2	4.1	3.8	4.9	6.1	6.0
Marital status											
Single	6.6	2.5	4.0	6.6	2.7	3.1	5.8	4.9	5.7	3.3	4.3
Married	21.9	21.9	25.2	23.2	23.5	22.7	21.8	21.8	18.4	19.7	19.4
Widower	16.3	19.4	22.1	19.3	14.0	18.2	17.9	13.9	18.4	16.1	16.1
Other	3.8	3.4	2.8	4.5	3.0	2.5	3.9	4.6	4.9	4.3	3.5
Education											
< 8 years	9.7	10.8	12.3	16.9	7.2	7.0	13.0	11.4	12.4	10.5	9.1
≥ 8 years	37.0	34.5	35.6	33.8	34.3	37.8	36.2	32.9	34.0	32.9	34.2

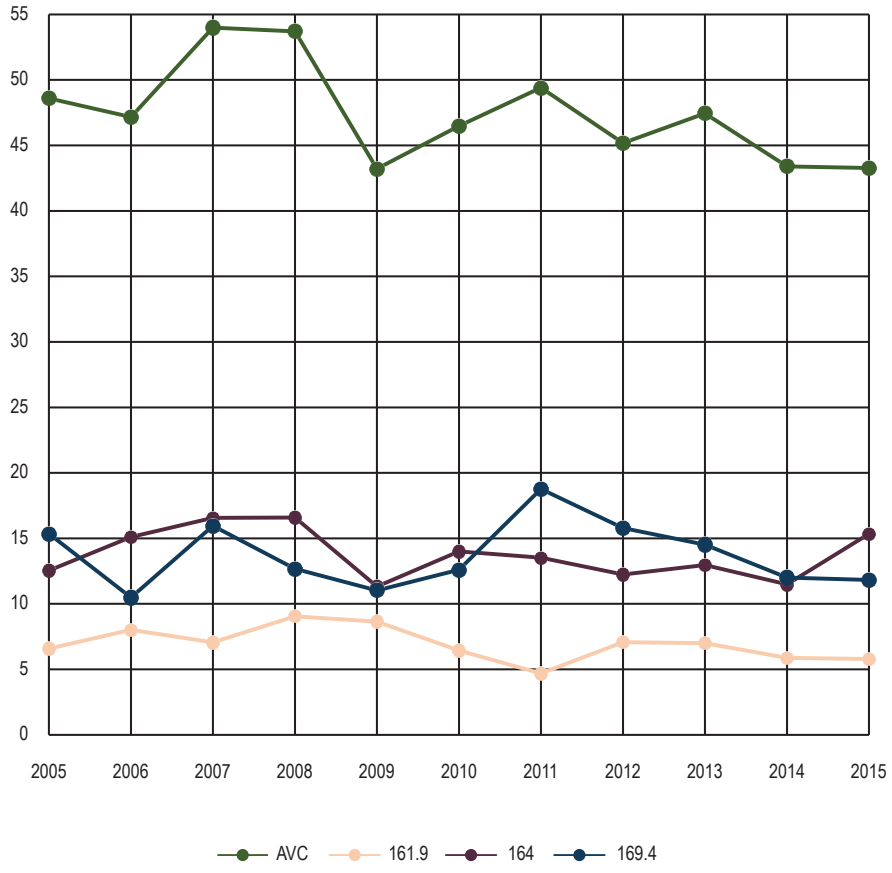

Figure 1 – *Distribution and trend models of mortality coefficients for stroke in total and according to ICD-10. Maringá, Paraná, Brazil, 2005 to 2015.*

individuals, with a mean coefficient of 21.76, and an increase of 0.42 per year (r^2 0.50). The overall trend in stroke mortality was constant.

Discussion

The present study shows stroke mortality trend (CVA) data specifying the cause of death according to the International Classification of Diseases (ICD). Deaths attributed to non-specified hemorrhagic or ischemic strokes (ICD-10 - I64) were the ones that most affected the population of Maringá in the period from 2005 to 2015. The trend in mortality coefficients (MC) for stroke was increasing in the male, white race and married civil status. For the most frequent vascular accidents: I61.9, I64 and I69.4 the mean coefficient was constant.

A study published in 2012 also observed the predominance of deaths due to stroke in males, representing 50.61% of the total.[9] These data are in agreement with the present research, because it was found that approximately 52% of all deaths occurred in males. Only in the years 2007, 2011 and 2014 the incidence of deaths in women exceeded that of men.

The mortality rate due to stroke in Brazil is one of the highest among Latin American countries, and although this mortality rate declined in recent years, the decrease is not the same in all regions of the country, since the Northeast still has higher rates.[10] The decline in mortality differs according to ethnicity, gender, and socioeconomic status. Although the research shows a higher incidence in the black population,[11] the present study showed a higher mortality in white individuals, which represented approximately 80% of the deaths. According to the 2010 IBGE Census, the city of Maringá had 70.8% of the population that declared themselves white and 3.39% who declared black. Therefore, if the number of deaths due to stroke in the black population and in the white population exposed to the risk is compared, it can be observed that in 2010, 0.05% of the white population and 0.18% of the black population died because of stroke.[12]

Table 2 – Trend analysis of mortality coefficients according to clinical and sociodemographic variables. Maringá-Paraná, 2005 to 2015

