

## TRENDS OF NEONATAL MORTALITY RATE IN IRAQ DURING THE PERIOD 2016-2021

<sup>1</sup>\*Zahraa Adnan Qassim and <sup>2</sup>Batool Ali Ghalib Yassin

<sup>1</sup>The Iraqi Board for Medical Specialization in Community Medicine, Institutional addresses: Baghdad, Bab Al Muadham, 10047.

<sup>2</sup>College of Medicine / University of Baghdad, Institutional addresses: Baghdad, Bab Al Muadham, 10047.

Received date: 29 April 2024

Revised date: 20 May 2024

Accepted date: 10 June 2024



\*Corresponding Author: Zahraa Adnan Qassim

The Iraqi Board for Medical Specialization in Community Medicine, Institutional addresses: Baghdad, Bab Al Muadham, 10047.

### ABSTRACT

**Background:** Neonatal mortality is not just a local issue but a global concern. It is a critical indicator of healthcare quality, especially in low and middle-income countries. The global community has made reducing neonatal mortality a priority under the Sustainable Development Goals, with emphasis on factors like prematurity, infections, birth asphyxia, and congenital anomalies. This study is part of that global effort, aiming to contribute to understanding neonatal mortality in Iraq and the world. **Objectives of the Study:** To describe the trend of neonatal mortality in Iraq during 2016-2021 and determine the most common causes of neonatal mortality. **Methods:** This research is based on comprehensive data from the Iraqi Ministry of Health from 2016-2021. The data encompassed sociodemographic information, gestational age, gender, weight of neonates, maternal age, mode and place of delivery, and causes of death. The data were meticulously analysed using the Statistical Package for Social Sciences (SPSS) version 26, focusing on frequency and relative frequency. **Results:** The study recorded 67,295 neonatal deaths in Iraq (excluding the Kurdistan region) from 2016 to 2021. The neonatal mortality rate fluctuated, peaking at 14.06 per 1000 live births in 2019. Baghdad had the highest neonatal mortality number, followed by Basra. However, the highest neonatal mortality rate per 1000 live births was recorded in Al-Najaf. The leading causes of death were respiratory distress syndrome (39.2%), sepsis (14.4%) and prematurity (13.2%). Significant differences were noted between the MOH and WHO NMR registered from 2016 to 2021; however, both data show a downward trend. **Conclusions:** This study's findings are significant, highlighting the need for sustained efforts to reduce neonatal mortality in Iraq. The neonatal mortality rate per 1000 live births decreased in 2017, peaked in 2019, and gradually declined in 2020 and 2021. Key factors influencing neonatal mortality, such as gestational age, gender, birth weight, and maternal age, were found to be most prevalent in general hospitals.

**KEYWORDS:** Neonatal, Mortality, Rate, Iraq.

### INTRODUCTION

Neonatal mortality rate (NMR) is the proportion of child deaths that occur within the first 28 days of life for every 1,000 live births in a particular year or other period. Early neonatal mortality, which happens during the first seven days of life and late neonatal mortality, which happens after the 7th day but before the 28th completed day of life, are two categories of neonatal mortality. By subdividing NMR, policymakers and healthcare professionals can better understand the underlying causes, timing and risk factors associated with neonatal deaths.<sup>[1]</sup>

According to the WHO, an NMR of less than ten deaths per 1,000 live births is considered a "low" rate, while rates above 30 per 1,000 live births are classified as "high."<sup>[2,3]</sup>

The World Bank provides data on the neonatal mortality rate in Iraq. According to their data, the neonatal mortality rate in Iraq was 14.4 deaths per 1,000 live births in 2021.<sup>[3]</sup>

The Sustainable Development Goals (SDGs), established in 2015 and expiring in 2030, include a specific target related to neonatal mortality. SDG 3 aims to "ensure healthy lives and promote well-being for all at all ages"

and includes a target to reduce neonatal mortality to no more than 12 deaths per 1,000 live births by 2030.<sup>[4]</sup>

Under the Millennium Development Goals (MDGs), established in 2000 and expired in 2015, the fourth goal focused on reducing child mortality rates, particularly neonatal mortality. The target was to reduce under-five mortality rates by two-thirds between 1990 and 2015. In Iraq, the neonatal mortality rate was 32 deaths per 1,000 live births in 2005, and the MDG target for neonatal mortality was to reduce this to 16 deaths per 1,000 live births by 2015.<sup>[5,6]</sup>

