Brazilian malnutrition-related infant mortality up to 11 months.

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ABSTRACT

Childhood malnutrition in Brazil has a profound impact on the physical and cognitive development of children, compromising their future and perpetuating the cycle of poverty. Moreover, death from this condition can define important aspects in the context of public health in the country. The objective of this study was to analyze and describe the peculiarities of deaths from child malnutrition in Brazil between the years 1996 and 2021. This is an ecological, epidemiological, cross-sectional, descriptive, and quantitative study of deaths due to malnutrition in children up to 11 months of age between 1996 and 2021, with the Brazilian states as the unit of analysis. The methodological strategy involved the analysis of raw data made available by the Sistema de Informações sobre Mortalidade (SIM). A total of 17.300 deaths due to malnutrition were reported in the studied population. The year 1998 had the highest number of deaths in the period, with 1.766, representing 10.2% of the notifications. The Northeast and Southeast regions presented the highest prevalence of deaths. The states of Bahia, Pernambuco, São Paulo, Minas Gerais, and Ceará had the highest number of deaths from infant malnutrition. The predominant characteristics of the victims were female, brown, with birth weight between 2500 and 3999 g, and age up to 3 months. Young pregnant women (between 15 and 29 years old) and those with a medium level of education were the most predisposed. Among deliveries, gestations between 37 and 41 weeks, single gestations, and vaginal deliveries were relevant in determining mortality. In conclusion, it is crucial to adopt prevention measures and access to education to eradicate mortality from child malnutrition in Brazil.

Keywords: Brazil. Death Record. Nutrition Disorders, Child.

Mortalidade infantil até 11 meses relacionada à desnutrição no Brasil

RESUMO

A desnutrição infantil no Brasil tem um impacto profundo no desenvolvimento físico e cognitivo das crianças, comprometendo seu futuro e perpetuando o ciclo da pobreza. Além disso, o óbito proveniente dessa condição pode definir aspectos importantes no contexto da saúde pública do país. O objetivo deste estudo foi analisar e descrever as peculiaridades dos óbitos por desnutrição infantil no Brasil entre os anos de 1996 e 2021. Trata-se de um estudo ecológico, epidemiológico, transversal, descritivo e quantitativo dos óbitos por desnutrição em crianças com até 11 meses de idade no período de 1996 a 2021, tendo como unidade de análise os estados brasileiros. A estratégia metodológica envolveu a análise dos dados brutos disponibilizados pelo Sistema de Informações sobre Mortalidade (SIM). Foram notificados 17.300 óbitos devido a desnutrição na população estudada. O ano de 1998 foi o que apresentou o maior número de óbitos no período, com 1.766, representando 10.2% das notificações. As regiões Nordeste e Sudeste apresentaram a maior prevalência das mortes. Os estados da Bahia, Pernambuco, São Paulo, Minas Gerais e Ceará foram os estados com maior número de óbitos por desnutrição infantil. As características predominantes das vítimas foram o sexo feminino, pardas, com peso ao nascimento entre 2500 e 3999 g, e idade até os 3 meses. As gestantes jovens (entre 15 e 29 anos) e aquelas com nível médio de escolaridade foram as mais predispostas. Entre os partos, as gestações entre 37 e 41 semanas, as gestações únicas e os partos vaginais foram relevantes na determinação da mortalidade. Em suma, é crucial adotar medidas de prevenção e acesso à educação para erradicar a mortalidade por desnutrição infantil no Brasil.

Palavras-chave: Brasil. Registros de Óbito. Transtornos Nutricionais da Criança.

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INTRODUCTION

Infant mortality is one of the main indicators for assessing the health of a population. The analysis of infant mortality, considering its quantitative and qualitative aspects, as well as its determinants, makes it possible to evaluate the quality of public policies on child health and the care provided to pregnant women during pregnancy and childbirth[1]. In this scenario, deaths related to child malnutrition stand out.

According to the United Nations International Children's Emergency Fund (UNICEF), at least 250 million children suffer from malnutrition[2]. In addition, the World Health Organization (WHO) states that 45% of deaths among children under the age of five are related to malnutrition[3].

