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RESEARCH

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NEONATAL MORTALITY IN PERNAMBUCO: TREND, GEOGRAPHICAL DISTRIBUTION AND PROFILE OF DEATHS FROM 2008 TO 2017

Mortalidade neonatal em Pernambuco: tendência, distribuição geográfica e perfil dos óbitos de 2008 a 2017
Mortalidad neonatal en Pernambuco: tendencia, distribución geográfica y perfil de muertes de 2008 a 2017

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ABSTRACT

Objective: to perform a temporal and spatial analysis of neonatal mortality in the state of Pernambuco, Brazil. **Methods:** ecological study based on DATASUS, whose population consisted of the live births of mothers living in Pernambuco and neonatal deaths in the first 27 days of life. The analysis of the neonatal mortality trend was performed using the Simple Linear Regression method, and the analysis of the maternal, neonatal and childbirth variables were performed using the Chi-square test, both using the RStudio program version 1.3.1073. Geographical distribution was analysed through Tabwin (version 3.2). **Results:** the decrease of neonatal mortality and its early component were more relevant ($p < 0,05$) when compared to its late component. The VII Health Region (Salgueiro) had the highest rate in the period. **Conclusion:** although a decrease in Pernambuco's neonatal mortality, it still is above national average, which indicates the need for more assertive strategies in Health & Care field to face this regional problem.

DESCRIPTORS: Indicators of morbidity and mortality; Infant mortality; Epidemiology; Information systems; Vital statistics.

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RESUMO

Objetivo: realizar uma análise temporal e espacial da mortalidade neonatal em Pernambuco no período de 2008 a 2017. **Método:** estudo ecológico com base no Datasus cuja população foi constituída pelos nascidos vivos de mães residentes em Pernambuco e pelos óbitos neonatais nos primeiros 27 dias de vida. A análise da tendência da mortalidade neonatal foi realizada através da Regressão Linear Simples, e a das variáveis maternas, neonatais e relacionadas ao parto pelo teste Qui-quadrado pelo programa RStudio versão 1.3.1073. Na análise da distribuição geográfica usou-se o Tabwin versão 3.2. **Resultados:** o declínio da mortalidade neonatal e do seu componente precoce foram mais significativos ($p < 0,05$) em comparação ao tardio. A VII Região de Saúde (Salgueiro) apresentou a maior taxa do período. **Conclusão:** apesar do declínio da mortalidade neonatal em Pernambuco, essa permanece superior à nacional, indicando a necessidade de estratégias mais assertivas em saúde para o enfrentamento do problema Estadual.

DESCRITORES: Indicadores de morbimortalidade; Mortalidade infantil; Epidemiologia; Sistemas de informação; Estatísticas vitais.

RESUMEN

Objetivo: realizar un análisis temporal y espacial de la mortalidad neonatal en Pernambuco en el período 2008 al 2017. **Método:** estudio ecológico basado en Datasus cuya población consistió en nacidos vivos de madres residentes en Pernambuco y muertes neonatales en los primeros 27 días de vida. El análisis de la tendencia de la mortalidad neonatal se realizó mediante regresión lineal simple y el análisis de las variables maternas, neonatales y relacionadas al parto mediante la prueba de Chi-cuadrado, ambos utilizando el programa RStudio versión 1.3.1073. En el análisis de distribución geográfica se utilizó la herramienta Tabwin versión 3.2. **Resultados:** la disminución de la mortalidad neonatal y el período temprano fue más significativa ($p < 0.05$) en comparación con el período tardío. La VII Región de Salud (Salgueiro) tuvo la tasa más alta. **Conclusión:** a pesar de la disminución de la mortalidad neonatal en Pernambuco, este es superior a la tasa nacional, lo que indica la necesidad de estrategias de salud más assertivas para enfrentar el problema del Estado.

DESCRIPTORES: Indicadores de morbimortalidad; Mortalidad infantil; Epidemiología; Sistemas de información; Estadísticas vitales.

INTRODUCTION

The most critical age for child survival corresponds to the neonatal period, which comprises the first 27 days after birth. Within this period, the number of early deaths (which occur from 0 to 6 days) is predominant in relation to late deaths (which occur from 7 to 27 days).¹ Although there is a worldwide trend toward reduction of infant mortality rates in the last decade, estimates show a lower reduction when the neonatal component is analyzed alone.² In Brazil, the difference in reduction was also discrepant, especially in the North and Northeast regions, which highlights the regional and socioeconomic inequalities in the country.^{1,3,4}

