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Postnatal Hospitalization Rates and Short-term Follow-up Results of Late Preterm, Early Term and Term Newborns

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Abstract: Late preterm newborns are infants delivered between 34 and 36 weeks of gestation, and early term newborns are born between 37 and 38 weeks. Infants born between the late preterm and early term stages are more susceptible to morbidity and mortality as compared to infants delivered at full term. This study aimed to examine the factors contributing to illness and death among newborns delivered between 34 and 37 weeks gestation, as well as those born at full term. This study included a group of 1000 newborns delivered within a gestational age range of 34 to 42 weeks in our hospital. The assessment of these cases was based on factors such as the mother's age, the weight of the baby at birth, the APGAR score, the method of delivery, the requirement for postnatal resuscitation, the family's income, the rate of hospitalization, and the necessity for mechanical ventilation. Out of the 1000 babies examined in the study, respiratory issues were more prevalent among male newborns. With the rise in income levels, there was a corresponding increase in the rate of births occurring closer to the expected delivery date. Late preterm babies exhibited a greater hospitalization rate in comparison to both early term and term newborns, accompanied with poorer APGAR scores. Ultimately, the demand for mechanical ventilation was greater among late preterm babies. When assessing late preterm and early term newborns, it is important to take into account their physiological immaturity and the fact that they are at a greater risk of experiencing health problems and death. Delivery should be scheduled after the 39th week of gestation only if there is a medical reason. ©2024 NTMS.

Keywords: Late preterm; Early Term; Morbidity.

1. Introduction

Prematurity, as defined by the World Health Organization, refers to newborns with a gestational age between 22 weeks (beyond the limit of viability) and 37 weeks. It is a significant contributor to both morbidity and mortality [1-4]. A more extensive categorization was formed due to the fact that the occurrence of morbidity and mortality differs based on the exact week of birth, resulting in variations in terms of financial impact. As per this categorization, "late preterm" newborns are defined as those that are born between 34+0/7 and 36+6/7 weeks of gestation [1]. “Early term” infants are born between 37+0/7 and 38+6/7 weeks, and “term” infants are born between 39+0/7 and 41+6/7 weeks [2]. The incidence of late preterm and early term births has been on the rise in recent years, with a noteworthy increase in late preterm births during the past two

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decades [3, 4]. The primary factors contributing to this phenomenon are the escalating prevalence of elective cesarean deliveries and the rising incidence of multiple pregnancies resulting from assisted reproductive technologies. Due to their physiological and metabolic immaturity, late preterm newborns have increased morbidity and mortality rates compared to term newborns. The prevalent short-term morbidities observed in this population are hypothermia, hypoglycemia, respiratory complications, apnea, hyperbilirubinemia, nutritional abnormalities, and, to a lesser degree, necrotizing enterocolitis and intraventricular hemorrhage [5]. Early term infants are more prone to respiratory difficulties, sepsis, jaundice, hypoglycemia, and hospital readmissions compared to term newborns [6-10]. Research has additionally demonstrated that there is a higher prevalence of chronic development difficulties, cognitive impairments, and mental health issues after deliveries that occur during the late preterm and early term periods [11, 12]. The mortality rates of late preterm and early term newborns have been found to be higher compared to term births [13-15].

The current study aimed to investigate the causes of neonatal morbidity and mortality in late preterm and early term newborns with reference to term births.

2. Material and Methods

This retrospective study investigated the rates of hospitalization and short-term outcomes of newborns with gestational ages ranging from 34 to 42 weeks who were born at Atatürk University Research Hospital over the period from 1 January 2016 to 31 December 2017. The study commenced with the authorization of the Atatürk University Faculty of Medicine Ethics Committee (Decision No. 12/5, dated 28.09.2017), and all research was carried out in conformity with the principles outlined in the Declaration of Helsinki.

