

## Evaluation of factors affecting the clinical course of neonates born in Bolu province: Implications for further precautions

Yasemin Baranoğlu Kılınc\* 

Department of Pediatrics, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye

### ABSTRACT

**Aim:** To examine the maternal and other factors affecting the clinical course of newborn infants in Bolu province and to reveal the possible relationships between them.

**Methods:** A total of 1592 newborns and their mothers were retrospectively included in the study between 2022-2023 at the Maternity and Child Unit of Bolu İzzet Baysal State Hospital. Clinical data of neonates and their mothers' pregnancy data were retrieved from the hospital data system. The categorical data were analyzed by chi-square test. Mann-Whitney U test was used to compare two independent groups. Spearman's rank correlation was employed to test if there was correlation between the variables.

**Results:** The rate of intensive care unit admission for caesarean deliveries (21.8%) was significantly higher than for normal deliveries (15%,  $p<0.01$ ). The rate of ventilator requirement was significantly higher in early-term (27%), late-preterm (49%) and moderately-preterm (100%) neonates compared to term ones (12%), respectively ( $p<0.01$ ). The most common risk factor for expectant mothers was thyroid disorder (27.7%). The rate of hospitalization for infection was higher than that due to congenital pneumonia in both caesarean section (45.6% vs 23.5%) and normal births (46.8% vs 18.3%,  $p<0.05$ ). The rate of cesarean delivery was significantly higher in those with late preterm (67.3%) than in those with term (49.7%,  $p<0.01$ ).

**Conclusions:** Expectant mothers should be encouraged to have a normal birth unless medically necessary. Factors that may cause prematurity should be kept under control as it causes many health problems after birth. More health precautions need to be taken for newborns under 1 year of the health of expectant mother should be closely monitored for the mother and her newborn. Awareness about the common causes of infant disorders is important in forward health planning and precautions to be taken.

**Keywords:** Newborn, prematurity, cesarean delivery, mechanical ventilation, intensive care unit.

✉ Dr. Yasemin Baranoğlu Kılınc\*

Department of Pediatrics, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye

E-mail: [yaseminbaranoglu@hotmail.com](mailto:yaseminbaranoglu@hotmail.com)

Received: 2024-12-11 / Revisions: 2024-12-26

Accepted: 2024-12-30 / Published: 2025-01-03

### 1. Introduction

Newborn infants still encounter serious problems and some of these problems can result in the death of the newborn, despite significant advances in modern medicine. For this reason, it

is very important to control the prenatal and postnatal factors that affect the health of the neonates. The intrauterine period is of great importance because of it is a period in which the foundations of human health are established [1]. A pregnancy spent in healthy conditions contributes significantly to the success of the newborn's survival after birth. Although mortality in neonates has largely been attributed to sudden emergencies [2], there may be important connections between many factors to

which the mother is exposed during pregnancy and mortality and other clinical characteristics of the newborn in the postnatal period. The prominent causes of this include maternal infection, smoking, alcohol use, poor nutrition and medications during pregnancy. In addition, asphyxia during birth and postnatal complications are also notable factors affecting newborn health. Thus, revealing the postnatal clinical features of newborn infants and the factors that the expectant mother is exposed to during pregnancy is crucial in preventing postnatal mortality and adverse developments.

The neonatal period is a critical stage in which the infant is exposed to the external environment following intrauterine life. During this period, the newborn tries to adapt to the external environment. However, it was reported that the majority of infant deaths in the first year of life occur during this period [3]. Diseases in the neonatal period have a prominent role in infant deaths without excluding prenatal and postnatal causes [4]. Additionally, premature birth has an important place among the causes of infant deaths [5]. It is also the leading cause of neonatal mortalities in Turkey [6]. Birth weight is another important factor affecting the infant's chance of survival, and extremely low birth weight infants have a hard time holding on to life [7].

In addition to the factors mentioned above, it is of great importance to reveal the possible relationship between postpartum mortality/morbidity and a wide range of factors such as maternal age, maternal disease accompanying pregnancy, multiple pregnancy, indications for hospitalization of the newborn, mode of delivery, and for intensive care necessity, thus preventing possible adverse developments after birth.

