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THE INCIDENCE OF FETAL MALNUTRITION IN TURKEY*

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Fetal malnutrition has been and continues to be a very important health problem for the whole world. It causes an increase in the intrauterine fetal death rate and neuro-intellectual morbidity in childhood. Although the average full scale intelligence score is not markedly lower in these children, they usually do poorly in school[1]. Follow-up studies of intrauterine growth-retarded infants have shown a tendency towards short stature and lower weight percentiles[2]. Congenital anomalies also occur more frequently in infants with fetal malnutrition[3].

Given the importance of the problem, this study was undertaken to assess the magnitude of fetal malnutrition in Turkey. Fetally malnourished babies were identified by considering deviations from the expected birthweight, which was obtained by adjusting for maternal age, height, pre-pregnancy weight, parity and the baby's gestational age and sex. This paper presents the incidence and possible causes of fetal malnutrition in our sample, which probably reflects the general situation in Turkey.

Material and Methods

The study was carried out on 1018 consecutive pregnancies, and complete data were compiled on 525 mothers and their liveborn infants delivered between July 10, 1978, and August 30, 1978, in the general maternity hospital of Ankara, Turkey.

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Infants were weighed in the delivery room immediately after birth. Since the accurate date of the last menstrual period was not known by about one-third of the women, the gestational age was estimated by Dubowitz scoring performed between 24 and 48 hours after delivery. The neonates were examined and all anthropometric measurements were obtained at the same time. Newborn babies with gross abnormalities and those born to diabetic and eclamptic mothers, as well as babies of fewer than 35 weeks of gestation, were not included in this study.

The mothers were interviewed and given questionnaires to determine certain socio-cultural factors which could influence normal intrauterine growth, and their anthropometric measurements were also taken. Diet recall of the last 3 days before admission to the hospital was obtained by a nutritionist. The mothers were also asked how often they consumed the foods usually advised for a normal pregnancy, such as eggs, milk, meat, etc.

Multiple regression analysis between adjusted birthweight as the dependent variable and maternal age, height, pre-pregnancy weight, parity, and baby sex and gestational age as independent variables was performed, and an equation for predicting the expected (adjusted) size of Turkish newborns was obtained.

Babies whose adjusted birthweights were 1 and 2 SD below the mean of the expected birthweights were classified as moderately and severely intrauterine growth retarded, respectively.

TABLE I

NEWBORN ANTHROPOMETRIC DATA

(n = 525)

Measurements	Range	Mean ± SD
Birthweight (gm)	1850.00 - 4800.00	3262.25 ± 454.99
Length (crown-heel) (mm)	440.00 - 570.00	499.41 ± 20.26
Fronto-occipital circumference (mm)	300.00 - 400.00	349.86 ± 14.34
Chest circumference (mm)	250.00 - 380.00	327.74 ± 19.19
Right thigh circumference (mm)	105.00 - 200.00	149.26 ± 14.09
Right arm circumference (mm)	70.00 - 135.00	99.45 ± 10.28
Skinfold thickness (mm)		
Right thigh	2.00 - 12.00	4.49 ± 1.48
Right arm	1.00 - 8.00	3.02 ± 1.21
Interscapular	1.00 - 8.00	2.65 ± 1.00

Results

The anthropometric data for the newborns and mothers are presented in Tables I and II, respectively.

Using the equation for computing expected birth measurements[4], the mean adjusted birthweight was found to be 3252.76 grams ± 232.56.

The adjusted birthweights of 151 out of 525 liveborn infants were more than 1 SD below the mean. Such cases constitute a total of 28.7% of the population studied with 11.4% (or 60 cases) being more than 2 SD below the mean (severely malnourished).

