

## Temporal Trends of Mortality in The City of Lagarto, Northeast of Brazil

Tendências Temporais da Mortalidade no Município de Lagarto, Nordeste do Brasil

Tendencias Temporales de la Mortalidad en el Municipio de Lagarto, Nordeste de Brasil

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### ABSTRACT

**Objective:** The study's purpose has been to analyze the temporal trends and the epidemiological profile of the main causes of mortality in residents of the Lagarto City, Sergipe State, between 2006 and 2015. **Methods:** This is an epidemiological, descriptive and historical series study, through secondary data on deaths reported in *Sistema de Informação de Mortalidade (SIM)* [Mortality Information System]. The analysis of temporal trends was performed by the Joinpoint Regression Program, obtaining the Annual Percentage Change (APC) of mortality rates through Poisson Regression. **Results:** 5,586 deaths were reported, with men predominating 58% and the elderly people 59.61%. There was an increase in the overall mortality rate of 1.58% per year (95% CI 0.5 to 2.6,  $p = 0.01$ ). Only Infant Mortality Rates (IMR) and their components showed declining trends. **Conclusion:** Despite the decreasing tendency of the IMR, they require specialized actions, as well as the reduction of mortality due to chronic diseases.

**Descriptors:** Epidemiology, Mortality, Time Series Study

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## RESUMO

**Objetivo:** Analisar as tendências temporais e o perfil epidemiológico das principais causas de mortalidade em residentes do município de Lagarto, Sergipe, entre 2006 a 2015. **Métodos:** Estudo epidemiológico, descritivo e de série histórica, através de dados secundários dos óbitos notificados no Sistema de Informação de Mortalidade (SIM). A análise das tendências temporais foi realizada pelo Programa Joinpoint Regression obtendo-se a variação percentual anual (APC) das taxas de mortalidade por meio da regressão Possion. **Resultados:** Foram notificados 5.586 óbitos, com predomínio do sexo masculino e idosos, 58% e 59,61% respectivamente. Observou-se um aumento da taxa de mortalidade geral de 1,58% ao ano (IC95%: 0,5 a 2,6;  $p=0,01$ ). Somente as taxas de mortalidade infantil (TMI) e de seus componentes apresentaram tendências decrescentes. **Conclusão:** Apesar da tendência decrescente das TMI, as mesmas requerem ações especializada, bem como para a redução da mortalidade por doenças crônicas.

**Descritores:** Epidemiologia, Mortalidade, Estudo de Séries Temporais.

## RESUMEN

**Objetivo:** Analizar las tendencias temporales y el perfil epidemiológico de las principales causas de mortalidad en residentes de la ciudad de Lagarto, Sergipe, entre 2006 y 2015. **Método:** series epidemiológicas, descriptivas e históricas, a través de datos secundarios sobre muertes relatadas en la Mortalidad Información SIM). El análisis fue realizado por el Programa de Regresión del Joinpoint, obteniendo Variaciones de las tasas de mortalidad a través de la Posibilidad de regresión. **Resultados:** 5.586 muertes fueron reportadas, con predominio de hombres 58% y ancianos 59.61%. Se observó un aumento en la tasa de mortalidad global del 1,58% anual (IC 95%: 0,5 a 2,6,  $p = 0,01$ ). Sólo las tasas de mortalidad infantil (IMR) y sus componentes presentaron tendencias en declive. **Conclusión:** A pesar de la tendencia decreciente del IMR, ellos requieren acciones especializadas, así como la reducción de la mortalidad por enfermedades crónicas.

**Descriptores:** Epidemiología, Mortalidad, Estudio de Series Temporales.

## INTRODUCTION

In Brazil, the production and use of health information take place in a complex context of institutional relations, comprising various management and financing mechanisms. In addition to government structures at the three levels of the Sistema Único de Saúde (SUS) [Unified Health System] management, other government sectors are involved that produce health-related information, educational and research institutions, technical-scientific associations, non-governmental agencies, international organs, and instances of social control.<sup>1</sup>

Data reported in the Death Certificate (DC) feed national and official statistics on the mortality profile in Brazil. From the information extracted from DC, most of the priorities that make up public health policies are defined. For this reason, death certificates need to be increasingly guaranteed as a full-scale instrument capable of capturing information in the most remote populations of the country.<sup>2</sup>