This study aimed to retrospectively examine the above-mentioned birth information of newborns born in Bolu province, to evaluate their

postnatal clinical course and to reveal the possible relationships between them.

## 2. Materials and methods

This retrospective study employed 1592 newborns and their mothers between November 2022-and 2023 at the Maternity and Child Unit of Bolu İzzet Baysal State Hospital. Data regarding newborns and their mothers were retrieved from the hospital data system. Ethical permission for the study was obtained from the Bolu Abant İzzet Baysal University Clinical Research Ethics Committee (license number 2023/437).

The following data of the newborns was collected: gender, gestational age, birth weight, hospitalization status, indication if hospitalization, ventilator connection status, blood culture request, positiveness or negativeness of reproduction in blood culture if any, postpartum death status, cause of death if postpartum death. In addition, the following information of expectant mothers was recorded: age, single and multiple pregnancies, mode of delivery (cesarean, normal delivery) and indication, pregnancy-related risk factors, postpartum hospitalization, indication for hospitalization if any.

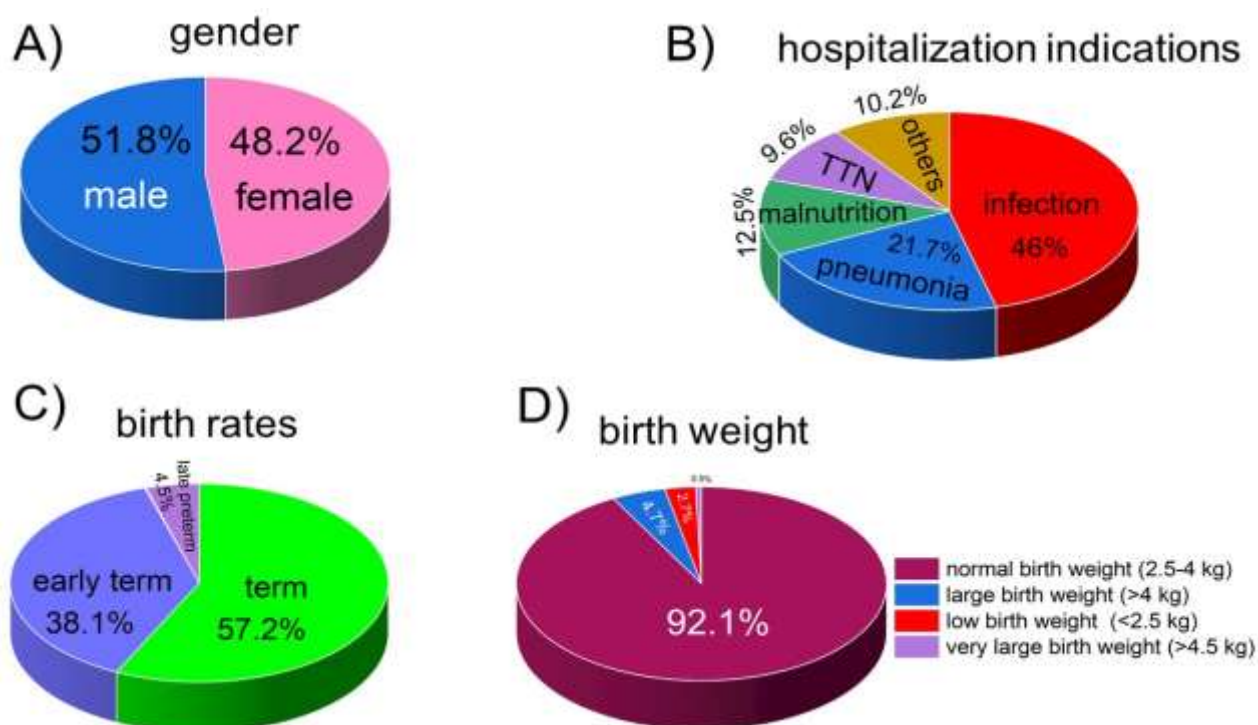
The inclusion criteria for newborns were gestational age over 24 weeks, born between November 2022 and 2023, and parental consent to participate in the study. Inclusion criteria for mothers were to have applied to the Maternity and Child Unit of Bolu İzzet Baysal State Hospital for delivery, to have given birth between November 2022 and 2023, and to have given consent to participate in the study (for their data to be used retrospectively). Newborns and their mothers were included in the study if both met the inclusion criteria. Exclusion criteria for newborns were determined as being under 24 weeks gestational age, being born outside the

period of November 2022 to 2023, and not having guardian consent to participate in the study. Exclusion criteria for the mother are the current pregnancy ended in miscarriage, the birth occurred before November 2022 to 2023, and have not given consent to participate in the study (her data being used retrospectively).

