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RESEARCH

Preventable infant mortality in Minas Gerais: epidemiological and spatial profile

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Abstract

Infant mortality is a public health problem and an important public health indicator, considering that part of these deaths occurs from preventable causes. This study aimed to identify spatial clusters of deaths of children between 0 and 4 years old, the preventable causes of death, and epidemiological variables in Minas Gerais, between 2011 and 2015, which may allow improvements in planning health services in the state. In decreasing order, the interventions that most contributed to reduce the incidence of these deaths were the delivery of care to women during pregnancy and childbirth, newborn care, and the actions related to diagnosis and treatment, health promotion, and immunoprevention. In addition, we found that 46.85% of deaths from preventable causes occurred during the neonatal period, 43.19% of the children were brown and 55.27% were boys. As for spatial territorial analysis, this mortality is mainly concentrated in the North, Vale do Mucuri and Jequitinhonha mesoregions.
Keywords: Infant mortality. Spatial analysis. Epidemiologic studies.

Resumo

Mortalidade infantil evitável em Minas Gerais: perfil epidemiológico e espacial

A mortalidade infantil é problema de saúde pública e importante indicador, considerando-se que parte dessas mortes ocorre por causas evitáveis. O objetivo deste estudo foi identificar aglomerados espaciais de óbitos de crianças entre 0 e 4 anos, causas evitáveis e variáveis epidemiológicas em Minas Gerais, entre 2011 e 2015, o que possibilitaria melhorar o planejamento dos serviços de saúde do estado. Em ordem decrescente, as intervenções que mais contribuíram para reduzir a incidência desses óbitos foram atenção à mulher na gestação e no parto, atenção ao recém-nascido e ações de diagnóstico e tratamento, de promoção à saúde e de imunoprevenção. Além disso, constatou-se que 46,85% das mortes por causas evitáveis ocorreram no período neonatal, sendo 43,19% das crianças pardas e 55,27% meninos. Quanto à análise espacial, essa mortalidade concentra-se principalmente nas mesorregiões Norte, Vale do Mucuri e Jequitinhonha.
Palavras-chave: Mortalidade infantil. Análise espacial. Estudos epidemiológicos.

Resumen

Mortalidad infantil prevenible en Minas Gerais: perfil epidemiológico y espacial

La mortalidad infantil se caracteriza como un problema de salud pública y un importante indicador de la salud, teniendo en cuenta que algunas de estas muertes se deben a causas prevenibles. El objetivo de este estudio fue identificar aglomerados espaciales de muertes de niños entre 0 y 4 años, causas prevenibles y variables epidemiológicas en el estado de Minas Gerais, en el período 2011-2015, lo que permitiría mejorar la planificación en los servicios de salud del estado. En orden decreciente, las intervenciones que más contribuyeron para reducir la incidencia de estas muertes fueron la atención a la mujer durante el embarazo y el parto, la atención al recién nacido y acciones de diagnóstico y tratamiento, de promoción de la salud y de inmunoprevención. Además de eso, se constató que el 46,85% de las muertes por causas prevenibles ocurrieron en el período neonatal, que el 43,19% de los niños eran pardos y que el 55,27% eran del sexo masculino. En cuanto al análisis espacial, esta mortalidad se concentra principalmente en las mesorregiones del Norte, Vale do Mucuri y Jequitinhonha.
Palabras clave: Mortalidad infantil. Análisis espacial. Estudios epidemiológicos.

The authors declare no conflict of interest.

Infant mortality is an important health indicator related to bio-sociocultural and care determinants, and its reduction depends on public policies and the improvement of the population's living conditions [1]. This index refers to early deaths, that are often preventable, whose prevention requires actions and commitment from the public health system to identify problems and strategies [1].

According to Malta and collaborators [2], preventable causes of death can be totally or partially prevented by actions from health services that are accessible in a specific place and time. In Brazil, the list of these causes was organized by specialists from a range of different fields under the coordination of the Ministry of Health, based on a comprehensive literature review on the topic [3]. The data are divided into two lists, concerning children under the age of 5 and people between 5 and 74 years old. The 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) [3] was used as a reference.