Prematurity, infections, congenital anomalies, and intrapartum complications such as asphyxia were configured as the main causes of neonatal death in the world in 2018, with socioeconomic conditions being one of the main social determinants related to mortality. In Brazil, what prevails as a cause of deaths are perinatal disorders, with emphasis on prematurity and sequelae such as NB respiratory distress, necrotizing enterocolitis, hyaline membrane disease, specific infections of the perinatal period, and asphyxia.^{2,4,5}

According to the literature, five main causes of neonatal mortality are found in the municipalities of Pernambuco: prematurity, hypoxia, maternal illnesses and complications, congenital malformations, and complications at the time of delivery. Similar to the national trend, prematurity is highlighted among the main

causes of neonatal death, which indicates inadequate prenatal, delivery, and newborn care in the state.^{4,6}

Studies show that in Brazil, 60% of infant deaths and 80% of neonatal deaths are considered preventable, which can be ratified by the association between the care process and perinatal outcomes. This is because unequal access to health services and problems in their resolution capacity certainly impact the number of neonatal deaths.⁷

Thus, the reduction in mortality can be linked to changes in the living conditions of the population and in public health policies. With this in mind, the countries of the United Nations (UN) have assumed as one of the Millennium Development Goals (MDG) the reduction of infant mortality. According to Agência Brasil, the reduction of infant mortality in the country relies on exemplary efforts, such as the National Immunization Program (PNI), basic care in poor communities, the National Newborn Screening Program (PNTN), policies to improve prenatal care, and incentives for family planning. However, the Ministry of Health admits that there is still much to be done to improve the indicators and ensure comprehensive care to children as provided by the Federal Constitution and the Statute of the Child and Adolescent.^{4,8,9}

Considering the close relationship between the quality of peripartum care and neonatal deaths, the study in question is an important tool to make this issue visible and to support interventions. Thus, this study aims to perform a temporal and spatial analysis of neonatal mortality in Pernambuco from 2008 to 2017.

METHODS

This is an ecological, descriptive study on neonatal mortality in the state of Pernambuco in the period from 2008 to 2017. The state of Pernambuco is composed of 185 municipalities and have a resident population of 9,496,294 inhabitants, in 2018, distributed in 12 Health Regions that mobilize the spatial and structural logic of health care in the state: I Region – Recife; II Region – Limoeiro; III Region – Palmares; IV Region – Caruaru; V Region – Garanhuns; VI Region - Arcoverde; VII Region – Salgueiro; VIII Region – Petrolina; IX Region – Ouricuri; X Region – Afogados da Ingazeira; XI Region - Serra Talhada; XII Region – Goiana.¹⁰

The study population consisted of live births of mothers residing in Pernambuco and neonatal deaths, occurring within the first 27 full days of life, in the period from 2008 to 2017. Chapter XVI (Some conditions arising in the perinatal period) of ICD-10, corresponding to events occurring in the perinatal period that compromise the health of the fetus or child and increase the risk of deaths, was chosen to be analyzed in this study because it accounts for a large portion of infant deaths in Brazil.¹¹

The deaths coded in chapter XVII (ICD-10) referring to “Congenital malformations, deformities, and chromosomal anomalies”, despite being the second leading cause of neonatal death, were not subject to analysis due to the difficulty of prevention and the low offer of early diagnostic interventions available by the Brazilian National Health System for such diseases.¹²

The Neonatal Mortality Rate (NMR) indicator was used to analyze mortality in Brazil, Pernambuco, and its Health Regions. To calculate the NMR, the numerator used was the deaths that occurred until the 27th day of life and the denominator was the number of live births (LB) multiplied by 1000. The NMR allows the analysis of temporal, population and geographical variations, in addition to identifying situations that require specific studies and allowing comparisons.¹³ The indicators Early Neonatal Mortality Rate (ENMR) and Late Neonatal Mortality Rate (LNMR) were also calculated, considering the age groups from 0 to 6 days of life and from 7 to 27 days of life, respectively. Data regarding births and deaths were collected, respectively, through the Live Births Information System (SINASC) and the Mortality Information System (SIM), available from the Unified Health System Informatics Department (Datasus).

In order to analyze the profile of neonatal deaths, data were also collected according to the following variables:

- Maternal variables: mother’s age (10 to 19; 20 or more years) and education (none; 1 or more years of study);
- Pregnancy and delivery related variables: type of delivery (vaginal; cesarean), duration of gestation (up to 26 weeks; 27 weeks or more);
- Variables related to the child: sex (male; female) and birth weight (< 2,500 grams; ≥ 2,500 grams).