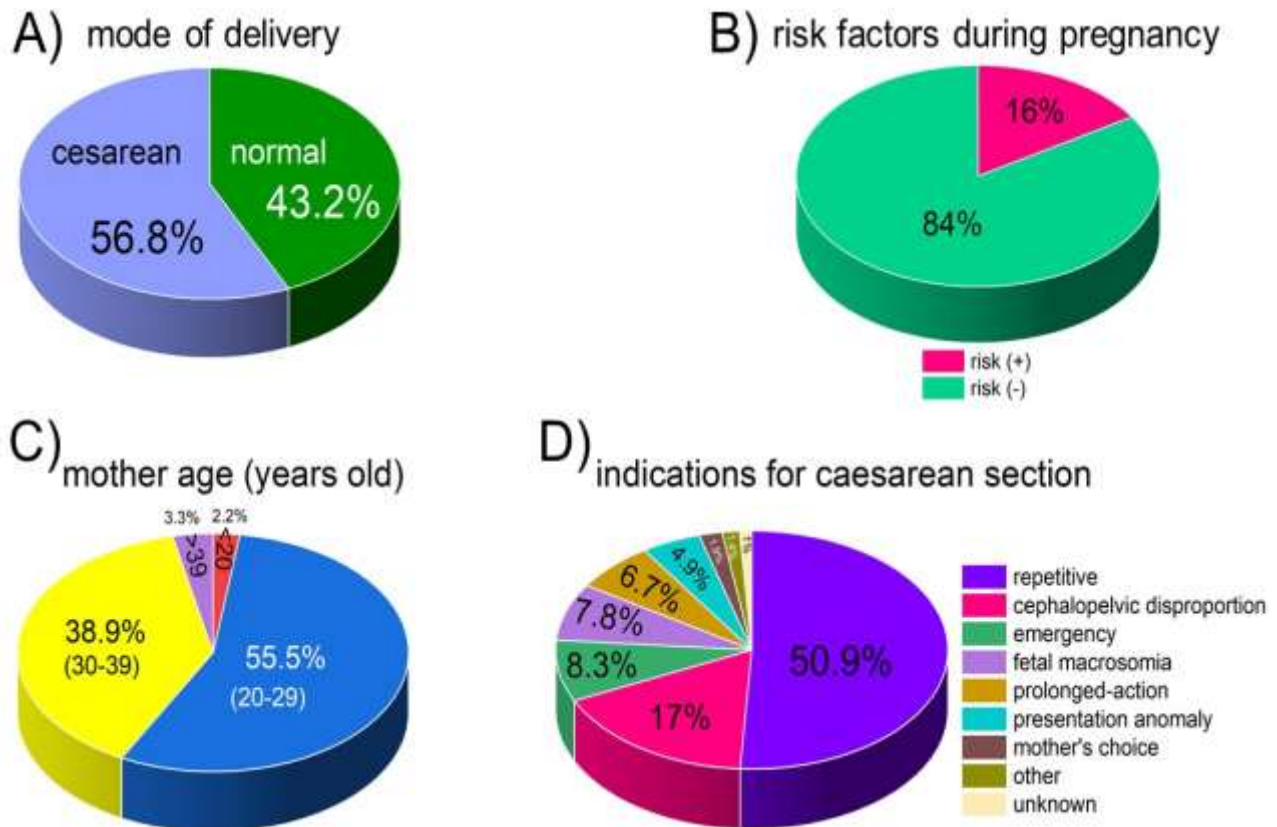
**2.1. Statistical analysis:** Categorical data like demographics were given as percentage however quantitative data were exhibited as mean  $\pm$  SEM. All statistical analyses were carried out using SPSS 22.0 software (IBM Corp, Armonk, NY, USA). Normality analysis of data was tested by Kolmogorov-Smirnov test. The categorical data were analyzed with the chi-square test. For quantitative data, Mann-Whitney U test was recruited to compare two independent groups. Whether there was a positive or negative correlation between the variables examined was analyzed with the Spearman's rank correlation. A *p* value of less than 0.05 was considered statistically significant.

