● **Original article**

MORTALITY BY CARDIOVASCULAR DISEASES IN THE STATE OF PARANÁ

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ABSTRACT: Objective: To analyze the trend in mortality from ischemic and cerebrovascular cardiovascular diseases by age and gender in the state of Paraná. Methodology: Ecological study of rates of mortality rates from cardiovascular diseases in the years 2000 to 2014, conducted in July 2016. Polynomial regression model was used for trend analysis. Results: There was a progressive increase in mortality rates with increasing age in both genders. Mortality rates were higher in the first triennium (2000-2002), except for cerebrovascular diseases in men aged 20-29 years and ischemic diseases in women in this age group. Conclusion: Given the high number of deaths from cardiovascular diseases in Paraná, with a trend of increased mortality from cerebrovascular diseases in the young male population, nursing activities at the various levels of care should be intensified to fight the risk factors in the referred population.
DESCRIPTORS: Cardiovascular diseases; Mortality; Chronic disease; Epidemiology; Ecological studies.

MORTALIDADE POR DOENÇAS CARDIOVASCULARES NO ESTADO DO PARANÁ

RESUMO: Objetivo: analisar a tendência da mortalidade por doenças cardiovasculares isquêmicas e cerebrovasculares, segundo faixa etária e sexo no estado do Paraná. Metodologia: estudo ecológico das taxas de mortalidade por doenças cardiovasculares nos anos 2000 a 2014, realizado no mês de julho de 2016. Utilizou-se o modelo de regressão polinomial para a tendência. Resultados: houve aumento progressivo das taxas de mortalidade com o aumento da idade em ambos os sexos. No primeiro triênio, 2000 a 2002, as taxas se mostraram mais elevadas, com exceção das doenças cerebrovasculares em homens de 20 a 29 anos e doenças isquêmicas em mulheres nessa mesma faixa etária. Conclusão: diante do elevado número de óbitos por doenças cardiovasculares no estado, com tendência de crescimento da mortalidade por doenças cerebrovasculares na população masculina jovem, evidencia-se a necessidade da intensificação do trabalho da Enfermagem, nos diversos níveis de atenção, para o combate aos fatores de risco nessa população.
DESCRITORES: Doenças cardiovasculares; Mortalidade; Doença crônica; Epidemiologia; Estudos ecológicos.

MORTALIDAD POR ENFERMEDADES CARDIOVASCULARES EN EL ESTADO DE PARANÁ

RESUMEN: Objetivo: evaluar la tendencia de la mortalidad por enfermedades cardiovasculares isquémicas y cerebrovasculares, de acuerdo a la franja etaria y al sexo en el estado de Paraná. Metodología: estudio ecológico de las tasas de mortalidad por enfermedades cardiovasculares en los años 2000 a 2014, que se realizó en el mes de julio de 2016. Se usó el modelo de regresión polinomial para la tendencia. Resultados: hubo aumento progresivo de las tasas de mortalidad con el aumento de la edad en ambos los sexos. En el primer trienio, 2000 a 2002, las tasas fueron más elevadas, con excepción de las enfermedades cerebrovasculares en hombres de 20 a 29 años y enfermedades isquémicas en mujeres en esa franja etaria. Conclusión: considerando el elevado número de óbitos por enfermedades cardiovasculares en estado, con tendencia de crecimiento de la mortalidad por enfermedades cerebrovasculares en la población masculina joven, se concluye que hay necesidad de intensificación del trabajo de la Enfermería en los distintos niveles de atención, para combatir los factores de riesgo en esa población.
DESCRIPTORES: Enfermedades cardiovasculares; Mortalidad; Enfermedad crónica; Epidemiología; Estudios ecológicos.

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● INTRODUCTION

Non-communicable chronic diseases (NCDs) are the leading causes of mortality worldwide accounting for approximately 52% of deaths in individuals under 70 years of age, especially circulatory diseases, which are prevalent [1].