The study assessed newborns in three distinct groups: late preterm newborns born between 34+0/6 and 36+6/7 weeks of gestation, early term newborns born between 37+0/7 and 38+6/7 weeks of gestation, and term newborns born between 39+0/6 and 41+6/7 weeks of gestation. All newborns included in the study were assessed for mother's age, birth weight, APGAR score, mode of delivery, the requirement for postnatal resuscitation, family's income level, rate of hospitalization, and need for mechanical ventilation. The gestational age of the newborn was ascertained based on the mother's most recent menstrual cycle. If this information was not available, it was established using ultrasonography and the new Ballard scoring system. The mode of delivery was classified into two categories: normal spontaneous vaginal birth and caesarean section. The assessment of the necessity for postnatal resuscitation was conducted by evaluating the application of positive pressure breathing and following appropriate measures. Hospitalized babies requiring mechanical ventilation were categorized into subgroups based on whether they received invasive or noninvasive ventilation. Continuous positive airway pressure (CPAP) is recognized as a form of noninvasive ventilation, whereas endotracheal intubation is recognized as a form of intrusive ventilation. Family income levels were assessed based on the hunger and poverty line thresholds for the period of 2017-2018.

2.1. Statistical Analysis

The statistical analysis was conducted using IBM SPSS Statistics 24.0. The analysis was conducted to assess how the data was distributed among the different groups. Mean and standard deviation were used to convey continuous data, while percentages were used to express frequency data. The chi-square test was employed to compare frequency data and ascertain risk factors for dependent variables, with risk analysis also conducted for the data. The analysis of variance (ANOVA) was conducted to examine parametric data in a unidirectional manner. The Duncan test was used to compare many variables. The significance level was deemed acceptable at a p-value of less than 0.05.

3. Results

This study included a group of 1000 babies, consisting of 274 late preterm, 370 early term, and 356 term births. No statistically significant difference was observed in the study of mother age between the groups. The average birth weight of the late preterm neonates was 2352 g, whereas the early term and term newborns had average birth weights of 3053 g and 3736 g, respectively. The weights of the babies included in the study were assessed as suitable based on their gestational age. Table 1 displays the comparisons of the babies based on maternal age, birth weight, and sex.

Upon analyzing the income levels of the families of the newborns during the study, we observed a correlation between approaching the poverty line and an increase in the rate of preterm births ($p<0.001$). Regarding late preterm births, 45.8% of the families had income levels that fell at or below the poverty line. 46.5% of households with early term newborns and 53.4% of families with term newborns had incomes above the poverty line ($p<0.001$).

When newborns were analyzed based on their method of delivery, it was shown that the rate of natural spontaneous vaginal birth increased as the gestational age advanced. The rate of caesarean section was highest among deliveries that occurred during the late preterm period, as indicated in Table 2.

The average APGAR scores for late preterm babies were 7.6 at the 1st minute and 9 at the 5th minute, based on the weeks of gestation. The average APGAR scores for early term newborns were 7.9 at the 1st minute and 9.2 at the 5th minute. In comparison, term newborns had scores of 8.5 at the 1st minute and 9.4 at the 5th minute. Hence, the APGAR scores of late preterm infants were seen to be markedly inferior to those of early term and term infants ($p<0.001$). The APGAR scores of early term neonates were seen to be significantly lower than those of term newborns

(p<0.001). Compared to term newborns, late preterm newborns had a 5.7 times higher requirement for postnatal resuscitation, whereas early term newborns had a 3.9 times higher demand (p<0.001). The requirement for resuscitation escalated in proportion to the decrease in birth weight, as indicated in Table 3. Figure 1 displays the techniques employed for neonates necessitating postnatal resuscitation.

Table 1: Demographic characteristics of late preterm, early term, and term newborns.

	Group 1 n=274	Group 2 n=370	Group 3 n=356	p
Maternal age	31.04±5.9	30.69±5.6	30.58±5.4	0.584
Birth weight	2352±319 g	3053±246 g	3736±175 g	<0.001
Male/female ratio	133/141	188/182	166/190	0.529

Table 2: Rates of cesarean and normal spontaneous vaginal birth according to groups.

	Group 1 n (%)	Group 2 n (%)	Group 3 n (%)	p
Cesarean	246 (89.7)	325 (88.5)	225 (63.1)	<0.001
Vaginal	29 (10.3)	43 (11.5)	132 (36.9)	<0.001

Table 3: Average APGAR scores and postnatal resuscitation needs according to groups.

