

Causes of mortality in a neonatal intensive care unit in Iran: one year data

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ABSTRACT

BACKGROUND Neonatal mortality rate is a major health index. Approximately, 65% of all deaths in the first year of life occur during this 4-week period. The present study was conducted to investigate the mortality rates and causes of death in a neonatal intensive care unit (NICU) in Ahvaz, Iran in a year.

METHODS This cross-sectional study was conducted in the NICU of Sina Hospital in Ahvaz. Medical records were studied, and data from 1,040 newborns admitted to the NICU within one year (March 2016 to March 2017) were collected following a checklist. Relevant data of 123 died newborns were collected. Data were analyzed using SPSS, version 20 (SPSS Inc., USA).

RESULTS The mortality rate was 11.82% (123 cases) out of 1,040 newborns admitted to NICU. Most of the newborns (48.8%) died on days 1–7. The causes of death were respiratory distress syndrome (RDS) (34.1%), asphyxia (25.2%), anomalies (10.6%), sepsis (7.3%), intracerebral hemorrhage (8.1%), pulmonary hemorrhage (7.3%), and other causes (6.4%), such as hydrops, severe pneumothorax, severe renal failure, and others.

CONCLUSIONS The mortality rate in the NICU of this center was similar to that in other Iranian provinces. The most common causes of NICU mortality included prematurity and its complications, such as asphyxia and RDS. Thus, a strategic plan for reducing preterm delivery and asphyxia are necessary.

KEYWORDS mortality rate, neonatal intensive care unit, premature birth

Neonatal death is an important health index with a direct impact on the indices of infant death and death of children under the age of five years.¹ According to the global statistics, out of 130 million children born annually, about 10 million children die before the fifth day of their life, among which 8 million deaths occur before the end of the first day, and at least one in three deaths in children under the age of five occurs during the neonatal period.² Prenatal mortality and neonatal mortality have the highest mortality rates compared with other age groups, and seven newborns die every minute on earth (415 newborns per hour).³

In developed countries, the main causes of neonatal mortality include unpreventable factors, such as congenital anomalies and congenital heart disease, whereas in developing countries preventable factors, such as prematurity, asphyxia, and infections, are among the most common causes of neonatal morbidity and mortality.³ The neonatal mortality rate (NMR) varies from one country to another based on economic and health conditions. The NMR in countries, such as Japan, Singapore, Finland, Iceland, and Slovenia, was one per 1,000 live births in 2015, whereas it was much higher in Sudan (39 per 1,000

live births), in Somalia (40 per 1,000 live births), in Pakistan (46 per 1,000 live births), and in Central Africa (43 per 1,000 live births). In Iran, it has been reported to reach 10 to 12 per 1,000 live births.⁴ Given the importance of evaluating the NMR in neonatal intensive care unit (NICU) and its causes, the present study was conducted to investigate the mortality rates and causes of death in a NICU in Sina Hospital in Ahvaz, Iran in a year.

METHODS

This cross-sectional study was conducted after the approval by the Ethics Committee of Behbahan Faculty of Medical Sciences (Number: IR.BHN.REC.1397.006).

Subjects' recruitment

Ahvaz is one of the metropolises of Iran and is the center of Khuzestan Province. According to the official census in 2011, the population of this city was 1,112,021 people, making Ahvaz the seventh most populated city in Iran. The NICU of Sina Hospital in Ahvaz is one of the largest NICUs in Khuzestan Province, and in addition to the admission of sick newborns in this center, most pregnant women with high-risk delivery are also referred to this center.

All newborns (up to 28 days old) in the NICU of Sina Hospital affiliated to Ahvaz Jundishapur University of Medical Sciences in one year (March 2016 to March 2017) were included. Sampling was conducted through census. The inclusion criteria was all newborns admitted to NICU, whereas the exclusion criteria was incomplete medical records ($n = 4$). The mortality rate in NICU is based on the number of deaths of newborns compared with the number of admissions at a specific time and place.

Data collection

From the NICU Registry Office of Sina Hospital, the total number of admission and the all dead newborns files were recorded. By referring to the hospital archives, the records were studied, and data were collected based on a checklist comprising gender, gestational age, birth weight, mode of delivery, interpregnancy interval, parity, length of stay in NICU, main cause of admission, place of residence, maternal age, history of chronic maternal diseases, pregnancy complications, intrauterine growth restriction, neonatal weight, mode of newborn admission,

maternal education, cause of cesarean section, history of stillbirth, and presence or absence of birth defects.

