

# Causes of Death and the Mortality Rate of Newborns in NICU in Mashhad for Five Years

Ashraf Mohammadzadeh<sup>1\*</sup>, Ahmadshah Farhat<sup>1</sup>, Reza Saeidi<sup>2</sup>, Fatemehsoltan Zegheibzadeh<sup>3</sup>, Farideh Golhasani<sup>4</sup>,

1. Neonatal Research Center, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

2. Neonatal Health Research Center, Research Institute for Children's Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran

3. Department of Pediatrics, Mashhad University of Medical Sciences, Mashhad, Iran

4. Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

## ABSTRACT

**Background:** The neonatal period is the riskiest time for child survival. Globally, 2.4 million children died in the first month of life in 2020, and there are approximately 6,700 newborn deaths every day. In this study, the authors have evaluated the causes of death among infants hospitalized in the Neonatal Intensive Care Unit (NICU) of Imam Reza Hospital, Mashhad, Iran, for five years, since 2015.

**Methods:** A cross-sectional study was conducted on all neonates who died in the NICU under study. Data were collected through one of the proposed questionnaires of the Ministry of Health and Medical Education (NOHME), known as the "Green Questionnaire for the Study of the Dead Infant". The data were recorded regarding asphyxia, congenital anomalies, sepsis or infection, respiratory distress syndrome (RDS), disseminated intravascular coagulation, pneumothorax, seizures, and the date of death. The extracted data were categorized and analyzed by the SPSS software (version 16). Babies who died at more than 28 days of age were excluded.

**Results:** Totally, 501 out of 4,348 NICU admissions died (11.52%), 54.5% of whom were male and 45.5% female. The mean birth weight was 1,658±1,018 grams, and the mean gestational age was 32±6 weeks. Most of them were between days one to six. The most common causes of NICU-Mortality Rate (MR) were RDS, congenital heart disease, and congenital anomalies, in descending order. The hospital under study recently expanded to a referral center for congenital heart disease in the east of Iran, which affected the NICU-MR in the ward under study. After the omission of congenital heart disease, the NICU-MR was 10.1%.

**Conclusion:** The NICU-MR was 10.1-11.5% in this study. After RDS, the second cause of death was congenital heart disease. As it is a new division in the hospital under study, it is hoped to get better improvement in congenital heart disease management.

**Keywords:** Etiology, Neonatal intensive care unit, Neonatal mortality rate, Newborns

## Introduction

The neonatal period includes the first 28 days after birth (1), and it is estimated that 47% of under-five year's deaths occur in this hazardous period of life (2). This incidence has a wide variation range in developed and developing countries (3) since the mortality rate for Neonatal Intensive Care unit admissions (NICU-MR), including all gestational ages, varies widely from 3.1%-29% (3).

Neonatal survival depends on the quality of medical care, severe preterm labor, Extremely Low Birth Weight, congenital anomalies, and perinatal asphyxia (4,5).

Neonatal death in developed countries mainly results from unpreventable causes, such as congenital abnormalities, whereas in developing countries, infections, birth asphyxia, and prematurity are the main causes of neonatal

\* Corresponding author: Ashraf Mohammadzadeh, Neonatal Research Center, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. Tel: +989153146917; Email: mohamadzadeha@mums.ac.ir

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death (6).

In-hospital mortality rates (MRs) of the NICUs significantly impact infant mortality (7, 8), and a fraction of NICU deaths in the post-neonatal period are attributable to conditions originating from the neonatal period (7).

Assessment of the NICU-MRs and the etiologies of death helps to improve the quality of services in the NICU departments and control preventable deaths.

This study, therefore, aimed to investigate the causes of infants' death and the NICU-MR in Imam Reza Hospital (Mashhad, Iran) from 2015 for five years.

## Methods

### Study design and period

An institutional-based cross-sectional study was conducted from June 2015 for five years, using the medical records of neonates admitted to the NICU of Imam Reza Hospital in Mashhad University of Medical Sciences (MUMS) in northeast Iran.

### Study setting

The study was carried out at the NICU of Imam Reza Hospital, a tertiary referral teaching hospital in northeast Iran. Two groups of neonates were admitted to this unit: in-born patients (high-risk and complicated neonates born in this hospital) and out-born babies (neonates transferred from other hospitals in the city). This ward has 25 standard NICU beds and nearly 3,500-4,000 deliveries annually.