We classified into subgroups the causes of death that could be prevented by health system interventions in the population under 5 years old as follows: *reducible by immunoprevention actions*[;] (…) *by adequate delivery of care to women during pregnancy and in childbirth and to the newborn*[;] (…) *by appropriate diagnostic and treatment actions*[; and] (…) *by appropriate health promotion actions, linked to appropriate health care actions* [4].

Infant mortality has decreased worldwide over the past few years, but this reduction has not been homogeneous throughout Brazil or even in regions of the same state [5]. Nevertheless, the development of digital mapping technologies has opened new paths for epidemiological investigations on the distribution of health-related events [6].

Spatial analysis and geoprocessing are important tools to better understand the transmission and distribution of diseases and other health-related issues. These techniques allow the identification of characteristics that determine risk factors, leading to the optimization of actions focused on context [7].

Health information based on the geographical distribution of events can influence the management of the health system and contribute to improve the care model. The descriptive study of the available data and its respective spatial correlations expands the understanding of the death determinants and can be used for the creation of public health policies [7].

Method

This is a descriptive epidemiological study. We collected the data on vital statistics on the website of the Informatics Department of the Brazilian Unified Health System [8] in April 2018 and analyzed them according to the variables available for tabulation. The variables – age, color, sex, and cause of death (ICD-10) – were selected and classified according to the cities of the state of Minas Gerais (2011-2015 period).

We verified with the GeoDa software the territorial autocorrelation between the municipalities of Minas Gerais and the incidence of deaths due to preventable causes of children aged between 0 to 4 years, determined by the global Moran Index and the Local Indicators of Spatial Association (Lisa). Thus, the spatial analysis allowed us to identify regions with the greatest need for intervention, the clusters of deaths, and the locations where the geographic factor is decisive.

After identifying the spatial distribution patterns of infant mortality, this research analyzed the spatial autocorrelation to identify variables that are possibly related to this occurrence. Thus, the Human Development Index (HDI) was also considered in terms of territories. As we used secondary data in the study, there was no need to submit it to a research ethics committee.

Results

Epidemiological analysis

Initially, we used descriptive statistics to search for data based on the vital statistics available in the Notifiable Diseases Information System [9]. Regarding preventable causes, the following actions contributed to reduce the incidence of deaths: provision of care to women during pregnancy and childbirth, newborn care, adequate diagnosis and treatment, health promotion and immunoprevention.

Approximately 46.85% of deaths from preventable causes in children under 5 years old occurred in the neonatal period (between 0 and 6 days of life), being important to point out that these data reflect results from the health care

delivered to pregnant women in the prenatal period and childbirth, as well as to the newborn. The incidence of deaths was higher in brown children (43.19%), followed by white (39.64%), black (3.53%), indigenous (0.42%) and yellow (0.21%) children – ethnicity was not reported on the other notifications (13.01%). In addition, infant deaths from preventable causes between 2011 and 2015 were higher for males (55.27%).

Spatial analysis

After the epidemiological analysis, we proceeded with the spatial analysis. The TabWin and GeoDa software were used to determine the Global Moran Index and Lisa, as well as to obtain the values of the Moran diagram. These indexes revealed spatial autocorrelation between several municipalities in the state of Minas Gerais and the incidence of preventable deaths from children between 0 and 4 years old in the 2011-2015 period.

Based on the incidence of these deaths per 100,000 inhabitants of Minas Gerais in the analyzed period, the thematic map of the stratified spatial distribution was divided into four classes, using the Quantis method. We found a cluster of deaths due to preventable causes in children under 5 years old in the Northern extension of the state of Minas Gerais (Figure 1).

The described method allowed us to identify mortality clusters due to preventable causes among children under 5 years old, mainly in the North, Jequitinhonha and Vale do Mucuri mesoregions [10], represented in Figure 1 in red. These clusters, identified as high-high, indicate the municipalities with high infant mortality rates that are surrounded by other municipalities with high incidence, thus characterizing the cluster (Lisa). On the other hand, blue clusters indicate cities with a low incidence of infant mortality from preventable causes among children under 5, whose neighbors are also characterized by this low incidence.

