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RESEARCH

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PREVALENCE AND CAUSES OF NEONATAL MORTALITY IN BRAZIL

*Prevalência e causas da mortalidade neonatal no Brasil**Prevalencia y causas de la mortalidad neonatal en Brasil***Marcilene Camara Paulista¹** **Lays Silva de Azevedo²** **Emiliana Cristina Melo³** **Rosana Rosseto de Oliveira²** 

ABSTRACT

Objective: to analyze the prevalence and the causes of neonatal mortality in Brazil. **Method:** cross-sectional study of neonatal deaths that occurred between 2010 and 2019. Data obtained from the Live Birth Information System and the Mortality Information System. The analysis was performed using absolute and relative frequencies. **Results:** analyzing the prevalence of neonatal mortality in Brazil was clear that there is a diversification of the coefficient in different regions. Although there was a reduction in the evaluated period, fluctuations are noticed, with higher coefficients for the Northeast region. The largest proportion of deaths occurs from perinatal causes, which in most cases could be avoided. **Conclusion:** the study allowed observing that despite advances in prenatal and neonatal care, significant coefficients of neonatal mortality still prevail and perinatal and congenital malformations are the main causes. Furthermore, the data allow indicating the regions with higher proportions, enabling a more effective regional planning.

DESCRIPTORS: Infant mortality; Perinatal care; Prenatal care; Public health.

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RESUMO

Objetivo: analisar a prevalência e causas da mortalidade neonatal no Brasil. **Método:** estudo transversal dos óbitos neonatais ocorridos de 2010 a 2019. Foram utilizados registros do Sistema de Informação sobre Nascidos Vivos e do Sistema de Informação sobre Mortalidade. As análises ocorreram por meio de frequências absolutas e relativas. **Resultados:** ao analisar a prevalência da mortalidade neonatal no Brasil, percebe-se grande diversificação no coeficiente nas diferentes regiões brasileiras. Embora houve redução no período, notam-se flutuações, com coeficientes maiores para região nordeste. A maior proporção dos óbitos ocorrem por causas perinatais, os quais, na grande maioria são evitáveis. **Conclusão:** o estudo permitiu observar que apesar dos avanços no atendimento pré-natal e ao recém nascido, ainda prevalecem coeficientes significativos de mortalidade neonatal, tendo como causas principais as perinatais e malformações congênitas. Por outro lado, os dados permitem sinalizar regiões com proporções elevadas, possibilitando um planejamento regional mais efetivo.

DESCRITORES: Mortalidade infantil; Assistência perinatal; Cuidado pré-natal; Saúde pública.

RESUMEN

Objetivo: analizar la prevalencia y causas de mortalidad neonatal en Brasil. **Método:** estudio transversal de los óbitos neonatales de 2010 a 2019. Se utilizó registros del Sistema de Información de Nascidos Vivos y del Sistema de información de Mortalidad. Los análisis se realizaron utilizando frecuencias absolutas y relativas. **Resultados:** al analizar la prevalencia de mortalidad neonatal en Brasil, se percibe una gran diversificación en diferentes regiones. Si bien hubo una reducción en el período evaluado, hay fluctuaciones, con coeficientes más altos en la región noreste. La mayor proporción de óbitos ocurren por causas perinatales, que a menudo se pueden prevenir. **Conclusión:** el estudio permitió observar que a pesar de los avances en la atención prenatal y del recién nacido, prevalecen coeficientes significativos de mortalidad neonatal, siendo las malformaciones perinatales y congénitas las principales causas. Por otro lado, los datos señalan las regiones con mayores proporciones, permitiendo una planificación regional eficaz.

DESCRIPTORES: Mortalidad infantil; Atención perinatal; Atención prenatal; Salud pública.

