Revista O Mundo da Saúde

Infant mortality in Brazil, 2007 to 2016

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Abstract

Health indicators are crucial, as they provide essential information for setting goals and evaluating social and economic plans. Therefore, the study aims to observe infant mortality in Brazil, from 2007 to 2016. This is an epidemiological, ecological time series study, using population-based data, which were extracted from the Unified Health System's Department of Informatics in Brazil, in order to obtain the Child Mortality Coefficient indicator. The results showed that infant mortality has declined based upon the annual assessment of this indicator between the years 2007 to 2015; however, the year 2016 showed a slight increase. It was also observed that conditions originating in the perinatal period emerged as the main cause of infant mortality in the analyzed period. The causes of infant mortality in the analyzed period were identified as the most prevalent conditions originating in the perinatal period. The states of Amapá (19.81), Bahia (17.37), and Acre (17.27) had the highest indicators, but this indicator can be reduced through better sanitary, economic, and care conditions. Therefore, it is essential to expand health services, especially in socially vulnerable locations, and to strengthen mother and baby care programs.

Keywords: Child. Infant mortality. Basic Health Indicators.

INTRODUCTION

It is known that child health outcomes are determined by multiple factors that require multifaceted interventions with the hope of producing positive results[1]. It is the persistence of inequalities in maternal and child health that[2].

The content of global and national health policy and child health discourse over the last decade has been significantly shaped by the Millennium Development Goals (MDGs)[3]. Samarasekera and Horton[4] state that the decrease in child mortality is due to dedication of researchers who not only produce evidence to save lives, but also lead a campaign to promote change.

The main strategies for reducing child mortality in Brazil are the expansion of access to vaccination, the encouragement of breastfeeding, better maternal education, coverage of Primary Care, and the Bolsa Família Program, which strengthen the use of health services and reduce the poverty with its conditionalities among the assisted families as well as the regional inequalities[5].

Improving child health indicators remains one of the most important global health challenges, especially in developing

DOI: 10.15343/0104-7809.202145273282

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countries, as neonatal mortality, infant mortality, and child mortality are still at unacceptably high levels[6-8]. Therefore, the importance of strategies searching to identify potentialities and obstacles related to the reduction of avoidable deaths in the child population are emphasized.

Important reductions in infant mortality have been observed, as well as the implementation of key interventions in the search to reduce the main causes of infant deaths, highlighting neonatal deaths, and those that had causes such as diarrhea and pneumonia. It is noteworthy that the global health community has expanded health initiatives addressing not only the continued reduction in mortality, but also the reduction of adverse exposures and morbidity[9,10].

The increase in inequality of child indicators implies that the rapid expansion of child health interventions may not demonstrate greater positive results when related to more vulnerable groups, suggesting that, in order to reduce inequalities, political reforms are necessary. These reforms should consider the needs of vulnerable and marginalized populations, as well as, when there is a global incorporation of the theme, guarantee a commitment marked by global and national investments in health[11,12].

In Brazil, the development of programs from the 2000s onwards is noteworthy, enhancing the reduction of infant mortality, as well as maternal mortality and poverty reduction. Advances in public social policies in Brazil are also noteworthy, especially for child health through the SUS. However, there are still demands for certification in this line of care, and it is in this sense that the country has been innovative, both in normative aspects and in the implementation of specific programs and actions[13,14].

Health indicators are crucial for the health area, since knowing about the number of deaths, their causes and conditions, as well as other events, provides essential information for setting goals and evaluating social and economic plans after analysis and interpretation. As an example, the infant mortality indicator is considered one of the most worrying indicators of the population's health and living conditions[15].

It is noteworthy that the concepts of assessment are increasingly part of the routine of health systems and services, and the systematization of evidence and health outcomes becomes the key issue for creating better decisions[16]. Therefore, this research proposes to assess infant mortality in Brazil, from 2007 to 2016.

METHODOLOGY

This is an epidemiological, ecological time-series study, with hospitalization data from the Hospital Information System of the Unified Health System (HIS/SUS) and deaths extracted from the Mortality Information System (MIS) in a historical series of a ten-year period (2007-2016). Both systems are within the public domain of the Ministry of Health entitled DATASUS - SUS Informatics Department. The underreported data correction was not adjusted.

Data corresponding to the number of infant deaths were extracted from DATASUS, considering children under one year of age, selected by unit of analysis in all municipalities, in order to obtain the indicator: Infant Mortality Coefficient (IMC), which is of the number of deaths among children under one year old, divided by the number of live births in Brazil and multiplied

by 1000.