### 3. Results

Of the 1592 newborns included in the study, 51.8 % were male and 48.2% were female (Fig 1A). The most common indication for hospitalization was infection (46%, Fig 1B). This was followed by congenital pneumonia (21,7%), neonatal malnutrition (12,5%), transient tachypnea of the newborn (9,6%), and others (Fig 1B). In terms of gestational age, 57.2% of births occurred at term, 38.1% at early term, 4.5% at late preterm, and 0.1% at midterm (Fig 1C). In terms of birth weight, 92.1% of the newborns had normal birth weight, 4.7% had large birth weight, 2.7% had low birth weight and 0.5% had very large birth weight (Fig 1D). 99.4% of pregnancies were singletons and 0.6% were multiples. 43.2% of births were normal while 56.8% were cesarean sections (Fig 2A). During pregnancy, 16% of expectant mothers were found to have risk factors (Fig 2B). 55.5% of mothers were between 20-29 years old, 38.9%



**Figure 1.** Information about newborns at birth. (A) Gender, (B) indications for hospitalization, (C) birth rates according to gestational age and (D) birth weight.

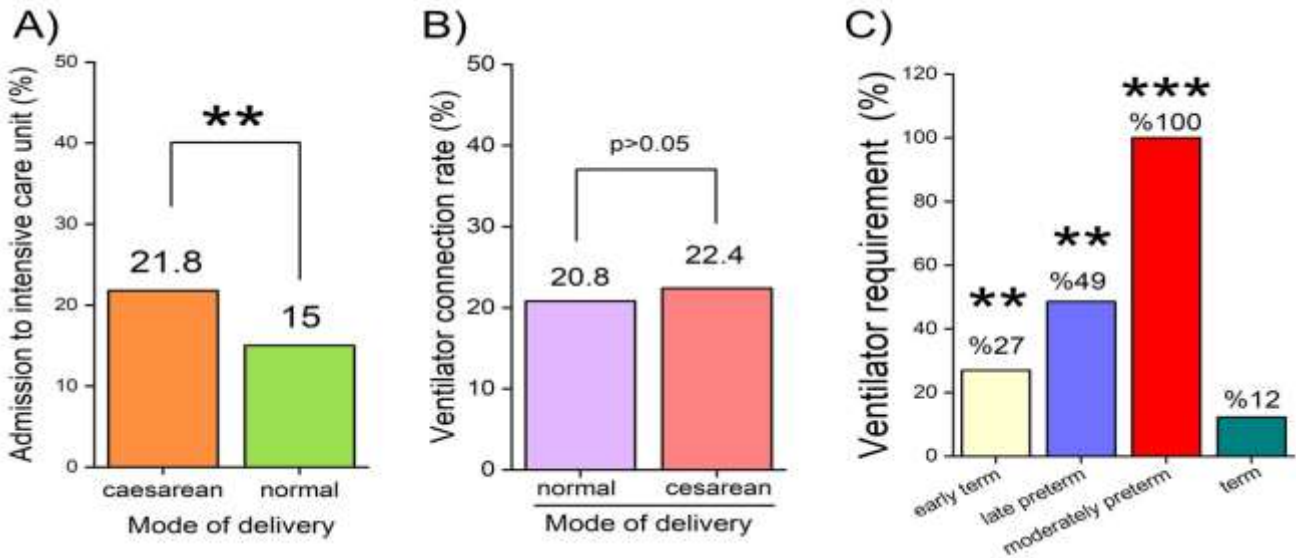


**Figure 2. Information about birth for expectant mothers.** (A) mode of delivery, (B) risk factors during pregnancy, (C) mother age, (D) indications for cesarean delivery.