In order to analyze the temporal trend of infant mortality and its components, in the study period, we used the Simple Linear Regression method, through the RStudio program version 1.3.1073, considering a significance level of 0.05. The NMRs, as well as their early and late components, were considered the dependent variables and the year as the independent variable. For comparison purposes, the neonatal mortality rates of the state of Pernambuco were compared to those of Brazil in the same reference period. This analysis was also applied to the Health Regions of the state of Pernambuco and to the causes of deaths by ICD-10, in order to identify those that showed an increase, decrease, or stability in the period from 2008 to 2017. The adequacy of the regression models was tested through the analysis of the residuals (normality, homoscedasticity, and absence of autocorrelation).

For the geographic analysis, the NMR was calculated for each municipality in Pernambuco in the cumulative period from 2008 to 2017, which allowed us to analyze the distribution of the indicator in the state’s Health Regions. It is important to note that the subdivision of the state in Regions allows to congregate several municipalities of a geographical area with economic and social similarities. For this, the parameters for classifying the indicator were elaborated from quartiles, through statistical methods, and classified as: low (0.00 – 6.11); moderate 1 (6.12 – 7.38); moderate 2 (7.39 – 9.47) and high (9.48 – 17.06).

Regarding the analysis of the variables related to the mother, delivery and child, the specific Neonatal Mortality Rate was calculated, relating the deaths and births that presented the same characteristics, such as number of deaths in children who were born with low weight divided by the total number of children who were born with low weight in the same period × 1000. To verify whether there was a statistically significant difference between the adjusted neonatal mortality rates for each variable, the Chi-square (χ^2) test was used at a 5% significance level.

This study was conducted exclusively with publicly accessible secondary data without identifying subjects, and did not need to be registered or reviewed by the Research Ethics Committee, in accordance with resolutions No.466, of December 12, 2012, and No.510, of April 7, 2016, of the National Health Council (CNS).

RESULTS

Between 2008 and 2017, there were 13,946 deaths in the neonatal age group in Pernambuco, considering all ICD 10 chapters, and 1,401,654 births. Of the deaths, 10,819 (77.6%) occurred in the first week of life.

The Early Neonatal Mortality Rate considering Chap. XVI was 7.598 deaths per 1000 LB, showing a variation from 8.79 deaths/1000 LB in 2008 to 6.35 deaths/1000 LB in 2017, while the late one was 1.64 deaths/1000 LB in 2008 and 1.35 deaths/1000 LB in 2017.

It can be seen that Brazil and the state of Pernambuco have a similar profile of mortality rate decline in all components in this time frame (Figure 1). It is worth noting the data for the year 2009, in the period analyzed, in which Pernambuco's NMR (9.24) showed greater variation compared to Brazil (8.06) in the same year.

To better understand this decline, a regression analysis of the NMR, ENMR, and LNMR was performed, as schematized in Table 1. From this, it can be understood that the decline in the neonatal and early neonatal components were more significant ($p < 0.05$) compared to the late neonatal component. The equations show that for each increment of variable X (year) there is a reduction of 0.27 in the Neonatal Mortality Rate and 0.23 in the Early Neonatal Mortality Rate.

The analysis of the Health Regions, based on data collected from Chapter XVI of ICD-10, demonstrated that Region VII (Salgueiro) had the highest NMR in the period (11.46 deaths/1000 LB), while Region II (Limoeiro) had the lowest (6.43 deaths/1000 LB) (Table 2 and Figure 2). Additionally, Health Regions I, II and III presented a higher percentage of their municipalities classified in the first 2 quartiles (low and moderate 1); Regions IV and V had more municipalities concentrated in the third quartile

(moderate 2); and Regions VI, VII, VIII, IX and XI presented a more worrisome situation with a large part of the municipalities classified in the fourth quartile (high).

Analyzing each Health Region along the studied period (Table 3), it was observed that there was a decreasing tendency ($p\text{-value} < 0.05$) in the Neonatal Mortality Rate in the following regions: Recife (I), Palmares (III), Caruaru (IV), Arcoverde (VI), Afogados da Ingazeira (X), Goiana (XII).

Table 4 shows the distribution of NMR according to birth weight, type of delivery, gestation length, age, and education of the mother. As for birth weight, it was found that live births with low birth weight had an adjusted Neonatal Mortality Rate of 70.36 deaths per 1000 live births, significantly higher when compared to mortality in children born with normal weight (1.88 deaths per 1000 live births). The length of gestation also showed a high neonatal mortality for children born at less than 37 weeks (54.61 deaths per 1000 live births). Information regarding the mother showed a significantly higher difference for mothers with no education and aged between 10 and 19 years. However, the type of delivery showed the highest neonatal mortality for children born by vaginal delivery (9.71 deaths per 1000 live births) compared to cesarean delivery (4.79 deaths per 1000 live births).