In 1976, the Ministry of Health adopted a standardized DC for the entire national territory. This, keeping the international model on the causes of death, standardizes the way to record all other types of information. The purpose

was to allow comparability of data, consolidating them at the national level through the Sistema de Informação de Mortalidade (SIM) [Mortality Information System], thus allowing greater rationalization of activities based on the information collected.<sup>2</sup>

There is a growing need to properly feed these systems, as they will support the planning and implementation of strategies aimed at prevention and health promotion. Information systems are still fundamental because they allow control and evaluation actions, they are valuable planning and programming tools.<sup>3</sup>

Cardiovascular diseases are the leading causes of death regarding both genders in Brazil, accounting for 20% of deaths in adults over 30 years. In absolute numbers, in 2009 there were 962,931 deaths in this age group. Ischemic heart and cerebrovascular diseases were highlighted, as well as deaths attributable to atherosclerosis. Already the neoplasms show with 166,036 deaths followed by respiratory causes with 106,927 deaths.<sup>4</sup>

Considering the aforesaid and the notorious lack of related studies, the question is: what is the epidemiological scenario of the various mortality rates in the city of Lagarto/Sergipe State from 2006 to 2015? Given the magnitude of mortality and potential differences in its rates between genders and main causes, it is essential to develop epidemiological studies that demonstrate how mortality behaves over time in a specific population. Thus, the objective of the present study was to analyze the temporal trend of mortality of residents of the City of Lagarto, Sergipe State, from 2006 to 2015.

## METHODS

This is a descriptive epidemiological study of historical series, through secondary data reported in SIM from the database of the Departamento de Informática do Sistema Único de Saúde (DATASUS) [Department of Informatics of the Unified Health System]. The study included all deaths of individuals of both sexes residing in the city of Lagarto, Sergipe State, occurring between January 1<sup>st</sup>, 2006 and December 31<sup>st</sup>, 2015. The city of Lagarto is located in the south-central region of the Sergipe State, the northeast region of Brazil, consisting of an area of 969,577 km<sup>2</sup> and population of 94,861 inhabitants.<sup>5</sup>

Overall mortality rates, by both sex and cause were calculated per 100,000 inhabitants, using as the denominator the overall total and sex of the resident population. Infant and component mortality rates were calculated per 1,000 inhabitants, using the denominator of total live births. Data from the 2010 Demographic Census and intercensitary projections produced by the Instituto Brasileiro de Geografia e Estatística (IBGE) [Brazilian Institute of Geography and Statistics] and made available by the DATASUS were used.

To investigate the temporal trend of mortality, the

following rates were calculated: a) overall mortality rate; b) infant mortality rate and its components; c) specific mortality rate due to diseases of the circulatory system, expressed in codes I00-I99 of CID-10 (10<sup>th</sup> Revision of the International Classification of Diseases); d) malignancy-specific mortality rate, codes C00-C97 (CID-10); e) AIDS-specific mortality rate, B20-B24 (CID-10); and f) External cause-specific mortality rate, codes V01-Y98 (CID-10).

The Annual Percentage Change (APC) of mortality rates in the period and the Average Annual Percentage Change (AAPC) of the last 10 years were calculated with Poisson Regression using the Joinpoint Regression Program, which allows the adjustment of data of a series from the smallest possible number of inflection points: values can range from minus to infinity (negative numbers representing decreasing trend, and positive numbers, increasing trend), with zero would represent the absence of tendency. The significance tests used were based on the Monte Carlo Permutation Method and the calculation of the rate of APC, using the rate logarithm, and there may be one to four inflection points (or trend changes).<sup>6,7</sup>

To describe the linear trend by period, the estimated APC and 95% Confidence Interval (95% CI) were calculated for each of its trends, composing a regression line according to the natural logarithm of the indices, using the annual calendar as the regression variable. The trend by sex, age group and group of causes for the city were analyzed by linear regression, where  $y$  (Annual Mortality Rate) =  $\alpha + \beta_1(x)$  and the trend with  $p < 0.05$  was considered significant. The value of the coefficient of determination ( $R^2$ ) and the residual analysis was also observed.

This research was approved by the Research Ethics Committee of the University Hospital from the Universidade Federal de Sergipe (UFS), Certificado de Apresentação para Apreciação Ética (CAAE) [Certificate of Presentation for Ethical Appreciation] No. 62110016.5.0000.5546.

