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The assessment of anthropometrical measurements of newborns and the incidence of fetal malnutrition in Erzurum region*

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Abstract: We included in this study 1100 newborns whose gestational ages were between 26 and 42 weeks. Of these infants, 323(29.4%) were preterm. The others 777(70.6%) were term infants. In term newborns, the mean weight, length, head circumference and ponderal indexes of males were significantly higher than those of females ($p<0.01$, $p<0.01$, $p<0.01$, $p<0.05$, respectively); in preterm infants there were no significant differences between the two sexes in these anthropometrical measurements ($p>0.05$). When the whole study group was evaluated by ponderal index, the rates of malnourished, well-nourished and overnourished infants were 8.3%, 82.8% and 8.9%, respectively. Of fetally malnourished infants 49.5% were premature and 50.5% were full-term. Furthermore, 50.4% of these infants were males and 39.6% were females. There was no significant difference in malnutrition rate between male and female infants or between term and preterm infants ($p>0.05$).

Key Words: Anthropometrical measurement, prematurity, newborn, ponderal index, fetal malnutrition

Introduction

Local standards derived from the same population can be used as reference for both fetal growth and nutritional status in the intrauterine period and infant growth and development in the postnatal period. Height, weight, weight and head circumference measurements according to gestaational ages are frequently used methods for evaluation of growth and nutritional status (1). Unfortunately, birth weight and calculated gestational age have considerable limitations in the evaluation of fetal malnutrition. Large differences in relative amounts of soft-tissue invalidate birth weight as the sole measure of linear fetal growth or of the newborn infant's nutritional status. In infants born at high altitudes intrauterine growth is also affected (1). In this report, the ponderal index was used to calculate the relative amount of soft-tissue mass present in an infant. We aimed to determine the mean birth weight, length, head circumference and fetal malnutrition rate by using the ponderal index in our region, located at 1946 metres above sea level.

Materials and Methods

1100 liveborn infants who were born at the Department of Gynecology and Obstetrics, Atatürk University Faculty of Medicine enrolled in this study. Our city is located at 1946 meters above sea level. The families were in moderate socio-economic status and mothers were regularly followed. Of these 1100 infants, 323 (29.4%) were preterm and their gestational ages were between 26-37 weeks. The other 777(70.6%) infants were term babies whose gestational ages were 38-42 weeks.

The anthropometric data (weight, length and head circumference) for the newborns were measured in the delivery room immediately after birth. Their gestational ages were between 26-42 weeks. Since about one-third of the women did not accurately know the dates of their last menstrual periods, the gestational age was estimated by Dubowitz scoring performed between 24 and 48 hours after delivery (2). The following infants were excluded from the study: twins, infants born to diabetic and eclamptic mothers, infants with hemolytic disease of newborn due to Rh factor, and infants with gross abnormalities.

We calculated the ponderal index (PI) with height and weight measurements of the infants (3). The index was calculated as follows:

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$$\frac{\text{weight in grams}}{(\text{Height})3} \times 100.$$

The newborns whose PIs were between PI±SD (standard deviation), higher than PI±1SD and lower than PI±1SD were considered well-nourished, overnourished and malnourished, respectively (4, 5).

Data were statistically evaluated by student's t test and the difference between two population proportions.

Results

We evaluated 1.100 liveborn infants whose gestational ages were between 26 and 42 weeks. Sexual distribution of cases is shown in Table 1. Anthropometrical measurements of nulliparous and multiparous infants were remarkably similar and no statistically significant differences were found.

The mean weight, length, head circumference and PI values of all infants according to sex and gestational ages are shown in Table 2.

The mean weight, length, head circumference and PI values of term and preterm infants without regard to gestational ages are shown in Table 3 and 4. In term newborns, the mean weight, height, head circumference and ponderal indexes of males were significantly higher than those of females ($p<0.01$, $p<0.01$, $p<0.01$, $p<0.05$, respectively). In preterm infants, on the other hand, there were no significant differences in these anthropometrical measurements between the two sexes ($p>0.05$).

The intrauterine nutritional status of term and preterm infants are shown in Table 5 and 6. For term infants, intrauterine nutrition rates of term infants were 6.3% for females and 5.6% for males; the difference was not statistically significant ($p>0.05$). Of all preterm

Table 1. Distribution of Cases According to Sex.