INTRODUCTION

Infant mortality is characterized by deaths in children under one year of age and is a highly relevant health indicator, since the offense may be related to socioeconomic factors and signals various aspects of health that need to be improved or implemented, such as work processes and health care assistance.¹ Infant mortality rates remind us of worse living conditions, health, and access to health care services, showing that most infant deaths can be avoided.²

The infant mortality rate is composed of the neonatal period, which occurs from birth to the 27th day of life, and the post-neonatal period, which occurs from the 28th to 364 days of life. Most deaths are concentrated in the neonatal period, especially in the early neonatal period (0 to 6 days of life), when mortality is difficult to reduce because it depends on actions aimed at qualifying the care provided specifically in prenatal care and health services during childbirth.³

In Brazil, as in the world, neonatal mortality rates have decreased since the late twentieth century, but despite numerous government efforts and investments, they still represent a significant portion of newborns, especially in regions with populations with minimal incomes, which statistics classify as poor or below the poverty line.²

In this condition, if only the poverty rate is considered among countries with information available from the World Bank (43 countries), Brazil is found as the 21st in highest rate, and with regional disparities that translate into neonatal mortality rates that are significantly higher in some locations, such as in Amapá,

where the rates reached values of 14.4, 13.2, and 12.9 per thousand live births, respectively, while the national rate in 2017 was 9.5 deaths per thousand live births.⁴

Regional problems such as poverty, precarious hygiene conditions, absence of basic sanitation, malnutrition, assistance provided with poor quality, premature birth, teenage pregnancy, no prenatal care, and comorbidities are among the most important risk factors for neonatal mortality.^{3,5-9}

Knowing the prevalence and causes of neonatal mortality in the country is an important aid to better understand the Brazilian reality and the factors and variables related to this outcome, since Brazil presents great disparity in its various regions and even with a decrease in the neonatal mortality rate, the values are still far from those recorded in developed countries.

Thus, the identification of the causes and prevalence of neonatal mortality can serve as a subsidy for the development of actions to address this public health problem. Therefore, the objective of this study was to analyze the prevalence and causes of neonatal mortality in Brazil and its respective regions.

METHOD

This is a descriptive, cross-sectional study of neonatal deaths that occurred in Brazil from 2010 to 2019.

With an estimated population in 2020 of 211.7 million people, Brazil is composed of 26 federative units, plus the Federal District, which are grouped into five large regions (North, Northeast, Southeast, South, and Midwest), with an HDI of 0.765 and an average infant mortality rate of 11.56 in 2020.¹⁰

Mortality and birth data were obtained from the records of the Mortality Information System (SIM) and Live Births Information System (SINASC), both available with free access in the repository of the Department of Informatics of the Unified Health System (DATASUS). The records were collected referring to the period from 2010 to 2019, from all regions of Brazil.

Regarding the prevalence of neonatal mortality, the rates were calculated from the ratio between the number of deaths of children aged 0 to 27 days of life and the number of live births in the same region and year, multiplied by the constant 1000. To identify the causes of neonatal mortality, we considered the underlying cause of death according to the International Statistical Classification of Diseases (ICD-10) and then the most prevalent causes were selected (perinatal, congenital malformations, infectious and parasitic, laboratory signs and symptoms, external causes) and the remaining deaths were grouped under "other causes".

Thus, figures and tables were prepared for presentation of the data obtained, and the calculation of percentage variation was also performed for comparison between the periods 2010 to 2014 and 2015 to 2019 ((period 2 - period 1)/period 1 X 100).

The study was conducted respecting the ethical standards in force according to the Resolution No. 510 of 04/12/2016 of the Ministry of Health. It was not necessary to be evaluated by a research ethics committee because this was a study using secondary databases, public domain and without sensitive data.

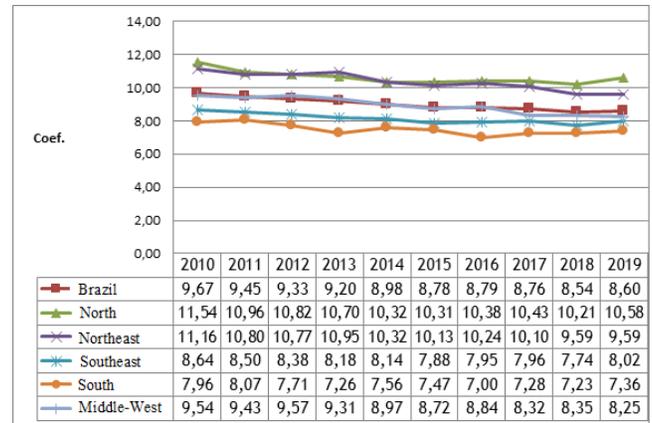
RESULTS

A total of 24,504 neonatal deaths of residents in Brazil were analyzed, representing 8.6 neonatal deaths per 1000 live births in the period from 2010 to 2019. The total neonatal mortality coefficients went from 9.67 in 2010 to 8.60 in 2019, evidencing a reduction in the rate.