The United States ranks tenth in the world with a rate of 352 per 100,000 inhabitants and Brazil ranks sixth, with a rate of 552 deaths per 100,000 inhabitants [2]. Although cardiovascular diseases (CVD) declined in Brazil by 46% from 1991 to 2010, according to adjusted mortality rates [3], they still represent the largest share of deaths in the country: in 2015, 111,863 deaths were due to circulatory diseases [4].

The most prevalent CVDs are ischemic heart diseases (IHD) and cerebrovascular diseases (CBVD). In Brazil, the number of deaths from IHD increased from 79,427 in 2001 to 110,993 in 2015, and the deaths from CBVD increased from 86,471 in 2001 to 99,728 in 2015 [5].

According to the World Health Organization (WHO), the high rates of sickening and mortality from Non-communicable Chronic Diseases (NCDs), especially in developing countries, are the result of insufficient investments in cost-effective interventions. This reveals a serious public health problem because when people get sick and die while in their prime, there is a decline in productivity growth. Also, the costs of disease treatment faced by the individuals and the country's health system can be very high [1]. Patients affected by CVA, for example, have to stay for a long time in the hospital and are often readmitted. This results in significant healthcare spending in early retirement arrangements or sick pay and rehabilitation services [6].

As a result, in recent years, several health policies aimed at the prevention and control of CNCDs have been implemented in the country, with extensive initiatives of the Ministry of Health aimed at addressing these diseases at the national level, with intense coordination efforts of public policies and strategic planning. One example is the National Health Promotion Policy, which brings an expanded concept of health production in the individual and collective spheres, involving participation and social control [7].

In this scenario, we stress the importance of studies that analyze the occurrence of deaths from CVDs in the population, by gender and age group in the state of Paraná, over the years. Time series analysis allows comparisons during the period investigated and can be an alternative to assess the impact of health programs and policies implemented during this period.

This type of study, which involves population stratification by gender and age group, favors the diagnosis of the health status of the population and allows recognizing the groups that need more attention, emphasizing the implementation of more focused strategies and enabling health managers to improve the care provided. It is therefore an adequate tool for resource planning and allocation [8].

Thus, the present study aimed to verify the trend in mortality from cardiovascular diseases by age and gender in the state of Paraná, through the analysis of all CVD and its main subgroups: IHD and CBVD.

● METHOD

Ecological and longitudinal study that describes the rates of mortality from CVD in the population over 20 years of age resident in the state of Paraná, from 2000 to 2014.

The state of Paraná is located to the north of Brazil's Southern Region and has an estimated population of 11,348,937 inhabitants and a per capita GDP of BRL 33,769. The life expectancy of the population is 77.1 years, infant mortality is 10.37 per thousand births and the HDI is 0.749 (9, 10).

Data was collected and analyzed in July 2016. It was obtained through the Mortality Information System (SIM), available in the database of the Department of Information Technology of SUS (DATASUS), from the death certificates. The search for the cause of the deaths was based on the International Statistical Classification of Diseases and Related Health Problems - 10th revision (ICD - 10), and was

divided into three categories: total deaths from diseases of the circulatory system that correspond to all causes of Chapter IX of the ICD - 10; ischemic heart diseases (IHD) corresponding to codes I20 to I25; and cerebrovascular diseases (CBVD) from I60 to I69.

Calculations of mortality coefficients were obtained by 100,000 men and 100,000 women. The numerator was the number of deaths for each group of diseases by gender and age group and the denominator was the population number. Population estimates were obtained by projecting population data by gender and age available on DATASUS through the link "demográficas e socioeconômicas" [11].

Observation of the magnitude of mortality by the group of cardiovascular diseases was performed by describing the mortality coefficients. The relative percentage difference for the selected groups between the second triennium (2012-2014) and the first triennium (2000-2002) was calculated for the comparison of the differences in the coefficients between the two triennia. The years of the period were grouped in triennia to mitigate possible fluctuations in mortality rates.

The trend in mortality rates was verified with the polynomial regression model. The coefficients of mortality by main diagnosis were considered as dependent variable (Y) and the years of the study as independent variable (X). Simple linear regression models ($y = \beta_0 + \beta_1 X$) and, when necessary, second order models ($y = \beta_0 + \beta_1 X + \beta_2 X^2$) were tested. The best fitted polynomial model had statistical significance, a better coefficient of determination and less residues. When two models had similar exploratory ability, the simplest model (lowest order) was used because it was most likely to be the best choice. The data were analyzed in IBM SPSS Statistics 20 software.

