

# Relationship Between Time and Day of Birth and Neonatal Mortality in Hospitalized Infants in Neonatal Intensive Care Unit in Fatemieh Hospital, Hamadan, Iran

Maryam Shokouhi,<sup>1</sup> Behnaz Basiri,<sup>1</sup> and Mohammad Kazem. Sabzehei<sup>1,\*</sup>

<sup>1</sup>Department of Neonatology, Fatemieh Hospital, Hamadan University of Medical Sciences, Hamadan, IR Iran

\*Corresponding author: Mohammad Kazem. Sabzehei, Department of Neonatology, Fatemieh Hospital, Hamadan University of Medical Sciences, Hamadan, IR Iran. Tel: +98-9188128458, Fax: +98-8138382929, E-mail: mk\_sabzehei@yahoo.com

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## Abstract

**Background:** The neonatal mortality rate is one of the most important indicators of health promotion. However, undoubtedly, the first step to decreasing this indicator is to identify the factors affecting neonatal mortality.

**Objectives:** This study was designed and implemented in order to identify other factors, such as time and day of birth, personnel shift, and work experience, and their relationship with neonatal mortality.

**Patients and Methods:** In this retrospective, cross-sectional study, the medical records of all deceased neonates hospitalized in Fatemieh hospital of Hamadan, during a 5-year period (2006 – 2011) were extracted. A questionnaire including sex, weight, gestational age, time of birth, delivery mode, maternal disease, and leading cause of death was filled out. The information was then analyzed using SPSS 19.

**Results:** In this study, 974 neonatal deaths were registered, among which 57.2% were male. The mean birth weight of neonates was 1548 g (ranging from 300 – 4800), and the mean gestational age was 31.2 weeks. The leading causes of death were respiratory distress syndrome (49.6%), septicemia (26.2%), and disseminated intravascular coagulation (4.9%). In terms of the time of death, 63.1% had died during night shifts. The mean length of stay from birth to death was 3.1 and 2.3 days for morning and night shifts, respectively. In terms of the average work experience, the morning shift nursing personnel (seven individuals/shift) had 8.3 years of experience, while the night shift nursing personnel had 4.1 years of experience (five individuals/shift).

**Conclusions:** The mortality rate is higher in neonates born during night shifts and weekends. This is because, in addition to known factors affecting the mortality rate, human factors, such as taking advantage of fewer personnel with less work experience during night shifts, can increase the neonatal mortality rate.

**Keywords:** Causes of Death, Neonatal Mortality, Time of Birth, Work Shift

## 1. Background

Neonatal mortality refers to the death of a neonate during the first four weeks of life, which is one of the most important indicators of health promotion, directly affecting the mortality rate among neonates and children under the age of five. Approximately, 3.7 million neonates die each year around the world, which accounts for nearly 38% of all deaths among children under the age of five. Moreover, 75% of neonatal mortality occurs within the first seven days of life (1, 2).

In Iran, about 20,000 neonates die before reaching the age of one month (3). As officially announced by the Ministry of Health and Medical Education, the neonatal mortality rate was 12.53 per 1,000 live births in 2008. In order to decrease this rate to eight per 1,000 live births, to meet the united nations millennium development goals (MDGs), the causes of neonatal mortality need to be well identified (4).

The most common causes of neonatal mortality in

developed countries are prematurity and congenital anomalies. In developing countries, however, these causes are congenital infections and asphyxia (5-7). Most studies show that prematurity and its related complications, such as congenital anomalies and low birth weight, are among the leading causes of neonatal mortality in Iran (8, 9).

In addition to the known and important causes of neonatal mortality, several studies in Europe and the United States have shown that the neonatal mortality rate was higher in neonates born during night shifts, and increased by 12 – 28% during the first week of their life for neonates born during night shifts (10-12).

## 2. Objectives

This aim of this study was to determine the effect of birth time on neonatal mortality.

### 3. Patients and Methods

In this retrospective, cross-sectional study the medical records of all deceased neonates hospitalized in Fatemeh hospital of Hamadan (0 – 30 days of age) were extracted during a 5-year period (2006 – 2011). Deceased fetuses and neonates with incomplete records were excluded from the study. After studying the medical records of neonates and mothers, a questionnaire with demographic information including sex, birth weight, gestational age, time of birth, delivery mode, birth order, maternal diseases, length of stay, and leading underlying cause of death for the neonates who met the inclusion criteria was filled out. Moreover, the work shifts of nursing personnel were divided into morning shifts (8 am – 2 pm), evening shifts (2 pm – 8 pm), and night shifts (the first half: 8 pm – 2 am; the second half: 2 am – 8 am). The work experience of personnel, and day, month, and season of birth were also recorded. The information obtained was then analyzed using SPSS 19.