The North region, despite the decrease, had the highest coefficients among the country's regions, going from 11.54 in 2010 to 10.58 in 2019. On the contrary, the South region presented the lowest neonatal mortality coefficients, represented by 7.96 neonatal deaths in 2010 and 7.36 in 2019 (Figure 1).

As for the analysis of neonatal mortality according to the underlying cause of death, the most prevalent causes were peri-

Figure 1 – Neonatal mortality coefficient (per 1,000 live births), according to year and region of residence. Brazil, 2010 to 2019



natal, congenital malformations, infectious and parasitic diseases, laboratory signs and symptoms, and external causes. It is also observed that there was a reduction in all coefficients comparing the periods 2010 to 2014 and 2015 to 2019. However, in relation to the percentage variation between the periods studied, an increase in mortality due to congenital malformations (7.23%), infectious and parasitic diseases (24.62%) and external causes (3.23%) is noted (Table 1).

Figure 2 presents the neonatal mortality coefficients according to the underlying cause of death in the different Brazilian regions from 2010 to 2019. Among the causes of death, mortality due to perinatal factors was the most incident for all regions of the country, but with an apparent decrease in the period. The northern region stands out with the highest coefficients for almost all causes that were analyzed, with the exception of congenital malformations. These presented the highest coefficients in the central-western region, but the southern and southeastern regions also presented coefficients greater than 1.50.

Still with respect to the northern region, in 2014 there was a significant increase in the mortality coefficient for infectious and parasitic diseases, a significant decline for laboratory signs/symptoms between the years analyzed, and a worrisome increase in neonatal mortality from external causes.

It is observed that there is a large number classified by other causes, mainly in the northern region, which presents itself re-

Table 1 – Neonatal mortality (number, percentage, and coefficient per 1000 live births), according to underlying cause of death. Brazil, 2010 to 2019

Basic cause	2010 to 2014			2015 to 2019			
	n	%	Coef.	N	%	Coef.	Var. %
Hatchlings	106277	78,25	7,3	96877	77,03	4,77	-1,56
Congenital malformation	25169	18,53	1,73	26136	19,87	1,23	7,23
Infectious and Parasitic	887	0,65	0,06	1154	0,81	0,05	24,62
Laboratory signs and symptoms	1248	0,92	0,09	794	0,73	0,04	-20,65
External Causes	843	0,62	0,06	837	0,64	0,04	3,23
Other causes	1386	1,02	0,1	1084	0,91	0,06	-10,78
Total	135810	51,70	9,32	126882	48,30	6,19	-6,57

lately high with a coefficient of 0.20 in 2010, slight decline in 2011 (0.13), increase for the years 2012 (0.17) and 2013 (0.20), and again decline for the following years (2014, 2015, 2016, 2017, 2018 and 2019), reaching rates of 0.15, these being very expressive for unspecified causes. The other regions remained with rates between 0.13 and 0.04, these being reduced for the year 2019, except for the Midwest region (Figure 2).

Table 2 focuses on the data specifically for 2019 because it is the most recent year of the study. The data shed light on the most common causes of death in neonates in the different Brazilian regions.

Perinatal causes are among the most frequent in all Brazilian regions in the year 2019, with variations in coefficients between 7.60 (northern region) and 5.24 (central-western region). Congenital malformations are among the second largest cause of neonatal death, however, much less expressive in the southern and southeastern regions, with coefficients ranging between 1.95 and 1.73, respectively. As for the other causes, such as infectious and parasitic, laboratory signs and symptoms, external causes and other causes, they presented coefficients < 1.0, with higher incidence in the Northeast region (Table 2).

DISCUSSION

In analyzing neonatal mortality in Brazil, it can be seen that there are disparities in the coefficients in the different Brazilian regions. Although there was a reduction in the period evaluated, fluctuations over the years are noted, with higher coefficients in the Northeast region.