Although Iraq did not meet this target, the country has made progress in reducing neonatal mortality rates over the past decade. According to the World Bank, the neonatal mortality rate in Iraq was 17 deaths per 1,000 live births in 2015. This progress can be attributed to several factors, including increased access to antenatal care, skilled attendance at delivery and improved neonatal intensive care.<sup>[7,8]</sup>

Some of the challenges that need to be addressed to reduce neonatal mortality rates in Iraq include improving the quality and availability of healthcare services, addressing social and environmental determinants of health, and addressing the effects of conflict and displacement on maternal and child health.<sup>[9-11]</sup>

This study aimed to identify the trend of neonatal mortality in Iraq during the period (2016- 2021) and to list the most common causes of neonatal mortality in Iraq (2016-2021).

## METHODS

Research was conducted at The Iraqi Ministry of Health / Department of Planning and Resource Development, Division of Health, and Vital Statistics on the available data of neonatal mortality reports. This division is responsible for collecting and analysing data on neonatal deaths and issuing monthly, quarterly, and annual statistical reports on this matter.

Ethical approval and official permissions were obtained from the Scientific Committee at the Department of Family and Community Medicine, College of Medicine, University of Baghdad, and the Iraqi Board of Medical Specialties/ Council for Family and Community Medicine, with a number 982, dated March 16, 2023, and from the MOH/National Centre for Training and Development.

Neonatal Mortality Rates (NMR) were calculated from the annual number of Neonatal Deaths and Live Births by the formula  $NMR = (No. of N.D / LB) \times 1000$ .<sup>[12]</sup> The mortality figures for the corresponding governorates were pooled and divided by the LB to construct a regional NMR plot graph.

The researcher visited the Division of Health and Vital Statistics twice weekly to collect data. The study included all records files from the Health and Vital Statistics Division from 2016 to 2021, from April 2023 to the end of February 2024.

A data collection form was prepared based on the official record adapted by the Vital Statistics Division to register neonatal mortality at hospitals, primary health care centres, and Forensic Medicine centres. The form consisted of two parts.

The first part included the age of the neonates in days and gestational age in weeks. Gestational age is categorised as Preterm (<37 weeks), Term (37-41 weeks), and post-term (>41 weeks), providing crucial context for assessing the circumstances and risk factors surrounding neonatal mortality. Sex (categorised as male, female and unclassified, where "unclassified" may refer to instances where the neonate's sex cannot be determined due to various medical reasons or is not reported). Weight in kilograms, weight is classified into five categories: Extremely Low Birth Weight (LBW) (<1000g), Very LBW (1000-1499g), LBW (1500-2499g), Normal Birth Weight (2500-4000g) and Macrosomia (>4000g). Mother's age in years, maternal age is classified into three categories: < 20 years old, (20-30) years and >31 years old, and residence.

The second part included mode of delivery (categorised as vaginal delivery, cesarean section and "Other" this involves the use of tools like forceps or a vacuum device (ventouse) to help deliver the baby through the birth canal. Delivery place (categorised as a general hospital, private hospital, home and road). Delivery date, number of neonates (categorised as a single neonate and multiple neonates), and cause of death, such as (Respiratory distress syndrome, Bacterial sepsis, Prematurity, Asphyxia and Congenital malformations, while the other causes, such as Jaundice, defined illness, etc.) and whether a death certificate was issued or not. It also records the Department of Health or health authority declaring the neonatal mortality and the declaration date. Additionally, it categorises neonatal death timing as early neonatal death, occurring during the first week and late neonatal death, occurring after the first week but within the first month of life.

The data were coded, and each form was assigned a serial identifying number. The researcher then entered the form into the computer using Statistical Package for Social Sciences (SPSS) version 26. Categorical data were presented in frequency and relative frequency.

## RESULTS

Over six years, from 2016 to 2021, the total neonatal mortality number officially registered was 67295 neonatal deaths in Iraq except Kurdistan. The highest registrations were found during the year 2020. The lowest was in 2017 (Table 1). The neonatal mortality rate

per 1000 live births fluctuated, yet the highest registrations were in 2019. The lowest was in 2017 (Figure 1).

