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Body weight changes of preterms in the postnatal period

Weight loss in preterm newborns

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Abstract
Aim: Survival and complications are very sensitive in preterm infants. Any negative situation in the preterms can lead to unintended consequences. In this study, it was aimed to analyze the data on demographic characteristics, complications, morbidity, mortality, and weight monitoring information of a high number of preterm neonates.
Material and Methods: A total of 1091 preterm newborns born before the 37th gestational week in our tertiary care hospital were included in the study. All data were analyzed from hospital records. The weights of the newborns at birth, on the 7th, 15th, and 30th days were recorded..
Results: Of the newborns, 39 (3.6%) died within 30 days after delivery. The cesarean section rate was 91.7%. While 7.9% of the preterms had birth weight below 1000 grams, the preterm rate in normal birth weight (>2500 g) was 15.6%. The mean birth weight was 1909.76 g, the first day mean weight loss was 0.6%, the first 3-day mean weight loss was 3.8% and the first 7-day mean weight loss was 2.5%.
The mean birth weight in late preterm infants was significantly lower than in those who were born in the following weeks, while the mean birth weight in late preterm births was significantly higher than in those born before ($p<0.001$).
Discussion: We found that preterm infants and those with lower birth weight had a worse prognosis, and that weight gain after birth was associated with prognosis. We believe that data obtained from our study may be a guide for clinicians and researchers.

Keywords
Preterm; Newborn; Birth weight; Weight loss

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Introduction

Newborns born in the 37th gestational week or before are called as preterms. The preterm birth rate has been reported to be over 10% in the world and Turkey and it has been noted that it is increasing [1-3]. It is stated that the birth of the baby as preterm can be due to lots of factors such as maternal age above 35 years, multiple pregnancies, history of elective cesarean section, birth induction, chronic pregnancy diseases or infections, socioeconomic and nutritional conditions and genetic diseases of the baby [1-4].

Survival and complications are very sensitive in preterm newborns. Any negative situation in the preterms can lead to unintended consequences. The fact that a newborn was born a few weeks before 37th week directly affects morbidity and mortality rates. Due to incomplete maturation of all systems towards birth, especially respiratory system problems affect prognosis [1 ,4, 5].

Weight loss in newborns is used to monitor whether nutrition is adequate. Newborns receive a small amount of fluid within the first days after birth, and weight loss within the first few days followed by weight gain. Nutrition and weight monitoring are necessary for newborns but they are important enough to affect the survival rate in premature infants. Because postnatal development patterns are closely related to health status, they are important, especially in preterm newborns. It has been reported that the postnatal development curve in preterm newborns can be affected by regional, local, ethnic and traditional factors as well as factors such as gestational week, gender, anthropometry of parents, nutritional conditions, presence of concomitant diseases [6-9]. Therefore, this comprehensive study of preterms is important in terms of presenting data that can contribute to the literature for our country.

There are many studies conducted on term newborns. However, the number of large-scale studies on premature newborns is very low, especially in our country. In this study, it was aimed to analyze the data on demographic characteristics, complications, morbidity, mortality, and weight monitoring information of a high number of preterm neonates.

Material and Methods

This study was approved by the local ethics committee. A total of 1091 preterm newborns born before the 38th gestational week in the Obstetrics Clinics of our tertiary care hospital were included in the study. Demographic information, pregnancy week, type of delivery, multiple pregnancies, concomitant disease, and follow-up mortality rates were screened and analyzed from hospital records. The weights of the newborns at birth, on the 7th,15th, and 30th days were recorded..

Statistical analysis

All statistical analyzes were performed using SPSS 25.0 software (IBM SPSS, Chicago, IL, USA). Descriptive data were given in numbers and percentages. The Pearson's Chi-Square test and the Fisherlars Exact Test were used to compare the categorical variables. The Kolmogorov-Smirnov test was used to determine whether continuous variables were suitable for normal distribution. Differences between groups in terms of continuous variables were made by the Student's t- test and variance analysis of the mean values between multiple groups. The results were evaluated with a 95% confidence interval and $p<0.05$ values were considered significant. The Bonferroni correction was performed where necessary.