Data analysis

Data were analyzed using SPSS, version 20 (SPSS Inc, USA). Demographic characteristics, causes, and mortality rate were reported as frequency or percentage.

RESULTS

Characteristics of the subjects and neonatal mortality

From 1,040 newborns who were admitted to the NICU, 123 newborns died, and the NICU mortality rate was 11.82%. Most of the newborns (48.8%) died on days 1–7. Most of the mothers were 18–29 years old (56.1%) and in the gestational age (GA) of 37–40 weeks (23.6%). Seventy-two newborns (58.5%) were born through cesarean section. Mothers with elementary school education (39%) had the highest frequency. Twenty mothers (16.3%) had a history of stillbirth. The most common problems of mothers during delivery were preterm delivery (24.4%) and premature rupture of membranes (17.1%). The most common underlying disease of mothers was hypertension (17.9%). Regarding the interpregnancy interval, the highest frequency was observed in nulliparous mothers (29.3%) and mothers with interpregnancy intervals of more than five years (23.6%). Table 1 shows the other demographic characteristics of mothers and dead newborns.

Causes of hospitalization and mortality of the newborns

The main causes of death among newborns admitted to the NICU were prematurity and respiratory problems (Figure 1). The causes of death were severe respiratory distress syndrome (RDS) (34.1%), asphyxia (25.2%), anomalies (10.6%), sepsis (8.1%), intracerebral hemorrhage (8.1%), pulmonary hemorrhage (7.3%), and other causes (6.6%), such as hydrops, severe pneumothorax, severe renal failure, and others (Figure 2).

DISCUSSION

NMR is an important health index that reflects the nutrition and community health care system. The main causes of neonatal mortality are categorized

into biological (prematurity, infection, and asphyxia at birth) and non-biological factors (socioeconomic status and parents of education).⁵ To reduce NMR, it is important to investigate the incidence and causes of mortality in the NICU and to identify the controllable

Table 1. Demographic characteristics of dead newborns and their mothers

Variable	n (%) (N= 123)
Infant's age (days)	
<1	26 (21.1)
1–7	60 (48.8)
>7	37 (30.1)
Infant's sex	
Male	68 (55.3)
Female	54 (43.9)
Sexual ambiguity	1 (0.8)
Mother's age (years)	
<18	6 (4.9)
18–<30	69 (56.1)
30–<35	27 (22.0)
35–<40	17 (13.8)
≥40	4 (3.3)
Gestational age (weeks)	
<28	24 (19.5)
28–<30	17 (13.8)
30–<34	27 (22.0)
34–<37	15 (12.2)
37–<40	29 (23.6)
≥40	11 (8.9)
Mother's education	
Illiterate	14 (11.4)
Elementary school	48 (39.0)
Middle school	20 (16.3)
High school/Diploma	24 (19.5)
Academic	17 (13.8)
Birth weight (g)	
<1,000	21 (17.1)
1,000–<1,500	24 (19.5)
1,500–<2,500	39 (31.7)
2,500–<4,000	31 (25.2)
≥4,000	8 (6.5)
Type of delivery	
Vaginal	51 (41.5)
Cesarean section	72 (58.5)
Congenital malformations at birth*	31 (25.2)
History of stillbirth	20 (16.3)

Table 1. (continued)

Variable	n (%) (N= 123)
Diseases during the mother's pregnancy	
Preterm delivery	30 (24.4)
Preterm rupture of the membranes	21 (17.1)
Preeclampsia	20 (16.3)
Gestational diabetes	8 (6.5)
Oligohydramnios	5 (4.1)
Post date	3 (2.4)
Polyhydramnios	2 (1.6)
Intrauterine growth restriction	2 (1.6)
Placental abruption	2 (1.6)
Abnormal presentation of the fetus	1 (0.8)
Other	1 (0.8)
No problem	28 (22.8)
Past medical history of mother	
Hypertension	22 (17.9)
Diabetic	9 (7.3)
Renal diseases	1 (0.8)
Thyroid diseases	1 (0.8)
Infection diseases	1 (0.8)
Other	1 (0.8)
No problem	88 (71.5)
Distance to previous pregnancy	
<1 year	13 (10.6)
1–<2 years	19 (15.4)
2–<5 years	26 (21.1)
≥5 years	29 (23.6)
Nullipara	36 (29.3)