The HDI, classified by the United Nations, was considered as an associated factor in this research as it measures human development based on income, education and life expectancy [11]. In this sense, infant mortality is directly related to the development of a given region, since it is linked to socioeconomic aspects and it is sensitive to its variations.

The maps in Figure 2 show infant mortality due to preventable causes (the investigated event in this research) and the HDI (related factor) according to the spatial distribution. From the representation of the HDI on the horizontal axis and the mortality rate on the vertical axis, we observed that the municipalities with high infant mortality rates are those with the lowest HDI.

Figure 1. Moran map with the areas of spatial autocorrelation regarding preventable infant mortality

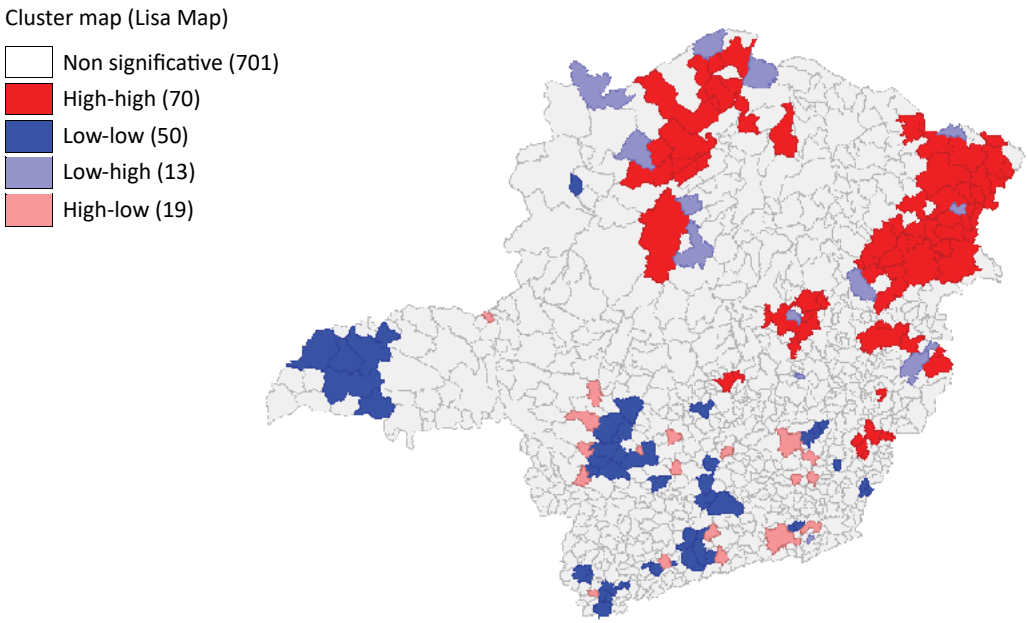

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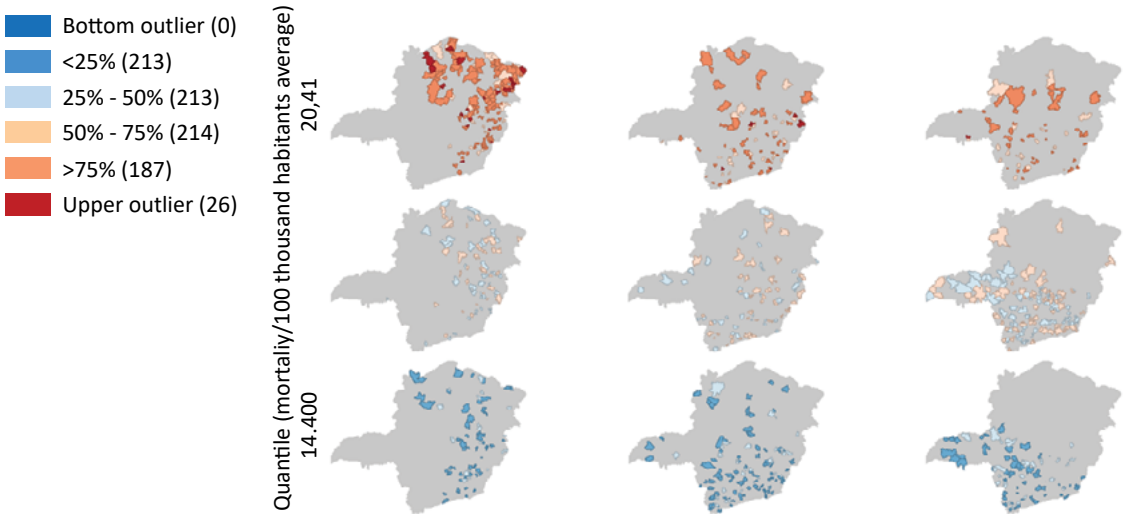
Figure 2. Relationship between infant mortality due to preventable causes and HDI