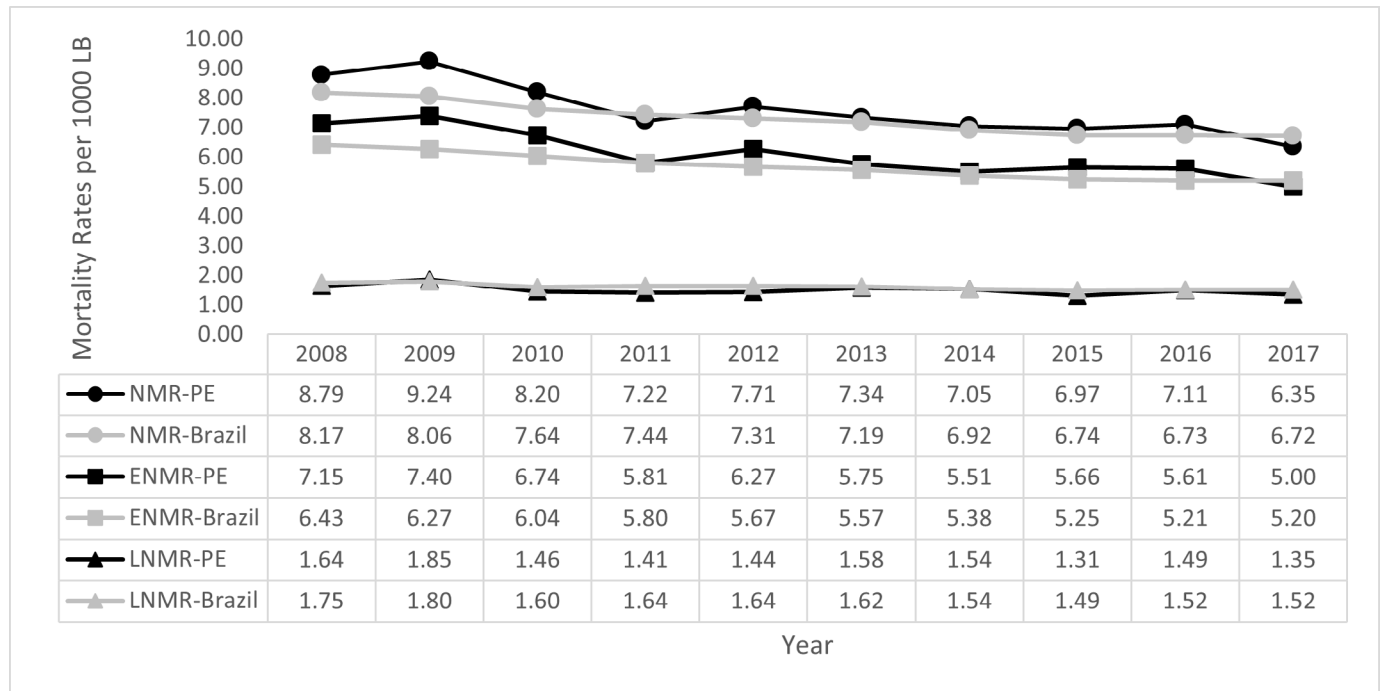


Figure 1 – Trends in Neonatal Mortality Rates from Chap. XVI of the ICD-10 (per 1000 live births) in Brazil and Pernambuco, 2008 to 2017. Source: DATASUS/SIM and SINASC.

Table 1 – Trends in Neonatal, Early Neonatal and Late Neonatal Mortality Rates according to Chap. XVI in Pernambuco, 2008-2017.