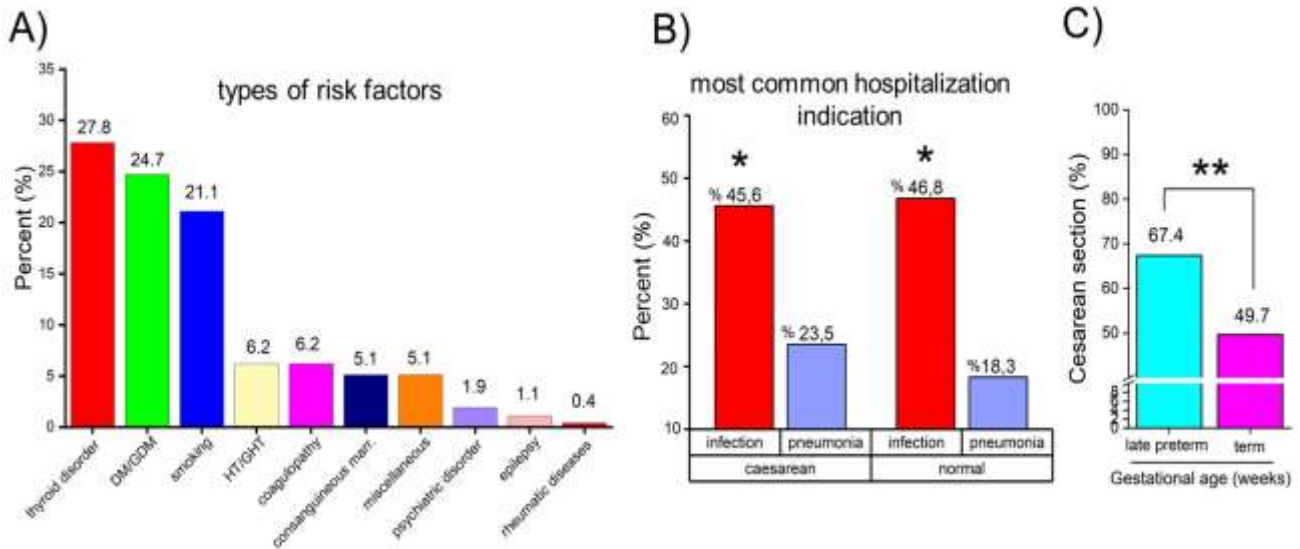
were between 30-39, 3.3% were over 39, and 2.2% were under 20 years old (Fig 2C). Indications for cesarean deliveries were 50.9% recurrent, 17% cephalopelvic disproportion, 8.3% emergency, and the remaining were miscellaneous (Fig 2D). The rate of newborns of pregnant mothers with urgent cesarean indications being admitted to intensive care was 40%. 40% of those who underwent cesarean section due to fetal macrosomia had a birth weight of over 4 kg. 30% of newborn infants of mothers who had a cesarean section with an indication of prolonged labor were admitted to intensive care. Of the newborns whose mothers had a cesarean section due to prolonged labor, 5.5% of those admitted to intensive care were placed on a ventilator.

The rate of intensive care unit admission for caesarean deliveries (21.8%) was significantly higher than for vaginal deliveries (15%,  $p < 0.01$ ,

Fig 3A). There was no significant difference between normal (20.8%) and cesarean (22.4%) deliveries in terms of ventilator connection rate ( $p > 0.05$ , Fig 3B). The rate of ventilator requirement was significantly higher in early term (27%,  $p < 0.01$ ), late preterm (49%,  $p < 0.01$ ) and moderately preterm (100%,  $p < 0.001$ ) infants compared to term ones (12%), respectively (Fig 3C). The most common risk factor for mothers during pregnancy was thyroid disorder (27.7%, Fig 4A). This was followed by diabetes/gestational diabetes (24.7%), smoking (21.1%), hypertension/gestational hypertension (6.2%), coagulopathy (6.2%), consanguineous marriage (5.1%), their combination (5.1%), psychiatric disorder (1.9%), epilepsy (1.1%) and rheumatic diseases (0.4%, Fig 4A). Infection, the most common hospitalization indication, was significantly higher than congenital pneumonia in both caesarean section and normal births ( $p <$



**Figure 3.** Medical needs of neonates for health problems that arise following birth. (A) admission to the intensive care unit in terms of cesarean section and normal birth, (B) ventilator connection status in terms of cesarean section and normal birth, (C) ventilator requirement in terms of gestational age. \*\*P<0.01, \*\*\*P<0.001.



