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INFANT MORTALITY IN THE CAPITAL OF THE STATE OF AMAZONAS: ANALYSIS OF AVOIDABLE CAUSES IN THE THREE YEARS 2018 TO 2020

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Jordan Percy Gonzales Saenz[1], Renata Ferreira dos Santos[2], Elaine Cristina Santana Cordovil[3], Maria do Livramento Coelho Prata[4], Valeria Lima da Cruz[5] and Winnie Lagoa de Souza[6]

ABSTRACT

Neonatal mortality remains a global challenge, with significant impacts on public health and social development. This study aims to analyze the preventable causes of infant mortality in Manaus between 2018 and 2020, highlighting factors associated with neonatal and post-neonatal deaths. This is a descriptive and retrospective study based on secondary data from SIM and SINASC. Deaths of children under one year of age were classified as early neonatal, late neonatal, and post-neonatal, using the Brazilian List of Preventable Causes of Deaths. A total of 1,535 deaths were recorded, of which 59.4% were preventable, with a higher prevalence in the early neonatal component (62.9%). Bacterial septicemia and respiratory complications were the predominant causes. The late neonatal component increased by 137% in 2020, possibly associated with the COVID-19 pandemic. The results

[1] Specialist in Obstetric Nursing
Amazonas State University – UEA
E-mail: jordanpercy@gmail.com
ORCID: https://orcid.org/0009-0003-0769-3567
LATTES: http://lattes.cnpq.br/2615250875261796
[2] Doctor in Public Health
Amazonas State University – UEA
E-mail: rfdsantos@uea.edu.br
ORCID: https://orcid.org/0000-0002-1794-2737
LATTES: http://lattes.cnpq.br/7517167539335837
[3] Master in Public Health
Amazonas State University – UEA Amazonas – UEA
E-mail: ec.cordovil@gmail.com
ORCID: https://orcid.org/0000-0003-4703-8295
LATTES: http://lattes.cnpq.br/1839028238590149
[4] Master in Nursing
Amazonas State University – UEA
E-mail: mprata@uea.edu.br
ORCID: https://orcid.org/0000-0002-8486-4484
LATTES: http://lattes.cnpq.br/2664876149819119
[5] Doctor in Public Health
Fluminense Federal University - UFF
E-mail: valeriacruz1969@gmail.com
ORCID: https://orcid.org/0000-0003-0452-6571
LATTES: https://lattes.cnpq.br/3493370566213730
[6] Master in Urban Biology
Alcance College – FAAL
E-mail: winnie_lagoa@hotmail.comORCID: https://orcid.org/0000-0002-7048-8342
LATTES: http://lattes.cnpq.br/3781817148829870

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reinforce the need for improvements in prenatal and neonatal care, professional training, and preventive strategies, such as infection control and strengthening of the National Immunization Program. Public policies should consider local specificities to reduce infant mortality in Manaus.

Keywords: Infant Mortality. Health Services Assessment. Health Information System. Epidemiology.

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INTRODUCTION

Neonatal mortality remains a global challenge, with significant impacts on public health and social development. Data from the World Health Organization (WHO, 2024) reveal that, in 2022, approximately 2.3 million children died in the first 20 days of life, representing approximately 6,500 deaths per day. These numbers correspond to 47% of all deaths of children under five years of age.

Despite considerable advances in child survival since 1990, when the number of neonatal deaths was 5 million, the pace of reduction has been uneven, especially since 2010, and many countries, including Brazil, are struggling to achieve the targets established in the Sustainable Development Goals (SDGs) by 2030 (WHO, 2024).

Infant mortality is widely recognized as a critical indicator of a population's health conditions, quality of life, and access to basic services (Ferreira et al., 2024). In Brazil, although the infant mortality rate has decreased in recent decades, significant regional inequalities persist, especially in the North and Northeast, which are reflected in the rates of preventable neonatal mortality (Souza et al., 2021; Freitas et al., 2022). In Amazonas, in particular, Manaus faces significant challenges related to prenatal and neonatal care, as well as precarious socioeconomic conditions, which directly affect the survival of children under one year of age (Monteiro; Santos, 2019).