	Male		Female		Total	
	n (%)		n (%)		n (%)	
Term infants	429	(55.2)	348	(44.8)	777	(100.0)
Preterm infants	209	(64.7)	114	(35.3)	323	(100.0)

Table 2. The Mean Weight, Height, Head Circumference Measurements and PI Values of All Infants According to Sex and Gestational Ages (Mean±Standard Deviation)

Gestational		Weight (gram)		Height (cm)		Head circumference (cm)		Ponderal index	
age (week)	n	Female	Male	Female	Male	Female	Male	Female	Male
26	25	1017±560	1036±588	34.8±1.8	35.2±4.0	24.8±1.3	25.1±1.7	2.40±0.71	2.41±0.47
27	26	1046±374	1069±448	35.7±3.2	36.1±3.6	25.2±1.6	25.6±2.2	2.42±0.53	2.42±0.83
28	42	1164±236	1199±525	36.6±4.5	36.9±3.4	26.1±3.4	26.4±3.6	2.44±0.72	2.45±0.53
29	46	1210±300	1234±390	38.4±5.1	39.2±5.6	26.6±2.3	26.9±4.0	2.44±0.19	2.45±0.79
30	49	1476±293	1501±452	40.3±2.5	40.4±2.3	27.1±1.6	27.5±1.8	2.45±0.41	2.46±0.49
31	62	1553±435	1555±262	40.8±3.6	41.4±3.2	28.6±2.3	28.9±2.6	2.46±0.34	2.47±0.34
32	67	1727±371	1769±435	41.6±5.1	42.0±5.4	29.1±1.6	29.9±2.1	2.47±0.35	2.48±0.49
33	53	2065±431	2127±371	42.1±4.3	42.6±3.6	30.4±1.7	30.9±1.1	2.48±0.87	2.48±0.63
34	61	2183±495	2265±631	43.5±3.3	43.9±2.4	31.3±2.6	31.7±1.8	2.52±0.47	2.56±0.61
35	56	2314±610	2367±547	45.1±5.2	45.7±5.7	31.6±1.8	32.1±2.2	2.58±0.38	2.62±0.57
36	77	2579±471	2616±396	46.8±2.4	47.1±3.1	32.8±1.1	33.1±1.5	2.64±0.38	2.65±0.53
37	72	2834±670	2891±448	47.4±3.3	47.9±3.8	33.2±2.5	33.8±2.1	2.69±0.13	2.73±0.34
38	87	3040±543	3089±588	48.1±2.4	48.9±4.2	34.0±1.5	34.4±2.2	2.72±0.35	2.75±0.33
39	108	3192±390	3218±374	48.8±3.0	49.1±2.9	34.3±3.1	34.8±3.7	2.74±0.28	2.70±0.34
40	115	3310±452	3360±494	49.2±1.8	49.6±2.0	34.6±1.2	34.9±1.9	2.74±0.10	2.78±0.13
41	91	3432±374	3464±572	49.7±2.2	50.1±2.5	35.0±1.1	35.3±1.2	2.75±0.39	2.81±0.46
42	63	3514±620	3560±568	50.3±3.8	50.6±4.4	35.4±1.8	35.6±2.2	2.76±0.34	2.86±0.44

infants were 14.8% for males and 12.3% for faemales; the difference was not statistically significant (p>0.05). When the whole study group was evaluated by ponderal index, malnourished, well-nourished and overnourished newborn rates were 8.3%, 82.8% and 8.9%, respectively. Of malnourished infants, 49.5% were premature and 50.5% were full-term; 50.4% fetal malnutrition cases were males and 49.6% were female.