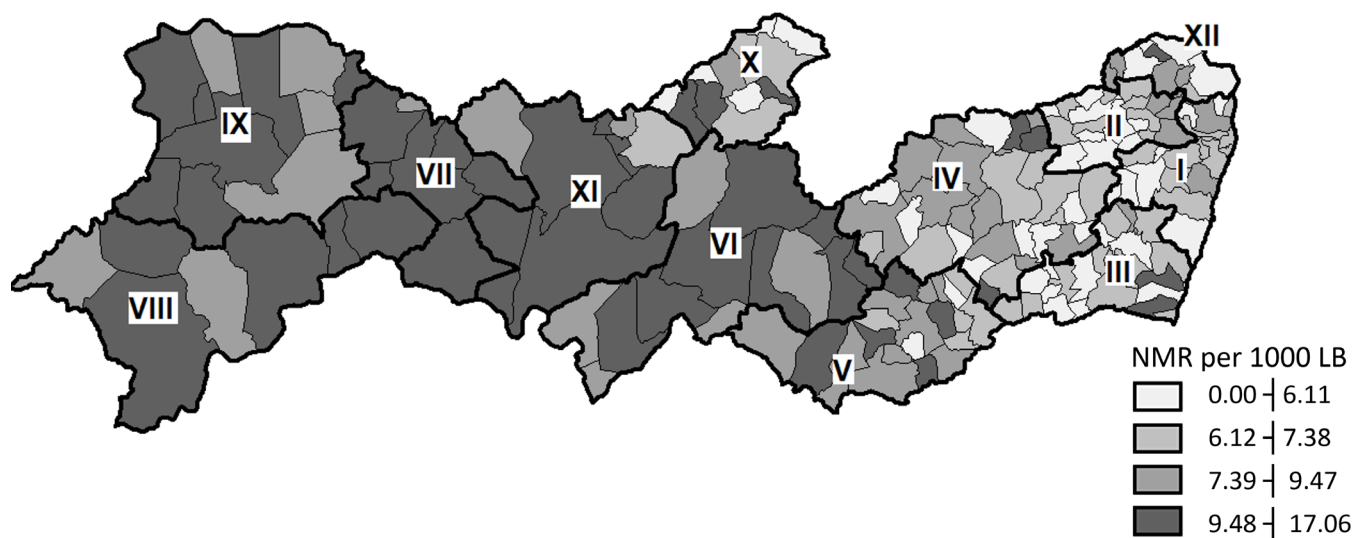
Indicator	Equation	R ²	p-value	Trend
NMR	$y = 543.04 - 0.27x$	0.81	0.000*	Decreasing
ENMR	$y = 478.11 - 0.23x$	0.84	0.000*	Decreasing
TNMR	$y = 66.76 - 0.03x$	0.39	0.053	–

*Statistically significant p-value ($p < 0.05$).

Table 2 – Distribution of municipalities in Pernambuco by health region, according to Neonatal Mortality Rate (Chap. XVI), 2008-2017.

Health Regions	NMR/1000LB	Number of cities in the Region	Low 0–6.11		Moderate 1 6.12–7.38		Moderate 2 7.39–9.47		High 9.48–17.06	
			n	%	n	%	n	%	n	%
I – Recife	6.66	20	7	35.0	10	50.0	2	10.0	1	5.0
II – Limoeiro	6.43	20	8	40.0	9	45.0	3	15.0	0	0.0
III – Palmares	6.83	22	7	31.8	11	50.0	2	9.1	2	9.1
IV – Caruaru	7.32	32	9	28.1	9	28.1	11	34.4	3	9.4
V – Garanhuns	8.38	21	2	9.5	3	14.3	10	47.6	6	28.6
VI – Arcoverde	9.90	13	0	0.0	0	0.0	5	38.5	8	61.5
VII – Salgueiro	11.46	7	0	0.0	0	0.0	1	14.3	6	85.7
VIII – Petrolina	9.82	7	0	0.0	0	0.0	2	28.6	5	71.4
IX – Ouricuri	10.52	11	0	0.0	0	0.0	4	36.4	7	63.6
X – Afogados da Ingazeira	7.53	12	5	41.7	2	16.7	2	16.7	3	25.0
XI – Serra Talhada	11.06	10	0	0.0	1	10.0	2	20.0	7	70.0
XII – Goiana	6.82	10	4	40.0	1	10.0	4	40.0	1	10.0

Source: DATASUS/SIM and SINASC

**Figure 2** – Distribution of municipalities in Pernambuco by health region, according to Neonatal Mortality Rate (Chap. XVI), 2008-2017.

Source: DATASUS/SIM and SINASC

Table 3 – Trends in Neonatal Mortality Rate by health region in Pernambuco, 2008-2017.

Health Regions	Equation	R ²	p-value	Trend
I – Recife	$y = 403.44 - 0.20x$	0.631	0.006*	Decreasing
II – Limoeiro	$y = 564.17 - 0.28x$	0.368	0.063	–
III – Palmares	$y = 657.30 - 0.32x$	0.633	0.006*	Decreasing
IV – Caruaru	$y = 420.54 - 0.20x$	0.863	0.000*	Decreasing
V – Garanhuns	$y = 542.57 - 0.26x$	0.390	0.053	–
VI – Arcoverde	$y = 754.47 - 0.37x$	0.684	0.003*	Decreasing
VII – Salgueiro	$y = 1,205.30 - 0.59x$	0.384	0.056	–
VIII – Petrolina	$y = 409.65 - 0.20x$	0.259	0.133	–
IX – Ouricuri	$y = 668.97 - 0.33x$	0.302	0.100	–
X – Afogados da Ingazeira	$y = 1,041.80 - 0.51x$	0.426	0.041*	Decreasing
XI – Serra Talhada	$y = 1,082.20 - 0.53x$	0.369	0.062	–
XII – Goiana	$y = 746.39 - 0.37x$	0.410	0.046*	Decreasing

Note: R2: determination coefficient.*Statistically significant p-value ($p < 0.05$).