	Group 1	Group 2	Group 3	p
APGAR, 1st minute	7.59±1.45	7.89±1.2	8.49±1	<0.001
APGAR, 5th minute	8.97±1.1	9.20±0.8	9.42±0.6	<0.001
Need for resuscitation after birth	42 (15.3%)	41 (11.1%)	11 (3.1%)	<0.001

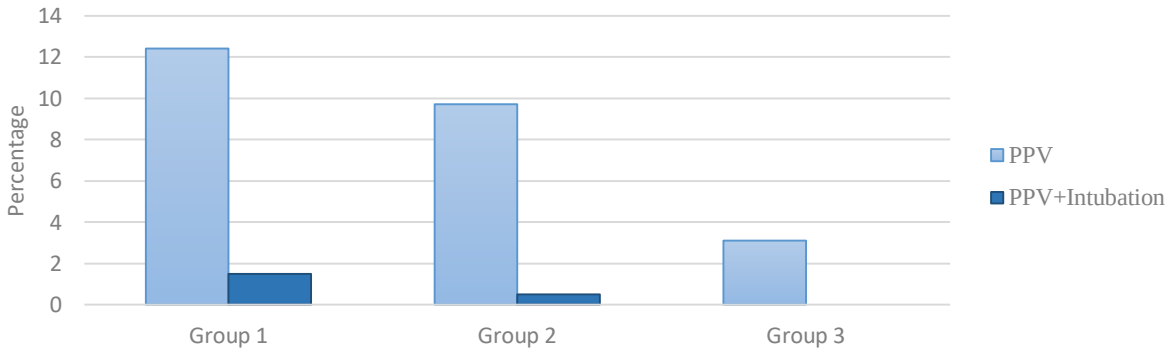

Figure 1: Resuscitation methods according to groups. PPV: Positive pressure ventilation.

Out of the 1000 newborns examined in this study, 260 needed to be admitted to the hospital. This group included 122 (47%) babies born at a later preterm stage, 105 (40%) babies born at an early term stage, and 33 (13%) babies born at a full-term stage. Consequently, late preterm neonates exhibited a considerably higher rate of hospitalization compared to early term and term newborns (p<0.001). The hospitalization rate of early term neonates was determined to be significantly greater than that of term newborns (p<0.001). Respiratory problems were the most common cause of hospitalization for late preterm and early term newborns, whereas term newborns were hospitalized for conditions such as neonatal hyperbilirubinemia, urinary tract infections, malnutrition, and congenital anomalies. Respiratory issues were discovered to be 5.9 times more prevalent in early term babies compared to term newborns, and 33.9 times more prevalent in late preterm newborns compared to term newborns (p<0.001). The incidence of respiratory issues was considerably higher in late preterm newborns compared to early term and term newborns (p<0.001). Respiratory distress syndrome (RDS) was the primary cause of hospitalization in the majority of this category, accounting for 28.1% of cases. Among early term newborns, the most frequent reason for hospitalization was Transient tachypnea of the newborn (TTN), which accounted for 39% of cases. The incidence of respiratory distress syndrome (RDS) and transient tachypnea of the newborn (TTN) was 33.9 and 3.6 times greater, respectively, for late preterm babies compared to term newborns. Similarly, early-term newborns had a 5.9- and 3.9-times higher risk of developing RDS and TTN, respectively, compared to term newborns. These findings were statistically significant (p<0.001).

In this study, respiratory problems were found to be more common among male newborns, being observed in 82/405 of the male infants and 56/457 of the female infants (p=0.007). Taking term newborns as a reference, statistical analysis of the hospitalized patients revealed that the need for mechanical ventilation was 2.9 and 1.6 times higher among late preterm and early term newborns, respectively. Late preterm newborns in neonatal intensive care had a higher need for mechanical ventilation (p=0.012); 63

(23%) patients in this group required noninvasive ventilation, while invasive ventilation was applied for 9 (3.2%) patients. In contrast, 47 (44.8%) of the early term newborns in the neonatal intensive care unit needed mechanical ventilation during hospitalization. While 42 (89%) of those infants improved with noninvasive ventilation, 5 (11%) needed invasive ventilation. Finally, 11 (33.3%) of the term newborns in the neonatal intensive care unit required mechanical ventilation and all of them improved with noninvasive ventilation.