Therefore, it was decided to use the Intermediate Urban Division Regions (IUDR) as units of analysis. These regions polarize a large number of municipalities concerning the provision of highly complex goods and services and concentrate public and private management activities as well as present, on a regional scale, agencies and private companies.

After processing in Microsoft Excel, all these data were entered into the Statistical Package for Social Sciences (SPSS) software, which were later aggregated in the Intermediate Urban Division Regions (IUDR), going from 5,565 municipalities to 161 regions, which served as units of analysis. After the data were measured as part of the IUDR of Brazil, all data used in SPSS were linked to the TerraView program, version 4.2.2, in order to perform spatialization and univariate analyses, generating the corresponding maps of the averages of these variables in relation to the Intermediate Urban Division Regions. This is a free, open-access program used for geoprocessing, as well as GeoDa used in bivariate analysis.

For analysis purposes, descriptive analysis (absolute and relative frequencies of aspects related to hospital morbidity and mortality were performed for the purpose of characterization of the study population) and inferential analysis using the Student's t test were used between the Intermediate Urban Division Regions corresponding with the coefficient of mortality variable by age groups, as well as the Chi-squared test, taking into account a confidence interval (CI) of 95% and p-value <0.05, aiming to identify significant associations.

In constructing the maps, darker colors were used for values that were at higher risk and lighter colors were used for values that were at a lesser risk. The study did not need to be analyzed by the Research Ethics Committee, as this data is in the public domain, according to resolution No. 510, of April 7, 2016[17].

RESULTS

Table 1 shows a decline in IMC from the annual assessment of the indicator between the years 2007 to 2015; however, the year 2016 showed a slight increase. An even lower IMC was observed in the states of Santa Catarina (10.75), Rio Grande do Sul (11.18) and the Federal District (11.55). A higher IMC was noticed in Amapá (19.81), Bahia (17.37), and Acre (17.27).

As for infant mortality, based on values of central tendency and dispersion in Table 2, a reduction in the Infant Mortality Coefficient up to the year 2015 was observed from the average of the 161 Intermediate Urban Division Regions. Related to the period observed, there was a decrease in the event when comparing 16.43 in 2007 and 13.41 in 2016. However, it is worth highlighting the interruption in the downward trend and a slight increase in 2016 compared to 2015, which had an average of 12.92 deaths in children under one year of age for every one thousand live births.

Table 3 shows that regarding the causes of mortality distributed according to higher prevalence, chapter XVI, conditions originating in the perinatal period emerge as the main cause of infant mortality in the period analyzed (2007 to 2016) in relation to overall infant mortality. Statistical significance was also observed from the Student's t.

The formation of clusters can be observed in the North, Northeast, and central regions of the Midwest (Figure 1). As for the BoxMap (Figure 2a) and MoranMap (Figure 2b), there

is a greater formation of High-High clusters in the North, Northeast and Midwest regions, in addition to spatial dependence, that is, a similar IMC among neighbors. The spatial autocorrelation value translated by the IMC Global Moran Index for the decade was equal to 0.53, a value that indicates that the IMC is correlated with space.

Table 1– Distribution of the Infant Mortality Coefficient by State, 2007 - 2016, Brazil, 2019.