The list of preventable causes of infant mortality, prepared by Malta et al. (2007), is a milestone in the assessment of the quality of health services in Brazil. This list considers the Brazilian context and categorizes preventable causes according to age groups and technologies available in the Unified Health System (SUS), and is a valuable instrument for directing preventive actions and public policies. Subsequent studies (Malta et al., 2019; Bernardino et al., 2022) highlight that a large proportion of preventable neonatal deaths occur due to the lack of adequate care during prenatal care, childbirth, and newborn care, with significant regional disparities that reveal inequalities in access and quality in the health system.

The analysis of infant mortality, from the perspective of territorial inequalities, reinforces its relevance as a “sentinel event” of the quality of health care (Kreutz; Santos, 2023). In the context of Manaus, the high rate of preventable infant mortality highlights the need for specific interventions that take into account local particularities and promote universal and equitable access to health services. In addition, neonatal mortality reflects

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broader structural problems, involving social and economic inequities that go beyond the health sector (Bernardino et al., 2022).

This study is justified by the need to understand the preventable causes of infant mortality in Manaus, using the analysis of secondary data from the Live Birth Information System (SINASC) and the Mortality Information System (SIM). By examining these data in detail, we seek to provide a clearer view of the local conditions of maternal and child health care and identify gaps that can contribute to supporting more targeted public policies and health strategies, promoting a deeper understanding of the inequalities and challenges faced in the region.

The research adopts a descriptive and retrospective nature, focusing on the regional specificities of the municipality of Manaus. In view of this, the present study has the general objective of analyzing the preventable causes of infant mortality in the municipality of Manaus between the years 2018 and 2020, seeking to identify associated factors.

METHODOLOGY

This descriptive and retrospective study was carried out in Manaus, the capital of the state of Amazonas, which, according to the 2022 Census, has a population of 2,063,689 inhabitants, with a population density of 181.01 inhabitants per square kilometer and a Human Development Index (HDI) of 0.737 (IBGE, 2022). The research analyzed preventable deaths of children under one year old, residing in the municipality, that occurred between 2018 and 2020, divided into three categories: early neonatal (0 to 6 days), late neonatal (7 to 27 days), and post-neonatal (28 to 364 days). Deaths due to non-preventable causes were excluded from the analysis. The data used were obtained through the Mortality Information System (SIM) and the Live Birth Information System (SINASC), available on the digital platform of the SUS Information Technology Department (DATASUS). Data extraction was performed using the TabNet tool, which allows direct access to public information on the web. After selecting the variables, the data were organized and analyzed in spreadsheets in Microsoft Excel 2019, using the double entry technique to ensure consistency, followed by descriptive analysis.

To classify To assess the preventability of deaths, the Brazilian List of Causes of Deaths Preventable by SUS Interventions in Children under Five Years Old, prepared by Malta et al. (2007) and revised in 2010, was adopted. This list groups the causes into three categories: preventable (subdivided into causes that can be reduced by immunoprevention,

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by adequate care for women during pregnancy and childbirth, by care for newborns, by adequate diagnosis and treatment, and by health promotion associated with adequate care), ill-defined causes, and other causes that are not preventable. The causes of death were coded and analyzed according to the International Statistical Classification of Diseases and Related Health Problems – 10th edition (ICD-10). Infant mortality rates were calculated by year and by component, and the main causes of death were examined in terms of proportions and rates, including the percentage variation in deaths during the three years studied. Since this was an analysis of secondary data in the public domain, without individual identification, it was not necessary to submit the data to the Research Ethics Committee, by Resolution No. 510, of April 7, 2016, of the National Health Council (Brazil, 2016).

RESULTS AND DISCUSSION

During the three years (2018-2020), 1,535 deaths of children under one year of age were recorded in SIM, of which just over half (64.8%) occurred in the neonatal period (n = 996) and 35.2% in the post-neonatal period (n = 539). In the same period, SINASC recorded a total of 113,801 live births (LB). In 2018, the total infant mortality rate (IMR) in Manaus was 13.84 deaths per thousand live births, distributed between 6.19 for the early neonatal component, 2.57 for the late neonatal component, and 5.08 for the post-neonatal component. In 2019, the total IMR showed a slight reduction to 13.81, with emphasis on the decrease in the late neonatal component (2.06) and in the post-neonatal component (4.79). In 2020, the total IMR fell to 12.78, influenced by a 15% reduction in the post-neonatal component (4.32). However, a significant increase of 137% was observed in the late neonatal component, which reached 4.88 (Table 1).