It is a multifactorial disease with a complex etiology characterized by an imbalance between the body's energy and nutrient supply and demand. Thus, both deficiencies and excesses of micro- and macronutrients can lead to malnutrition[4]. The disease can be associated with socioeconomic, environmental, and maternal conditions related to infant feeding practices, morbidity, and access to health services[5,6].

Childhood malnutrition, diagnosed by stunting, is a major health problem in developing countries. This condition is associated with an increased risk of infectious diseases and early mortality, impaired neuro-sensory-motor development, poor school performance, and reduced adult productivity[7-9].

Knowing that factors such as the level of economic development, distribution of wealth, political stability, priorities in public spending, and the sociocultural pattern of a country can influence the prevalence of child malnutrition[6,9,10]. Thus, the set of determinants of child death from malnutrition is very broad and complex, and there is a network of interactions among these determinants that needs to be better understood. Therefore, the objective of this study was to analyze and describe the peculiarities of deaths from child malnutrition in Brazil between the years 1996 and 2021.

METHODOLOGY

This is an ecological, epidemiological, cross-sectional, descriptive, and

quantitative study of deaths due to malnutrition in children up to 11 months of age between 1996 and 2021, with the Brazilian states as the unit of analysis. It meets some of the requirements of the Brazilian Política Nacional de Vigilância em Saúde, such as "*data analysis and dissemination of information on health-related events*"[11].

Data on deaths were obtained from the Ministry of Health's Sistema de Informações sobre Mortalidade (SIM)[12] by consulting the website of the Departamento de Informática do Sistema Único de Saúde (DATASUS). Research involving only publicly available data that does not identify participants does not require approval from Brazilian research ethics committees.

Data were collected in May 2023. For SIM, the analysis period was from January 1996 to December 2021. Variables were transferred, analyzed, and presented in figures and tables using TabWin 4.15® and GraphPad Prism 6®. The map of the spatial distribution of cases was generated using TabWin 4.15®.

For the epidemiological characterization of the deaths reported in SIM, the gross socio-demographic characteristics were analyzed, such as sex (male and female), region of residence (north, northeast, southeast, south, and central west), race (white, black, yellow, brown, and indigenous), age group (less than 1-month-old, and between 1 and 11 months of age), and weight at birth (less than 500 grams, 500 to 999 grams, 1000 to 1499 grams, 1500 to 2499 grams, 2500 to 2999 grams, 3000 to 3999 grams, and 4000 grams or more).

Regarding the characteristics of the pregnant woman and delivery, the age of pregnant woman (10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55 years or older), mother's education (illiterate, 1 to 3 full years, 4 to 7 full years, 8 to 11 full years, 12 years or more), duration of pregnancy (less than 22 weeks, 22-27, 28-31, 32-36, 37-41, 42 weeks and more, type of pregnancy (singleton, couple, triplet and more), and type of delivery (vaginal or cesarean).

To calculate the infant mortality rate due to malnutrition in Brazil during the study period, we took the number of deaths per year and multiplied it by 1000. The result of the multiplication was divided by the number of live births in Brazil by year, according to the Sistema de Informações sobre Nascidos Vivos[13].

Statistical analysis of the raw number of deaths was performed using GraphPad

Prism 6®. The normality of the number of reports over the study period was assessed using the Kolmogorov-Smirnov test, which found a parametric distribution of the data. Data were subjected to one-way analysis of variance (ANOVA) and Tukey's multiple comparison test for comparison between groups. Values p<0.05 were considered significant.

RESULTS

In Brazil, 17.300 deaths due to malnutrition in children under 1 year of age were reported between January 1996 and December 2021.

The column graph in Figure 1 represents the number of cases and should be analyzed with the Y-axis on the left. The line graph with circle symbols represents the annual infant mortality rate and should be analyzed with the Y-axis on the right side of the figure.

The year 1998 had the highest number of deaths during the period, with 1.766, representing 10.2% of the notifications. Tukey's multiple comparison test revealed significant differences between the reports of the study years. The year 1998 had a significantly higher number of cases compared to 1996 and all other years of the study. Infant mortality rates were not significantly different.