These data remind us of the need for the government to assume public health as a priority, intensifying investments, especially regarding pregnancy, delivery, and birth, that is, all maternal and child care. It is known that early neonatal deaths are closely related to the quality of prenatal and neonatal care during delivery, denoting weaknesses in the care of the maternal and child population, which needs to be improved to reduce neonatal mortality.⁵

Higher neonatal mortality coefficients were caused by some diseases originating in the perinatal period, chapter XVI of ICD-10, in all Brazilian regions, i.e., deaths that could have been prevented by accessible and effective health services. Moreover, perinatal causes indicate an association between prematurity and neonatal mortality. In this scenario, it is worth pointing out that the younger the gestational age of the newborn, the higher the risk of death, leading us to a worldwide concern regarding premature birth. Prematurity has been identified as the main cause of neonatal mortality and a challenge to public health.⁶⁻⁸

In Brazil, it is true that there are programs aimed at reducing infant deaths, especially neonatal deaths, such as the Family Health Program, currently the Family Health Strategy (ESF), together with the Community Health Agents Program (PACS), which is an important strategy for child health surveillance, contributing to strengthen primary health care actions.^{11,12}

In 2006, the Health Pact was launched, which encompasses the three spheres of SUS management for innovations, based on three components: Pact for Life, Pact in Defense of SUS and Management Pact, being the Pact for Life the commitment about the health situation of the Brazilian population, in which stands out, among the objectives, the reduction of infant and maternal mortality, providing for actions to reduce neonatal mortality, among others.¹³ Specifically in Paraná, the Paranaense Mother Network (RMP) program was implemented in 2012, aiming to organize maternal and child care from several actions, such as the early capture of pregnant women at risk, prenatal care, and guaranteed delivery.¹⁴

However, these still do not meet the Brazilian demand, and there is a need for greater investments in actions to prevent avoidable prematurity, focusing on the qualification of health professionals, especially in prenatal care, risk pregnancy, as well as prevention of iatrogenic prematurity related to unnecessary termination of pregnancy, and also incorrectly indicated cesarean sections.⁷

Moreover, it should be noted that access to quality care is directly influenced by socioeconomic and demographic conditions, in which the existence of necessary resources is a protective factor for the generation of healthy children.¹⁵

Due to the vast Brazilian territory, it is necessary to improve access to health services, eliminating the vulnerability barriers that prevent them from being provided, such as geographical, cultural, financial, and others. Such barriers must be minimized for the achievement of access and quality of health services. A review study conducted in 2018 exemplifies how social vulnerability barriers impact on access and quality of services, when it highlights the impact of the Bolsa Família Program in contributing to the updating of the vaccination schedule, as well as monitoring of child growth and development, causing significant improvement in infant mortality.¹² Health needs to be integrated with other educational and financial programs that can contribute to health and better quality of life.

During this study, it became evident that most neonatal deaths could be avoided by more effective actions provided to women during pregnancy, with the need for appreciation of reproductive planning, as well as the strengthening of primary health care, which implies investments in infrastructure, with more effective actions and constant improvement of professionals who work directly in gravidic-puerperal care, especially in prenatal care, because the findings of this study, as already mentioned in other studies, indicate deficits in the resoluteness and quality of prenatal care.⁵⁻⁹

In a study of neonatal deaths in São Luiz, Maranhão, the most frequent causes of neonatal death were respiratory diseases and sepsis (early or late),³ meeting the data presented in this study, for which perinatal diseases prevail in all regions of Brazil.

However, other causes are also present in neonatal mortality, among them are Congenital Malformations. By 2019, Brazilian regions maintained coefficients between 1.5 and 2.0 neonatal deaths from malformations per thousand live births. When

Figure 2 – Neonatal mortality coefficient (per 1000 live births), according to underlying cause of death, year and region of residence. Brazil, 2010 to 2019

