
Sociodemographic and obstetric profiles of fetal deaths due to intrauterine hypoxia and birth asphyxia in Brazil

Perfis sociodemográficos e obstétricos dos óbitos fetais por hipóxia intrauterina e asfixia ao nascer no Brasil

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ABSTRACT

This article aims to analyze the clinical and epidemiological data of mortality due to intrauterine hypoxia and birth asphyxia in Brazil, focusing on the social determinants of the health of fetuses and pregnant women. It is an epidemiologic, quantitative, cross-sectional, and descriptive study. Its object of study was the notifications of deaths by the above-mentioned condition in Brazil between January 1996 and December 2021. The data were collected from the database of the Sistema de Informações sobre Mortalidade (SIM). 219.850 deaths were recorded in Brazil. The Brazilian states with a high prevalence of cases are São Paulo, Rio de Janeiro, Bahia, Minas Gerais, and Pernambuco. The predominant social characteristics of the fetuses were male, and brown, with 500 and 999 grams. 74.25% of the deaths occurred before birth. Young pregnant women (between 15 and 29 years of age) with a medium level of education were the most predisposed. Pregnancies between 32 and 41 weeks, singleton pregnancies, and vaginal deliveries were relevant in determining mortality. 93.47% of deaths occurred in a hospital setting.

Keywords: Brazil; Fetal hypoxia; Public health surveillance; Uses of epidemiology.

RESUMO

O objetivo deste artigo é analisar os dados clínicos e epidemiológicos da mortalidade por hipóxia intrauterina e asfixia ao nascer no Brasil, com foco nos determinantes sociais da saúde do feto e da gestante. Trata-se de um estudo epidemiológico, quantitativo, transversal e descritivo. Seu objeto de estudo foram as notificações de óbitos pela condição sobredita no Brasil entre janeiro de 1996 e dezembro de 2021. Os dados foram coletados do banco de dados do Sistema de Informações sobre Mortalidade (SIM). Foram registradas 219.850 mortes no Brasil. Os estados brasileiros com alta prevalência de casos são São Paulo, Rio de Janeiro, Bahia, Minas Gerais e Pernambuco. As características sociais predominantes dos fetos eram o sexo masculino, pardos, com 500 e 999 gramas. 74.25% dos óbitos ocorreram antes do nascimento. As gestantes jovens (entre 15 e 29 anos de idade) com nível médio de escolaridade foram as mais predispostas. Gestações entre 32 e 41 semanas, gestações únicas e partos vaginais foram relevantes na determinação da mortalidade. 93.47% das mortes ocorreram em um ambiente hospitalar.

Palavras-chave: Brasil; Hipóxia fetal; Vigilância em saúde pública; Usos da epidemiologia.

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INTRODUCTION

Intrauterine hypoxia and fetal hypoxia result from conditions at the maternal-fetal interface in which the fetus is deprived of adequate amounts of oxygen due to environmental, maternal, placental, and fetal factors (Ducsay et al., 2018; Åmark et al., 2020; Turner et al., 2020). Prolonged or excessive hypoxia prevents the fetus from developing normally according to its genetic makeup, causing up to 10% of babies to be stunted in utero and born prematurely. In addition, it can interfere with perinatal plasticity by affecting lung development and interfering with repair processes (Ducsay et al., 2018).

According to the World Health Organization, intrauterine hypoxia and asphyxia at birth is the second leading cause of neonatal and perinatal death worldwide, accounting for 23.93% of fetal deaths, second only to prematurity (Who, 2023). The scenario reflects the quality of care provided to parturient women and newborns in maternity hospitals (Daripa et al., 2013), in line with Rêgo et al. (2018), who associate these conditions with countries with less access to health care or limited resources.

Given the interventions planned for the treatment and/or prevention of risk factors for these conditions, such as adequate prenatal and childbirth care, it is essential to know the epidemiological profile of the victims of these dysfunctions in the country (Borges et al., 2020; Sousa et al., 2022). To this end, this article aims to analyze the clinical and epidemiological data of mortality due to intrauterine hypoxia and birth asphyxia in Brazil, focusing on the social determinants of the health of fetuses and pregnant women.