**Figure 4.** Maternal and neonatal factors impairing infant health. (A) pregnancy-related risk factors, (B) the two most common hospitalization indications for cesarean section and normal birth (C) cesarean section rate by gestational age. DM, diabetes mellitus; GDM, gestational diabetes mellitus; HT, hypertension; GHT, gestational hypertension; marr, marriage. \*P<0.05, \*\*P<0.01.

0.05 for both, Fig 4B). The rate of cesarean delivery was significantly higher in those with low gestational age (late preterm, 67.3%) than in those with term gestational age (49.7%,  $p < 0.01$ , Fig 4C). There was no difference in the birth weights of newborn infants between pregnant mothers who smoked and pregnant mothers with other risk factors, or pregnant mothers without risk factors ( $3202 \pm 465$  g,  $3308 \pm 437$  g and  $3300 \pm 422$  g, respectively,  $p > 0.05$ ). When a

similar comparison was performed for diabetes mellitus as a risk factor, no statistically significant difference was found ( $3356 \pm 470$  g,  $3300 \pm 422$  g and  $3258 \pm 434$  g, respectively,  $p > 0.05$ ). The frequency of cesarean section in those whose maternal age was over 39 (79.6%) was higher than in those whose maternal age was in the normal range (56.5%) ( $p = 0.001$ ).

Blood culture requests were made for 94.5% of infants hospitalized with an indication of

infection. Only 1.5% of the infants who were requested had positive blood cultures. The bacterial species grown were *Staphylococcus haemolyticus* and *epidermidis*. No mortality was observed in any of the newborns examined. No correlation was found between risk factors during pregnancy and other variables such as postpartum hospitalization, birth weight, and need for a ventilator during postpartum hospitalization.

#### 4. Discussion

In parallel with scientific advances, infant mortality has decreased significantly worldwide. However, this rate is still much higher in developing countries than in developed ones [8]. One of the important indicators of a country's level of development worldwide is the infant mortality rate [9]. Infant mortality has decreased significantly in developed countries, but factors affecting infant health in the intrauterine and postnatal periods are still a serious problem. Thus, the current study attempted to investigate the factors affecting intrauterine and postnatal infant health in Bolu province.

We found that the rate of newborns born early term was 38.1%. It was reported that the rate of newborns born early term varies between 15 % and 31% across countries [10]. Our finding regarding the rate of newborns born early term is relatively higher than this previous report. However, considering the lack of data on low and middle-income countries in determining the rate in the relevant study, our finding is consistent with this. Our finding is also consistent with Türkiye being a developing country.

Additionally, we found that cesarean section (56.8 %) had a higher rate than normal delivery (43.2 %). This finding is consistent with the recent increase in cesarean deliveries worldwide [11]. In a previous study, the absolute and relative indications for cesarean delivery were

listed as follows. Absolute indications included absolute disproportion, chorioamnionitis, maternal pelvic deformity, eclampsia and HELLP syndrome, fetal asphyxia or fetal acidosis, umbilical cord prolapse, placenta previa, abnormal presentation and uterine rupture [12]. Relative indications included pathological cardiotocography, prolonged labor and previous cesarean section (repetitive) [12]. We found that the frequency of cesarean section was higher in older mothers than in those of normal age. The main reason for this is that older mothers had at least one cesarean section in their previous births. We also found the highest rate of previous cesarean section (50.9%) as the indication for cesarean delivery in our study. This finding shows that the rate of cesarean sections increases alarmingly in our country as it is worldwide. It is considered that once a cesarean section is performed, this makes vaginal birth impossible in subsequent pregnancies [12]. Moreover we found that the rate of admission to the intensive care unit was significantly higher in cesarean sections (21.8%) than in normal deliveries (15%). It is reported that respiratory tract infections, obesity and asthma symptoms occur more frequently in children born by cesarean section than in children who gave birth normally [13]. It is also suggested that children who have undergone a cesarean delivery are at increased risk of developing type 1 diabetes or neurological disorders [13,14]. Considering these adverse influences and risks of cesarean section for infants, it becomes necessary to encourage expectant mothers to have normal birth unless medically necessary. The current study found that only forty percent of those who had a cesarean delivery due to fetal macrosomia had a birth weight over 4 kg. In other words, a cesarean delivery was not actually needed for 60% of them. These findings suggest that intrauterine fetal weight measurements should be evaluated more