State	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Acre	22.12	17.89	19.06	17.40	14.37	16.41	16.40	16.98	17.14	15.15	17.27
Alagoas	21.48	18.60	19.16	16.95	15.70	15.16	16.23	15.29	14.64	14.31	16.85
Amapá	20.80	22.64	22.45	19.12	20.11	20.41	19.92	18.07	16.76	18.30	19.81
Amazonas	16.97	16.75	16.77	15.88	15.45	16.80	17.22	15.71	15.54	15.97	16.30
Bahia	19.75	18.43	18.63	17.97	16.80	17.02	17.03	16.42	15.32	15.99	17.37
Ceará	16.12	15.71	15.52	13.13	13.61	12.68	13.82	12.29	12.06	12.64	13.78
Distrito Federal	11.09	11.89	11.88	12.63	11.48	11.63	12.73	11.40	10.58	10.31	11.56
Espírito Santo	13.90	14.50	11.99	11.90	11.86	11.47	11.04	11.30	11.42	11.68	12.08
Goiás	14.13	13.89	13.29	12.75	13.97	14.40	13.86	12.85	12.23	13.02	13.42
Maranhão	17.00	16.45	16.59	15.56	16.01	14.68	16.49	15.49	15.22	14.99	15.87
Mato Grosso	16.25	16.11	16.44	15.10	14.45	13.99	14.57	14.66	13.78	13.82	14.87
Mato Grosso do Sul	19.19	16.54	18.27	15.72	13.21	13.37	12.84	12.96	12.03	12.91	14.62
Minas Gerais	14.87	14.70	13.97	13.08	13.05	12.72	12.15	11.34	11.44	11.49	12.87
Pará	18.76	18.20	18.39	18.00	17.40	17.04	16.46	15.74	14.97	15.67	17.08
Paraíba	18.28	16.56	15.16	14.48	14.40	14.51	14.56	13.52	11.64	12.64	14.60
Paraná	13.22	13.09	12.49	12.10	11.65	11.67	10.96	11.20	10.92	10.51	11.76
Pernambuco	18.73	17.00	17.16	15.25	13.98	14.22	14.13	13.19	13.00	13.93	15.07
Piauí	19.84	18.46	17.90	16.85	16.89	16.62	16.39	15.50	14.82	16.24	17.00
Rio de Janeiro	14.78	14.39	14.44	13.96	13.88	13.81	13.12	12.71	12.57	13.64	13.71
Rio Grande do Norte	15.77	14.61	13.82	13.38	13.31	14.02	14.42	12.85	13.85	12.81	13.89
Rio Grande do Sul	12.75	12.76	11.54	11.20	11.48	10.80	10.57	10.67	10.12	10.18	11.18
Rondônia	19.39	16.27	17.44	18.54	13.31	13.73	13.91	14.33	14.51	13.42	15.40
Roraima	17.12	16.63	18.30	12.94	12.67	16.51	19.33	20.23	16.74	18.46	16.97
Santa Catarina	12.77	11.69	11.32	10.50	11.81	10.61	10.46	10.11	9.93	8.75	10.75
São Paulo	13.06	12.60	12.50	11.91	11.62	11.54	11.57	11.46	10.80	11.09	11.81
Sergipe	18.57	17.74	16.69	14.99	16.09	16.27	15.10	15.80	15.01	15.36	16.19
Tocantins	17.47	15.40	16.50	16.31	15.62	14.18	13.60	12.67	13.02	12.48	14.74
Total	15.69	15.03	14.80	13.93	13.63	13.46	13.42	12.90	12.43	12.72	13.79

Source: MIS/DATASUS, 2019.

Table 2– Distribution of the Infant Mortality Coefficient by Intermediate Urban Division Regions, 2007 to 2016, Brazil, 2019 (n=161).

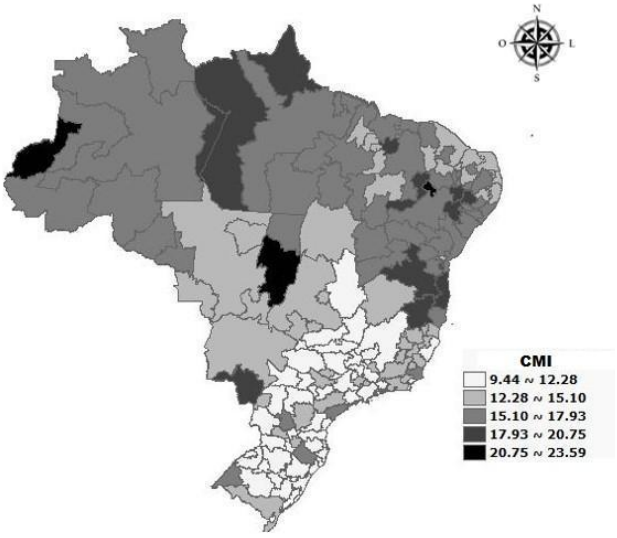
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Decade
Infant Mortality Coefficient	Mean	16.43	15.83	15.44	14.51	14.8	14.01	13.95	13.55	12.92	13.41	14.43
	Median	15.95	15.46	15.26	14.02	14.35	13.78	13.58	13.34	12.67	13.18	14.30
	SD	3.93	3.53	3.66	3.63	2.80	3.20	3.34	2.95	2.82	3.29	2.81
	CI	8.07 – 30.13	8.28 – 27.25	6.73 – 26.35	8.41 – 28.25	8.63 – 23.44	7.79 – 27.65	6.63 – 30.04	8.35 – 25.25	8.35 – 27.19	6.50 – 26.18	9.45 – 23.58
	p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Fonte: SIM/DATASUS, 2019.