Source: DATASUS/SIM and SINASC.

Table 4 – Distribution of Neonatal Mortality Rates according to variables related to pregnancy/delivery, mother and child in Pernambuco, 2008 to 2017.

VARIABLES	Newborn Death	Birth	NMR	p-value
Birth weight				
Low weight	7,651	108,738	70.36	0.000
Normal weight	2,424	1,290,723	1.88	
Delivery tipe				
Vaginal	6,733	693,329	9.71	0.000
Cesarean	3,384	706,700	4.79	
During of pregnancy				
<37 weeks	7,413	135,744	54.61	0.000
>=37 weeks	2,163	1,209,507	1.79	
Mother's education				
None	512	22,073	23.20	0.000
1 or more years	9,045	1,361,636	6.64	
Mother's age				
10 to 19 years	2,604	294,439	8.84	0.000
20 or more years	7,304	1,089,263	6.71	

Source: DATASUS / SIM and SINASC.

DISCUSSION

Despite the reduction in neonatal mortality observed, it is still higher in the state of Pernambuco than the national mortality, and the early neonatal component predominates, which is also observed nationally. It is estimated that in Brazil approximately 25% of neonatal deaths occur within the first 24 hours of life, demonstrating the intrinsic relationship with peripartum care.¹

When analyzing the temporal evolution in the state, one notices a greater percentage drop in the early neonatal component. However, mortality in this age group is still predominant

among cases of death in the neonatal period.¹⁴ Moreover, the early neonatal component in the state of Pernambuco presents TNT with higher rates compared to Brazil in the studied period.

The declining trend of NCD can be attributed to improvements in health care from national and international programs and public policies for the child population. The institution of the Millennium Development Goals by the UN in the 2000s helped not only Brazil, but also 190 other countries to set goals to reduce infant mortality by two-thirds in children under five years between the years 1990 and 2015. In addition, Brazil has income distribution policies (Bolsa Família) and the Family

Health Strategy. Thus, the Brazilian goal set for 2015 was achieved in 2011 when the Infant Mortality Rate (IMR) showed a value of 15.3 per 1000 live births.^{15,16}

According to studies, the same profile of decline in the Neonatal Mortality Rate can be observed in Piauí (2007-2016) and Rio Grande do Norte (2003-2012) and this is attributed to the improvements coming with the implementation of the Stork Network Program and Program for Humanization of Prenatal and Birth (PHPN).^{14,17} As for the health regions of the state of Pernambuco, neonatal mortality is not homogeneously distributed. According to the literature, this can be justified by socioeconomic differences and differences in access to health services between urban and rural regions and municipal health expenditure per inhabitant.^{18,19}

Regarding the variables analyzed, the profile is similar to what is pointed out in the literature as the influence of prematurity and low birth weight on neonatal mortality. This is because preterm birth is associated with a higher frequency of problems such as respiratory distress, sepsis, hypothermia, hypoglycemia, hyperbilirubinemia, intracranial hemorrhage, patent ductus arteriosus, and necrotizing enterocolitis. There is, therefore, an inverse relationship between mortality and gestation length.²⁰

It is also worth noting that low birth weight, observed in a higher proportion of neonatal deaths in the study, is considered a determinant and isolated predictor of mortality. In a prospective cohort study, for example, it was found that 76% of very low birth weight preterm infants died on the first day of life in the Northeast region.^{3,4}

In this study, the largest portion of the mothers were young and those with low education, both of which are considered factors associated with neonatal mortality, since they are related to the mother's and child's health care. In this context, it should be noted that younger age and low education are considered risk factors with regard to prenatal care. This is because it is suggested that they are associated with lower adherence to such assistance, greater difficulty in understanding the health condition that involves the pregnancy cycle, and lack of knowledge about the risks.²¹

According to the literature, the higher educational level of the patient facilitates access and correct use of health services. In Brazil, the educational level of women indicates improvements in conjunction with child health indicators. This progress has enabled the country to reach the Millennium Goal goal of reducing mortality before the established deadline.^{14,22}

The study by Fonseca et al (2017), states that the state of Rio de Janeiro shows a drop in NCM in groups of pregnant women with intermediate to advanced schooling. Thus, it is possible to identify that vulnerable groups raise the issue of social inequality and the persistence of inequities of NMR.

The relevance of the continuous production of information about the problem is perceived in order to raise actions for its control as the qualification of perinatal care and the guarantee of access in a resolute way, thus assisting in decision making

and planning of assertive public policies. The present study thus provides elements for tackling the problem.