precisely and carefully to prevent unnecessary cesarean decisions.

On the other hand, we found that late preterm neonates had a significantly higher rate of cesarean delivery than term neonates (67.4% vs 49.7 %). In cases of premature birth, planned cesarean section may be protective for the newborn and may include various indications such as preeclampsia, fetal distress, and placental abruption [15]. Taken together with previous reports, our finding suggests that the possible risks associated with prematurity may be an indication for cesarean section. However, factors that may cause premature birth should be controlled as best and as soon as possible.

On the other hand, we found that the most common indications for intensive care admission were sepsis (46%) and congenital pneumonia (21.7 %). Diseases suffered by the expectant mother, especially in the last trimester of pregnancy, play a key role in the etiology of these diseases [16]. Therefore, the expectant mother should be closely monitored and if any infection is detected, treatment should be started as soon as possible.

However, although the rate of ventilator connection was higher in cesarean section (22.4%) compared to normal birth (20.8%), this was not found to be statistically significant. The possible reason for this may be the relatively low sample size of the study.

Infants born moderately preterm (100%), late preterm (49%) and early term (27%) had significantly higher ventilator requirements than term newborns (12%), respectively. Neonates born preterm are at high risk of developing respiratory distress and this often requires surfactant therapy [17]. A wide range of risk factors such as environmental conditions, obstetric and neonatal factors are reported to be associated with preterm birth [18]. Among these, factors such as infection, thyroid diseases,

gestational diabetes, severe anemia, smoking, maternal age and maternal education level come to the fore [19-21]. Consistent with these previous reports, our study revealed that thyroid disorders, gestational diabetes and smoking were the top risk factors. However, although we did not find a significant correlation between prematurity and risk factors that may cause prematurity during pregnancy, the risk factors examined may be facilitators for premature birth. We found that the highest cause of hospitalization in both caesarean and normal births was infection, and this was significantly higher than pneumonia. Blood cultures were requested for 94.5% of newborns hospitalized with infection. Despite this high rate of blood culture requests, only 1.5% of them had blood culture reproduction. The main reason for this relatively low reproduction rate may be the waiting time of the samples taken. It may also be insufficient removal of the antiseptic at the body location where blood is taken. Another reason may be that a smaller amount of blood sample was taken for culture than was required.

**4.1. Limitations of the study:** Although the sample size of the study is generally sufficient, it is relatively small because subcategories of many clinical features were analyzed. The retrospective nature of the study limits the types of clinical features of newborns and their mothers that were examined. The single-center nature of the study may be a limiting factor for the generalizability of the results.

**4.2. Conclusions:** Our study offers the following suggestions. Since protecting and improving the health of infants under 1 year of age is of critical importance for their survival, more health precautions should be taken for newborns in this period. Due to the close relationship between the pregnancy and some of infant health, pregnant health should also be closely monitored for the health of the mother

and the newborn. Awareness about the common causes of infant disorders is important in forward health planning and precautions to be taken.