## RESULTS AND DISCUSSION

Over the 10 years of study of this historical series, there were a total of 5,586 deaths of residents in Lagarto City/ Sergipe State. From these total, 3,256 (58.28%) occurred in males and 2,320 (41.53%) in females and 10 deaths (0.17%) with undetermined sex. Regarding the age group in which these deaths occurred, it was observed that the age group from 60 years old obtained the highest percentage with 3,330 deaths (59.61%), followed by the age group between 20 and 59 years old with 1610 (28.82%) deaths. The age ranges from 1 to 4, 5 to 9 and 10 to 19 years old were around 224 (4%) deaths. The age group < 1 year old and fetal deaths totaled 238 (4.26%) and 148 (2.64%), respectively, as shown in **Table 1**.

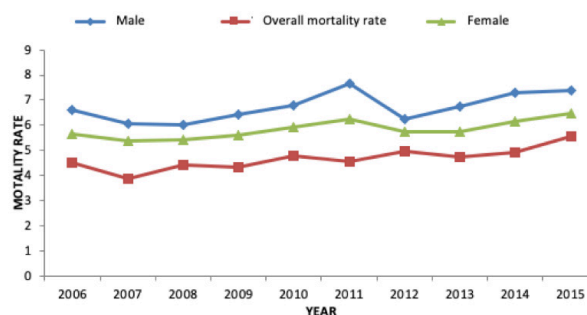
**Table 1** – Proportional distribution of deaths according to gender and age in Lagarto City/ Sergipe State, 2006-2015.

GENDER	Frequency (n)	Percentage (%)
Male	3,256	58.28
Female	2,320	41.53
Undetermined	10	0.17
<b>AGE</b>		
Fetal	148	2.64
< 1 year old	238	4.26
1 - 4 years old	43	0.76
5 - 9 years old	32	0.57
10 - 19 years old	149	2.66
20 - 59 years old	1,610	28.82
> 60 years old	3,330	59.61
<b>MAIN CAUSE</b>		
Circulatory system diseases	1,526	27.45
External causes	852	15.32
Neoplasms	630	11.33
Infectious and parasitic diseases	206	3.68
Other causes	2,372	42.46
<b>TOTAL</b>	<b>5,586</b>	<b>100</b>

Source: SIM/DATASUS, 2006-2015.

Also, according to Table 1, when analyzing the main causes of deaths according to CID 10, circulatory diseases predominated 1,526 (27.45%), followed by deaths from external causes 852 (15.32%), neoplasms 630 (11.33%), and infectious and parasitic diseases that corresponded to 206 (3.68%) deaths.

The general and specific mortality rates per sex showed a tendency of growth (Figure 1). Despite evidence of male over-mortality, there was a higher growth trend for females (APC = 2.62%). The overall mortality rate ranged from 5.64 (2006) to 6.45 (2015) per 100,000 inhabitants (95% CI: 0.5 to 2.6;  $p = 0.01$ ; APC = 1.58%); the specific mortality rate for males ranged from 6.63 (2006) to 7.37 (2015) per 100,000 population (95% CI: 0.0 to 3.6;  $p = 0.05$ ; APC = 1.8%) and for the females evolved from 4.52 (2006) to 5.56 (2015) per 100,000 inhabitants (95% CI: 1.1 to 4.2;  $p = 0.005$ ; APC = 2.62%) (**Table 2**).



**Figure 1** - Trends in general and sex mortality rates (per 100,000 population) in Lagarto City, Sergipe State, 2006-2015.

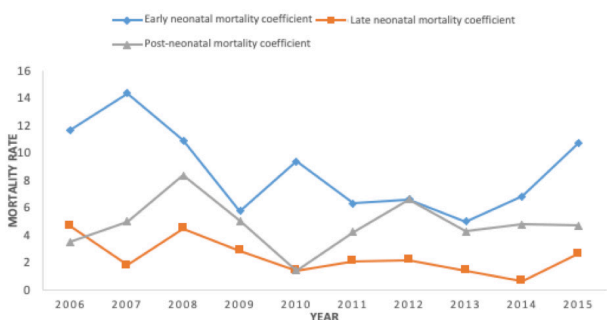
Early neonatal mortality rates (95% CI: -13.2 to 2.3;  $p = 0.1$ ; APC = -5.79%), late neonatal mortality rates (95%