### Study population, sample size, and inclusion/exclusion criteria

The study population included all neonates admitted to the NICU of Imam Reza Hospital from June 2015 for five years. Neonates with available medical records were included in this study, and those with missing data were excluded.

### Data collection procedures

Data were extracted by reviewing the medical records of newborns using a structured questionnaire developed by the Ministry of Health and Medical Education as the "green questioner" (9) used for evaluating dead neonates in Iran. It has four parts: the first part collects the characteristic data of the newborns, and the second part particularly finds the exact

cause of death based on the International Classification of Diseases, Tenth Revision (ICD-10). The third part has questions about the maternal condition, delivery, and underlying diseases, and the final part is about neonates' admission and transfer.

### Data analysis

The collected data were coded and analyzed using the SPSS software (version 16) for windows.

### Ethical considerations

Ethical clearance to conduct the study was obtained from the institutional review board of the Institute of Health, Faculty of Health Sciences, Mashhad University of Medical Sciences, Mashhad, Iran (Ethical reference: IR.MUMS.MEDICAL.REC.1398.544).

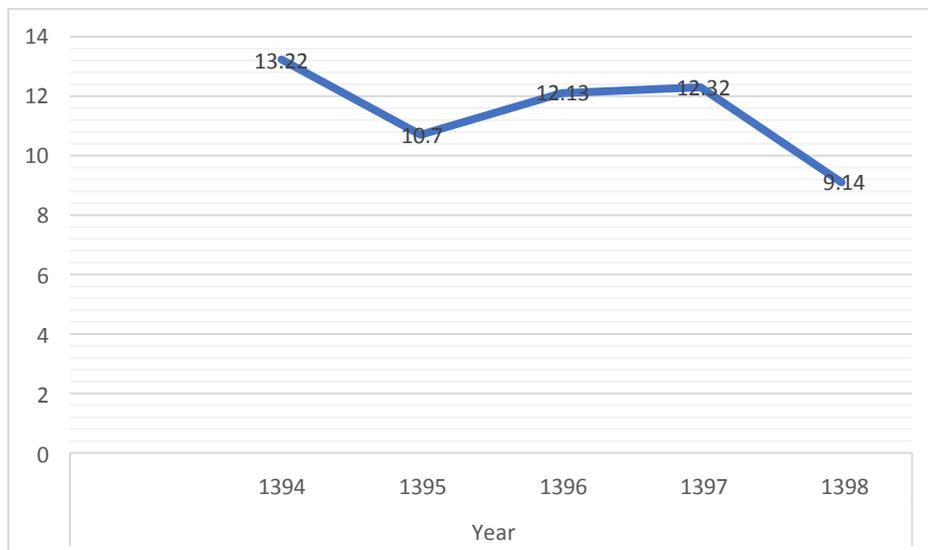
## Results

During five years, 4,368 newborns were admitted to the NICU, 20 of whom were excluded from the study because of incorrectly recorded data; therefore, 4,348 neonates were included for further analysis. Totally, 501 out of 4,348 NICU admissions died (11.52%), 54.5% of whom were male and 45.5% female. The mean birth weight was  $1,658 \pm 1,018$  grams, and the mean gestational age was  $32 \pm 6$  weeks. Most of them were between days one to six. The mean age of their mothers was  $29 \pm 6$  years, and 70% of them were less than the parity tree. The most common causes of NICU-MR were respiratory distress syndrome (RDS), congenital anomalies, and congenital heart disease, in descending order (Table 1).

Mortality rate reduced during these five years, with the lowest rate reported in 2019. In 2014, the death rate in the NICU department was 13.22%; however, it reached 9.14% in 2018 (Figure 1).

**Table 1.** Causes of mortality in the Neonatal Intensive Care Unit

Disease	Number	Percent
Respiratory distress syndrome	295	51.7%
Major anomalies	82	16.4%
Congenital heart disease	67	13.5%
Sepsis	36	7.1%
Asphyxia	32	6.4%
Others	25	5%



**Figure 1.** Mortality rate during the five years of study

## Discussion

The NICU-MR in this interval was 11.52%. Neonatal mortality has been a significant public health burden, particularly over the past two decades. However, new developmental advantages in prenatal, delivery, and postnatal care have greatly improved the survival of premature neonates.