METHODOLOGY

This is an epidemiologic, quantitative, cross-sectional, and descriptive study. Its subject is the notifications of deaths due to intrauterine hypoxia and birth asphyxia in Brazil between January 1996 and December 2021. This methodology, which covers a very large annual study period, is pioneering in Brazil.

Brazil is a South American country made up of 27 federal states, stretching from the Amazônica basin in the north to the vineyards and the gigantic Foz do Iguaçu in the south. It is the fifth largest country in the world by area, with 8.510.345.540 km², representing 47.3% of the South American territory, with an estimated population of 213.317.639 inhabitants for 2021. The country presented a Produto Interno Bruto *per*

capita of 35,161.70 in 2019. As for the age range of the population, those between the ages of 10 and 14 are the most prominent in males, second only to those referring to the ages of 20 to 24 for females (Brasil, 2022).

The methodological strategy used was to analyze the epidemiological bulletins provided by the Diretoria de Vigilância Epidemiológica (DIVE), which uses the Sistema de Informações sobre Mortalidade (SIM) database (Brasil, 2023a). The SIM is a system used to collect, register, and analyze data on deaths, providing essential information for monitoring and planning health policies (Senna, 2009). Research using only publicly available data that does not identify participants does not require approval from Brazilian research ethics committees.

Data were collected in May 2023. The variables analyzed were the annual and spatial distribution of cases, fetal/neonatal sociodemographic variables (sex, race, birth weight), place of death, pregnancy-related death, age and educational level of the pregnant woman, duration, and type of pregnancy, and type of delivery. TabWin 4.15® was used to stratify and analyze the data and to create the map of the spatial distribution of cases.

Statistical analysis was performed with GraphPad Prism 6®. The normality of the data was assessed using the Kolmogorov-Smirnov test, which indicated a nonparametric distribution of the data. Kruskal-Wallis's test and Dunn's multiple comparison test were used to compare between groups. “*p*” values <0.05 were considered significant.

To calculate the prevalence of deaths, the number of deaths in each year was used as the numerator and the number of live births in Brazil by year, according to the Sistema de Informações sobre Nascidos Vivos (Brasil, 2023b), was used as the denominator. The values found in the divisions were multiplied by 10.000, adapted from Oliveira et al. (2022).