Since the information used in this study was freely available in the public domain through the internet, there was no need for authorization by the Standing Committee on Ethics in Research Involving Human Beings, under protocol 16/2016, of Universidade Estadual de Maringá.

● RESULTS

Analysis of mortality coefficients showed decrease in mortality rates from the three groups of diseases. There is also a predominance of mortality coefficients in people aged 70 years or older, with a predominance of CBVD compared to IHD in this age group.

Table 1 shows the mortality coefficients of men according to disease groups (CVD, IHD and CBVD) by age group in each period, and the relative percentage difference in the coefficients between the first and second triennia, as well as the results of the trend analysis.

Table 1 – Mortality coefficients for all cardiovascular diseases and specific groups per 100,000 inhabitants for male gender. Paraná, Brazil, 2016 (continues)

	Men			
Age range/Cause of death	2000 to 2002	2012 to 2014	Relative difference	β1 (CI 95%)
20-29 years				
All cardiovascular diseases	8.5	5.6	-34.1	-0.20 (-0.28; -0.11)*
Ischemic heart diseases	2.7	1.7	-37	-0.09 (-0.16; -0.01)*
Cerebrovascular diseases	1.3	1.4	7.7	0.026 (+0.005; +0.04)*
30-39 years				
All cardiovascular diseases	32.5	22.4	-31.1	-0.83 (-0.96; -0.70)*
Ischemic heart diseases	12.4	8.9	-28.2	-0.31 (-0.40; -0.22)*
Cerebrovascular diseases	7.9	5.2	-34.2	-0.25 (-0.31; -0.18)*
40-49 years				
All cardiovascular diseases	127.8	82.8	-35.2	-3.66 (-4.22; -3.09)*
Ischemic heart diseases	58.3	38.0	-34.8	-1.64 (-2.03; -1.25)*
Cerebrovascular diseases	32.4	18.6	-42.6	-1.12 (-1.31; -0.94)*

50-59 years				
All cardiovascular diseases	387.6	249.4	-35.7	-11.79 (-12.77; -10.80)*
Ischemic heart diseases	162.5	112.7	-30.6	-4.42 (-4.91; -3.93)*
Cerebrovascular diseases	112	59.7	-46.7	-4.56 (-5.07; -4.05)*
60-69 years				
All cardiovascular diseases	1073.6	685	-36.2	-33.05 (-35.11; -30.98)*
Ischemic heart diseases	400.5	271.3	-32.3	-10.67 (-11.85; -9.88)*
Cerebrovascular diseases	334.2	196	-41.4	-11.81 (-12.64; -10.99)*
70 years and older				
All cardiovascular diseases	3310.4	2435.1	-26.4	-73.46 (-79.10; -67.81)*
Ischemic heart diseases	931.6	663.7	-28.8	-24.97 (-28.36; -21.57)*
Cerebrovascular diseases	1201.3	852.7	-29	-28.73 (-30.42; -27.04)*

* p-value <0.05.

Table 2 includes the same information as in Table 1 and refers to women. Mortality coefficients were higher in all groups in the 2000-2002 triennium, except for CBVD in men aged 20-29 years and IHD in women in this age group.

Table 2 – Mortality coefficients for all cardiovascular diseases and specific groups per 100,000 inhabitants for female gender. Paraná, Brazil, 2016