Three late preterm newborns, four early term newborns, and one term newborn followed in the intensive care unit died. When mortality rates were calculated, the mortality rate was found to be 3.8% for early term and 2.5% for late preterm newborns. The mortality rate for term newborns was 3%. Thus, in this study, the mortality rate of late preterm newborns was lower than that of early term births. Causes of mortality included non-immune hydrops fetalis, perinatal asphyxia, anencephaly, Crouzon syndrome, congenital multiple anomalies, double outlet right ventricle, and congenital diaphragmatic hernia.

4. Discussion

The rates of premature birth and early term birth are steadily increasing in the world in general and in Turkey [16, 17]. These globally increasing rates of early births are attributed to pregnancy complications, the increase in multiple pregnancies achieved with assisted reproductive techniques, and the increase in elective cesarean sections. Studies conducted in recent years have shown that late preterm and early term newborns have higher risks of morbidity and mortality than term newborns [18-20]. The treatments provided in these cases are also important in terms of economic burden as the hospitalization of these infants is prolonged and postnatal problems such as hypoglycemia, hyperbilirubinemia, RDS, and TTN occur.

In our study, it was found that late preterm newborns had more respiratory problems than term newborns. In a study conducted with 90 term and 95 late preterm newborns, Wang et al. reported that respiratory problems were 9 times more common in the late preterm group compared to term newborns [19]. In another recent study, it was reported that respiratory problems were more common among early term infants compared to term infants [21]. Our research yielded similar results. In our study, the risks of RDS and TTN were higher in the late preterm and early term groups, respectively, when term newborns were taken as a reference and Thomas et al. found that the incidence of RDS and TTN was higher in late preterm and early term infants than in term infants [22]. Data on lung maturation in late preterm infants and the application of antenatal steroids before 34 weeks are based on studies evaluating lung maturation with amniotic fluid measurements. More specifically, it is reported that the maturation of surfactant production in the lungs is completed at about 35 weeks based on measurements of the lectin/sphingomyelin ratio and lamellar bodies in the amniotic fluid [23]. However, it is obvious that alveolarization continues in these infants [23]. As the production of fetal lung fluid and therefore its passage into the amniotic fluid decreases due to the intrauterine stress the fetuses are exposed to, which also causes premature birth, fetal markers of surfactant production are misleading and previously published information on surfactant maturation has become controversial [23]. Considering this information and the frequency of respiratory problems in late preterm newborns, complete lung maturation cannot be discussed for these infants. In a study conducted with early term newborns, Tita et al. found that respiratory problems increased in this population as a result of elective cesarean sections compared to term newborns [24]. Ghartey et al. found that the rates of respiratory problems such as RDS, TTN, and pneumonia in early term newborns were two times higher compared to term newborns[25]. When differences between the sexes were evaluated, we found that respiratory problems were more common in male infants in our study. Similarly, some studies reported that respiratory problems were more common in male infants at 37, 38, and 39 weeks [25, 26]. Differences in hormonal regulation of lung development provide candidate mechanisms to account for an increased risk of RDS associated with male sex. The increased incidence breathing problems in males may be due to the increased levels of fetal androgens. Fetal androgens delay lung maturation and PG production (by approximately a week) through direct action on lung fibroblasts [27].

Our hospital is a reference hospital, and for that reason, the number of high-risk pregnancies being followed was high. The resulting increase in cesarean section rates was an expected result. We found that the rate of births by normal spontaneous vaginal delivery increased as gestational age increased. Some previous studies similarly reported that the rate of cesarean sections decreased as the weeks of gestation increased [12, 28].

In our study, as expected, we found that early term and late preterm newborns had lower APGAR scores than term newborns, supporting the literature. In a previous study, it was reported that 48 late preterm newborns (17.5%) required resuscitation procedures of any type, and 37 of those 48 late preterm newborns (13.5%) required ventilation [29]. In the same study, it was found that the rate of 5-minute APGAR scores of <7 was higher in the 34th week than in the 35th and 36th weeks [29]. In another recent study, APGAR scores were lower among late preterm and early term newborns [30].