### 4. Results

Of a total of 974 deceased neonates during the five year study period, 557 (57.2%) were male and 417 (42.8%) were female. The mean birth weight of neonates was 1,548 g (ranging from 300 – 4800 g), the mean gestational age was 31.2 weeks, and the mean maternal age was 27.7 years (ranging from 14 – 50 years). In terms of delivery mode, 65.8% of the neonates were born by cesarean. No symptoms/signs of any underlying disease were observed among 85.7% of the mothers (Table 1). The leading causes of mortality were respiratory distress syndrome (49.6%), septicemia (26.2%), and disseminated intravascular coagulation (4.9%) (Table 2). In terms of the birth time of deceased neonates, based on the nursing personnel's work shifts, 188 (19.2%), 275 (28.2%), and 511 (52.5%) neonates were born during morning, evening, and night shifts, respectively (Table 3). In terms of the death time of neonates, based on the nursing personnel's work shifts, 615 (63.1%) neonates died during night shifts. The mean length of stay from birth to death was 3.1 and 2.3 days for morning and night shifts, respectively (Table 4). The average work experience of nursing personnel was 5.2 years (range, 1 – 17 years). Morning and night shift nursing personnel had the highest (8.3 years) and lowest (4.1 years) work experience, respectively. There were seven, four, and five nursing personnel for morning, evening, and night shifts, respectively (Table 5). In terms of frequency of death based on birth day, most of the deaths occurred on Friday (22.1%) and Thursday (18.8%). In terms of frequency of death based on birth month, most of the deaths occurred in February (14.2%) and January (11.7%). In terms of frequency of death based on birth season, most of the deaths occurred in winter (33.2%) and summer (27.4%).

**Table 1.** Demographic Information of Neonates

| Variable                     | No.( %)    |
|------------------------------|------------|
| <b>Gender</b>                |            |
| Male                         | 557 (57.2) |
| Female                       | 417 (42.7) |
| <b>Birth weight, g</b>       |            |
| <1000                        | 240 (24.6) |
| 1000 -1500                   | 433 (44.6) |
| 1501 -2500                   | 204 (20.9) |
| > 2500                       | 97 (9.9)   |
| <b>Gestational age, Week</b> |            |
| < 28                         | 236 (24.3) |
| 28 - 37                      | 665 (68.2) |
| 38 - 40                      | 67 (7)     |
| > 40                         | 6 (0.6)    |
| <b>Delivery mode</b>         |            |
| Natural                      | 333 (34.2) |
| Cesarean                     | 641 (65.8) |
| <b>Birth order</b>           |            |
| First                        | 409 (42)   |
| Second                       | 287 (29.5) |
| Third                        | 137 (14.1) |
| Fourth and Higher            | 141 (14.4) |
| <b>Maternal disease</b>      |            |
| Preeclampsia                 | 153 (15.7) |
| Diabetes                     | 18 (1.8)   |
| Polyhydramnios               | 6 (0.6)    |
| Hypothyroidism               | 6 (0.6)    |
| Pyelonephritis               | 5 (0.5)    |
| No Disease                   | 786 (80.7) |
| <b>Total</b>                 | 974 (100)  |

**Table 2.** Cause of Death Among Neonates

| Cause   | No. (%)    |
|---|------------|
| <b>Respiratory distress syndrome</b>          | 484 (49.6) |
| <b>Septicemia</b>                             | 255 (26.2) |
| <b>Disseminated intravascular coagulation</b> | 48 (4.9)   |
| <b>Severe prematurity</b>                     | 30 (3)     |
| <b>Hydrocephalus</b>                          | 18 (1.8)   |
| <b>Hypoxic-ischemic encephalopathy</b>        | 12 (1.2)   |
| <b>Necrotizing enterocolitis</b>              | 11 (1.1)   |
| <b>Diaphragmatic hernia</b>                   | 11 (1.1)   |
| <b>Inherited metabolic disease</b>            | 11 (1.1)   |
| <b>Meconium aspiration</b>                    | 6 (0.6)    |
| <b>Renal failure</b>                          | 6 (0.6)    |
| <b>Other causes</b>                           | 48 (49)    |
| <b>Total</b>                                  | 974 (100)  |