Figure 1 - Deaths due to malnutrition in children under 1 year in Brazil (1996-2021)
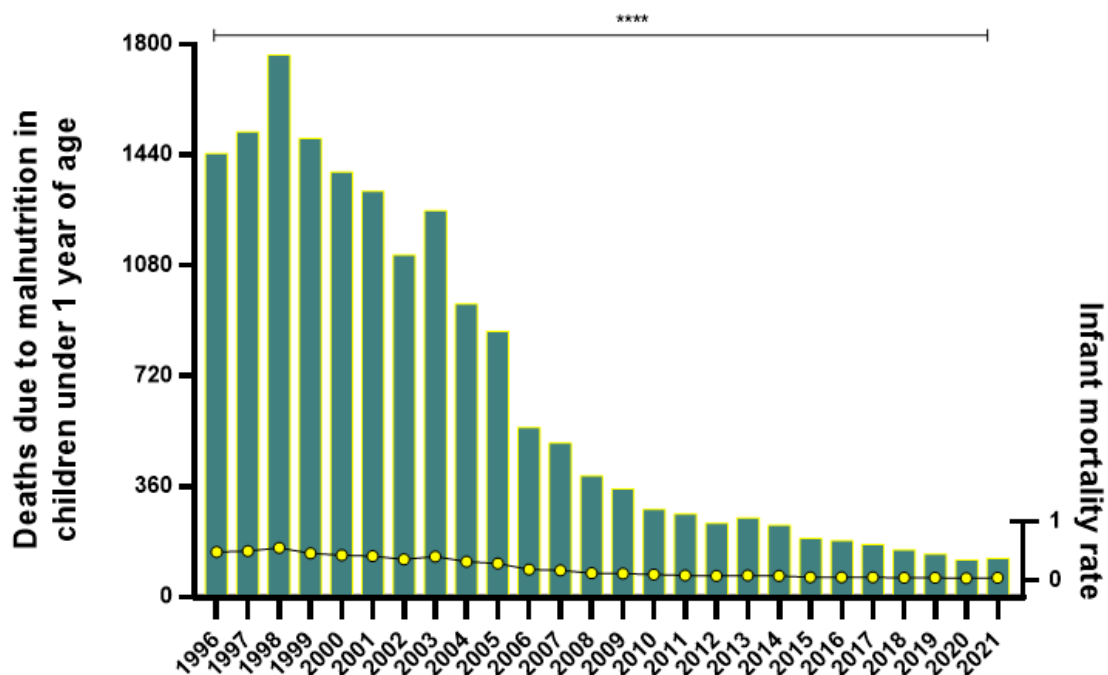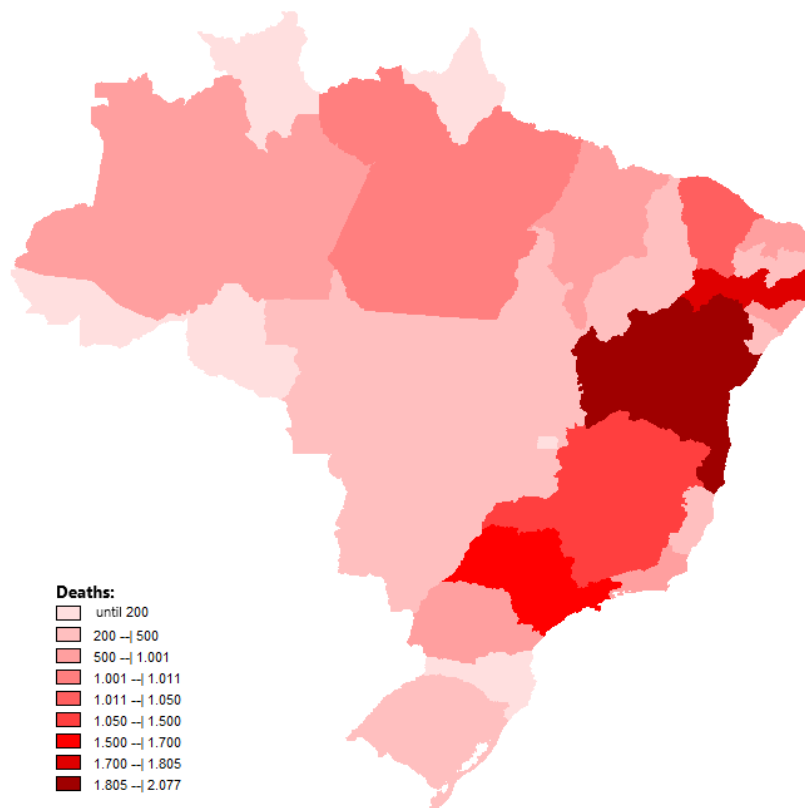
Caption: ****Statistical analysis revealed significant differences in the number of deaths per year over the study period.
Source: Author's preparation with data from the SIM[12].