Table 1 – Infant Mortality Rate by Component and Year. Manaus, 2018 to 2020.

Year	Early Neonatal (n = 750)	Late Neonatal (n = 246)	Post-Neonatal (n = 539)	Total (n = 1,535)
2018	6.19	2.57	5.08	13.84
2019	6.96	2.06	4.79	13.81
2020	6.62	4.88	4.32	12.78
Variation (%)	+6.94%	-28%	-15%	-7.58%

Note: IMR per 1,000 live births.
Source: SIM; SINASC, 2018-2020.

According to the data, between 2018 and 2020, the average annual Infant Mortality Rate (IMR) in Manaus was 13.48 per 1,000 live births, showing an overall reduction of

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7.58%. The IMR components displayed distinct variations: the early neonatal component increased by 6.94%, whereas the late neonatal component significantly decreased by 28%. The post-neonatal component showed a 15% decrease. These fluctuations in infant mortality patterns highlight the need for targeted measures to investigate and intervene at each stage of infancy.

These findings suggest that while the early neonatal component continues to significantly contribute to the total IMR, public health strategies focused on post-neonatal care may have positively impacted the reduction of this segment. However, the persistence of high early neonatal mortality rates indicates the need for continuous improvement in perinatal care and newborn follow-up to further reduce infant mortality in Manaus.

According to **Table 2**, the total number of deaths in the study period was 1,535, of which 913 (59.4%) were classified as preventable, 578 (37.6%) as not preventable, and 44 (2.8%) were considered ill-defined causes, making classification impossible.

Table 2 – Proportional Infant Mortality by Preventable, Non-Preventable, and Ill-Defined Causes. Manaus, 2018 to 2020.

Year	Preventable	Non-Preventable	Ill-Defined	Total Deaths (n)
	n	%	n	%
2018	323	60.4	193	36.1
2019	313	59.7	203	38.7
2020	277	58.07	182	38.1
Total	**913**	**59.4**	**578**	**37.6**

Source: SIM, 2018-2020.

Table 3 presents the total number of preventable deaths according to infant mortality components, highlighting the early neonatal component, which accounted for 62.9% of deaths during the study period.

Table 3 – Total Preventable Deaths by Infant Mortality Components. Manaus, 2018 to 2020.

Component	2018 (n)	2019 (n)	2020 (n)	Total (n)	%
Early Neonatal	192	194	188	574	62.9
Late Neonatal	51	50	42	143	15.7
Post-Neonatal	80	69	47	196	21.4
Total	**323**	**313**	**277**	**913**	**100%**

Source: MS/SVS/CGIAE - Mortality Information System (SIM), 2018-2020.

Between 2018 and 2020, the total number of preventable infant deaths was 913. Among these, the majority (412 cases) were associated with inadequate maternal healthcare during pregnancy. Death causes related to pregnancy complications, childbirth, and neonatal care highlight an urgent need for improvements in the care provided to

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pregnant women and newborns at all stages. The low occurrence of deaths related to lack of immunization indicates effective vaccine coverage for preventable diseases (**Table 4**).

Table 4 – Preventable Infant Deaths According to the Brazilian List of Avoidable Deaths and Main ICD-10 Codes. Manaus, 2018 to 2020.