CI: -21.0 to 1.8 ;  $p = 0.1$ ; APC = -10.3%) and post-neonatal (95% CI: -11.2 to 13.9;  $p = 0.1$ ; APC = 0.5%) showed decreasing trends between the years from 2006 to 2009 (Table 2). The late neonatal mortality rate showed large oscillations throughout the series, with successive milestones of 3.5/1000 NV in 2006; 8.36/1000 in 2008; 1.44/1000 in 2010; 6.6/1000 in 2012 and 4.7/1000 in 2015. The post-neonatal mortality rate was the lowest, varying in the first three years of the series and remaining around 2.00/1000 LB in the other years (Figure 2).

**Table 2** – Models of linear trend equations of mortality rates and Annual Percentage Change (ACP) in the State of Sergipe, Brazil, 2000-2015.

Mortality Rates	Model	R <sup>2</sup> (%)	Trend	APC	p-Value	CI (95%)
Overall	$y=0.091X$ 177.4	60	Increasing	1.58	0,01*	0.5; 2.6
Male Sex	$Y=0.118X$ 230.8	40	Increasing	1.8	0,05*	0.0; 3.6
Female Sex	$y=0.121X$ 239.1	66	Increasing	2.62	0,005*	1.1; 4.2
Early neonatal	$y= - 0.552X$ + 1119	29	Decreasing	-5.79	0,1	-13.2; 2.3
Late neonatal	$Y= -0.257X$ + 520.1	36	Decreasing	-10.3	0,1	-21.0; 1.8
Post-neonatal	$Y = -0.021X$ + 48.41	0.1	Decreasing	-0.5	0,1	-11.2; 13.9
Cardiovascular diseases	$y= -1.961X$ + 4101	7.6	Decreasing	-1.3	0.4	-4.9; 2.5
Malignant neoplasm	$Y= 2.529X$ - 5019	58.6	Increasing	3.73	0,01*	1; 6.5
External causes	$Y = 1.770X$ - 3471	15	Increasing	2.11	0,2	-1.6; 6.0
Infectious and Parasitic Diseases	$Y = 0.655X$ - 1295	13.8	Increasing	3.26	0,2	-2.5; 9.3

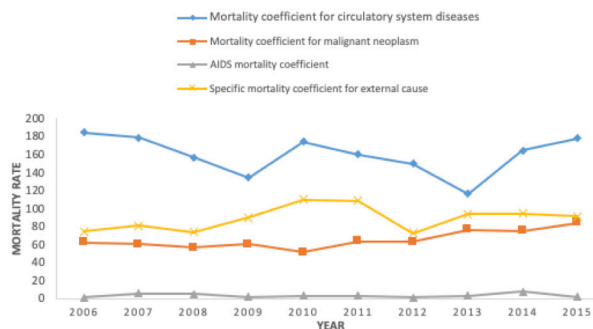
Source: The authors.



**Figure 2** – Trends in early neonatal, late neonatal and post-neonatal mortality rates (per 1,000 live births) in Lagarto, Sergipe State, 2006-2015

Relating the different mortality rates for specific causes, circulatory diseases stood out, ranging from 184 in 2006 to 177 in 2015 (per 100,000 inhabitants). The mortality rate from malignant neoplasm increased from 62.22 in 2006 to 84.10 in 2015 (per 100,000 inhabitants). Then, mortality from external causes also showed a growth trend, with

74.23 at the beginning of the series, reaching 109.63 in 2010 and around 90 in 2015 (per 100,000 inhabitants). Mortality of infectious and parasitic diseases was numerically lower, remaining around 20 deaths per year per 100,000 inhabitants, without significant variations over the 10 years of study (Figure 03).



**Figure 3** -Specific cause mortality rate (per 100,000 inhabitants) in the city of Lagarto/Sergipe State, 2006-2010.

Correlating the percentage of deaths from circulatory system diseases with the age group involved, significant growth was observed after each decade of life. This percentage still increases in the age group of 80 years old and more, adding up throughout the study 625 (39.93%) deaths.