As for the specific distribution of deaths by region of the country, the Northeast region presented the highest prevalence of cases with 49.1%, followed by the Southeast with 23.33%, the North with 14.77%, the South with 7.06%, and the Midwest with 5.73%.

Figure 2 shows the spatial distribution of deaths by state of residence. The states with a high prevalence of reporting in Brazil are Bahia at 12.01%, Pernambuco at 10.41%, São Paulo at 9.53%, Minas Gerais at 8.49% and Ceará at 6.05%.

Figure 2 - Geographical distribution of the deaths according to the federal states (1996-2021)

Deaths:
- until 200
- 200 –| 500
- 500 –| 1.001
- 1.001 –| 1.011
- 1.011 –| 1.050
- 1.050 –| 1.500
- 1.500 –| 1.700
- 1.700 –| 1.805
- 1.805 –| 2.077

Source: Author's preparation with data from the SIM[12].

Table 1 shows the sociodemographic profile of malnutrition deaths among the children included in this study. Female, brown, with a birth weight between 2500 and

3999 g, up to 3 months of age were the predominant characteristics of the victims.

Table 1 - Social and demographic profile of infants in Brazil (1996-2021)

Sex	n
Male	9.364
Female	7.905
Ignored/white	31
Race	**n**
White	4.302
Black	544
Yellow	109
Brown	5.912
Indigenous	683
Ignored/white	5.750
Age group	**n**
Less than 1 month old	625
1 month old	2.376
2 months old	2.451
3 months old	2.349
4 months old	1.980
5 months old	1.561
6 months old	1.265
7 months old	1.194
8 months old	1.091
9 months old	883
10 months old	838
11 months old	686
Weight at birth	**n**
Less than 500 grams	79
500 to 999 grams	109
1000 to 1499 grams	367
1500 to 2499 grams	1.916
2500 to 2999 grams	1.834
3000 to 3999 grams	2.731
4000 grams or more of weight	218
Ignored/white	10.046

Caption: "n" is the raw number of notifications related to the described feature.
Source: Author's preparation with data from SIM[12].

Table 2 shows the characteristics of pregnancy and delivery. Young pregnant women (between 15 and 29 years of age) and those with a medium level of education were the most predisposed. Among births, pregnancies between 37 and 41 weeks, singleton pregnancies, and vaginal deliveries were relevant in determining mortality.

Table 2 - Characteristics of pregnancy and delivery (1996-2021)

Age of pregnant woman	n
10-14 years old	178
15-19 years old	2.422
20-24 years old	2.954
25-29 years old	1.832
30-34 years old	1.251
35-39 years old	861
40-44 years old	354
45-49 years old	66
50-54 years old	6
55 years or older	3
Age ignored	7.373
Mother's education	**n**
Illiterate	2.717
1 to 3 full years	1.635
4 to 7 full years	2.151
8 to 11 full years	1.070
12 years or more	171
Ignored/white	9.175
Duration of pregnancy	**n**
Less than 22 weeks	197
22 to 27 weeks	171
28 to 31 weeks	344
32 to 36 weeks	1.284
37 to 41 weeks	5.035
42 weeks and more	413
Ignored/white	9.351
Type of pregnancy	**n**
Singleton	8.433
Couple	567
Triple and more	37
Ignored/white	8.263
Type of delivery	**n**
Vaginal	7.067
Cesarean	1.777
Ignored/white	8.456

Caption: "n" is the raw number of notifications related to the described feature.
Source: Author's preparation with data from the SIM[12].

78.17% of deaths occurred in a hospital setting.

DISCUSSION

This research is pioneering in the identification of some social determinants of health associated with child malnutrition deaths in Brazil over a long period, between 1996 and 2021. Mortality due to malnutrition in children under 1 year of age in Brazil showed a decreasing trend between 1996 and 2021, according to the survey conducted by Xavier et al.[14].