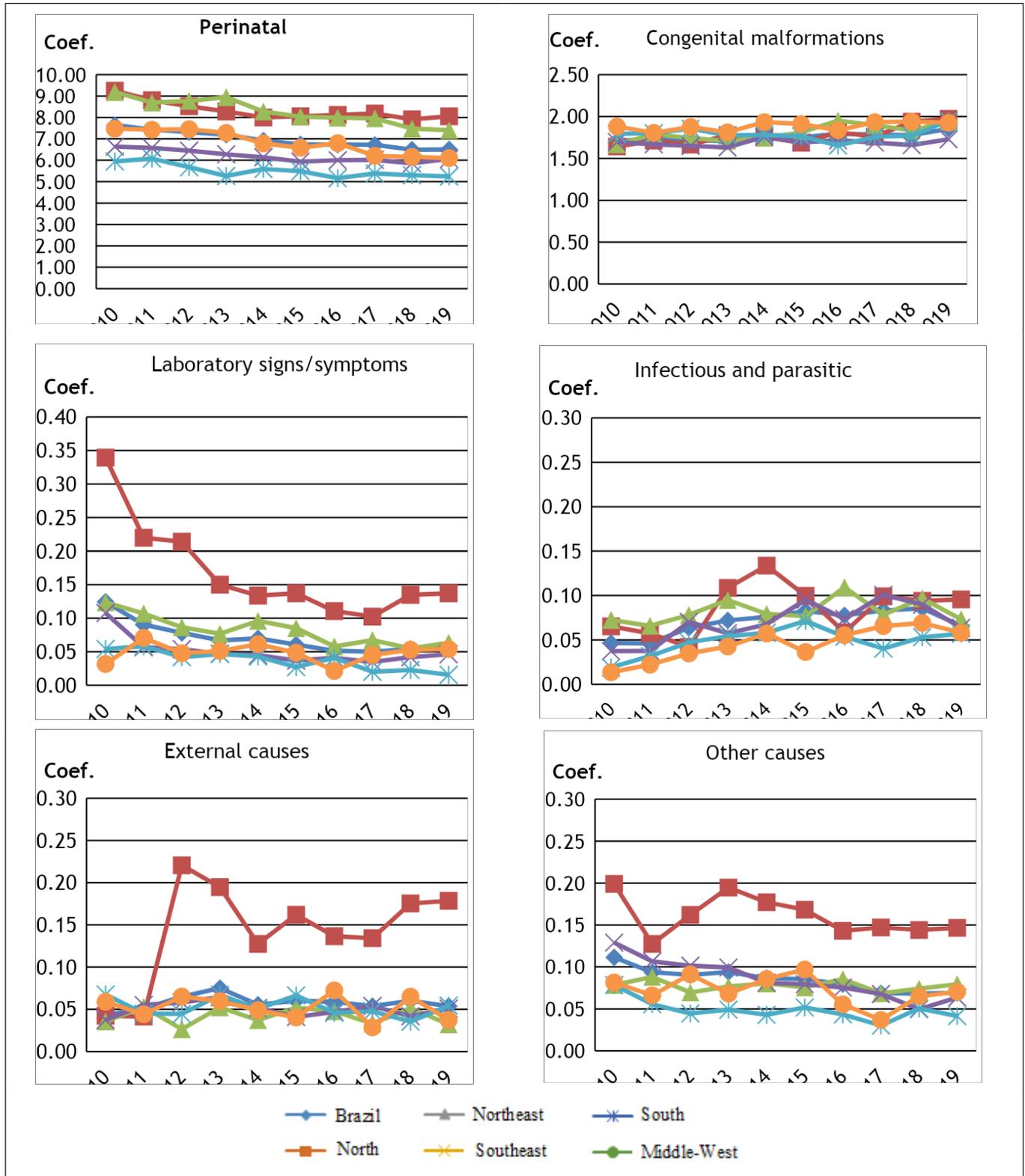


Table 2 – Neonatal mortality (number, percentage, and coefficient per 1000 live births), according to underlying cause and region. Brazil, 2019