Results

Of the preterm neonates included in the study, 606 (55.6%) were male and 485 (44.4%) were female. Of the newborns, 39 (3.6%) died within 30 days after delivery; 593 (60.5%) of the births were singleton, and 407 (39.5%) were multiple. A total of 27 of the newborns (2.8%) had no concomitant disease; 819 (85.4%) of the remaining newborns had respiratory problems. A total of 338 of the newborns (31.0%) were born between the 24th-31st gestational weeks (advanced preterm), 646 (59.2%) were born between the 32nd-35th gestational weeks (moderate preterm), and 107 (9.8%) were between 36th-37th weeks (late preterm). The cesarean section rate was 91.7%. While 7.9% of the preterms had birth weight below 1000 grams, the preterm rate in normal birth weight (>2500 gr) was 15.6% (Table 1).

The survival rate (90.2%) in preterm infants (born at 24th to 31st weeks of gestation) was significantly lower than in the postnatal week ($p<0.001$). The rate of multiple pregnancies (15.1%) was significantly lower in the late preterm group ($p<0.001$), and the rate of boys in this group (68.2%) was significantly higher than the other groups ($p=0.013$). All newborns in this group (100%) had concomitant diseases, but this rate was not significantly different from the other groups (Table 2).

The rate of concomitant disease in male newborns (98.3%) was significantly higher than that of female neonates ($p=0.020$). There was no significant difference in terms of survival, cesarean rate and multiple pregnancy rates ($p>0.05$ for each) (Table 2).

The rate of cesarean section in the group with multiple pregnancies (98.9%) was significantly higher than in singleton pregnancy ($p<0.001$). There was no significant difference in survival and comorbid disease rates between multiple and singleton pregnancy groups ($p>0.05$ for both) (Table 2).

The survival rate (96.9%) was significantly higher in patients born by cesarean section ($p=0.008$). All patients (100%) had a concomitant disease, but this rate was not significantly different from those born by cesarean section ($p=0.114$) (Table 2).

The survival rate (89.4%) in patients with any concomitant disease other than respiratory system was significantly higher than those with a concomitant respiratory disease and those without any diseases ($p<0.001$). All newborns without any concomitant disease survived (Table 2). There was no significant difference in the rate of respiratory distress between gestational periods ($p=0.589$).

The mean birth weight was 1909.76 grams, the first day mean weight loss was 0.6%, the first 3-day mean weight loss was 3.8% and the first 7-day mean weight loss was 2.5% (Table 3).

The mean birth weight in late preterm infants was significantly lower than in those who were born in the following weeks, while the mean birth weight in late preterm newborns was significantly higher than in those born before ($p<0.001$). There was no significant difference between the early, mid, and late preterm neonatal groups in terms of weight gain/loss ratios

Table 1. Distribution of some variables of preterm newborns

Variables	n	%
Male	606	55.6
Female	485	44.4
Alive	1052	96.4
Exitus	39	3.6
Singleton	593	60.5
Twin	346	35.3
Triplet - Quadruplet	41	4.2
Concomitant disease		
None	27	2.8
Respiratory	819	85.4
Cardiological	28	2.9
Sepsis	4	0.4
Complex	61	6.4
Others	20	2.1
Week of pregnancy		
24-31	338	31.0
32-35	646	59.2
36-37	107	9.8
Normal birth	79	8.3
Cesarean	873	91.7
Birth weight (Gram)		
<1000	86	7.9
1000-1499	169	15.5
1500-2499	666	61.0
>2500	170	15.6