Preventable Causes	2018-2020 (n)	%	IMR
1.1 Immunization Actions	2	0.2	0.01
B05 – Measles	2	100	0.021
1.2.1 Adequate Maternal Care During Pregnancy	412	45	3.6
P00 – Fetus and newborn affected by maternal conditions	128	28.4	1.1
P22 – Respiratory distress syndrome of the newborn	257	68.4	2.25
1.2.2 Adequate Maternal Care During Childbirth	75	8	0.65
P02 – Fetus and newborn affected by placental, umbilical cord, and membrane complications	21	29.2	0.18
P21 – Birth asphyxia	30	39.3	0.26
P24 – Neonatal aspiration syndrome	24	84.3	0.21
1.2.3 Adequate Fetal and Neonatal Care	151	16	1.32
P23 – Congenital pneumonia	34	20.7	0.27
P36 – Bacterial sepsis of newborn	108	65.9	0.94
1.3 Adequate Diagnosis and Treatment Actions	202	22	1.77
A41 – Other septicemias	42	20	0.36
J18 – Pneumonia due to unspecified microorganism	86	49.9	0.75
1.4 Adequate Health Promotion Actions	71	7	0.62
A09 – Presumed infectious diarrhea and gastroenteritis	19	20.8	0.15
W84 – Unspecified respiratory risks	20	21.9	0.17
W79 – Food inhalation and ingestion causing airway obstruction	2	2.2	0.01
R95 – Sudden infant death syndrome	7	7.7	0.06
Total	**913**	**100**	**7.97**

Source: SIM, 2018-2020.

Global efforts to combat the main causes of child mortality through high-impact interventions such as immunization, access to nutrition and micronutrients, the presence of qualified professionals at birth and postnatal care, and increased access to drinking water, sanitation, and hygiene have yielded significant results, substantially reducing mortality rates in children under 5 years of age since 1990 (Sharrow et al., 2022). However, many children still die, facing significant inequalities, both in terms of geography and income, which directly affect their chances of survival.

The decline in child mortality in Brazil due to preventable causes has been more pronounced (5.1% per year) compared to non-preventable causes (2.5% per year), reflecting advances in health systems and social improvements, as pointed out by Malta et al. (2019). However, deaths related to inadequate care during pregnancy still represent a significant challenge, with a modest average annual reduction (2.1%) and a worrying increase in deaths related to maternal conditions (8.3% per year). This situation highlights the need to improve prenatal care, especially in the North and Northeast regions, where

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challenges associated with access and quality of care persist. In Manaus, between 2018 and 2020, the early neonatal component was responsible for 48.9% of infant mortality, reflecting failures in perinatal care and newborn monitoring. Santos and Monteiro (2019) also point out the relevance of these causes in analyses between 2012 and 2014 carried out in Manaus, reinforcing that the reduction of preventable deaths requires improvements in the quality of prenatal care and the integration between primary and hospital care. Strategies such as carrying out at least seven prenatal consultations and early diagnosis of infections are essential. Although the Northeast has shown a general trend of reduction in infant mortality, it still faces challenges. Souza et al. (2021) highlight that, while post-neonatal mortality registered significant reductions in states such as Alagoas (-8.6%) and Pernambuco (-7.6%), the early neonatal component, similar to that observed in Manaus, showed greater difficulty in declining, highlighting the need for actions targeted at the perinatal period. Thus, the data from Manaus converge with regional challenges, reinforcing the urgency of specific strategies to improve care in the neonatal period and reduce inequalities in access to health services. In Manaus, neonatal deaths due to respiratory problems, such as respiratory distress syndrome (P22) and neonatal aspiration syndrome (P24), highlight the need for interventions aimed at respiratory support and immediate neonatal monitoring. In addition, complications related to the placenta, umbilical cord, and membranes (P02) contribute significantly to deaths, highlighting the importance of continuous monitoring during childbirth. Outside the neonatal period, diseases such as pneumonia (P23) and diarrhea (A09) remain among the main preventable causes of infant mortality, requiring improvements in early diagnosis and treatment, in addition to greater investment in health promotion actions and education of families to identify warning signs.

These data reflect trends already identified by Santos and Monteiro (2019), who highlighted difficulties in neonatal intensive care in Manaus between 2012 and 2014, including low-quality prenatal care and inadequate intensive care for newborns. The situation points to the need for better professional qualifications and strengthening of primary care. In a similar context, Cavalcante et al. (2022) identified in Campo Grande that septicemia and pneumonia continue to be the predominant causes of infant death, demonstrating the low resolution of the health system, since these conditions could be reduced by more effective diagnostic and treatment actions.