**Funding:** *The authors received no financial support for the research, authorship, and/or publication of this article.*

**Conflict of Interest:** *The authors declared no conflict of interest.*

**Ethical Statement:** *Ethical permission for the study was obtained from the Bolu Abant İzzet Baysal University Clinical Research Ethics Committee (license number 2023/437).*

### **Open Access Statement**

*Experimental Biomedical Research is an open access journal and all content is freely available without charge to the user or his/her institution. This journal is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/). Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author.*

**Copyright (c) 2025:** Author (s).

### **References**

- [1]Dunkerton S, Mrcog M, Aiken C, et al. Impact of the intrauterine environment on future reproductive and metabolic health. *Obstet Gynaecol.* 2022;24(2):93-100.
- [2]Wang XL, Wang J, Yuan L, et al. Trend and causes of neonatal mortality in a level III children's hospital in Shanghai: a 15-year retrospective study. *World J Pediatr.* 2018;14(1):44-51.
- [3]Lee HC, Bardach NS, Maselli JH, et al. Emergency department visits in the neonatal period in the United States. *Pediatr Emerg Care.* 2014;30(5):315-318.
- [4]Sacchetti AD, Gerardi M, Sawchuk P, et al. Boomerang babies: emergency department utilization by early discharge neonates. *Pediatr Emerg Care.* 1997;13(6):365-368.
- [5]Patel RM, Kandefor S, Walsh MC, et al. Causes and timing of death in extremely premature infants from 2000 through 2011. *N Engl J Med.* 2015;372(4):331-40.
- [6]Çatak B, Öner C. Bebek Ölümünün Temel Nedenleri Değişiyor mu? Kayıt Temelli Kesitsel bir Çalışma. *TJFMPC.* 2019;13(3): 311-317.
- [7]Jana A, Saha UR, Reshmi RS, et al. Relationship between low birth weight and infant mortality: evidence from National Family Health Survey 2019-21. *India Arch Public Health.* 2023;81(1):28.
- [8]Parmigiani S, Bevilacqua G. Can we reduce worldwide neonatal mortality? *Acta Biomed.* 2022;93(5):e2022294.
- [9]Sharifzadeh GR, Namakin K, Mehrjoofard H. An epidemiological study on infant mortality and factors affecting it in rural areas of Birjand, Iran. *Iran J Pediatr.* 2008;18(4):335–342.
- [10]Delnord M, Zeitlin J. Epidemiology of late preterm and early term births - An international perspective. *Semin Fetal Neonatal Med.* 2019;24(1):3-10.
- [11]Singh N, Pradeep Y, Jauhari S. Indications and Determinants of Cesarean Section: A Cross-Sectional Study. *Int J Appl Basic Med Res.* 2020;10(4):280-285.
- [12]Mylonas I, Friese K. Indications for and Risks of Elective Cesarean Section. *Dtsch Arztebl Int.* 2015;112(29-30):489-95.
- [13]Słabuszewska-Józwiak A, Szymański JK, Ciebiera M, et al. Pediatrics Consequences of Caesarean Section-A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health.* 2020;17(21):8031.
- [14]Boutsikou T, Malamitsi-Puchner A.



- Caesarean section: impact on mother and child. *Acta Paediatr.* 2011;100(12):1518-1522.
- [15] Lin CH, Lin SY, Yang YH, et al. Extremely preterm cesarean delivery "en caul". *Taiwan J Obstet Gynecol.* 2010;49(3):254-259.
- [16] Hooven TA, Polin RA. Pneumonia. *Semin Fetal Neonatal Med.* 2017;22(4):206-213.
- [17] Tana M, Tirone C, Aurilia C, et al. Respiratory Management of the Preterm Infant: Supporting Evidence-Based Practice at the Bedside. *Children (Basel).* 2023;10(3):535.
- [18] Goldenberg RL, Culhane JF, Iams JD, et al. Epidemiology and causes of preterm birth. *Lancet.* 2008;371(9606):75-84.
- [19] Gurung A, Wrammert J, Sunny AK, et al. Incidence, risk factors and consequences of preterm birth - findings from a multi-centric observational study for 14 months in Nepal. *Arch Public Health.* 2020;78:64.
- [20] Meng Y, Lin J, Fan J. A Novel Nomogram for Predicting the Risk of Premature Delivery Based on the Thyroid Function in Pregnant Women. *Front Endocrinol (Lausanne).* 2022;12:793650.
- [21] Preda A, Iliescu DG, Comănescu A, et al. Gestational Diabetes and Preterm Birth: What Do We Know? Our Experience and Mini-Review of the Literature. *J Clin Med.* 2023;12(14):4572.