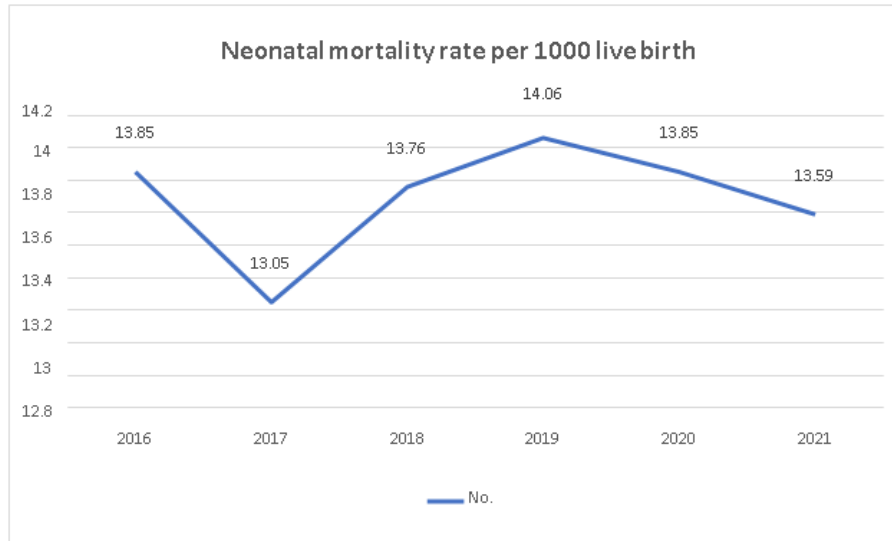


Figure 1: Annual neonatal mortality rate per 1000 live births in Iraq except Kurdistan: 2016-2021.

Table 1: The no. of live births, Neonatal Mortality Rates, and Associated Deaths in Iraq except Kurdistan (2016-2021).

| Year         | No. of live births | Numbers of death | Numbers of mortality rate /1000 live birth |
|--------------|--------------------|------------------|--|
| 2016         | 564,765            | 7822             | 13.8                                       |
| 2017         | 512,414            | 6687             | 13.1                                       |
| 2018         | 944,113            | 12991            | 13.7                                       |
| 2019         | 905,192            | 12727            | 14.1                                       |
| 2020         | 1,025,632          | 14205            | 13.8                                       |
| 2021         | 946,505            | 12863            | 13.5                                       |
| <b>Total</b> | <b>4898621</b>     | <b>67289</b>     | <b>13.7</b>                                |

Table 2 displays the neonatal mortality rate (NMR) per 1,000 live births across Iraqi provinces except Kurdistan from 2016-2021. During 2016, the highest NMRs were registered in Diyala at 19.0/1000 LB, followed by Basra at 18.4/1000 LB and Najaf at 17.4/1000LB and during 2017, Babel and Baghdad registered the highest NMR (17.7 & 17.6/1000LB respectively). In contrast, during 2018, the highest NMR were registered in Diwaniyah at 19.3/1000 LB, Babel at 18.9/1000 LB, and Baghdad and Basra at 17.2/100 each. During 2019, the highest NMR were registered in Najaf at 20.3/1000 LB, followed by

Diwaniyah at 19.3/1000 LB and Dhi Qar at 18.4/1000LB; during 2020, Najaf remained with the highest NMR, 20.2/1000LB, followed by Basra 18.6/1000LB and Dhi Qar 18.1/1000LB. During 2021, the highest NMR was registered in Najaf at 18.5/1000 LB, followed by Diwaniyah at 17.8/1000 LB and Dhi Qar at 18.1/1000 LB. NM was unavailable from Nineveh during 2016-2017 and Anbar during 2016. In contrast, the lowest NMRs were registered in Salah Al-Din during the whole period except 2016, as the lowest was from Anbar and 2021 from Al Muthanna (Table 2).