	Women			
Age range/Cause of death	**2000 to 2002**	**2012 to 2014**	**Relative difference**	**β1 (IC 95%)**
20-29 years				
All cardiovascular diseases	6	1.3	-78.3	-0.17 (-0.21; -0.12)*
Ischemic heart diseases	0.5	1.1	120	0.004 (-0.06; +0.07)
Cerebrovascular diseases	2.5	0.4	-84	-0.07 (-0.10; -0.04)*
30-39 years				
All cardiovascular diseases	23	4.5	-80.4	-0.65 (-0.82; -0.48)*
Ischemic heart diseases	4.8	1.1	-77.1	-0.08 (-0.12; -0.03)*
Cerebrovascular diseases	8.1	1.5	-81.5	-0.24 (-0.32; -0.15)*
40-49 years				
All cardiovascular diseases	82.9	16.8	-79.7	-2.73 (-2.99; -2.46)*
Ischemic heart diseases	24.7	4,9	-80.2	-0.76 (-0.89; -0.63)*
Cerebrovascular diseases	31.7	6	-81.1	-1.17 (-1.37; -0.96)*
50-59 years				
All cardiovascular diseases	242.5	44	-81.9	-8.39 (-9.32; -7.45)*
Ischemic heart diseases	78.1	14.4	-81.6	-2.78 (-3.06; -2.50)*
Cerebrovascular diseases	80.2	13.9	-82.7	-2.93 (-3.41; -2.45)*
60-69 years				
All cardiovascular diseases	674.6	131,7	-80.5	-22.62 (-24.13; -21,12)*
Ischemic heart diseases	219.2	41,9	-80.9	-8.38 (-9.22; -7.54)*
Cerebrovascular diseases	202.9	38	-81.3	-7.47 (-8.08; -6.86)*
70 years or older				
All cardiovascular diseases	2760.4	677.9	-75.4	-59.86 (-63.63; -56.09)*
Ischemic heart diseases	702.9	160.6	-77.2	-20.70 (-23.28; -18.12)*
Cerebrovascular diseases	913.3	216.8	-76.3	-20.80 (-23; -18.59)*

* p-value <0.05

The coefficients increase progressively with age in both genders. For males, the age group of 70 years and older was the one with the highest decreasing trend, with a mean reduction of 73.46 in the coefficient per year for CVD. In the youngest male population, 20 to 29 years old, the increasing trend for CBVD diseases, with an average increase of 0.026 per year and increase in the relative difference between the two periods (triennia) of 7.7 is surprising. The value obtained was statistically significant and differs for the other age groups and female gender. This aspect should be investigated since there has been a growing increase in the mortality of economically active individuals over the years.

The opposite was observed for women, since the age group of 20-29 years had the most significant reduction in the relative difference between the two periods (triennia) for CBVD, with a decreasing trend and a mean reduction of 0.07 per year. In turn, also regarding the 20-29 year old group, women had an increase of 120 in the relative difference between the two periods for IHD, a very impressive number, which, however, was not significant in trend analysis. Except for the referred analysis, for all groups of diseases and age groups there was a greater reduction in the relative difference between the two periods for the female gender.

Also, for the individuals aged 30 years or older there was a higher decreasing trend for the male population for all the groups of diseases. The highest mean reduction of the relative difference between the two periods for both genders was found in the age group of 70 years or older, for CVD, as follows: a mean reduction of 73.46 per year in the male population and of 59.86 per year in the female population.

● DISCUSSION

Although the number of deaths from diseases is high, there has been a significant decrease over the years, especially in the female population aged 30 years or older. A study revealed a decreasing trend in the rates of mortality from CVD, IHD and CBVD in the 30-39 year olds of both genders in the Southeastern and Southern regions of Brazil, except for IHD in the female population of the Central-Western region, which remained stable [12]. In the present study, there has been an increase in the coefficient of IHD in the second period investigated for women aged 20-29 years old. However, this increase was not significant in trend analysis.

It is known that cardiovascular diseases are mainly caused by modifiable risk factors such as smoking, inadequate diet, physical inactivity and alcohol use. These are habits of life commonly found in the Brazilian population and identified in the result of the telephone-based surveillance of risk and protective factors for chronic diseases (VIGITEL)[13-14]. In order to establish measures to reduce mortality from NCDs, especially in developing countries, the WHO proposed report of strategies described as nine global targets for the prevention and control of non-communicable diseases to be met by 2025[1]. The goals include shared responsibility and reinforce the importance of effective interventions that will significantly reduce mortality from these diseases.