*Congenital malformations include cardiovascular (2.8%), musculoskeletal (10.5%), urogenital (7.9%), cerebral (4%)

factors; hence appropriate plans are developed to address it. Moreover, these studies should be carried out continuously in each region, as they may yield different outcomes over time. For example, in the current study, the mortality rate in the NICU was 11.8%; whereas in the same region in 2011, the rate reached to 17.5%.⁶

In various studies conducted in Iran, the mortality rate in NICU has been reported to be between 6.2% and 48.1%.^{6–10} In a meta-analysis in 2015, Chow et al¹¹ observed that the NMR was 4% in Canada, 5.7% in Portugal, 6.5% in Qatar, 8.1% in the UK, 9.2% in Australia, 14.2% in Nigeria, and 26–29% in Uganda. These differences in NMR indicate different factors in health, economics, and social development on developed

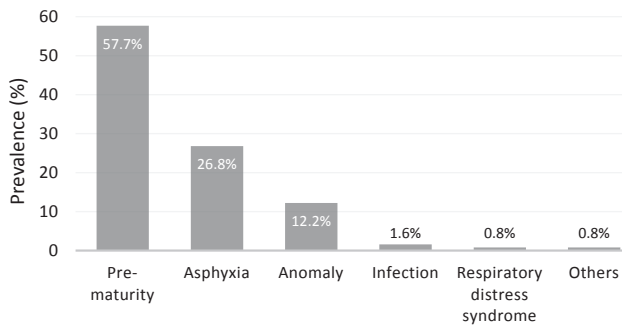


Figure 1. Primary causes of hospitalization of dead newborns in NICU of Sina Hospital in Ahvaz. Others=hydrops, severe pneumothorax, and severe renal failure

countries compared with developing countries; other factors, such as the number of referrals from other centers, modern equipment, the ratio of the nurse and the medical staff to the bed, and the experience and skill of medical staff and physicians, also affect the NMR in NICU in different areas.⁷⁻¹⁰ In the study of Chow et al,¹¹ the mortality rates in NICU in developed countries reached 4-46%, but this rate in developing countries was up to 64.4%. The results of this study showed that the prevalence of mortality rate in one NICU in Ahvaz, Iran (known as a developing country) is notably lower than the previous estimates provided for developing countries.

In the present study, the most common causes of neonatal mortality were prematurity and respiratory problems, followed by asphyxia and congenital anomalies, accounting for 69.9% of the causes. According to the study of Aramesh et al,⁶ the most common causes of death were prematurity and its associated problems (58.8%), anomalies (17.3%), and asphyxia (8%). In the study of Sareshtedari et al⁷ in Qazvin, Iran, the most common causes of death in NICU included sepsis and its complications (40%), RDS (26%), asphyxia (16%), and congenital anomalies (14%).

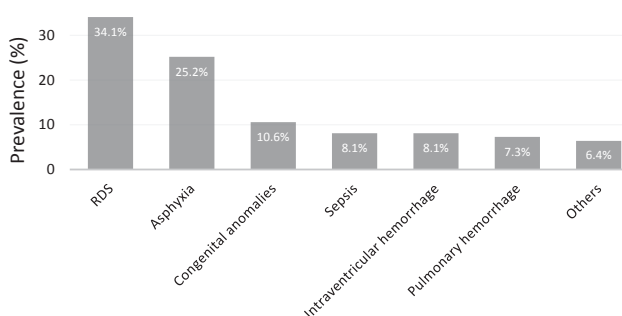


Figure 2. Main causes of neonatal mortality in NICU of Sina Hospital in Ahvaz. Others=pneumatic thorax, renal failure, seizures. RDS=respiratory distress syndrome