Causes	North			Northeast			Southeast			South			Midwest			Brazil		
	n	%	Coef.	n	%	Coef.												
Cap XVI - Perinates																		
P00 Fet rec-nasc afec afec mat n obr rel grav at	260	10,9	0,83	617	10,4	0,77	810	12,1	0,73	281	13,9	0,73	218	14,8	0,90	2186	11,8	0,77
P22 Newborn respiratory distress	313	13,2	1,00	654	11,0	0,81	777	11,6	0,70	217	10,7	0,56	143	9,7	0,59	2104	11,3	0,74
P36 Bacterial sepsis of the newborn	301	12,6	0,96	806	13,5	1,00	912	13,6	0,83	228	11,3	0,59	178	12,1	0,74	2425	13,1	0,85
Other perinatal	1509	63,3	4,81	3884	65,1	4,82	4189	62,7	3,80	1299	64,1	3,36	932	63,4	3,87	11813	63,8	4,15
Total	2383	100	7,60	5961	100	7,40	6688	100	6,06	2025	100	5,24	1471	100	6,10	18528	100	6,50
Chap XVII - Congenital Malformations																		
Q89 Other congenital malformations NCOP	95	16,0	0,30	231	14,8	0,29	240	12,6	0,22	76	10,1	0,20	45	9,7	0,19	687	13,0	0,24
Q24 Other congenital malformations of the heart	108	18,2	0,34	342	21,9	0,42	292	15,3	0,26	111	14,7	0,29	88	19,0	0,37	941	17,8	0,33
Q33 Congenital malformations of the lung	37	6,2	0,12	120	7,7	0,15	212	11,1	0,19	61	8,1	0,16	47	10,1	0,19	477	9,0	0,17
Other congenital malformations	353	59,6	1,13	870	55,6	1,08	1162	61,0	1,05	505	67,1	1,31	284	61,2	1,18	3174	60,2	1,11
Total	593	100	1,89	1563	100	1,94	1906	100	1,73	753	100	1,95	464	100	1,92	5279	100	1,85
Chap I - Infectious and Parasitic Diseases																		
A50 Congenital syphilis	15	65,2	0,05	41	69,5	0,05	63	90,0	0,06	18	81,8	0,05	11	78,6	0,05	148	78,7	0,05
A09 Diarrhea and gastroenteritis orig.	2	8,7	0,01	6	10,2	0,01	4	5,7	0,00	2	9,1	0,01	2	14,3	0,01	16	8,5	0,01
B99 Infectious disease other and NE	0	0	0,00	8	13,5	0,01	1	1,4	0,00	0	0	0,00	0	0	0,00	9	4,8	0,00
Other Infectious and Parasitic	6	26,1	0,02	4	6,8	0,00	2	2,9	0,00	2	9,1	0,01	1	7,1	0,00	15	8,0	0,01
Total	23	100	0,07	59	100	0,07	70	100	0,06	22	100	0,06	14	100	0,06	188	100	0,07
Chap XVIII - Laboratory Signs and Symptoms																		
R95 Sudden death syndrome in infancy	12	31,6	0,04	18	35,3	0,02	21	41,2	0,02	3	50,0	0,01	3	23,1	0,01	57	35,8	0,02
R98 Death without assistance	21	55,3	0,07	11	21,6	0,01	9	17,6	0,01	1	16,7	0,00	3	23,1	0,01	45	28,3	0,02
R99 Other ill-defined causes and NE mortality	2	5,2	0,01	17	33,3	0,02	14	27,5	0,01	1	16,7	0,00	7	53,8	0,03	41	25,8	0,01
Other signs/symptoms/laboratory findings	3	7,9	0,01	5	9,8	0,01	7	13,7	0,01	1	16,6	0,00	0	0	0,00	16	10,0	0,01
Total	38	100	0,12	51	100	0,06	51	100	0,05	6	100	0,02	13	100	0,05	159	100	0,06
Chap XX - External Causes																		
W78 Inhalation of gastric contents	2	4,9	0,01	9	34,6	0,01	13	23,2	0,01	8	38,1	0,02	2	22,2	0,01	34	22,2	0,01
Y09 Assault by means NE	27	65,9	0,09	0	0	0,00	1	1,8	0,00	0	0	0,00	1	11,1	0,00	29	19,0	0,01
Y34 NE facts or events and intent not determined	2	4,9	0,01	5	19,3	0,01	10	17,9	0,01	1	4,7	0,00	1	11,1	0,00	19	12,4	0,01
W84 NE breathing hazards	1	2,4	0,00	1	3,8	0,00	14	25,0	0,01	1	4,8	0,00	0	0	0,00	17	11,1	0,01
Other external causes	9	21,9	0,03	11	42,3	0,01	18	32,2	0,02	11	52,4	0,03	5	55,6	0,02	54	35,3	0,02
Total	41	100	0,13	26	100	0,03	56	100	0,05	21	100	0,05	9	100	0,04	153	100	0,05
Other causes	46		0,15	64	100	0,08	70	100	0,06	16	100	0,04	17	100	0,07	197	100	0,07
Total	3124	100	9,96	7724	100	9,59	8841	100	8,02	2843	100	7,36	1988	100	8,25	24504	100	8,60

analyzing the data regarding neonatal mortality in the year 2019, it can be observed that malformations are present with an incidence > 1.90 in the southern, northeastern, and midwestern regions. It is assumed that one of the reasons for congenital malformations stems from pregnancy occurring after the age of 35, as it is an age group that can increase the likelihood of congenital malformations. Thus, maternal age over 35 years is an important risk factor for congenital malformation and chromosomal abnormalities such as Down Syndrome, with the risk increasing as the maternal age increases.¹⁶