According to Lautharte et al. (2023), delays in diagnosis are factors that increase infant mortality rates, highlighting the need for public health actions focused on early

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awareness and professional qualification, in addition to structural improvements in the health system from primary care onwards. Bacterial septicemia (P36), with 108 registered cases, reinforces the urgency of strict infection prevention and control protocols, especially in neonatal ICUs. Fontes et al. (2024) highlight the potential of biomarkers, such as CRP and procalcitonin, and molecular methods in the early diagnosis of neonatal sepsis, but warn of the challenges posed by antimicrobial resistance, which demands the rational use of antibiotics. Preventive strategies, such as intrapartum antibiotic prophylaxis, hand hygiene, breastfeeding, and kangaroo care, are effective in reducing the incidence of sepsis.

In this context, In this text, it is important to highlight that exclusive breastfeeding (EBF) plays a fundamental role in preventing neonatal infections and strengthening the newborn's immune system (Araújo et al., 2024). Research indicates that breast milk significantly reduces the risk of neonatal sepsis, in addition to favoring the maturation of the baby's respiratory and immune systems (Santos et al., 2020; Camacho-Morales et al., 2021; Manurung et al., 2022).

In addition, Palmeira and Carneiro-Sampaio (2016) explain that the immunological composition of breast milk changes over time. In the early stages of lactation, it is rich in secretory IgA (IgAS), anti-inflammatory factors, and immunologically active cells, which provide additional support to the newborn's still-developing immune system. After this initial stage, breast milk continues to adapt remarkably to changes in the infant's growth and needs.

The role of nursing professionals is crucial in this process, especially in the adoption of early recognition protocols and standardized interventions, strategies that have been shown to reduce mortality from neonatal sepsis (Souza et al., 2021). The significant percentage variation in the late neonatal component (+137% in 2020) may be associated with changes in infant mortality patterns, possibly influenced by the COVID-19 pandemic. As observed by Cândido et al. (2024), the restrictive measures implemented during the health emergency directly impacted care for the mother-infant binomial, requiring adaptations in the care provided.

Regarding immunization, although deaths related to vaccine-preventable diseases were limited (0.2%), this reflects good vaccination coverage in Manaus, possibly attributed to the National Immunization Program (PNI). However, Barata et al. (2023) and Oliveira et al. (2024) warn of the decline in complete vaccination coverage in recent years, which

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raises concerns about the program's reach. Nursing professionals play an essential role not only in the technical implementation of vaccination but also in building bonds with families and ineffective communication, strategies that promote better vaccination coverage and contribute to the efficiency of the PNI.

These findings reinforce the need for continuous qualification of public health programs, with a focus on disease prevention and strengthening diagnostic, treatment, and health promotion actions, contributing to the reduction of infant mortality and supporting managers and health professionals in the implementation of more effective strategies.

CONCLUSION

The analysis of the data showed that infant mortality in Manaus, between 2018 and 2020, continues to be a significant challenge, with emphasis on the high rates of early neonatal deaths related to respiratory problems and gestational complications. Despite some progress in certain components, such as the reduction in post-neonatal deaths in 2019, the persistence of preventable causes reinforces the need for more effective actions in prenatal care, professional training, and the structuring of neonatal health services. These results indicate that efforts to improve care for the mother-baby binomial have not yet reached satisfactory levels to ensure a consistent reduction in infant mortality.

The predominance of deaths due to bacterial septicemia and respiratory diseases demonstrates the urgency of implementing preventive measures and early diagnosis, in addition to reinforcing adherence to infection control protocols in maternity wards and neonatal ICUs. The role of nursing professionals is central in this context, both in the execution of technical care and in educating and raising awareness among families about the prevention and management of preventable conditions. Strategies such as intrapartum antibiotic prophylaxis, breastfeeding, and kangaroo care need to be strengthened, and aligned with the rational use of antibiotics in the face of growing microbial resistance.

Finally, the analysis also highlights the importance of preventive programs such as immunization, which, although successful in Manaus, face challenges in maintaining full coverage for all vaccines. Integrated action between managers, health professionals, and the community is essential to overcome barriers to access and communication with families, increasing the positive impact of public policies. It is concluded that reducing infant mortality in Manaus depends on a multidisciplinary approach, based on

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epidemiological data, continuous improvement of services, and consistent investments in primary and specialized care.

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