**Table 3.** Frequency of Neonate Delivery During Each Work Shift

| Work Shift     | No. (%)    |
|----------------|------------|
| <b>Morning</b> | 188 (16.3) |
| <b>Evening</b> | 275 (28.2) |
| <b>Night</b>   |            |
| 8 pm – 2 am    | 287 (52.5) |
| 2 am – 8 am    | 224 (52.5) |
| <b>Total</b>   | 974 (100)  |

**Table 4.** Frequency of Neonate Mortality and Mean Length of Stay During Each Work Shift

| Work Shift     | No. (%)    | Mean Length of Stay |
|----------------|------------|---------------------|
| <b>Morning</b> | 142 (14.5) | 3.1                 |
| <b>Evening</b> | 217 (22.2) | 2.4                 |
| <b>Night</b>   |            |                     |
| 8 pm – 2 am    | 289 (29.6) | 2.7                 |
| 2 am – 8 am    | 326 (33.4) | 1.8                 |
| <b>Total</b>   | 974 (100)  |                     |

**Table 5.** Average Work Experience of Nursing Personnel Based on Neonates' Births and Deaths

| Work Shift     | Average Work Experience |       |
|----------------|-------------------------|-------|
|                | Birth                   | Death |
| <b>Morning</b> | 9.41                    | 8.2   |
| <b>Evening</b> | 3.9                     | 5     |
| <b>Night</b>   | 3.2                     | 4.15  |

## 5. Discussion

Investigation and identification of the causes of and risk factors for neonatal mortality is the first step to decreasing this indicator. This study showed that respiratory distress syndrome is the leading cause of neonatal mortality, which is similar to the results of most studies. For example, a study by Alberman et al. in Britain showed that 45% of neonatal mortality was caused by respiratory distress syndrome and severe prematurity (13). A study by Agbere et al. in Togo showed that 45.6% of neonatal mortality was caused by prematurity and respiratory distress syndrome (14). A study by Foran et al. showed congenital anomalies and prematurity were the leading causes of 40% and 37% of neonatal mortalities, respectively (15). With the recent advances in neonatal care in special care units, especially in developed countries, respiratory distress syndrome-related mortality has decreased (16).

The results of this study showed that septicemia is the second most common cause of death, which is similar to the results of other studies conducted in countries such as Iraq, China, and Croatia (6, 17, 18). The mean birth weight of deceased neonates in our study was 1,548 g. The

causes of death among premature and very low birth weight neonates are similar to each other, which is similar to the results of other studies (16, 19).

In addition to predetermined factors affecting neonatal mortality, other factors were also investigated in this study. The results showed that there is a significant relationship between the neonatal mortality rate and personnel's work shifts. Moreover, comparing the morning and evening shifts, most of the deaths occurred during the night shifts, which is consistent with the results of several studies in Europe and the United States. A study by Gould et al. showed that there is a significant relationship between neonatal mortality and birth during night shifts. Within the first week of life, the neonatal mortality rate is increased by 12 – 28% for neonates born during night shifts (10). Studies by Pasupathy (2010) in Britain and Stephansson (2003) in Sweden showed that the infant mortality rate is higher during night shifts (11, 20). The possible increase in neonatal mortality during night shifts is due to taking advantage of fewer nursing personnel with less work experience, as well as fatigue among night shift personnel. The night shifts are divided into less fatiguing (8 pm – 2 am) and more fatiguing (2 am – 8 am) shifts. This fatigue can increase medical errors, though the present study rejects the effect of fatigue on increasing such errors. Lack of access to professors and lack of diagnostic procedures during the night are among the other causes of neonatal mortality during night shifts (10). In the present study, the number of morning shift personnel (seven individuals) was greater than the number of night shift personnel (five individuals). Moreover, the work experience of morning shift personnel (8.1 years) was greater than the work experience of night shift personnel (4.1 years).

The present study also showed that the neonatal mortality rate is higher on weekends than other days of the week, which is consistent with the results of a number of papers. However, no significant relationship was found in other studies (10, 11, 20).

### 5.1. Conclusions

The neonatal mortality rate is higher in neonates born during night shifts and weekends than in those born during morning shifts, which is due to fewer nursing personnel with less work experience and other relevant factors. Generalizing the results of this study as a general principle requires further studies in the future.

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## Footnotes

**Authors' Contribution:** Design and conduction of study: Maryam Shokouhi; management: Maryam Shokouhi and Behnaz Basiri; analysis of data and preparation, review and approval of the manuscript: Maryam Shokouhi, Mohammad Kazem Sabzehei, and Behnaz Basiri.

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