Some factors affected the NICU-MR in the ward under study. Firstly, the hospital recently expanded to a referral center for congenital heart disease in the east of Iran, which affected the NICU-MR. After the omission of congenital heart disease death, the NICU-MR was 10.1%. There was a difference between the first two years and the last two years concerning the causes of death. In the first two years, the main causes of neonatal mortality after RDS were birth defects and congenital anomalies while in the last two years, the most common problems were congenital heart defects and congenital anomalies.

The second influential factor was that some newborns admitted to the NICU were referred from other NICUs in the city because of severely ill babies, which increases the MR. Third, it is noticeable that the maternity ward of the Imam Reza Hospital is one of the two centers for high-risk pregnant admissions in Mashhad and produces severely ill newborns.

The NICU-MR of admissions, including all gestational ages, varies widely from 3.1%-29% (8). Countries with higher levels of facilities reported a low level of mortality. It was 19.2% in Ghana (7), 4% in Canada (1996-1997) (10), and 8.3% in Australia (2001-2006) (11).

Boskabadi et al. conducted a one-year study in 2010 and reported the NICU-MR as 9.4% in another

tertiary NICU in Mashhad, which was lower than that estimated in the present study. However, this study was long and lasted for five years; therefore, the discrepancy in findings may be due to the shorter period of their study (12). Prematurity and its related consequences were the main causes of neonatal mortality in their study. Mohammadi et al. (13), in a meta-analysis, studied the NICU-MR in Iran for 18 years and found the overall prevalence of mortality was 21.8% (95%CI: 14.4-31.6%), and the lowest MR in babies in Babol University was 5.1% (95%CI: 3.8-6.7%).

In the present study, a higher MR was observed in male neonates and those with the cesarean section method for delivery. Male infants are at the risk of more complications at birth (such as RDS, jaundice, and infection), and thus, their MR is justifiable. Mac Dorman also found in a 2006 study in Texas that term infant mortality due to cesarean delivery was higher (14), which is compatible with the results of the present study.

The main cause of death in the patients in this study was respiratory-related diseases, particularly RDS, although the incidence of respiratory diseases reduced in the last years of the study due to the improvements in the NICU. Generally, based on the high number of premature infants death, the development of care and educational programs should be considered a main priority to prevent preterm delivery. It can also reduce RDS, asphyxia, and birth problems.

According to the findings of a study by Oshvandi (15) in 2016, the primary reasons for neonatal death were RDS, sepsis, asphyxia, and congenital

anomalies. Bahman-Bijari (16) also revealed that immaturity, birth asphyxia, sepsis, and congenital anomalies were the most prevalent causes of death in the NICU admitted population in 2012.

A study in 2013 showed that prematurity and low birth weight were the main reasons for neonatal mortality in a university in the north of Iran (17). The present study also confirmed RDS and anomalies are the primary causes of death in neonates with a gestational age of below 28 weeks. The present study was conducted in a tertiary referral hospital to which most high-risk pregnant women are being admitted.

Aref Nejad (2016) suggested prematurity and low birth weight as the most common causes of neonatal mortality (18).

Shirvani, in a large study in 1998, reported prematurity as the primary reason for neonatal death in Tehran (19).

However, since the gestational age of more than 60% of dead neonates was less than 32 weeks in this study, the first cause of neonatal mortality was RDS, and congenital malformations were the second leading cause of neonatal mortality. The fact that congenital anomalies are reaching the top causes of neonatal MR indicates that the conditions in developing countries are the same as that in developed countries. Congenital malformations are one of the major causes of neonatal and fetal death, and proper perinatal diagnosis, as well as early treatment, can reduce the severity of problems.

In a study by Javanmardi, conducted in Isfahan, Iran, the first reasons for mortality were prematurity, congenital malformation, and RDS (20). On the other hand, in Kumar's study in India, the causes of mortality were prematurity (31%), asphyxia (26%), sepsis (22%), and congenital malformation (9%) (21).

The present study suffered from some limitations. Firstly, it was retrospective, and secondly, it was conducted in a tertiary referral hospital NICU; therefore, the findings might vary in urban hospital NICUs. The NICU under study is the main referral hospital for congenital heart disease in the east of Iran, to which many patients with congenital heart defects are referred. As a result, congenital heart disease might have affected the reported incidence of NICU-MR.

## Conclusion

The NICU-MR was 10.1%-11.52% in this study, compared to the worldwide range of 3.1%-29%. After RDS, the second cause of neonatal death was congenital heart disease in the present study. As it is a new division in the hospital under study, it is

hoped to get better improvement in congenital heart disease management.

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## Conflicts of interest

None.

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