Table 2. Comparison between some variables of preterm newborns

Variables	Alive (%)	Rate of Concomitant disease	Cesarean rate	Multiple pregnancy rate	Rate for males
Birth weight	p <0.001	0.133	0.177	<0.001	0.013
24-31 weeks	90.2	97.5	91.5	41.6	55.8
32-35 weeks	99.2	96.5	92.6	42.3	53.0
36-37 weeks	99.1	100	86.8	15.1	68.2
Gender	p 0.500	0.020	0.059	0.164	X
Male	96.8	98.3	90.2	37.4	X
Female	6.1	95.8	93.6	41.8	X
Multiple/singleton pregnancy	p 0.053	0.142	<0.001	X	-
Multiple	97.9	95.7	98.9	X	-
Singleton	95.6	97.5	87.2	X	-
Birth type	p 0.008	0.114	X	-	-
Normal birth	91.1	100	X	-	-
Cesarean	96.9	96.4	X	-	-
Concomitant disease	p <0.001	X	-	-	-
None	100	X	-	-	-
Respiratory	97.6	X	-	-	-
Others	89.4	X	-	-	-
*Analysis of variances (ANOVA)					

within 1, 3, and 7 days after birth (p>0.05 for each). However, there were significant differences at first 15 and first 30 days in terms of weight gain (p=0.007 and p<0.001, respectively). Accordingly, the weight gain within the first 15 days was significantly lower in early preterms, and the weight gain ratio within the first 30 days was significantly higher in the preterm infants (Table 3).

Table 3. Weight gain rates in preterm newborns

Variables	Mean birth weight (gr)*	Mean first-day weight gain rate (%)	Mean first 3-day weight gain rate (%)	Mean first 7-day weight gain rate (%)	Mean first 15-day weight gain rate (%)	Mean first 30-day weight gain rate (%)
Mean	1909.76	-0.6	-3.8	-2.5	7.1	32.2
Birth weight	p <0.001	0.029	0.720	0.086	0.007	<0.001
24-31 weeks	1319.81	0.0	-4.0	-1.8	8.3	36.1
32-35 weeks	2098.08	-0.9	-3.6	-2.8	6.1	27.2
36-37 weeks	2636.36	-1.0	-3.8	-3.1	2.6	25.2
Gender	p 0.003	0.547	0.569	0.892	0.552	0.527
Male	1959.20	-0.7	-3.9	-2.5	6.9	31.7
Female	1847.37	-0.5	-3.6	-2.6	7.4	32.9
Multiple/singleton pregnancy	p 0.002	0.669	0.137	0.204	0.633	0.778
Multiple	1843.13	-0.6	-4.2	-3.0	6.7	31.8
Singleton	1946.87	-0.7	-3.5	-2.4	7.4	33.0
Birth type	p 0.042	0.926	0.446	0.578	0.547	0.650
Normal birth	2037.59	-0.7	-4.3	-3.0	8.1	31.3
Cesarean	1893.68	-0.6	-3.7	-2.6	7.0	32.9
Concomitant disease	p 0.039	0.233	0.169	<0.001	0.029	0.965
None	1822.22	-1.1	-4.4	-3.8	3.8	32.1
Respiratory	1965.78	-0.7	-3.9	-3.2	6.7	31.8
Others	1820.96	0.1	-2.6	1.3	9.9	32.6
Mortality	p <0.001	0.137	0.279	<0.001	<0.001	0.442
Alive	1941.69	-0.7	-3.7	-2.7	6.8	32.2
Exitus	1048.46	0.6	-4.9	1.6	19.8	22.9
* Analysis of variances (ANOVA)						

Mean birth weight was significantly higher in male preterm infants than females (p=0.003). There was no significant difference between the genders in terms of weight gain ratios within the first 1, 3, 7, 15 and 30 days after birth (p>0,05 for each) (Table 3).

Mean birth weight was significantly lower in preterm infants than in singleton pregnancies (p=0.002). However, there was no significant difference between the rates of weight gain during the first 1, 3, 7, 15 and 30 days after birth (p>0,05 for each) among the preterms born from singleton and multiple pregnancies (Table 3).