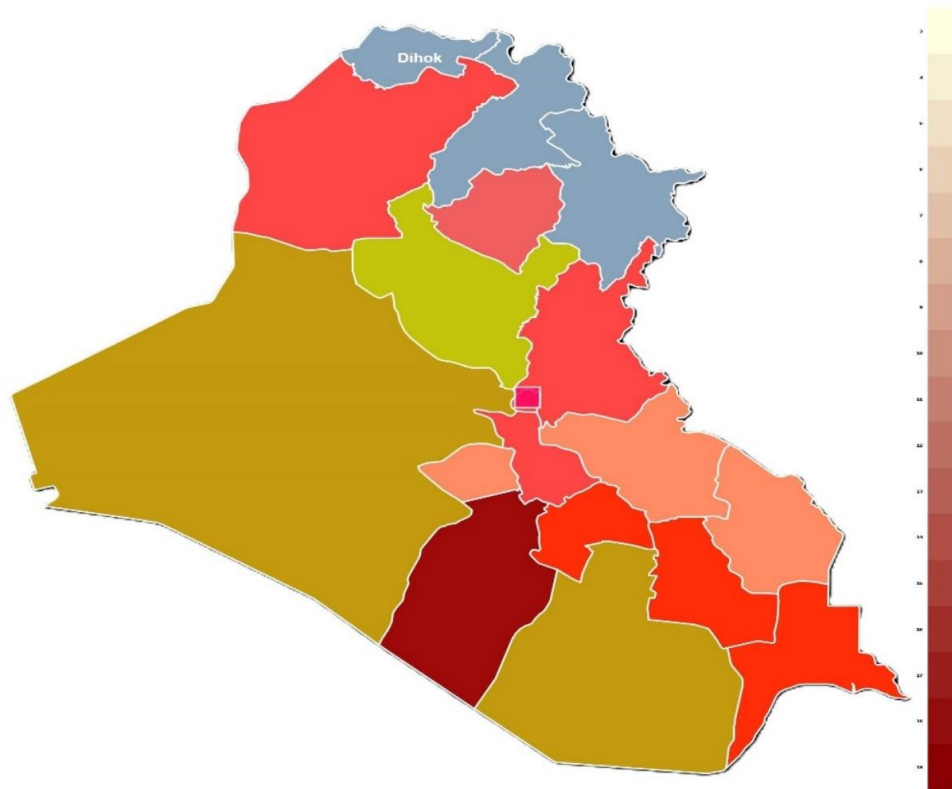
Table 2: Neonatal Mortality Rate per 1,000 Live Births by Province in Iraq: 2016-2021.

| Description                                   | Province  | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|-----------|------|------|------|------|------|------|
| Neonatal mortality rate per 1,000 live births | Baghdad   | 15.3 | 17.6 | 17.2 | 17.4 | 15.8 | 16.4 |
|   | Basra     | 18.4 | 16.9 | 17.2 | 17.7 | 18.6 | 17.0 |
|   | Nineveh   | NA   | NA   | 13.4 | 11.6 | 12.0 | 11.2 |
|   | Maysan    | 14.2 | 10.4 | 10.8 | 11.8 | 8.7  | 10.7 |
|   | Diwaniyah | 15.9 | 16.8 | 19.3 | 19.3 | 17.9 | 17.8 |
|   | Diyala    | 19.0 | 15.1 | 17.3 | 15.5 | 17.0 | 14.3 |
|   | Anbar     | NA   | 4.6  | 2.7  | 5.4  | 7.3  | 9.9  |
|   | Babel     | 14.8 | 17.7 | 18.9 | 17.0 | 17.4 | 15.1 |
|   | Karbala   | 13.2 | 12.9 | 13.3 | 12.0 | 13.1 | 11.8 |
|   | Kirkuk    | 14.1 | 14.1 | 16.2 | 16.0 | 15.9 | 15.0 |
|   | Wasit     | 13.0 | 13.1 | 11.9 | 15.3 | 13.5 | 16.0 |

|              |              |      |      |      |      |      |      |
|--------------|--------------|------|------|------|------|------|------|
|              | Dhi Qar      | 16.2 | 15.8 | 16.2 | 18.9 | 18.1 | 17.1 |
|              | Al Muthanna  | 8.4  | 10.2 | 10.9 | 8.2  | 7.7  | 6.2  |
|              | Salah Al-Din | 0.1  | 0.6  | 4.6  | 4.5  | 4.5  | 6.9  |
|              | Najaf        | 17.4 | 16.9 | 16.5 | 20.3 | 20.2 | 18.5 |
| <b>Total</b> |              | 13.8 | 13.1 | 13.7 | 14.1 | 13.8 | 13.5 |

The map offers a nuanced visualisation of the neonatal mortality rate per 1000 live births across Iraq's governorates from 2016 to 2021. Darker shades represent a higher rate, with Najaf emerging as a high-mortality rate/ 1000 live birth zone with 18.3. Diwaniyah followed with 17.8 and Basra and Dhi-Qar had 17.6 and 17.1 respectively. Moderate mortality zones like Baghdad,

Diyala, Babil, Kerbala, Kirkuk, Nineveh, and Maysan, while Al-Muthanna and Al-Anbar report 8.6 and 5.9, respectively. Salah Al-Din reports the lowest neonatal mortality rate per 1000 live births at 3.5 feature lighter shades, indicating lower mortality rates. Al-Sulaymaniyah, Erbil and Duhok are coloured greys, excluding them from this study (Figure 2).