França et al.[15] ranked the leading causes of infant mortality in Brazil and found that malnutrition ranked 7th in 1990, while in 2015 it was not among the 30 leading causes of death in this population in Brazil. The change of position in the ranking is explained by the fact that in 1993 the Program for the Prevention and Control of Malnutrition was implemented in Brazil[16], the effects of which can be seen in the deaths from this cause from 1999 onwards.

Several factors have contributed to the reduction of the infant mortality rate in Brazil, such as the expansion of beds, the quality of neonatal care, the improvement of prenatal and maternity care, and the implementation of the Rede Cegonha, as well as the expansion of programs such as Bolsa Família, the Estratégia Saúde da Família, and Mais Médicos[17,18]. Associated with these factors are also improvements in the country's sanitary and nutritional conditions, access to health care, and preventive measures such as the promotion of breastfeeding[15].

It is worth noting that although malnutrition is highly prevalent in the North and Northeast regions concerning mortality, this trend has decreased in recent years, as noted by França et al.[15] in a survey conducted in 1990 and 2015. However, it is understood that these regions have higher rates due to increased poverty and social inequality[14].

The fact that most deaths are concentrated in the first three months of life underscores the importance of factors related to pregnancy, childbirth, and the postpartum period in reducing infant mortality to a level compatible with the country's economic development. The strengthening of the perinatal care network, with continuity of comprehensive care from prenatal care of pregnant women to neonatal care, is a strategy that has been progressively reorganized in the country[19,20].

Maternal education has long been considered an important determinant of child mortality. In this study, we found that the mothers had a medium level of education.

Therefore, it is understood that mothers with higher levels of education have more knowledge and give more importance to the cleanliness of the home, eating habits, and hygienic habits regarding the child[21].

In addition, those who do not work are close to their babies for a long time and feed them adequately, especially with breast milk in the first months of life[21]. Given these facts, it is assumed that mothers with more education are those of higher economic classes, with fewer children, and with greater access to knowledge about childcare, goods, and services - especially health - factors that would increase protection against infant mortality[22].

Most of the deaths in Brazil occurred among brown people. It is feasible to understand that this population exhibits vulnerabilities due to the impact of inequality on the numerous social determinants of health. The determinants are composed of safety, economic instability, housing, and working conditions of family members, as described by Estrela et al.[23] for COVID-19 cases.

Although infant deaths have been recorded in Brazil since 1996, malnutrition has been recognized as a social and public health problem since the second half of the 1930s, during the administration of former President Getúlio Vargas[24]. At that time, it was recognized that malnutrition was associated with extreme poverty and inadequate health and nutrition services. Thus, it was understood at that time that long-term interventions targeting the most vulnerable groups were needed[14].

This may be the reason why malnutrition mortality in children up to 11 months of age has decreased over the years. However, this decreasing trend in mortality in the population studied may be underestimated because malnutrition itself is often not selected as the underlying cause of death by the CID-10 underlying cause selection rules or because it is not mentioned on the death certificate[21].

The SIM is a fundamental tool for monitoring public health in Brazil. The problem with this study is that there are variables that are ignored and not included in the notifications. The occurrence of underreporting and missing variables can be attributed to several factors, including inadequate training of health workers, difficulty in identifying or completing certain variables, work overload, inadequate standardization of records, and communication failures among health services. Health authorities need

to provide regular training to reduce underreporting, promote standardization of records, and ensure the availability of resources and technology for data collection and analysis[25].

CONCLUSIONS

The reduction of malnutrition-related mortality among children under 11 months of age in Brazil is of immense public health importance. Over the years, the concerted efforts of the government, health professionals, and various stakeholders have led to remarkable progress in addressing this critical issue. The decline in child mortality rates reflects increased access to health services, improved nutritional interventions, and targeted public health campaigns aimed at raising awareness of the importance of proper nutrition during infancy.

The results of this study underscore the importance of prioritizing and investing in strategies to address malnutrition in young children. The observed decline in mortality rates represents not only improved child survival but also a society that values the health and well-being of its future generation. By addressing the underlying determinants of malnutrition, such as poverty, food insecurity, and inadequate health infrastructure, Brazil has demonstrated its commitment to promoting child health and reducing health inequalities. Sustained efforts are needed to further reduce mortality and ensure equitable access to quality health care and nutritional support for all children in Brazil.

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