Mean birth weight was significantly higher in preterm infants than those born by cesarean section (p=0.042). However, there was no significant difference in terms of weight gain ratios between the first and 3rd day after delivery (p>0.05 for each) between the normal- and cesarean-born preterms (Table 3).

The mean birth weight of the patients with a concomitant respiratory disease was significantly higher than those with any other diseases or without any concomitant diseases (p=0.039). Weight gain ratios were significantly higher within the first 7 days and 15 days after delivery (p<0.001 and p=0.029, respectively) (Table 3).

The mean birth weight (p<0.001) and weight loss ratio (p<0.001) within the first 7 days after delivery were significantly higher than in the preterms who died within the first month after birth, but the weight gain ratio within the first 15 days was

significantly lower (p<0.001).

Of the neonates, 75 (6.8%) lost 5% of weight within the first 24 hours after birth. The number of newborns who lost 5% of weight at the end of the first 3 days was 408 (37.4%), and the first 7 days was 410 (37.6%). In general, the mean weight of all newborns was found to decrease continuously from 1894 gr to 1723 gr within 15 days after delivery. A total of 15.3% of all newborns started to gain weight within the first 3 days, and 26% started to gain within the first 7 days.

The mortality rate (11.8%) in preterm infants with a birth weight below 1500 gr was significantly higher than those over 1500 grams (1.0%) (p<0.001).

Discussion

Preterm or, in other words, premature neonates have the highest morbidity and mortality risk among all neonates. Since premature newborns are not fully ready for delivery, the concomitant serious health problems cause the prognosis to be negatively affected. For these reasons, preterm neonates should be followed up seriously [1, 3, 10]. Our study is an analysis which includes the evaluation of the data and follow-up information of the preterms.

Özvarol et al. reported that 23.3% of newborns were in normal birth weight in their study with preterms. In our study, this rate was found to be 15.6%. Özvarol et al. reported that newborns were most frequently born in the range of 1500-2499 grams (52.1%) [3]. The same birth-weight group was the most common birth-weight group in our study (61,0%). In the same study, they found the rate of preterm below 1000 grams as 4.1%. In our study, the rate of newborns below 1000 grams was 7.9%. The birth weight distribution in our study was consistent with the literature.

Weight loss within the first days after birth is physiological for a newborn [1, 7]. Muskinje-Montanji et al. reported that physiological weight loss for term newborns occurred on the 2nd and 3rd days after birth [11]. In our study, it was observed that for all preterm newborns, the mean weight was decreasing continuously within 15 days from delivery. Bhat et al. reported that about 25% of newborns lost 5% of their weight within the first 24 hours [12]. In our study, we found that 6.8% of the newborns lost 5% of their weight within the first 24 hours after the birth, and the rate of newborn who lost 5% weight at the end of the first 3 days reached to 37.4%, and 37.6% at the end of the first 7 days. The mean weight loss in term newborns ranged between 3.2% and 8.3%, and most studies reported a rate of 6% [1,13]. In our study, the mean weight loss was 0.6% within the first day, the mean weight loss within the first 3 days was 3.8%, and the mean weight loss was 2.5% within the first 7 days. In our study, although the preterms were analyzed, we found that our rates were more positive because of the large differences in the general clinical situation between the preterms and the weight loss interval. Hossain et al. reported that 56% of newborns started to regain weight within the first 5 days in their studies involving low birth weight newborns [14]. Jolly et al. reported that 90% started to regain weight within the first 3 days [15]. In our study, it was observed that 15.3% of all newborns started to gain weight within the first 3 days after delivery, and a total of 26% started to gain weight within the first 7 days. We consider that the high rate and continuity of weight loss were due to including only the preterm neonates, and therefore to the high concomitant disease and complication rates in our study.