Prematurity is the main etiology for neonatal mortality, because infants who died in a hospital, including those with low birth weight, are mostly prematurely born.^{1,12-15} In the present study, prematurity and respiratory problems accounted for more than one-third of the deaths. In other studies conducted in Iran, such as the studies of Javanmardi et al¹⁶ in Isfahan (44.6%), Aramesh et al⁶ in Ahvaz (24.8%), and Aref Nejad et al¹⁷ in Zabul (73%), prematurity was the most common cause of mortality in NICU, but in other studies, such as those of Basiri et al¹⁸ in Hamadan (73.8%), Hoseini et al¹⁹ in Sabzevar (46%), Fallahi et al²⁰ in Tehran (43.3%), and Mirzarahimi et al²¹ in Ardabil (47.9%), RDS was the most common cause. However, the RDS-specific mortality rate in low-income countries is difficult to determine. Improving prenatal care and reducing risk factors, combined with the use of anabolic steroids and surfactants, may lead to better outcomes for infants with RDS.⁸

Asphyxia (26.8%) was also a common cause of NICU mortality in the present study. In other studies, asphyxia accounted for 3.6% to 16% of mortality causes,^{5,6,17,20,21} and the estimates of the present study are considerably higher than those of previous studies. These findings could be due to the high transfer of patients with asphyxia from other cities and unorganized transfer of these patients.

In the present study, congenital anomalies accounted for 10.6% of the cause of mortality. Other studies have reported varied mortality rates caused by congenital anomalies (8.3% to 23.5%) in various cities in Iran.^{17,19,21} Similar results were reported in other countries.^{22,23} According to a meta-analysis by Chow et al,¹¹ congenital anomalies and chromosomal abnormalities were the most common causes of neonatal death in NICUs in countries, such as Canada (34%), Portugal (50%), and Qatar (30.8%). Therefore, congenital anomalies are important causes of admission in NICU and death, and this finding indicates the importance of using preventive strategies to reduce the incidence of congenital anomalies and improve prenatal diagnosis.

In association with GA in the present study, asphyxia was the most common cause of death among newborns with GA above 37 weeks, whereas all deaths due to RDS were among newborns with GA below 37 weeks. The difference in the cause of death in term newborns can be due to the variation in the time of study and the change in policies and interventions

of the health system. Thus, by controlling perinatal infections, the prevalence of sepsis decreases, but the prevalence of asphyxia increases. Therefore, the high prevalence of asphyxia in surviving term newborns can be considered as a concern considering the morbidity and irreparable brain damage.

In the present study, the prevalence of pregnancy complications, such as preeclampsia and preterm labor in mothers who lost their newborn, reached 16.3% and 24.4%, respectively. Meanwhile, according to Iranian meta-analyses, the prevalence of eclampsia was 5%, whereas the prevalence of preterm labor was 9.2%.^{24,25} Other meta-analysis studies were established that maternal hypothyroidism, maternal anemia, depression, and obesity during pregnancy increased risk of prematurity.²⁶⁻²⁸ Hence, it may indicate the important role of prenatal care.

In the present study, 21.1% of deaths occurred in the first 24 hours of birth (15 cases of prematurity, 7 cases of asphyxia, and 4 cases for anomaly); meanwhile, 48.8% of deaths occurred on days 1-7 (38 cases of prematurity, 18 cases of asphyxia, 3 cases of anomaly, and 1 case of sepsis). A total of 30.1% of deaths occurred after day 7 (18 cases of prematurity, 8 cases of asphyxia, 8 cases of anomaly, 1 case of sepsis, and 1 case of RDS), consistent with the study of Mirzarahimi et al,²¹ who observed death prevalence of 34.45% and 28.6% during the first day and 87% and 62.4% deaths during the first week, respectively. Furthermore, these results were similar with the studies of Fallahzadeh et al²⁹ and Nayeri et al¹ who reported 95% and 78% of deaths occurring during the first week, respectively.

The limitation of this study was the lack of complete information about all newborns admitted to the NICU. Thus, we could not report the risk factors for mortality. Another limitation was that the NICU of Ahvaz (as the center of the province) accepts all critically ill infants from other cities. Thus, the mortality rate in this hospital might be higher.

In conclusion, the mortality rate in this study was 11.82%, similar to that of other Iranian Provinces. The most common causes of NICU mortality were prematurity and its complications, such as asphyxia and RDS. Thus, it is important to design plans for reducing preterm delivery and asphyxia. Moreover, as the second common causes of death, genetic counseling is necessary before marriage to reduce congenital anomalies. The causes and incidence of deaths in each

center must be reviewed and analyzed annually to control neonatal mortality in medical centers.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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