It is worth noting, however, that the use of secondary data related to deaths and births from health information systems is subject to limitations due to failures in filling out notification forms. The number of live births, for example, may be underestimated due to inadequate classification of the death as stillbirth, when in fact it occurred shortly after birth.¹³

CONCLUSION

The Neonatal Mortality Rate in Pernambuco showed a decreasing trend in the period from 2008 to 2017. Still, the state presents data that are above the national trend and heterogeneity among its health regions, being the Salgueiro region, the one with the highest rate in the period. It is important to emphasize the need to reduce these numbers when considering their relevance as an indicator of the quality of local care. The research, therefore, aims to subsidize health actions by revealing the epidemiological situation of neonatal mortality in the state of Pernambuco over the past 10 years.

REFERENCES

1. Lansky S, Friche AAL, Silva AAM, Campos D, Bittencourt SDA, Carvalho ML et al. Pesquisa Nascer no Brasil: perfil da mortalidade neonatal e avaliação da assistência à gestante e ao recém-nascido. *Cad. Saúde Pública*. [Internet]. 2014 [acesso em 24 de dezembro 2020];30, S192-S207. Disponível em: <https://scielosp.org/article/csp/2014.v30suppl1/S192-S207/#:~:text=Nascer%20no%20Brasil%20%C3%A9%20um,foi%20selecionada%20em%20tr%C3%AAs%20est%C3%A1gios>.
2. United Nations Children's Fund. Levels and trends in child malnutrition: Report 2019 - Estimates developed by the UN Inter-agency Group for Child Mortality Estimation [Internet]. 2019 [cited 2020 dec 24]. Available from: <https://www.unicef.org/media/60561/file/UN-IGME-child-mortality-report-2019.pdf>.
3. Veloso FCS, Kassar LML, Oliveira MJC, Lima THB, Bueno NB, Gurdez RQ et al. Analysis of neonatal mortality risk factors in Brazil: a systematic review and meta-analysis of observational studies. [Internet]. *J Pediatr*. 2019 [cited 2020 dec 24];95(5). Available from: <https://pubmed.ncbi.nlm.nih.gov/31028747/>.
4. Ministério da Saúde (BR). Secretaria de Ciência, Tecnologia e Insumos Estratégicos. Síntese de Evidências para Políticas de Saúde: mortalidade perinatal [Internet]. 2. ed. Brasília: Ministério da Saúde; 2012 [acesso em 24 de dezembro de 2020]. Disponível em: https://bvsms.saude.gov.br/bvs/publicacoes/sintese_evidencias_mortalidade_perinatal.pdf.
5. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Secretaria de Atenção à Saúde. Manual de vigilância