Table 3– Distribution of the Infant Mortality Coefficient according to the most prevalent causes, by Intermediate Urban Division Regions, 2007 - 2016, Brazil, 2019 (n=161).

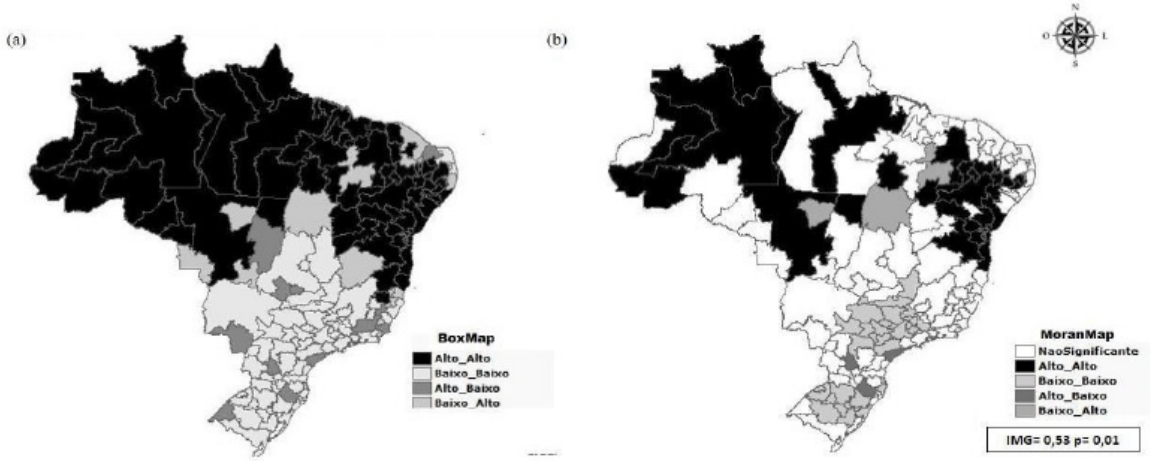
		Some infectious and parasitic diseases	Respiratory System Diseases	Some conditions originating in the perinatal period	Congenital malformations, deformities and chromosomal anomalies	External causes of morbidity and mortality
Coeficiente de Mortalidade Infantil	Mean	0.71	0.71	8.62	2.68	0.32
	Median	0.65	0.63	8.38	2.70	0.26
	SD	0.42	0.46	1.87	0.41	0.20
	CI	1.2 – 2.7	0.15 – 3.7	4.9 – 13.1	1.4 – 3.7	0.0 – 1.8
	p	<0.001	<0.001	<0.001	<0.001	<0.001

Source: MIS/DATASUS, 2019.



Fonte: SIM/DATASUS, 2019.

Figure 1– Spatialization of the average Infant Mortality Coefficient in the Intermediate Urban Division Regions, 2007 - 2016, Brazil, 2019.



Fonte: SIM/DATASUS, 2019.

Figure 2– BoxMap (a) and MoranMap (b) of the spatial autocorrelation of the average Infant Mortality Coefficient in the Intermediate Urban Division Regions, 2007 - 2016, Brazil, 2019.

DISCUSSION

Based on the results, it can be seen that there is a variation in infant mortality from 2007 to 2015 (table 1), showing even a lower IMC in the southern region and higher in some states in the northern region. In areas with more critical concentrations in the North and Northeast regions in terms of infant mortality, there is a reduction throughout the series and, although they have been reduced, regional inequalities are still present. Leal *et al.*[14] highlight the significant reduction demonstrated by the North and Northeast regions in the period 2000-2010, which contributed to the reduction of regional inequalities, reflecting the expansion of Primary Health Care (PHC) in these areas, with a focus on care for mothers and children, as well as universalization of vaccines.

In table 2, a downward trend was observed in the period studied, which may be associated with the improvement of health services. However, within the context of health services, there are also contradictions, that is, while PHC has expanded in the Brazilian territory, medium and high complexity equipment continues to be concentrated in large urban centers[18,19].