**Figure 2: Geospatial Distribution of Neonatal Mortality rate per 1000 live birth in Iraq: A Comprehensive Analysis for 2016-2021.**

Table 3 The "Sex" variable shows 28,068 females, 38,871 males, and 356 unclassified cases among neonates. "Gestational Age" categorises 43,903 neonates as "Preterm," 23,319 as "Term", and 73 as "post-term". The "Age of Neonate until Death" reveals an average lifespan of 4.54 days. The "Weight" variable divides

neonates into categories: 8.2% as "Extremely LBW," 17.5% as "Very LBW," 33.1% as "LBW," 39.4% as "Normal BW" and 1.7% as "Macrosomia." Maternal characteristics are captured in the "Maternal Age" variable, with 9.5% under 20 years, 61.2% between 20-30 years and 29.3% over 31 years.

**Table 3: Neonatal and Maternal Demographics and Characteristics.**

| Variables                   |                            | No    | %    |
|-----------------------------|----------------------------|-------|------|
| <b>Sex</b>                  | Female                     | 28068 | 41.7 |
|                             | Male                       | 38871 | 57.8 |
|                             | Unclassified               | 356   | 0.5  |
| <b>Gestational Age</b>      | Preterm (<37) wks.         | 43903 | 65.2 |
|                             | Term (37-41 wks.)          | 23319 | 34.7 |
|                             | Post-term (>41) wks.       | 73    | 0.1  |
| <b>Age of Neonate until</b> | Early 1 <sup>st</sup> week | 56307 | 83.7 |

|                     |                               |       |      |
|---------------------|-------------------------------|-------|------|
| <b>death/days</b>   | late neonatal death 1-4 weeks | 10988 | 16.3 |
| <b>Weight</b>       | Extremely LBW (<1000g)        | 5501  | 8.2  |
|                     | Very LBW (1000-1499g)         | 11799 | 17.5 |
|                     | LBW (1500-2499g)              | 22282 | 33.1 |
|                     | Average BW (2500-4000g)       | 26541 | 39.4 |
|                     | Macrosomia (>4000g)           | 1172  | 1.7  |
| <b>Maternal Age</b> | < 20 years old                | 6410  | 9.5  |
|                     | 20-30 years                   | 41157 | 61.2 |
|                     | > 31 years                    | 19728 | 29.3 |
| <b>Total</b>        |                               | 67295 | 100  |

Table 4 showed that 85.6% of deliveries occurred in general hospitals, 7.9% in private hospitals, 4.9% at home and 1.7% in other settings. Most deliveries (91.4%) resulted in a single neonate, while 8.6% involved multiple births.

Delivery methods comprised 60.1% vaginal deliveries and 39.8% Cesarean sections, with 0.1% classified as "Other". This involves the use of tools like forceps or a

vacuum device (ventouse) to help deliver the baby through the birth canal. Neonatal deaths mainly occurred at the same hospital where delivery occurs (80.6%), other general hospitals (15.6%) or at home (3.1%), with few on the road (0.1%). Death certificates were done for 80.83% of neonatal deaths, highlighting a documentation gap in the remaining 19.17% of cases, as shown in Table 4.

**Table 4: Delivery, Neonatal and Death Characteristics in the Study Population.**

| Variables                 |  | No    | %    |
|---------------------------|--|-------|------|
| <b>Site of Delivery</b>   | General Hospital                                 | 57575 | 85.6 |
|                           | Private hospital                                 | 5301  | 7.9  |
|                           | At home  | 3277  | 4.9  |
|                           | Other (at road)                                  | 1142  | 1.7  |
| <b>Number of neonates</b> | Single neonate                                   | 61514 | 91.4 |
|                           | Twin or more                                     | 5781  | 8.6  |
| <b>Mode of delivery</b>   | Normal vaginal delivery                          | 40431 | 60.1 |
|                           | C/S  | 26810 | 39.8 |
|                           | Other (use of tools and devices)                 | 54    | 0.1  |
| <b>Place of Death</b>     | At the same hospital (may be general or private) | 54271 | 80.6 |
|                           | In other general hospital                        | 10494 | 15.6 |
|                           | At private hospital                              | 347   | 0.5  |
|                           | At home  | 2112  | 3.1  |
|                           | At road  | 71    | 0.1  |
| <b>Death Certificate</b>  | Yes  | 54394 | 80.8 |
|                           | No   | 12901 | 19.1 |
| <b>Total</b>              |  | 67295 | 100  |