In the present study, the mean birth weight was lower in the newborn group who died within the first 30 days. In addition, the mean weight loss within the first day was higher in the newborns who died within 30 days than the survived newborns. In contrast, the mean weight loss within the 3 days was higher in the "died" newborns than the "survived" ones. This might be caused by the high rate of loss of the newborns due to the concomitant diseases. In addition, it was reported that mortality rates in those below 1500 grams would reach 60% [4-6]. In our study, this rate in the newborns below 1500 grams was found to be only 11.8%, which was significantly higher than the mortality rate (1.0%) in those over 1500 grams.

Zhang et al. found that male preterms gained significantly more weight than females [6]. However, in our study, although the mean birth weight in male preterms was significantly higher than that of girls, no significant difference was found between the genders in terms of weight gain ratios within the first, 3rd, 7th, 15th and 30th days after birth.

Özvarol et al. reported a mortality rate of 4.1% in preterms [3]. Similarly, the postnatal mortality rate was 3.6% in our study. In addition, the mortality rate in early preterms was found to be significantly higher than late preterms. In our study, the mortality rate in early preterms was found to be significantly higher. It was reported that low birth weight was the most influential factor in mortality in preterm newborns [16]. Özvarol et al. reported that mortality rates were significantly higher in the newborns delivered by normal birth, those born with very low birth weight, and those born from a multiple pregnancy [3]. Although the mortality rate was significantly higher in patients with very low birth weight, the mortality rate in normal birth was significantly lower. There was also no significant change in the mortality rate in multiple pregnancies. We think that these differences between the studies are due to the fact that completely homogeneous criteria cannot be used in the preterm separation and classification and to the difference between numbers of the preterms among the studies.

The development of respiratory distress is reported to be high due to incomplete respiratory system development in preterm newborns. It has been reported that this rate is nine times higher than term neonates [2]. Helvacı et al. reported that the rate of respiratory distress was 76.7% [10]. In our study, respiratory distress was observed in 85% of the preterms. Özvarol et al. found a significantly higher rate of respiratory distress in those born earlier in gestational week [3]. However, there was no significant difference between the rate of respiratory distress and preterm periods in our study. The survival rate in neonates with respiratory distress was similar to those without any concomitant diseases. These data show that respiratory distress due to premature birth does not significantly affect mortality.

The rate of development of sepsis in late preterm birth was reported as 8.3% by Helvacı et al. [10], as 3.9% by Özlü et al. [2], and as 0.4% by Cohen-Wolkowiez et al. [17]. In our study, the rate of sepsis was found to be as low as 0.4%. This might be

due to the fact that our study had early preterms and therefore different problems. In addition, it might be due to the fact that the non-sepsis mortality rate was higher in our study than similar studies.

Zhang et al. reported that preterms from multiple pregnancies gained weight after birth and reached normal curve [6]. In our study, the mean birth weight was significantly lower in preterm infants than in singleton pregnancies, but there was no significant difference between the weight gain rates within the first, 3rd, 7th, 15th and 30th days after birth.

Cesarean rates were reported to be high in preterm deliveries [1,5]. Özvarol et al. reported the cesarean as 80.8% of deliveries in their study conducted on only preterm neonates [3]. Helvacı et al. stated that 80% of the newborns included in their study were delivered by cesarean section. In our study, the rate of cesarean section was found to be 91.7% [10].

There were some limitations in our study. Since the data were obtained retrospectively from the hospital records, some of the information about some patients could not be accessed. Since the number of completely healthy preterms was low in the study, the reference intervals could not be established in terms of the analyzed variables. As long-term follow-ups of neonates could not be performed, only postnatal mortality rates could be analyzed.

Conclusions

This is a large-scale study of data on more than a thousand preterm neonates. In our study, we found that preterm infants and those with lower birth weight had a worse prognosis and that weight gain after birth was associated with prognosis. We believe that the data obtained from our study may be a guide for clinicians and researchers.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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