It should be mentioned that the decline of cardiovascular diseases in the state of Paraná reported in longitudinal studies conducted in longer periods of time is possibly related to better access to Primary Health Care (PHC), the use of diagnostic and therapeutic allied technologies [8]. Another study carried out in Paraná suggests the increase in the coverage of the Family Health Strategy (FHS) was an important factor in the reduction of hospitalizations for cardiovascular diseases, and a positive correlation can be inferred in most of the health regions of the state [15].

In the present study, the most noteworthy finding was the increasing trend of mortality from cardiovascular diseases in men aged 20-29 years, an age group that is often not described in such studies, as elderly individuals have higher mortality rates than younger individuals [8,14,16-17]. A study carried out in Piauí identified several risk factors for chronic diseases in a young population, including increased waist circumference, blood pressure disorders, sedentary lifestyle, and use of alcohol and other drugs [18]. The combination of these factors exposes this population to a high risk for the development of cardiovascular complications [18]. In view of the aforementioned, it is essential to promote more efforts to control these risk factors, as well as to ensure greater access of the population to health services and their actions targeted to the protection and prevention of diseases [17].

The significant increase in the number of deaths is evident with advancing age, but comparison

between the two triennia showed that decrease in mortality rates for all groups was significant after 30 years in both genders. A national study on mortality from cardiovascular diseases in the elderly showed an increase in the rates of mortality from these diseases in the Northern and Northeastern regions, and decrease the Southern, Southeastern and Central Western regions. The rise in mortality rates in the Northern and Northeastern regions are possibly related to the change in the mortality profile and also to the improvement in the quality of information, which result from health surveillance actions in these regions [14,16].

Comparison between the Brazilian regions showed a downward trend in the rates of mortality from IHD and DCBV [14], as well as from heart failure. However, there was no homogeneity in mortality rates in Brazil as a whole, which indicates the existence of considerable regional variations. In the case of public policies, the funding of actions and the planning of the healthcare system can substantially reduce the effects of chronic conditions, demonstrating the importance of preventive measures, of raising awareness among managers, health control and promotion [16]. It is known that proper action planning should aim the reduction of the rates of mortality from circulatory system diseases, considering regional differences [19].

Based on the findings of this study, it can be affirmed that the Brazilian healthcare should be more organized and coordinated to cope with chronic conditions, in order to reduce morbidity and mortality from cardiovascular diseases. It should be stressed that there is a paradox between the epidemiological transition in Brazil and the health care that is provided in a fragmented, reactive and episodic manner and is primarily focused on acute events, or on acute exacerbation of chronic diseases [20].

Aware of this situation and considering the regional particularities of a very large country, such as Brazil, the managers of the healthcare system decided to implement Health Care Networks (RAS), through ordinance GM/MS no.4.279/2010. These are thematic networks that prioritize some lines of care, welcome and redefine new models of health care in order to organize an effective strategy for the control of chronic diseases [20].

To ensure the success of the healthcare system, as well as its new programs and organizational arrangements, it is essential to strengthen primary health care. PHC is the main gateway to health care systems and the main strategy for coping with chronic diseases, as it gives access to information on the social conditions and the management of the health conditions of the population, ensuring more comprehensive care and not only care to patients with acute conditions [21]. Therefore, further studies on mortality rates are needed to assess the effectiveness of these recent public policies that have been established to ensure the integrality of care.

The limitations of this study can be related to possible errors of diagnosis and to the completion of death certificates available in the system that contains information on mortality rates in Brazil.

● **CONCLUSION**

Although mortality from cardiovascular diseases has declined over the years, it should be noted that these diseases are the leading cause of death in the state of Paraná and in Brazil. Such evidence reveals the need for strategic interventions on the risk factors related to the development of these chronic diseases and their complications.

The importance of proper health care to the young population is stressed here. This population, most of them men, showed an increasing trend in mortality from cerebrovascular diseases. Considering that this is an economically active population, in their prime, public policies targeted to this population should be more specific, reflecting the life habits of these individuals over the years, in order to reduce mortality rates.

● **ACKNOWLEDGMENT**

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