Discussion

The spatial location of health events has an important role and it is gaining increasing prominence in the public health literature. In this context, analyzing the geographic distribution of deaths from preventable causes of children under 5 years old can direct actions to improve the health service to reduce this rate.

This study identified areas of Minas Gerais where mortality from preventable causes in the investigated age group is higher, mainly in the North, Vale do Mucuri and Jequitinhonha regions. It is also noticeable that low HDI was a factor directly related to this health indicator.

In general, infant mortality from preventable causes are related to socioeconomic development, environmental infrastructure and other issues that shapes health problems in a certain region. In addition, the access and quality of resources offered to mother and child health are also determinants for the infant mortality rates from preventable causes. Thus, the data discussed here can support the planning and management of public health policies aimed at adequate prenatal and childbirth care, and the protection of health in childhood.

According to the results of this study, children aged from 0 to 6 days deserve special attention, as they are in group with a high mortality rate. In this context, we suggest actions aimed at improving prenatal care, perinatal health – focused on adequate childbirth – and postpartum: for instance, increasing the number of hospital beds in the neonatal intensive care unit.

On the other hand, immunoprevention actions represent the smallest percentage of preventable causes of infant deaths. From this, we could say the expansion of the Family Health Strategy along with the National Immunization Program is essential to protect children against preventable diseases since their birth, being no more the cause of infant mortality.

Moreover, the obtained epidemiological data show the need for in-depth investigations of influences and determinants of deaths from preventable causes among children aged 0 to 4 years, going beyond the spatial characteristics and factors, considering that HDI is an important parameter to mobilize resources and to implement public policies for the most vulnerable areas.

In this context, the approach of this study allows us to reflect on the efforts necessary to improve the availability, use and effectiveness of healthcare, especially in prenatal, childbirth, and newborn care, and the child population in general. The knowledge of the mortality profile from preventable causes in children under 5 years old can help to establish interventions in the scope of public health that seeks its reduction, considering the most critical regions and having as premise the integral health of mother and child to achieve good social and health indicators.

Final considerations

The infant mortality rate is important for developing public health policies. In this sense, the data consolidated in this study emphasize the need and relevance of constant investigations on health system

flaws that contribute to the occurrence of preventable deaths in the 0-4 years age group. Since deaths from these causes are related to the quality of healthcare, both health authorities and the population must be made aware of the issue, in order to deepen the discussion and influence public health strategies.

In addition, the relationship between HDI and preventable infant mortality allow us to infer that there are important variables not limited to the delivery of health services by the state. It is essential to combat regional inequalities and inequities to reduce homogeneously the child mortality, while considering public policies that are consistent with the reality of the regions. Therefore, economic development, education and income distribution are determinant aspects of the mortality rates of children, and their improvement is associated with human development, the population's quality of life and life expectancy.

It is evident that the conditions of preventable infant mortality encompass not only access to health services and the quality of health care, but also the socioeconomic dimension of the population. Joint interventions in both areas can change this scenario. These efforts to reduce child mortality reflect the principle of human dignity, since they focus on the respect for the fundamental and inalienable rights of human beings [12], acting as instruments to transform reality and fulfill bioethical precepts in the perspective of public health.

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Participation of the authors
Both authors wrote and revised the manuscript.

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