Table 5 highlights the primary causes of neonatal mortality in the studied population. Respiratory distress syndrome leads at 39.22%, followed by bacterial sepsis of newborns at 15.5%. Other notable causes include

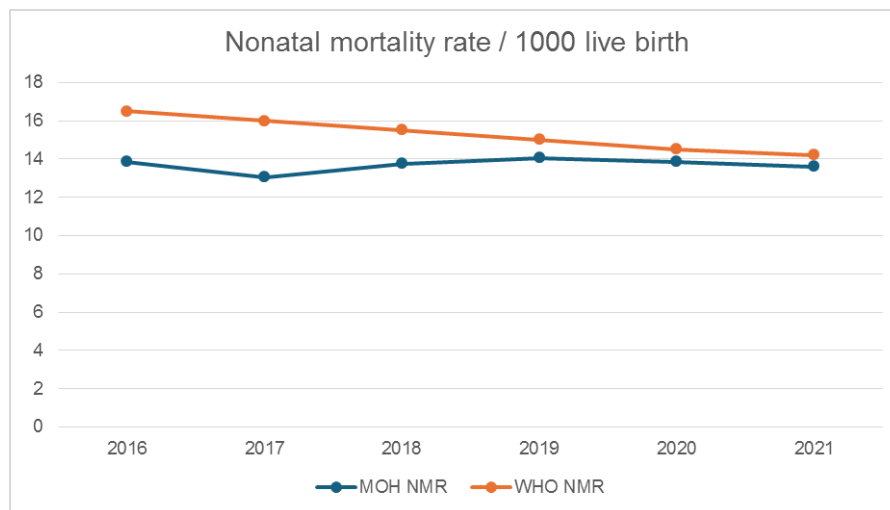
prematurity (13.2%), Asphyxia (12.1%) and congenital malformations (11.1%), while the other causes (Jaundice, ill-defined illness, etc.) represented 6.9% of the cases reported, as shown in Table 5.

**Table 5: The top causes of Neonatal Mortality in Iraq from 2016 to 2021.**

| Cause of Death                                     | Number of Cases | Percentage |
|--|-----------------|------------|
| Respiratory distress syndrome                      | 26,390          | 39.2       |
| Bacterial sepsis of newborn                        | 10467           | 15.5       |
| Prematurity  | 8,941           | 13.2       |
| Asphyxia   | 8,206           | 12.1       |
| Congenital malformations                           | 7,482           | 11.1       |
| Congenital pneumonia                               | 845             | 1.2        |
| Disorders relating to low birth weight             | 542             | 0.8        |
| Other Causes (Jaundice, ill-defined illness, etc.) | 4422            | 6.9        |
| <b>Total</b>                                       | 67295           | 100        |

Figure 3 compares neonatal mortality rates (NMR) per 1000 live births in Iraq from 2016 to 2021, according to Ministry of Health (MOH) and World Health Organization (WHO) data. The MOH figures ranged

from 13.05 to 14.06, while WHO rates were higher, from 14.2 to 16.5. Both sources showed a downward trend over the years, with WHO consistently reporting higher rates than MOH.



**Figure 3: Comparing the Neonatal mortality rate per 1000 live births according to the data of MOH and WHO.**

## DISCUSSION

The neonatal mortality rate is a critical indicator of a country's healthcare system and socio-economic conditions.<sup>[13]</sup> According to the current study, in Iraq, excluding Kurdistan, the neonatal mortality rate has shown fluctuations from 2016 to 2021. The highest rate was recorded in 2019, with 14.06 deaths per 1,000 live births, while the lowest rate was observed in 2017, with 13.05 deaths per 1,000 live births. The total number of neonatal deaths during this period was 67,295, with the highest number of deaths recorded in 2020. Several factors could contribute to these fluctuations. Because of political instability and the war, some data was missing in 2016 and 2017 for three governorates, Nineveh, Anbar and Salah Al-Din. It's also worth noting that the overall trend in Iraq has been a decrease in infant mortality rate from 24.1 deaths per 1,000 live births in 2016 to 20.7 deaths per 1,000 live births in 2021. This includes both neonatal and post-neonatal (28 days to 1 year) deaths.<sup>[13]</sup>