TABLE II

SOME MATERNAL ANTHROPOMETRIC, SOCIO-CULTURAL AND DIETARY DATA

(n = 525)

Variable	Range	Mean ± SD
Age (yrs)	15 - 30	22.75 ± 3.96
Pre-pregnant weight (kg)	34 - 100	56.48 ± 8.75
Height (cm)	135 - 175	155.81 ± 5.88
Number of pregnancies	1 - 4	1.78 ± 1.07
Education (yrs)	0 - 21	6.23 ± 4.09
Mother works outside the home (hours/wk)	0 - 60	7.78 ± 15.92
Annual family income (TL)*	21,600 - 360,000	87,143.59 ± 58,202.84
Number of people living at home	2 - 17	3.92 ± 2.50
Living accomodations (no. of rooms)	1 - 10	3.45 ± 1.32
Calorie intake (Kcal/kg/day)	13.22 - 115.53	41.92 ± 14.12
Protein intake (gm/kg/day)	0.39 - 3.78	1.42 ± 0.49

* 90 Turkish liras (TL) = 1 American dollar ($).

As can be seen in Figure 1, many of the babies with 1 SD below the mean adjusted birthweight fall between the 50th and 75th percentiles on Lubchenco's scale.

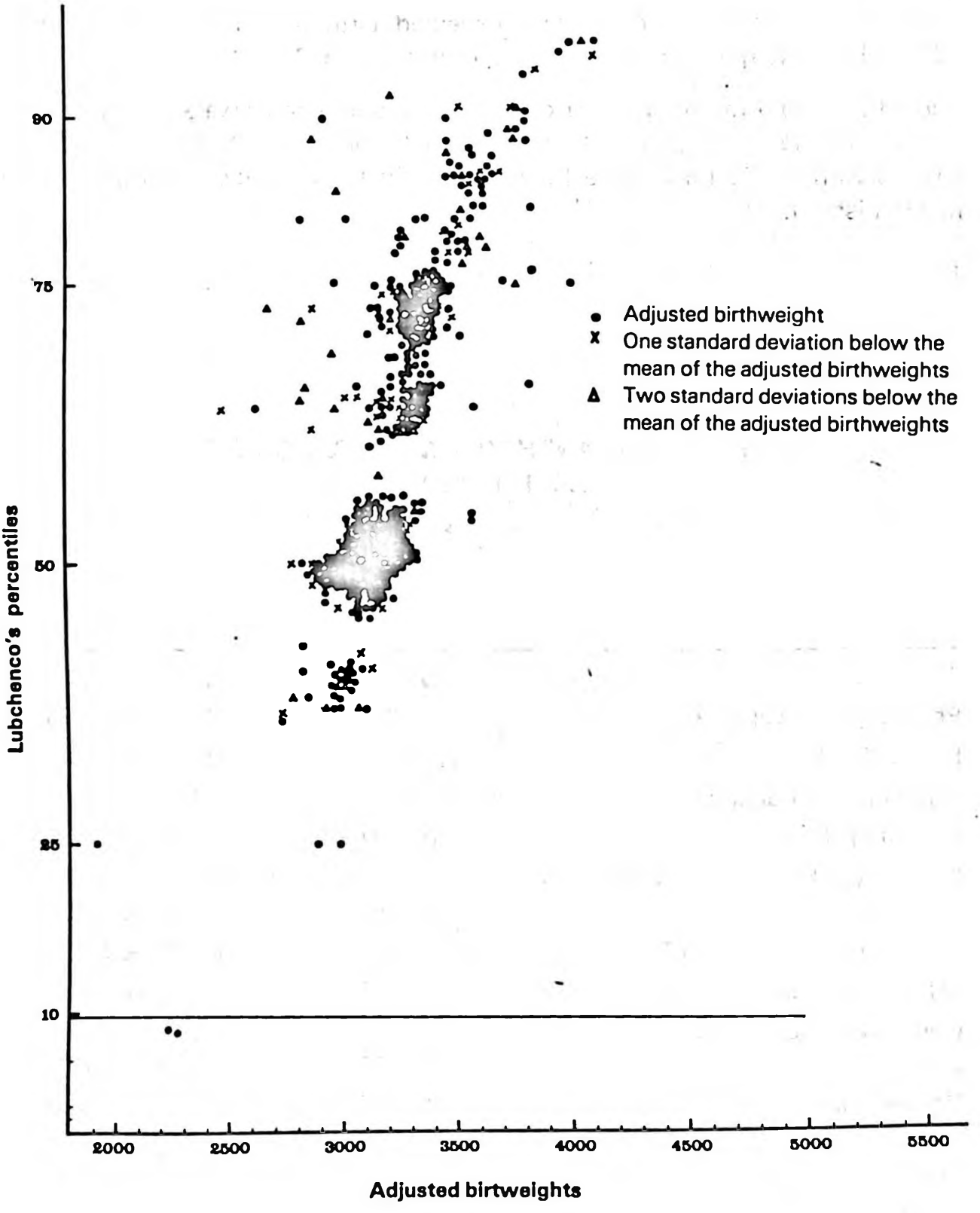
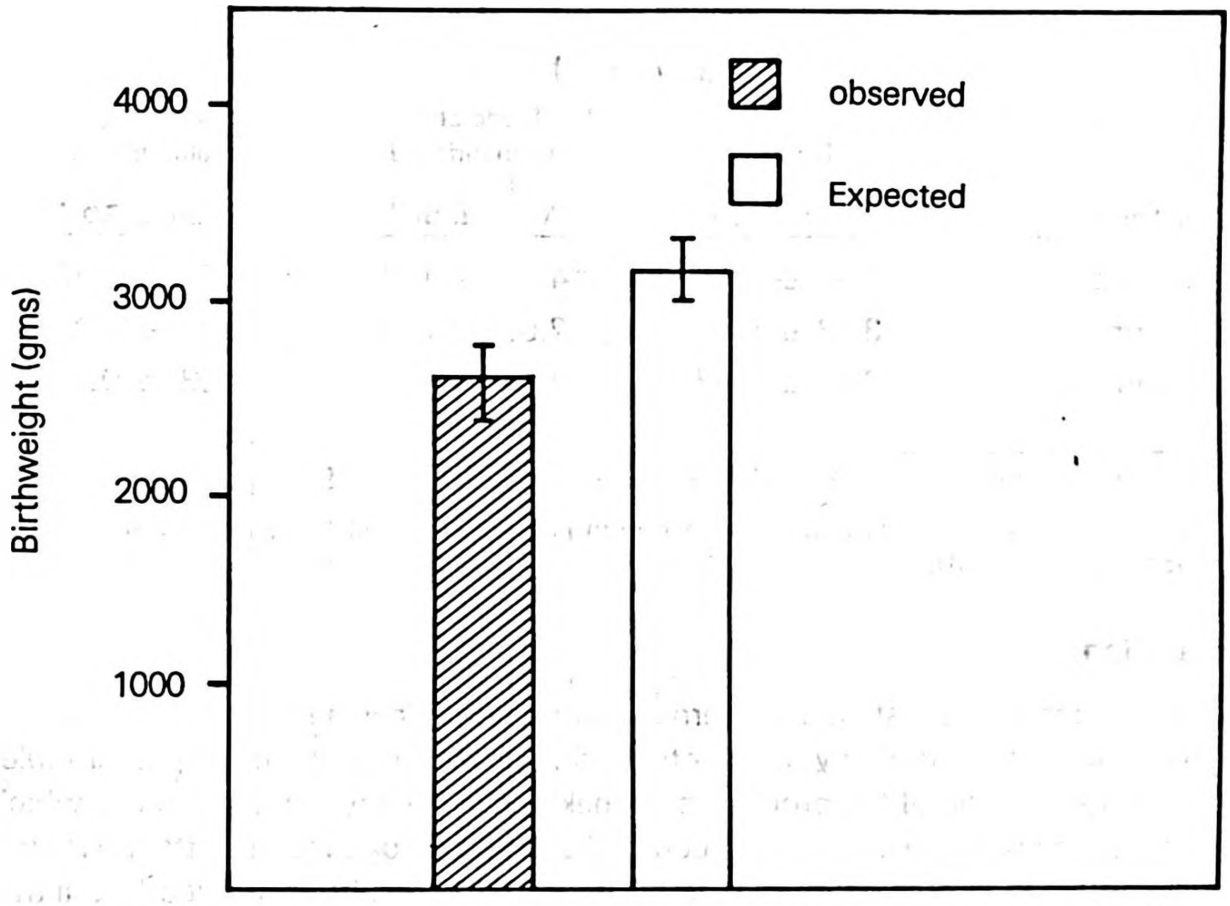


Figure 1

The plot of Lubchenco's birthweight percentiles of the babies vs. their adjusted birthweights.