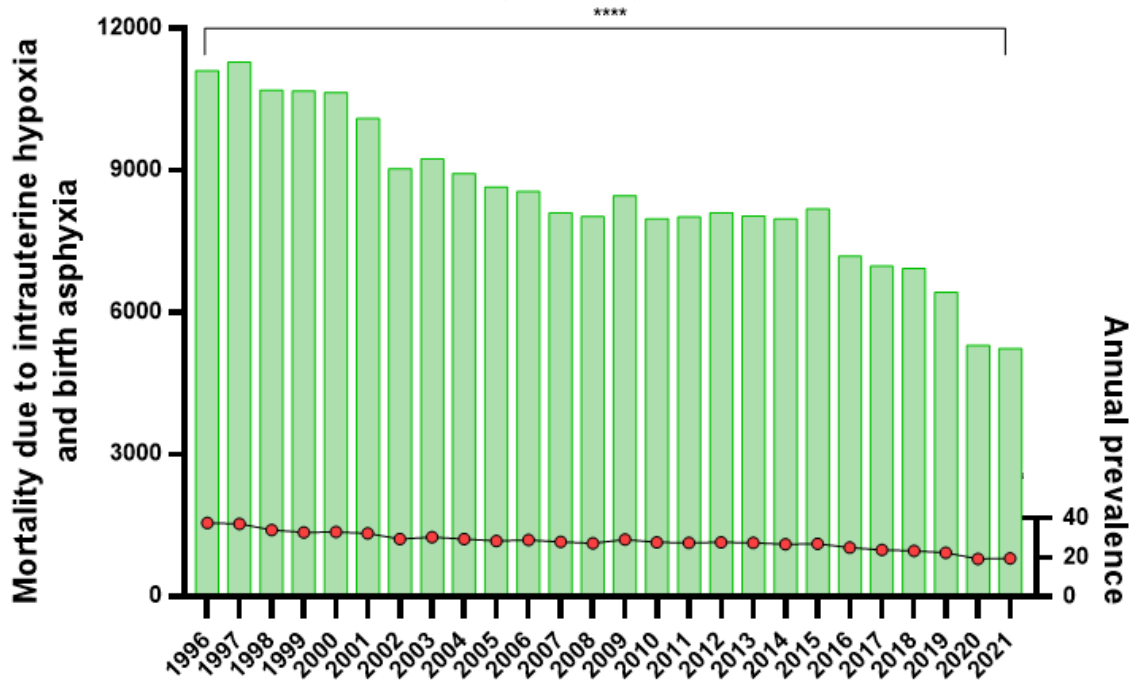
RESULTS

During the study period, 219.850 deaths from intrauterine hypoxia and birth asphyxia were recorded in Brazil.

Figure 1 shows the trend of cases over time. 1997 was the year with the highest prevalence of cases in the period. Since then, there has been a decreasing trend in the number of cases.

For proper analysis of Figure 1, the column chart represents the number of deaths and should be analyzed with the y-axis on the left. The line graph with circular symbols refers to their annual prevalence (per 10.000 live births) and should be analyzed with the y-axis on the right of the figure.

Figure 1 - Deaths from intrauterine hypoxia and birth asphyxia and annual prevalence in Brazil (1996-2021)

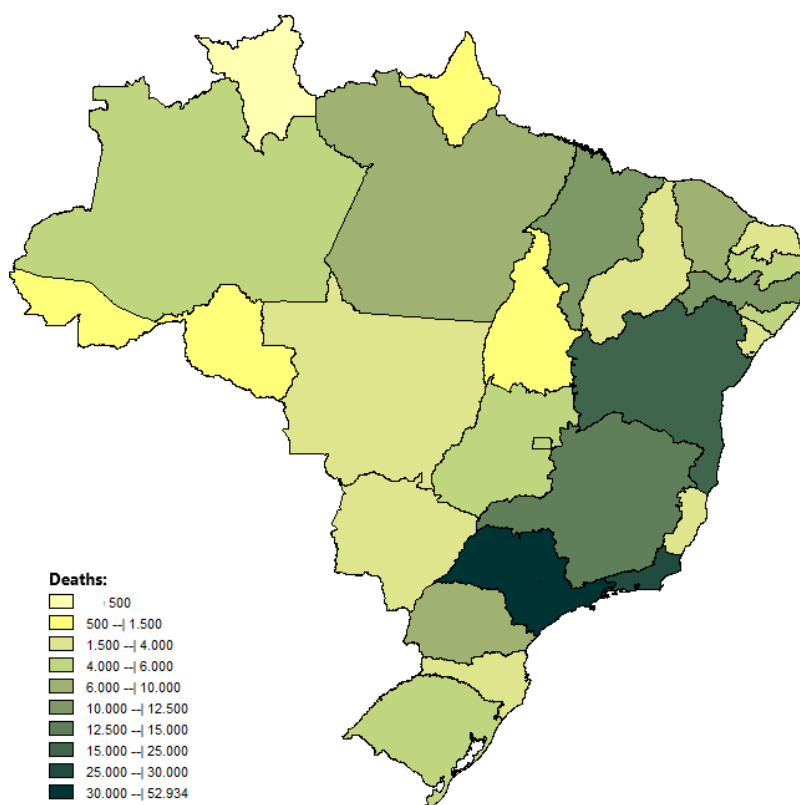


Source: Author's preparation with data from the SIM (Brasil, 2023a).

Caption: **** represents a significant difference ($p < 0.0001$) between the years examined using Dunn's multiple comparison test.

Figure 2 shows the spatial distribution of deaths due to intrauterine hypoxia and birth asphyxia in Brazil. The states with a high prevalence of cases are São Paulo at 24.08%, Rio de Janeiro at 13.49%, Bahia at 10.5%, Minas Gerais at 6.59%, and Pernambuco at 5.66%.

Figure 2 - Geographic distribution of deaths in Brazil (1996-2021)



Source: Author's preparation with data from the SIM (Brasil, 2023a).