- do óbito infantil e fetal e do Comitê de Prevenção do Óbito Infantil e Fetal [Internet]. 2. ed. Brasília: Ministério da Saúde; 2009 [acesso em 24 de dezembro de 2020]. Disponível em: https://bvsm.sau.gov.br/bvs/publicacoes/manual_obito_infantil_fetal_2ed.pdf.
6. Bezerra NF, Rassy MBC, Alves BLA, Carvalho TCN, Bandeira FJS. Fatores relacionados à mortalidade neonatal. *Rev Enferm UFPE online* [Internet]. 2016 [acesso em 24 de dezembro 2020];10(11). Disponível em: <https://periodicos.ufpe.br/revistas/revistaenfermagem/article/view/11477>.
 7. Lansky S et al. Mortalidade infantil: tendências da mortalidade neonatal e pós neonatal em 20 anos do SUS. Brasília: Ministério da Saúde; 2009.
 8. Moreira LMC, Alves CRL, Belisário SA, Bueno MC. Políticas públicas voltadas para a redução da mortalidade infantil: uma história de desafios. *Revista Médica de Minas Gerais*. [Internet]. 2012 [acesso em 24 de dezembro 2020];22 (supl. 7). Disponível em: <https://pesquisa.bvsalud.org/ripsa/resource/pt/biblio-868402>,
 9. Ronchini CE, Franchini AA, Siviero PCL. Mortalidade Infantil e na Infância no Brasil de 1990 a 2011: Acompanhamento dos Objetivos de Desenvolvimento do Milênio (ODMs). *Cadernos de Estudos Interdisciplinares* [Internet]. 2014 [acesso em 24 de dezembro 2020];1(1). Disponível em: <https://publicacoes.unifal-mg.edu.br/revistas/index.php/cei/article/view/265>.
 10. Instituto Brasileiro de Geografia e Estatística [homepage na internet]. Pernambuco: população [acesso em 25 de dezembro de 2020]. Disponível em: <https://cidades.ibge.gov.br/brasil/pe/panorama>.
 11. Lansky S, França E. Mortalidade infantil neonatal no Brasil: situação, tendências e perspectivas. In: Rede Interagencial de Informações para Saúde. *Demografia e saúde: contribuição para análise de situação e tendências*. Brasília: OPAS, 2009 [acesso em 24 de dezembro de 2020]. Disponível em: <http://www.abep.org.br/publicacoes/index.php/anais/article/view/1763/1723>.
 12. Bittencourt SDS. Vigilância do óbito materno, infantil e fetal e atuação em comitês de mortalidade [Internet]. Rio de Janeiro: EAD/Ensp; 2013 [acesso em 24 de dezembro de 2020]. Disponível em: https://portaldeboaspraticas.iff.fiocruz.br/wp-content/uploads/2021/01/livro_texto.pdf.
 13. Rede Interagencial de Informações para a saúde. *Indicadores básicos para a saúde no Brasil: conceitos e aplicações* [Internet]. 2. ed. Brasília: Organização Pan-Americana da Saúde; 2008 [acesso em 24 de dezembro de 2020]. Disponível em: <http://tabnet.datasus.gov.br/tabdata/livroidb/2ed/indicadores.pdf>.
 14. Teixeira GA, Costa FML, Mata MS, Carvalho JBL, Souza NL, Silva RAR. Fatores de risco para a mortalidade neonatal na primeira semana de vida. *Rev. Pesqui* [Internet]. 2016 [acesso em 24 de dezembro 2020];8(1). Disponível em: http://www.seer.unirio.br/index.php/cuidadofundamental/article/view/3943/pdf_1832.
 15. Araújo ACA, Araújo ANL, Almeida PD, Rocha SS. Mortalidade infantil em uma capital do nordeste brasileiro. *Enferm foco*. [Internet]. 2017 [acesso em 24 de dezembro 2020];1(8). Disponível em: https://www.researchgate.net/publication/315959451_Mortalidade_infantil_em_uma_capital_do_nordeste_brasileiro.
 16. Areco KCN, Konstantyner T, & Taddei JADAC. Tendência secular da mortalidade infantil, componentes etários e evitabilidade no Estado de São Paulo–1996 a 2012. *Revista Paulista de Pediatria*. [Internet]. 2016 [acesso em 24 de dezembro 2020];34(3). Disponível em: https://www.scielo.br/pdf/rpp/v34n3/pt_0103-0582-rpp-34-03-0263.pdf.
 17. Pinheiro AC, Matos SCS, Silva ZM, Medeiros LC. Perfil epidemiológico da mortalidade neonatal no estado do Piauí, Brasil. *Rev Ciên Plur*. [Internet]. 2020 [acesso em 24 de dezembro 2020];6(supl.1). Disponível em: <https://periodicos.ufrn.br/rcp/article/view/21182/13106>.
 18. Silva, TJJ. Os determinantes socioeconômicos da mortalidade infantil nos anos de 2000 e 2010: evidências empíricas para os municípios pernambucanos. *Humanas & Sociais Aplicadas*. [Internet]. 2016 [acesso em 24 de dezembro 2020];6(17). Disponível em: https://ojs3.perspectivasonline.com.br/humanas_sociais_e_aplicadas/article/view/584.
 19. Lima SSD, Braga MC, Vanderlei LCDM, Luna CF, & Frias PG. Avaliação do impacto de programas de assistência pré-natal, parto e ao recém-nascido nas mortes neonatais evitáveis em Pernambuco, Brasil: estudo de adequação. *Cadernos de Saúde Pública* [Internet]. 2020 [acesso em 24 de dezembro 2020];36(2). Disponível em: <https://www.scielo.br/j/csp/a/xjBngQW39sVHzVBL4q9Zj3P/?lang=pt&format=pdf>.
 20. Moreira MDS, Gaíva MAM, Bittencourt RM. Mortalidade neonatal: características assistenciais e biológicas dos recém-nascidos e de suas mães. *Cogitare enferm*. [Internet]. 2012 [acesso em 24 de dezembro 2020];17(1). Disponível em: <https://revistas.ufpr.br/cogitare/article/view/26383/17576>.
 21. Ministério da Saúde (BR). Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. *Gestação de alto risco: Manual técnico* [Internet]. 5 ed. Brasília: Ministério da Saúde; 2012 [acesso em 24 de dezembro de 2020]. Disponível em: https://bvsm.sau.gov.br/bvs/publicacoes/manual_tecnico_gestacao_alto_risco.pdf.
 22. Fonseca SC, Flores PVG, Júnior KRC, Pinheiro RS, Coeli CM. Escolaridade e idade materna: desigualdades no óbito neonatal. *Rev de saúde pública* [Internet]. 2017 [acesso em 24 de dezembro 2020];51(94). Disponível em: https://www.scielo.br/pdf/rsp/v51/pt_0034-8910-rsp-S1518-87872017051007013.pdf