When hospitalization rates were evaluated, it was determined in our study that 122 late preterm (47%), 105 early term (40%), and 33 term newborns (13%) were hospitalized. In another study, it was determined that 88% of infants born at 34 weeks, 12% of infants born at 37 weeks, and 2.6% of infants born between 38 and 40 weeks were hospitalized[31]. In a study conducted in 2021, it was found that the hospital stays of early

term newborns were longer than those of term newborns[22]. When mechanical ventilation and CPAP support rates were examined, it was seen that they were also higher among late preterm and early term newborns. It was determined that 59% of late preterm newborns, 44.8% of early term newborns, and 33.3% of term newborns in intensive care needed mechanical ventilation. In our study, we found that the need for mechanical ventilation decreased as weeks of gestation increased. Hibbard et al. determined that the need for mechanical ventilation decreased in evaluations performed from the 34th week to the 40th week [9]. Thomas et al. determined that 1.2% of early term newborns and 0.8% of term newborns needed invasive ventilation among the hospitalized infants included in their study[22]. In our study, supporting the literature, we found that late preterm newborns needed CPAP more often than early term and term newborns, and early term newborns need CPAP more often than term newborns. In the study conducted by Ghartey et al., 39 weeks was taken as a reference point and the need for CPAP was found to be 2.2 times higher in the 37th week, 1.7 times higher in the 38th week, and 1.9 times higher when the 37th and 38th weeks were evaluated together [25].

In our study, which was conducted taking into account the 2016-2017 minimum wage and poverty and hunger thresholds, it was found that the rate of premature birth increased as income levels decreased. It has been observed that as income levels decrease, malnutrition during pregnancy and inadequate pregnancy follow-up due to sociocultural factors are more likely to occur, and these are associated with preterm birth. Previous studies showed that socioeconomic level is associated with preterm birth [32] and that lower socioeconomic levels were linked to increased preterm birth rates [33].

In our study, the neonatal mortality rate was found to be 2.5% (three patients) among the late preterm newborns in intensive care, 3.8% (four patients) among the early term newborns, and 3% (one patient) among the term newborns. Looking at studies in the literature, mortality rates were found by some researchers to be higher among early term infants [34, 35], in contrast to our study. In a study conducted in 2007, Engle et al. reported that the mortality rate in the first week of life was 9.5 times for births that occurred in the 34th week, 6.4 times in the 35th week, and 3.7 times in the 36th week per 1000 live births in comparison to births in the 39th week[36]. In the same study, the neonatal mortality rate was found to be 2.3 times higher in the first week of life for those born in the 37th week and 1.4 times higher in the 38th week [36]. However, when the causes of mortality were examined in the current study for late preterm newborns, there was one death each due to Crouzon syndrome, congenital diaphragmatic hernia, and perinatal asphyxia. Among the early term newborns, the causes of death were non-immune hydrops fetalis in one case, anencephaly in one case, and complex congenital heart disease in two cases. The single death recorded among the term newborns was due to perinatal asphyxia. Looking at these etiologies, it is noteworthy that all of them carry inherently high risks of mortality.

One of the limitations of our study since our center is a reference hospital, the relatively high mortality rate observed in term newborns in this study may not statistically generalizable.

5. Conclusion

Early term newborns, like late preterm newborns, should be evaluated considering their physiological immaturity, and obstetricians should work in consensus with pediatricians to prevent unnecessarily early births. Ensuring frequent monitoring after birth, making the right discharge decisions and delaying discharge if necessary, and providing adequate education to families will also help prevent possible complications.

Limitations of the Study

One of the limitations of our study since our center is a reference hospital, the relatively high mortality rate observed in term newborns in this study may not statistically generalizable.

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Conflict of Interests

All authors have no conflict of interest regarding this paper.

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Author Contributions

Conception and Design of the study: KST, Data Collection and/or Processing and Literature review: ASD, Writing Original Manuscript: ASD, Critical review, Analysis and/or interpretation: MK. All authors provided critical feedback and helped shape the research, analysis and manuscript. ASD directed the final version and is responsible for final approval of the submitted manuscript.

Ethical Approval

The study was approved by the Ataturk University Clinical Research Ethics Committee with the decision date 28.09.2017 and numbered 5/12.

Data sharing statement

All data relevant to the study are included in the article

Consent to participate

Consent was obtained from all patients for the use of data under ethical conditions.

Informed Statement

Informed consent forms were obtained from all patients the patient data could be used in the retrospective studies.

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