The current study showed varying trends in neonatal mortality rates among different governorates. Najaf had a higher mortality rate, followed by Diwaniyah, and the least was in Salah Al-Din. Factors contributing to these disparities could be multifaceted. Issues with healthcare infrastructure, accessibility and quality of services may play a crucial role. For instance, regions with higher population densities might face challenges in providing adequate healthcare services, impacting neonatal health outcomes. The healthcare system in Iraq is in crisis, with a shortage of drugs and medical staff, according to a study done by Aber in 2016.<sup>[14]</sup> The population density of Iraq in 2023 is 104.60 people per square kilometre. Higher population density can strain healthcare resources, potentially leading to higher mortality rates.<sup>[15]</sup> Iraq's economy is gradually recovering from the twin

shocks of the COVID-19 pandemic and the collapse in oil prices in 2020.

The present research highlights that the reasons for neonatal deaths are substantial and consistent with worldwide patterns. As identified in Mahtab et al.'s 2023 research, the primary factors contributing to neonatal mortality include intrapartum complications (31%), prematurity-related issues (28%), infectious diseases (17%), respiratory ailments (11%) and congenital disabilities (8%).<sup>[16]</sup>

In this study, respiratory distress syndrome leads at 39.22%, which is higher than the global average but aligns with the fact that respiratory disorders are a significant cause of neonatal death, bacterial sepsis of the newborn, which accounts for 14.47% of deaths in this study data. Congenital malformations account for 11.12% of deaths in this study, which is slightly higher than the global average of 8%.

The World Health Organization also highlights preterm birth, childbirth-related complications (birth asphyxia or lack of breathing at birth), infections, and congenital disabilities as the leading causes of neonatal deaths.<sup>[17,18]</sup>

In this study, the WHO NMR in Iraq was higher than the MOH finding. However, both had similar downtrend patterns, and this finding was close to the finding of the Knoema Atlas finding.<sup>[13]</sup>

The authors are confident, and some of their strengths include comparing findings with global studies and established research (such as the World Health Organization), which adds depth and context to the study's results and enhances its credibility.

However, the authors noticed some limitations, such as the data obtained from the Vital Statistics Division database in the Iraqi Ministry of Health. Some information was unavailable, such as cultural practices, education levels, and specific disease outbreaks that could affect neonatal mortality rates. Excluding Kurdistan might limit the study's representativeness of the entire country.

The current study concluded that neonatal mortality rates showed a reduction during 2017, then increased to peak during 2019 and decreased gradually during 2020 and 2021. Neonatal mortality rate ranged from (13.8/1000 live births) during 2016 to (13.5/1000 live births) during 2021. Baghdad city had the highest neonatal mortality among other governorates, followed by Basra. However, the highest neonatal mortality rate per 1000 live births was recorded in Al-Najaf, and the lowest rate was in Salah Al-Din. The leading causes of death were respiratory diseases, bacterial sepsis, and prematurity.

We recommend enhancing maternal healthcare services to address factors influencing neonatal health, including maternal age and prenatal health. We also use the research findings to inform healthcare policies, particularly those targeting high-risk demographics. Increase public awareness about prenatal care and neonatal health risks. Investigate and optimise delivery practices in general hospitals, emphasising safe delivery and emergency obstetric care. Implement strategies to prevent and better manage preterm births through enhanced prenatal care and public health education. And strengthen hospitals' capabilities to address the leading causes of neonatal death, such as respiratory distress syndrome and bacterial sepsis, by providing advanced training and equipment. Continue monitoring neonatal mortality trends and conducting research for ongoing policy and strategy adaptation.