On the other hand, congenital malformations also affect adolescent mothers under the age of 20, the most frequent being gastroschisis and other vascular disruptions, as well as low birth weight and prematurity. Congenital malformations also vary in different ethnic groups, such as in blacks, where the most frequent is postaxial polydactyly, while in whites, heart diseases, anencephaly and spina bifida are the most prevalent.¹⁶

Among congenital malformations, heart disease has been the most prevalent and has a high mortality rate in the first year of life.¹⁷ Musculoskeletal malformations also have a high prevalence, but they are visible at birth, which increases the possibility of detection. These can be recognized prenatally, through morphological ultrasonography and nuchal translucency measurement, favoring a safe postpartum diagnosis.¹² Thus, the greater availability of prenatal imaging tests is necessary for early diagnosis of various malformations.¹⁸

The factors associated with a higher chance of congenital malformation are malnutrition, maternal infections during pregnancy, maternal exposure to teratogenic substances such as illicit drugs, medication, alcohol, and advanced age of the mother. Maternal diseases and infections may increase the risk for abnormalities in newborns, such as Diabetes Mellitus, which in the pregestational and gestational phase affects especially the central nervous system and the cardiovascular system. Infectious diseases during pregnancy can also result in abnormalities, such as toxoplasmosis (hydrocephalus), rubella (heart disease and blindness), and herpes simplex (microcephaly), among others.¹⁶

It is observed that laboratory signs and symptoms showed a significant drop throughout the period studied, but in 2019 the northern region showed a slight increase, signaling for preventive measures in care by health professionals, especially during childbirth and postpartum, in order to predict and avoid complications.

The external causes presented a slight decrease in relation to the year 2010, however the Northern region presented a coefficient > 0.20 , in this way it may be that it is related to the outbreak of Dengue and Chikungunya experienced in the region. From 2017 to 2019, the North region presented a neonatal mortality rate by external causes < 0.20 , but with an increase in the year 2017. It should be noted that the respective rates may also be associated with failures in the filling of the cause of death, which may cause an increase or decrease in the coefficient.

CONCLUSION

Although it is known that there are other factors that corroborate these rates, such as socioeconomic conditions, culture, and education, this study made it possible to identify the regions where pregnant women and children are more vulnerable to health care, i.e., the regions with higher percentages of neonatal mortality. There is a need for better planning of neonatal health care, reinforcing that it should start in the early stages of pregnancy, with prenatal care and monitoring of babies throughout their development.

The results presented in this study also indicate that some regions, such as the North, Northeast, and Midwest, need more specific studies to better identify the high rates of neonatal mortality, especially from perinatal causes, i.e., causes that could be avoided. Furthermore, they reinforce some conclusions already presented by the literature on the subject, one of which is the concern with the high neonatal mortality coefficients in the world and in Brazil, showing the need for investments in infrastructure, but also in the training of professionals who work directly with pregnant women.

Following the example of other countries, in Brazil some programs for the care of pregnant women have been established, with emphasis on a greater follow-up during the prenatal period, clarification lectures, but there is still much to be done, especially regarding the qualification of health professionals, especially in the care of pregnant and postpartum women. It is necessary that services and health professionals also develop strategies for early recruitment and accessibility of pregnant women, enabling a comprehensive and quality maternal and child health care. Thus, this study can serve as a subsidy for the development of actions to confront and prevent this problem in all regions of Brazil.

The study found limits in updating the data due to the pandemic of COVID-19, because the most recent data found refer to 2019. This signals the need for the creation of a more computerized system, which enables real-time data so that the alternatives of assistance can also be planned in real time, providing an opportunity to reduce neonatal deaths in the Brazilian reality more effectively.

The conclusions are concluded emphasizing the importance of the qualification of prenatal care, since it has been highlighted as a determining factor in the positive outcomes of pregnancy, as it allows a decrease in neonatal mortality coefficients. It is also emphasized the importance of a better preparation of the professionals who work in the administrative part, in order to fidelize the data and enable improvements in the infrastructure and preventive care in the regions that have the highest concentration of deaths.

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