The various mortality measures have as their main objective, to be used in the evaluation of health level and as an indication of preventive measures. This concept aims, on the one hand, to suggest actions that reduce the risk of dying from a certain preventable cause and, on the other hand, to indicate the need for control actions on the risk factors of illness or diseases associated with high mortality rates.<sup>8</sup>

The Gross Mortality Rate in Brazil has been around 6.00/1000 in the last decade. In the city in question, it was observed that the mortality rate was close to the national average, with a slight increase in the trend in 2012. The increase in the mortality rate in men may be related to their seeking fewer health services, overvaluation of the population. Attention to specialization in detriment of primary care, leading to greater costs for the Health System. Besides, the phenomenon of idealized masculinity creates an idea that men are hardly affected by diseases, which may predispose to risk behaviors.<sup>9</sup>

Proportional infant mortality, early neonatal, late neonatal and post-neonatal decreased in overall and increased in the last years of the series. This reduction in proportional infant mortality represents a decrease in the number of children who died among other deaths, or in the second hypothesis, may refer to a bias in reporting deaths. Evidence shows that the evolution of the proportional infant mortality rate behaves differently among the five regions of Brazil. The north and northeast regions experienced a

significant reduction in this rate, but they continue to lead the national scenario, followed by the Center-West region, with the South having the index twice as low as the North<sup>8</sup>. It is also worth mentioning the need to carry out prenatal actions as a health promotion measure, with the use of trained human resources, the guarantee of reference and counter-reference, not underestimating complex technologies and the use of sophisticated laboratories, aiming above all to reduce maternal, fetal and neonatal death rates.<sup>10</sup>

The various cause-specific mortality coefficients allow us to know the reality in local health over time, the intensity with which a given cause contributes to the increase in the number of deaths, besides directing specific measures for disease control and prevention. Thus, in the first analysis, the specific mortality rate due to diseases of the circulatory system is ahead of the others, which is an important topic in the evaluation of causes of death. Therefore, Noncommunicable Chronic Diseases (NCDs) are related to the leading causes of death worldwide, accounting for 35 million deaths in 2012.<sup>11</sup> Among them, ischemic heart and cerebrovascular diseases are responsible for 7.4 and 6.7 million deaths, respectively. This trend is also observed in Sergipe State, where in the last 10 years DATASUS reveals that among the 98,852 deaths, 26.72% were due to circulatory system diseases, followed by 15.82% attributed to external causes.<sup>12</sup>

Still, from pathophysiological causes, the mortality coefficient for infectious and parasitic diseases remained the lowest among the others, which represents an epidemiological change observed not only in the city but also in Brazil and other Latin American countries. It is related to the fact that Brazil is experiencing a moment of epidemiological polarization, characterized by the progressive fall of infectious and parasitic diseases and the rise of NCDs, especially cardiovascular diseases, which ultimately requires a new analysis of health policies.<sup>13</sup>

Finally, deaths from external causes, which include those resulting from any type of violence or accident, have a leading position among the others. Since 2004, mortality from external causes has increased throughout Brazil, drawing attention to the homicide that ranked first in the North, Northeast, and Southeast. The use of these data allows us to evaluate the population's health and socioeconomic development levels, as well as to support the planning, management, and evaluation of health promotion, protection and recovery policies regarding external causes of mortality.<sup>1</sup>

In elderly people, the tendency of mortality shifts from other causes to chronic degenerative diseases, generally behaving in 2009 as follows: first those of the circulatory system, according to neoplasms, followed by diseases of the respiratory system. Once again, in addition to the leading causes, such as cerebrovascular disease, ischemic heart disease, and chronic airway disease, diabetes, and heart failure also deserve to be highlighted.<sup>14</sup> Therefore, it is clear from

the present study, that age represents an important risk factor for the development of circulatory diseases.

## CONCLUSIONS

This study allowed us to know the variations in the different mortality rates in the city, evidencing the overlap in the number of deaths in men in relation to women, as well as the increase in mortality rates due to NCDs and external causes. When correlated, it becomes evident that circulatory diseases have grown in line with the increase in age.

Mortality in children and newborns also analyzed in the study, showed a reduction, especially in 2007-2009, although it is important to highlight the need to adopt measures to reduce these numbers, given their relevance as a sensitive indicator of the local health level.

Finally, the research fills remarkable gaps in this region and aims above all to serve as a scientific reference for health planning, as it reveals the clinical and epidemiological situation of the different mortality rates in the city of Lagarto/Sergipe State over the last 10 years.

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