## REFERENCES

- Jayani Pathirana, Muñoz Flor M, Abbing-Karahagopian Victoria, Bhat Niranjana, Harris Tara, Kapoor Ambujam, et al. Neonatal death: Case definition & guidelines for data collection, analysis, and presentation of immunization safety data. *Vaccine*, 2016; 34(49): 6027-37.
- Nurbek Yerdessov, Zhamantayev Olzhas, Bolatova Zhanerke, Nukeshtayeva Karina, Kayupova Gaukhar, Turmukhambetova Anar. Infant Mortality Trends and Determinants in Kazakhstan. *Children*, 2023; 10(6): 923.
- Shadrach Dare, Oduro Abraham R, Owusu-Agyei Seth, Mackay Daniel F, Gruer Laurence, Manyeh Alfred Kwesi, et al. Neonatal mortality rates, characteristics, and risk factors for neonatal deaths in Ghana: analyses of data from two health and demographic surveillance systems. *Global health action*, 2021; 14(1): 1938871.
- Vanessa Brizuela, Tunçalp Özge. Global initiatives in maternal and newborn health. *Obstetric medicine*, 2017; 10(1): 21-5.
- Marie A Brault, Mwinga Kasonde, Kipp Aaron M, Kennedy Stephen B, Maimbolwa Margaret, Moyo Precious, et al. Measuring child survival for the Millennium Development Goals in Africa: what have we learned and what more is needed to evaluate the Sustainable Development Goals? *Global health action*, 2020; 13(1): 1732668.
- Mohammed Aziz Katie, Mohan Jabbar Badr, Zugair Rikan Mohsen, Abd Basher Falah. Neonatal Mortality in Thi-Qar/Bint Al-Huda Teaching Hospital/Neonatal Care Unit: Five Years (2015-2019) Trend And Causes. *University of Thi-Qar Journal Of Medicine*, 2020; 20(2): 41-55.
- Alaka Adiso Limaso, Dangisso Mesay Hailu, Hibstu Desalegn Tsegaw. Neonatal survival and determinants of mortality in Aroresa district, Southern Ethiopia: a prospective cohort study. *BMC Pediatr*, 2020; 20: 1-8.
- Hiroko Taniguchi, Rahman Md Mizanur, Swe Khin Thet, Islam Md Rashedul, Rahman Md Shafiur, Parsell Nadia, et al. Equity and determinants in universal health coverage indicators in Iraq, 2000–2030: a national and subnational study. *International journal for equity in health*, 2021; 20: 1-10.
- UNICEF. Child-related SDG indicators: UNICEF; [cited 2024 May 20]. Available from: <https://data.unicef.org/sdgs/country/irq/>.
- Taysir Al Janabi. Barriers to the Utilization of Primary Health Centers (PHCs) in Iraq. *Epidemiologia*, 2023; 4(2): 121-33.
- World Health Organization. World Health Organization Iraq annual report 2021. World Health Organization Iraq annual report 2021/2022.
- Shahreen Raihana, Dibley Michael J, Rahman Mohammad Masudur, Tahsina Tazeen, Siddique Md Abu Bakkar, Rahman Qazi Sadequr, et al. Early initiation of breastfeeding and severe illness in the early newborn period: An observational study in rural Bangladesh. *PLoS Med.*, 2019; 16(8): e1002904.
- WORLD DATA ATLAS. Iraq - Neonatal mortality rate: Knoema; 2021 [cited 2024 May 20]. Available from: <https://knoema.com/atlas/Iraq/Neonatal-mortality-rate>.
- A Aber. How the 2003 Iraq Invasion Devastated the Country's Health Service, 2016.
- Macrotrends. Iraq Population Density 1950-2024: Macrotrends; [cited 2024 May 20]. Available from: <https://www.macrotrends.net/global-metrics/countries/IRQ/iraq/population-density#:~:text=The%20population%20density%20of%20Iraq,a%202.21%25%20increase%20from%202021>.
- Sana Mahtab, Madhi Shabir A, Baillie Vicky L, Els Toyah, Thwala Bukiwe Nana, Onyango Dickens, et al. Causes of death identified in neonates enrolled through Child Health and Mortality Prevention

- Surveillance (CHAMPS), December 2016–December 2021. PLOS Global Public Health, 2023; 3(3): e0001612.
17. WHO. Newborn mortality: World Health Organization; 2024 [cited 2024 May 20]. Available from: <https://www.who.int/news-room/fact-sheets/detail/newborn-mortality>.
  18. WHO. Newborns: improving survival and well-being: World Health Organization; 2020 [cited 2024 May 20]. Available from: <https://www.who.int/westernpacific/news-room/fact-sheets/detail/newborns-reducing-mortality>.