The difference between the mean of observed and expected birthweights of fetally malnourished babies was found to be statistically significant ($p < 0.001$, Figure 2).



Expected birthweight = 13.16 X_1 (mother's age) + 73.81 X_2 (gestational age) + 5.65 X_3 (mother's pre-pregnancy weight) + 11.31 X_4 (mother's height) + 69.45 X_5 (number of pregnancies) −124.04 X_6 (baby's sex) (♂ = 1, ♀ = 2) − 1999.45 (intercept)

Figure 2

The comparison of the observed and expected birthweights of 60 fetally malnourished newborns.

The mean skinfold thickness of fetally malnourished babies was found to be significantly lower than that of babies with normal growth ($p < 0.001$). The difference between the moderately and severely malnourished groups was also significant ($p < 0.001$, Table III).

Table IV summarizes maternal dietary intake during pregnancy and some of the socio-cultural factors that may affect intrauterine growth. In the severely malnourished group, maternal protein and calorie intakes were found to be significantly lower, respectively, than those of the mothers of normal babies ($p < 0.010$, $p < 0.020$).

The mothers of the babies with fetal malnutrition had lower levels of education than those of the normal group ($p < 0.001$).

TABLE III

THE MEAN SKINFOLD THICKNESS OF NORMAL AND FETALLY MALNOURISHED BABIES

(n = 525)

Skinfold measurements	Normal Mean ± SD	Moderately malnourished Mean ± SD*	Severely malnourished Mean ± SD**
Right thigh	4.67 ± 0.08	4.11 ± 0.14	3.59 ± 0.15
Right arm	3.23 ± 0.06	2.63 ± 0.10	2.21 ± 0.12
Interscapular	2.86 ± 0.07	2.28 ± 0.08	2.03 ± 0.09

* The mean values are significantly lower than normals ($p < 0.001$).

** The mean values are significantly lower than both normals and moderately malnourished babies ($p < 0.001$, $p < 0.001$).

Discussion

Present evidence suggests that maternal environment plays a major etiological role in fetal malnutrition. In many cases intrauterine growth retardation is preventable, and early recognition of the problem may make possible active intervention, which in turn may improve the outcome. A comprehensive approach to intrauterine recognition and management of deviate fetal growth also results in reduced perinatal morbidity and mortality.

The terminology and criteria for altered fetal growth are rather confusing[5,6]. The relationship of birthweight to gestational age, expressed as a percentile, reflects the quality of fetal growth and is, at present, a generally used standard for defining deviate fetal growth[7]. However, certain infants are genetically pre-determined to be large. They manifest fetal malnutrition by soft tissue wasting even though they do not fall below the normal range of weight. Conversely, other infants may be smaller than usual for their gestational age due to genetic rather than pathological reasons, with no soft tissue wasting and no risk of morbidity or death associated with their small size. In the light of the above, we derived from our own data fetal weight adjustment factors for maternal age, height, pre-pregnancy weight, parity and infant gestational age and sex and calculated the expected birthweight for each baby as described earlier[8-10].

Fetally malnourished babies were identified as those whose adjusted birthweights were more than 1 SD below the expected (Figure 1). In the group studied, 28.7% of the infants were found to be fetally malnourished: 11.4% severely (more than 2 SD below the expected) and the remaining 17.3% moderately.

TABLE IV

T TEST BETWEEN NORMAL AND MODERATELY MALNOURISHED AND NORMAL AND SEVERELY MALNOURISHED NEWBORNS FOR DIEATRY AND SOCIO-CULTURAL FACTORS

(n = 525)