Table 1 shows the characteristics of the victims and the location of the deaths. Male, brown, with a birth weight between 500 and 999 grams are the predominant characteristics of the analyzed fetal deaths. In addition, 74.25% of deaths occurred before birth.

Table 1 – Sociodemographic characteristics of the victims from Brazil (1996-2021)

Sex	n
Male	115.596
Female	97.410
Ignored/white	6.844
Race	n
White	2.384
Black	2.651
Yellow	161
Brown	3.131
Indigenous	220
Ignored/white	211.303
Birth weight	n
Less than 500g	8.704
500 to 999g	45.976
1000 to 1499 g	26.405
1500 to 2499 g	43.975

2500 to 2999 g	20.927
3000 to 3999 g	27.951
4000g and more	5.404
Ignored/white	40.508
Death concerning births	n
Before childbirth	163.245
During childbirth	9.663
After childbirth	1.028
Ignored/white	45.914

Caption: “n” is the raw number of notifications related to the described feature.

Source: Author's preparation with data from the SIM (Brasil, 2023a).

Table 2 shows the characteristics of pregnancy and childbirth. 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 32 and 41 weeks, singleton pregnancies, and vaginal deliveries were relevant in determining mortality.

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

Age of pregnant woman	n
Less than 10 years old	6
10-14 years old	2.267
15-19 years old	36.324
20-24 years old	47.839
25-29 years old	38.288
30-34 years old	29.163
35-39 years old	19.163
40-44 years old	7.528
45-49 years old	776
50-54 years old	27
55 years or older	8
Age ignored	38.392
Mother's education	n
Illiterate	12.892
1 to 3 full years	19.856
4 to 7 full years	45.089
8 to 11 full years	50.176
12 years or older	13.593
Ignored/white	74.965
Duration of pregnancy	n
Less than 22 weeks	12.754
22 to 27 weeks	40.747
28 to 31 weeks	28.964
32 to 36 weeks	40.877
37 to 41 weeks	49.286
42 weeks and more	7.938
Ignored/white	29.172
Type of pregnancy	n
Only	184.001
Couple	9.462
Triple and more	430

Ignored/white	25.957
Type of delivery	n
Vaginal	150.440
Cesario	40.797
Ignored/white	28.613

Caption: “n” is the raw number of notifications related to the described feature.

Source: Author's preparation with data from the SIM (Brasil, 2023a).

93.47% of deaths occurred in a hospital setting.

DISCUSSION

Preterm birth, infections, and hypoxia/asphyxia at birth are the main causes of neonatal death worldwide, and their magnitude is higher in less developed countries (Gonçalves et al., 2015; Who, 2023). Although Brazil is a developing country, the management of childbirth and hypoxia/asphyxia at birth has great potential for prevention, as 98% of births in the country take place in specialized maternity hospitals and 97% are performed by physicians (Gonçalves et al., 2015).

The present population-based study demonstrated that intrauterine hypoxia and neonatal asphyxia contributed to the death of an average of 28.38 newborns per 10,000 live births in Brazil. Such a value tends to be underestimated, since vital statistics consider the presence of maternal disorders or prematurity as the underlying cause of early neonatal death, even when hypoxia and/or perinatal asphyxia are reported in the lines of the death certificate (Daripa, 2013).

Mortality due to intrauterine hypoxia and birth asphyxia in Brazil showed a decreasing trend between 1996 and 2021, according to previous descriptions from different periods in Brazilian states such as São Paulo (Kawakami et al., 2021), Espírito Santo (Bezerra et al., 2021), and Recife (Rêgo et al., 2018).

Several factors have contributed to the reduction of fetal and perinatal mortality 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 (Rasella et al., 2013; Tomasi et al., 2017).

It is known from WHO data that intrauterine hypoxia and asphyxia at birth are the second cause of perinatal deaths in the world, representing 23.93% of all deaths. Compared to the data obtained in this article, the State of São Paulo has 24.08% of cases

of this condition, which is significantly higher than the international average (Who, 2023). Nevertheless, this situation shows that it is extremely necessary to intensify investments in health focused on pregnancy, delivery, and childbirth in the state, as stated by Gonçalves et al. (2015).