The decrease in infant mortality is also related to the important reduction in the post-neonatal component, causing changes of its profile in Brazil, which are related to specific actions of the PHC services, such as the immunization programs, combating childhood diarrhea, early detection of respiratory diseases, encouraging breastfeeding, basic education, and improvements in socio-sanitary conditions. On the other hand, since neonatal mortality mainly issues from relationships between biological, social, and health care variables, its reduction becomes slower and more difficult[20,21].

In this context, there is the Rede Cegonha, a maternal and child healthcare program within PHC, which is a Federal Government strategy available for the adhesion of municipalities, instituted under SUS in 2011, based on the components: prenatal care, delivery and birth, puerperium, and comprehensive child health care. There is also a logistical system including: sanitary transportation and regulations, which will be gradually implemented throughout the national territory based on epidemiological criteria; foreseeable changes related to the improvement of the structure of services; the creation of pregnant women homes and normal delivery centers; an increase in the number of neonatal and adult Intensive Care Unit (ICU) beds; and improvements in outpatient and transport services[22].

In a study carried out by Nascimento *et al.*[23], when analyzing the care provided to women in prenatal care, delivery, and birth after the implementation of the Rede Cegonha, highlights significant advances. However, there are still obstacles such as delays in attracting pregnant women, delays in carrying out exams, the lack a connection between the pregnant woman and the place where the birth will take place, the inappropriate conduct of some professionals, and rapid tests performed below the recommendations. Therefore, clear action is needed between civil society, health professionals, and the government, with the purpose of improving the quality of care provided to women in the pregnancy and puerperal period, which consequently reflects on child healthcare.

Regarding table 3, which deals with the causes of infant mortality, there is an emphasis on conditions originating during the perinatal period in the period studied. It is noteworthy that regarding the causes of infant mortality according to higher prevalence, the conditions originating in the perinatal period stand out. This situation is pointed out as a global trend, highlighting the need for a substantial reduction in mortality in the neonatal component for childhood survival[24].

Such results further testify against the quality of health care offered to pregnant women and may indicate a possible deficiency in the resolvability of prenatal care[25].

This variation in the causes of mortality over the years has a direct influence on local-regional situations and, in light of this, on the social inequalities that permeate Brazilian states. For Leal *et al.*[26], the inequalities related to socioeconomic development, access to health services, as well as problems related to the coverage of vital events, which is a fact that affects the knowledge concerning the dimension of infant mortality, along with the identification of associated factors were observed in municipalities located in remote areas. Precarious care and perinatal outcome indicators were almost always invisible due to incomplete data, which reinforces the need to enhance municipal capacities to provide quality care during pregnancy, labor, and birth.

Regarding Figure 1, there is the formation of a concentrated mortality indicator in the North and Northeast regions, and this may be related to the social and economic behavior of the health indicators in these two regions. It is known that infant mortality rates in countries with a low HDI are still high, and the reduction in mortality in Brazil is related to the decrease in fertility, the expansion of basic sanitation, the reorganization of the health care model (Family Health Strategy -FHS), improvements in child healthcare, increased coverage of vaccination campaigns, and the prevalence of breastfeeding, as well as a combination of economic growth with improved education and income distribution with strong effects on the reduction of infectious diseases in the first years of life[27].

In addition to representing the quality of life of populations, this epidemiological information represents deaths of children that could have been avoided through better sanitary, economic, and healthcare conditions. Claeson *et al.*[28] emphasize the importance of epidemiological information, carrying out effective interventions for childhood survival that reach all children and mothers who need them and implementing strategies to identify inequalities and constant monitoring.

CONCLUSION

In this study, a variation in mortality was observed in some regions, with an emphasis on the North and Northeast regions. However, when analyzing the aggregate of the period, it was noticed that there is a decrease in mortality in children under one year of age in the period from 2007 to 2015, with a slight increase in 2016. It is noteworthy that the most frequent illnesses were the conditions that originated in the perinatal period. Moreover, it is observed that regional inequalities also influence this scenario, since there is a poor distribution of health services, which are concentrated in urban areas.

In this context, the need for efficient and accessible prenatal and puerperal care within the scope of Primary Health Care is highlighted. As limitations of this study, the presence of underreporting of deaths and failures to correctly complete the death certificates stand out, which may compromise such findings; however, continuous strategies have been implemented in order to avoid such facts related to the DATASUS system. Nevertheless, existing data must be analyzed and used in the implementation of strategies, assessments, as well as constant monitoring in the maternal-infant network, considering local-regional needs, weaknesses, and potentialities in the context of child health.

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Received in october 2020.
Accepted in may 2021.