Variable	Normal Mean ± SD	Malnourished Mean ± SD	T	P	Severely malnourished Mean ± SD	T	P
Daily protein intake (gm/kg)	1.53 ± 0.46	1.47 ± 0.48	0.92	> 0.020	1.30 ± 0.46	2.70	< 0.010
Daily calorie intake (kcal/kg)	44.57 ± 13.52	43.34 ± 14.01	0.78	> 0.020	38.79 ± 13.74	2.53	< 0.020
Annual family income (TL)	89661.91 ± 54964.53	92614.88 ± 63699.96	−0.42	> 0.500	87365.66 ± 66200.00	0.22	> 0.800
Living accomodations (no. of rooms)	3.65 ± 1.35	3.50 ± 1.19	0.99	> 0.200	3.30 ± 1.30	1.53	> 0.100
People living at home (no.)	3.81 ± 2.28	4.20 ± 2.97	1.39	> 0.100	4.27 ± 3.02	−1.16	> 0.200
Outside work (hours/wk)	5.91 ± 14.20	2.33 ± 9.32	4.15	< 0.001	0.84 ± 5.76	6.51	< 0.001
Maternal education (yrs)	5.29 ± 4.75	1.67 ± 3.58	11.98	< 0.001	0.59 ± 2.09	17.86	< 0.001
Smoking (no. cig/day)	3.73 ± 2.62	0.38 ± 2.49	2.23	< 0.050	0.19 ± 1.94	3.61	< 0.001

From Figure 1, comparing adjusted birthweight with birthweight for gestational age, it is clear that there are many babies for whom the deviation from adjusted birthweight is more than 1 SD below the expected birthweight, but who are above the 20th percentile by the Lubchenco criterion[11]. If the results in this study are evaluated according to WHO criteria for intrauterine growth retardation, there are many babies who weighed more than 2500 gr but whose birthweights are lower than 1 SD below the expected. Therefore, unless the adjusting factors are taken into account, infants who are actually considerably smaller than they should be given their sex, gestational age and characteristics of their mothers, may not be recognized as undergrown.

We have previously reported the growth chart obtained from the same data and stated tentatively that the incidence of fetal malnutrition is only 8.9% when the criterion for fetal malnutrition is weight below the 10th percentile[12]. The significant difference between the findings of fetal malnutrition calculated from the same data by different methods (28.7% vs. 8.9%) underscores the need for adjusting baby size for certain factors. Such an adjustment could make identification of intrauterine growth retardation more reliable.

It has been reported that about 5-8% of all babies born in the USA and about 8-30% of those born in some developing countries are grossly undergrown in utero[13]. The figure obtained by the method described in this paper (28.7%) is in the higher range of this wide spectrum. Therefore, the incidence of fetal malnutrition should be considered as quite high in Turkey.

The influence of nutrition during pregnancy on the condition of the infant has been reported[14-15]. Women from low socio-economic classes tend to have smaller babies[16]. It was observed that mean annual family income in Turkey is rather low in relation to recent cost-of-living increases (Table IV). In spite of this rather low income, maternal calorie and protein intakes appear to be within normal limits. Dietary history has shown, however, that primarily biologically low protein was consumed during this vulnerable period.

Low protein and calorie intake combined with low educational levels in the mothers of the severely malnourished infants suggest that these factors may account for a significant proportion of cases of fetal malnutrition in Turkey.

It is known that maternal undernutrition during the first months of pregnancy causes a proportional intrauterine growth retardation while during the later months it may lead to tissue wasting[17]. Therefore, the significant differences of the skinfold thickness of the moderately and severely malnourished babies compared to normal babies in this study may indicate that poor growth occurred during the later weeks of pregnancy (Table III).

Mothers from the same income group who smoke more have bigger babies, probably because they are often better educated (Table IV).

Since the patients admitted to this general maternity hospital come from almost all provinces of Turkey and from extremely varied socio-economic backgrounds, this study may be considered as representative of the whole country[18].

Summary

Five-hundred twenty-five newborn babies and their mothers were studied to assess the magnitude of fetal malnutrition in Turkey by considering deviations from expected birthweight, obtained after adjusting for maternal age, height, pre-pregnancy weight, parity, gestational age and the sex of the baby. Babies whose adjusted birthweights were 1 and 2 SD below the mean of the expected birthweight were classified as moderate and severely intrauterine growth retarded, respectively. Such cases in total constitute 28.7% (151 babies) of the population studied. 60 of the cases were severely malnourished (11.4%). It was noticed that there were many babies who weighed more than 2500 gr, or above the 25th percentile by the Lubchenco criterion, yet their observed birthweights were 1 or 2 SD below their expected birthweights. It was concluded that unless the adjusting factors are taken into account, infants who are actually considerably smaller than they should be given their sex, gestational age, and characteristics of their mothers may not be recognized to be undergrown.

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