The variables analyzed regarding the sex of the stillborn showed a high prevalence of male deaths. These data are consistent with the theory of innate male biological vulnerability, as described by Chiavegatto-Filho and Laurenti (2012). The authors state that stressful situations would lead to an increase in male fetal mortality due to the greater vulnerability of fetuses of this sex to corticosteroids released in stressful situations such as hypoxia.

Most deaths in Brazil occurred among black and 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 work conditions of family members, as described by Estrela et al. (2020) for COVID-19 cases.

Rêgo et al. (2018), in a study of preventable perinatal deaths, listed that the maternal age range of the cases was between 20 and 34 years, with more than eight years of schooling. These data are in line with this study and those of Lassi and Bhutta (2015) and Sousa et al. (2022), since perinatal deaths persist in women of middle age, lower socioeconomic levels, certain ethnic groups - black and brown, low educational levels, and those living in disadvantaged areas, in underdeveloped and developing countries.

Regarding the type of pregnancy, a higher number of fetal deaths occurred in singleton pregnancies. In this study, there was no prevalence of deaths due to intrauterine hypoxia and neonatal asphyxia in multiple gestations, although, according to the Ministry of Health, these are associated with a higher risk of fetal death (Brasil, 2012).

Milsom et al. (2015) show that 56.4% of vaginal deliveries are associated with potential intrapartum risk factors for asphyxia. The fact that vaginal delivery predisposes neonates to asphyxia is difficult to interpret. Vaginal deliveries of infants with established antepartum compromise or a fetus exposed to vaginal pelvic delivery are at increased risk, as reported in a randomized trial (Hannah et al., 2000). External compression associated with pelvic floor compression to assist delivery is a method that has been used for many years, and this study demonstrated an increased risk of asphyxia associated with its use (Milsom et al., 2015).

During the early stages of a healthy pregnancy (12 weeks), oxygen availability in the uterus is reduced due to low blood flow. This hypoxic microenvironment is essential for progenitor cells to maintain homeostasis, prevent DNA damage, and selectively differentiate (Spencer et al., 2014; Zhao, Wong, & Stevenson, 2021). Such knowledge justifies the data of this study since the prevalence of fetal deaths due to intrauterine hypoxia will occur from 32 weeks of gestation, characterized as the last third of the process in which hypoxic conditions are detrimental to the termination of fetal development.

In a systematic analysis linked to global perinatal mortality, some recommendations have been made to reduce intrauterine hypoxia and birth asphyxia. These are training of personnel in neonatal resuscitation, sustainable financing mechanisms to provide integrated and high-quality antenatal, delivery, and postpartum care, use of nutrition education during antenatal care, screening, and treatment of genitourinary tract infections in pregnant women, skilled attendance at delivery, and investments and policies to achieve greater equity (Shukla and Carlo, 2020).

In contrast to the Brazilian Sistema Único de Saúde (SUS), which provides equal opportunities for access to health care based on equal needs, there is no equality of supply and structural resources, which is associated with inadequate and untimely health care, with significant implications for perinatal and neonatal mortality (Bezerra et al., 2021).

The SIM is a fundamental tool for monitoring public health in Brazil. However, one of the main challenges faced in this study is the presence of ignored and blank variables in the notifications.

Underreporting and missing variables can occur for a variety of reasons, including inadequate training of health workers, difficulty in identifying or completing some variables, work overload, lack of standardization of records, and communication errors between health departments. To reduce underreporting, health departments should provide regular training, promote standardization of records, and ensure the availability of resources and technology for data collection and analysis.

CONCLUSIONS

The knowledge of the epidemiological aspects of intrauterine hypoxia is indispensable for addressing its impact on public health in Brazil. By studying its prevalence, risk factors, and consequences, healthcare professionals and policymakers can develop targeted interventions, early detection strategies, and cost-effective management approaches. Ultimately, this understanding will not only improve maternal and fetal health outcomes but also contribute to the overall well-being and prosperity of the nation. Thus, continued research and collaborative efforts in this field are crucial to ensure a healthier future for the population of Brazil.

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