Variables	Modell	R²*	p	Trend
Gender				
Male	$y = 25.07+0.73x-0.019x^2-0.007x^3$	0.5347	0.0106	Crescent
Female	$y = 23.2+0.32x-0.064x^2-0.015x^3$	0.0033	0.8667	Constant
TOTAL	$y = 48.27+1.05x-0.083x^2-0.022x^3$	0.3267	0.0662	Constant
Kind of Stroke				
I61.9	$y = 7.23+0.50x-0.030x^2-0.017x^3$	0.2343	0.1314	Constant
I64	$y = 13.65+1.04x+0.01x^2-0.04x^3$	0.0797	0.4003	Constant
I69.4	$y = 14.34-0.89x-0.06x^2+0.051x^3$	0.0005	0.9482	Constant
Age Group				
0 - 29 y.a.	$y = 0.09+0.06x+0.016x^2-0.003x^3$	0.0002	0.9648	Constant
30 - 49 y.a.	$y = 3.10-0.19x+0.009x^2+0.022x^3$	0.3145	0.0727	Constant
50 - 65 y.a.	$y = 10.05+0.58x-0.11x^2-0.022x^3$	0.1000	0.3434	Constant
> 65 y.a.	$y = 35.02+0.60x+0.002x^2-0.019x^3$	0.1171	0.3029	Constant
Race/color				
White	$y = 37.94+0.94x$	0.5149	0.0129	Crescent
Not white	$y = 4.86+0.10x+0.007x^2-0.013x^3$	0.1742	0.2016	Constant
Marital status				
Single	$y = 4.35-0.369x+0.013x^2+0.022x^3$	0.0043	0.8473	Constant
Married	$y = 21.76+0.4245x$	0.5061	0.0141	Crescent
Education				
< 8 years	$y = 11.35+0.16x-0.04x^2-0.004x^3$	0.0097	0.7730	Constant
≥ 8 years	$y = 34.93+0.07x-0.01x^2+0.008x^3$	0.2211	0.1444	Constant

R^2: Determination coefficient

A significant reduction in mortality from circulatory diseases (cerebrovascular diseases and ischemic heart disease) occurs in Brazil today.[13] One study showed that between 1980 and 2002 there was a reduction in mortality from cerebrovascular disease greater than 50% in most regions of Brazil, except for the Northeast region where the reduction was 41%. This reduction in mortality is compared to what was also observed in the USA and Canada due to improvements in public health policies.[14]

A study carried out in Porto Alegre, Brazil, showed the main risk factors for the development of stroke. Among them are age, marital status and socioeconomic factor. Was identified a higher incidence of the disease between 40 and 79 years, in widowed and individuals of low socioeconomic status. They also reported that the highest number of years of schooling is a protective factor against stroke.[15] However, the present study has shown somewhat different data, since a greater number of deaths were observed in older people over 65 years of age (74 % of total) in married and widowed individuals and the highest number of deaths occurred in individuals with 8 years or more of study. A possible explanation for the divergence in relation to schooling may be due to the fact that, according to the 2010 Census, approximately 68.37% of the Maringá population had 8 years or more of study.[16]

Researches that seek for associate risk factors for stroke and strategies that can improve prevention, diagnosis and therapeutic assistance are fundamental for the reduction of the indicators.

One of the possible limitations of the study was the use of secondary data, which may underreport deaths due to stroke.

Conclusion

In the period of this study, the trend of stroke mortality was constant. There were 20,387 deaths in total. The cerebrovascular accident was responsible for 1,843 of the deaths, and the ICD 10 - I64, I69.4 and I61.9 were the most found. There was a growing trend of deaths in males, marital status and white race people. The years that were most affected by deaths in this pathology were 2007 and 2008.

The occurrence of deaths due to the disease described in this study, did not show to be decreasing, may be as a reflection of the inefficiency of care and control programs, that can not constitute a prevention program. It is important to emphasize that the effectiveness of prevention can be related to the reduction of deaths and health costs, bringing benefits both for the population and the economy.

Prevention, early diagnosis, rapid treatment and the way in which professionals and families accompany patients with stroke are key points in reducing numbers related to disease mortality. In this context, the importance of the topic addressed in the study to enable both professionals involved in care and health managers is highlighted. They need to be able to identify factors that put the health of the population at risk, and thus to perform the appropriate care and necessary referrals, in order to reduce indicators of morbidity and mortality.

We hope that this work will contribute to the definition, implementation and execution of awareness programs on the early recognition, tracking and assistance of stroke in the city of Maringá.

Author contributions

Conception and design of the research: Araújo JP, Darcis JVV, Tomas ACV, Mello WA. Acquisition of data: Araújo JP, Darcis JVV, Tomas ACV, Mello WA. Analysis and interpretation of the data: Araújo JP, Darcis JVV, Tomas ACV, Mello WA. Statistical analysis: Araújo JP, Darcis JVV, Tomas ACV, Mello WA. Obtaining financing: Araújo JP, Darcis JVV, Tomas ACV, Mello WA. Writing of the manuscript: Araújo JP, Darcis JVV, Tomas ACV, Mello WA. Critical revision of the manuscript for intellectual content: Araújo JP, Darcis JVV, Tomas ACV, Mello WA. Supervision / as the major investigador: Araújo JP, Darcis JVV, Tomas ACV, Mello WA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Centro Universitário de Maringá - Unicesumar under the protocol number 1.745.904. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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