Table 3. The Mean Weight, Length, Head Circumference and PI Values of Term Infants Without Regard to Gestational Ages (Mean±Standard Deviation)

	Male (n=429)	Female (n=348)	p
Weight (gram)	3234±452	3193±461	<0.01
Height (cm)	49.5±2.7	48.9±2.4	<0.01
Head circumference (cm)	34.8±1.9	34.3±2.3	<0.01
Ponderal index	2.80±0.26	2.76±0.31	<0.05

Table 4. The Mean Weight, Length, Head Circumference and PI Values of Preterm Infants Without Regard to Gestational Ages (Mean±Standard Deviation)

	Male (n=209)	Female (n=114)	p
Weight (gram)	2285±679	2012±594	>0.05
Height (cm)	44.9±3.7	42.6±4.9	>0.05
Head circumference (cm)	31.7±2.4	31.4±2.6	>0.05
Ponderal index	2.31±0.64	2.30±0.72	>0.05

Table 5. The Intrauterine Nutritional Status of Term Infants

Intrauterine nutritional status								
Sex	Malnutrition		Normal nutrition		Over-nutrition		Total	
	n	%	n	%	n	%	n	%
Male	24	5.6	377	87.9	28	6.5	429	100.0
Female	22	6.3	301	86.5	25	7.2	348	100.0
Total	46	5.9	678	87.3	53	6.8	777	100.0

Table 6. The Intrauterine Nutritional Status of Preterm Infants

Intrauterine nutritional status								
Sex	Malnutrition		Normal nutrition		Over-nutrition		Total	
	n	%	n	%	n	%	n	%
Male	31	14.8	149	71.3	29	13.9	209	100.0
Female	14	12.3	84	73.7	16	14.0	114	100.0
Total	45	13.9	233	72.2	45	13.9	323	100.0

There was no significant difference in malnutrition rates between male and female infants, or between term and preterm infants (p>0.05).

Discussion

Perinatal and subsequent developmental effects of fetal malnutrition are often serious. Fetal malnutrition can affect body composition and brain development (6). Because social and environmental differences can influence anthropometrical measurements, the standard values also vary, so growth evaluation of newborns must not rely on standard anthropometrical measurements. An index formulated by using the newborns' own length and weight measurements may be considered a true quage. Thus PI described by Lubchenco et al. (7) and Miller and

Hassanein (3), is used for evaluation of fetal malnutrition. In our study, we used HI in order to determine the intrauterine nutrition status of term and preterm infants.

In a study conducted by Neyzi et al (8), the mean birth weight of males was 3315±504 grams and that of females was 3197±502 grams. In another study on infants of families with high socioeconomic level, Neyzi (9) showed that mean birth weight values of males and females were 3414±575 grams and 3317±535 grams, respectively. Özalp et al. (10) found that the mean weight, length and head circumference were 3262±455 grams, 49.9±2.0 cm and 34.9±1.4 cm, respectively. A study done by Tümerdem et al. (5) in İstanbul showed that the mean weight was 3466±317 grams for term infants. They also found that there were significant differences between the two sexes in weight and height. The birth weights of our infants were lower than those reported in these studies, possibly because of the high altitude.

Fetal malnutrition can be determined either by using PI (3, 7) or by data derived from serial ultrasound exams (11) or by a scoring system based on a clinical evaluation of nutritional status, which is recommonded by Metkoff (6). In Turkey, different methods have been used in each study for definition of fetal malnutrition. For infants whose gestational ages were between 35-42 weeks, Özalp et al (10) found that the fetal malnutrition rate was 28.7% according to Lubchenco' percentile curves. In two different studies Tümerdem et al (4, 5), it was determined that fetal malnutrition rates of term infants were 12.8% and 6.2%, and overnutrition rates were 14.4% and 7.4%, respectively. In a study on 500 preterm infants whose gestational ages were 34-37 weeks, Erdem (12) found that fetal malnutrition rate was 28%. In another study done by Yüksel et al. (13) in the Adana region, it was found to be 6.5% for term infants and 41% for preterm infants. In the same study, overnourished infant rates were 11.8% and 8.5% for term and preterm infants, respectively. When the whole study group was evaluated by ponderal index, 10.7% of the newborns had fetal malnutrition, and of fetal malnourished infants 46.8% were premature and 53.2% were full-term infants; 42.4% of the fetal malnutrition cases were male and 57.6% were female (13).

We found fetal malnutrition rate was 8.3% according to the ponderal index. Our high fetal malnutrition rate showed again that pregnant women must be closely and regularly followed up during pregnancy. Regular prenatal visits devrease the fetal malnutrition rate. As fetal malnutrition effects postanatal development (6), all infants should be evaluated for fetal malnutrition at birth and the malnourished ones should be followed closely.

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