Ultrasonographic Measurements of Fetal Femur Length and Biparietal Diameter in an Israeli Population

Tamy Shohat MD MPH[1,2], Orly Romano-Zelekha[1], and the Israel Network for Ultrasound in Obstetrics and Gynecology*

[1]Israel Center for Disease Control, Gertner Institute for Policy Research, Sheba Medical Center, Tel-Hashomer, and [2]Department of Epidemiology and Preventive Medicine, Sackler Faculty of Medicine, Tel Aviv University, Israel

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Abstract

Background: Charts of fetal measurements are widely used in the follow-up of pregnant women, however no charts have been constructed for the Israeli population.

Objectives: To establish growth charts for fetal femur size and biparietal diameter.

Methods: A prospective cross-sectional study of 1,422 singleton pregnancies was conducted.

Results: A total of 1,143 pregnancies met the inclusion criteria. Femur length and biparietal diameter were measured. A linear cubic model was fitted to construct growth charts for the different centiles. The charts were compared with previously published data.

Conclusions: We have constructed new fetal measurement charts for femur length and biparietal diameter that are unique for the Israeli population. These charts have been found to be similar to those published for other Caucasian populations.

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Several fetal growth curves have been published in the literature [1–5] and are used widely for the prediction of gestational age and fetal size as well as for the detection of fetal anomalies. The possibility of inter-population variability in fetal growth patterns has been addressed in a few studies but with inconsistent results [5–8]. The aim of the present study was to establish growth charts for fetal femur length and biparietal diameter for the Israeli population.

Patients and Methods

In a joint effort of the Israel Center for Disease Control and the Israel Association for Ultrasound in Obstetrics and Gynecology, we established a network of gynecologists who routinely perform ultrasound in pregnant women. The physicians who joined the network were asked to complete a form for each woman who came for a routine ultrasound scan. The information requested from each woman included date of last menstrual period, population group and country of origin of the pregnant woman and her partner, their height, and any chronic diseases of the pregnant woman. Since a cross-sectional design was used, each fetus was examined once. We excluded from the analysis women in any of the following categories:

- uncertain date of last menstrual period
- ultrasound and menstrual age differing by more than 10 days
- multiple pregnancies
- fetal malformations
- maternal disease or medication that could affect the growth of the fetus

All the measurements were taken by certified gynecologists. BPD was measured from the outer border of the skull to the inner border (outer-inner), and the femur length was measured from the greater trochanter to the lateral condyle.

Statistical analysis

For each measurement a regression analysis was done examining linear, quadric and cubic models for the association with gestational age. The regression equations used to generate the charts and tables for femur length and biparietal diameter are, respectively:

Mean = $-35.82 + 4.01w - 0.026w^2 - 0.0001w^3$, where w is the exact gestational age in weeks.

Mean = $-5.87 + 1.54w + 0.089w^2 - 0.0001w^3$, where w is the exact gestational age in weeks.

The Pearson correlation coefficient (r^2) was calculated in each case to compare the strength of the association for the regression model.

Results

Fifty-five gynecologists reported the measurements in 1,422 pregnant women; 1,143 women fitted the inclusion criteria. A total of 279 women were excluded for the following reasons: no information on the date of their last menstrual period (n = 203), multiple fetuses (n = 31), and chronic diseases (n = 45). The

* A list of all participating physicians appears at the end of the manuscript.

BPD = biparietal diameter

Table 1. Number of fetuses measured at each week of gestation

Week of gestation	No. of women	%
13+0–13+6	4	0.4
14+0–14+6	32	2.8
15+0–15+6	49	4.3
16+0–16+6	46	4.0
17+0–17+6	16	1.4
18+0–18+6	19	1.7
19+0–19+6	32	2.8
20+0–20+6	59	5.2
21+0–21+6	130	11.4
22+0–22+6	156	13.7
23+0–23+6	120	10.5
24+0–24+6	50	4.4
25+0–25+6	34	3.0
26+0–26+6	26	2.3
27+0–27+6	15	1.3
28+0–28+6	22	1.9
29+0–29+6	14	1.2
30+0–30+6	30	2.6
31+0–31+6	29	2.5
32+0–32+6	39	3.4
33+0–33+6	36	3.2
34+0–34+6	30	2.6
35+0–35+6	26	2.3
36+0–36+6	27	2.3
37+0–37+6	27	2.3
38+0–38+6	22	1.9
39+0–39+6	14	1.2
40+0–40+6	31	2.7
41+0–41+6	8	0.7

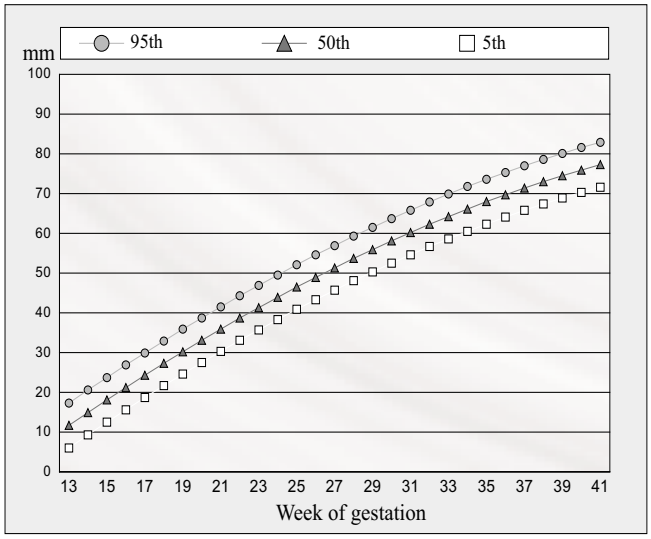

Figure 1. Fitted 5th, 50th, and 95th centiles for femur length

cubic model gave the best fit to the mean for both femur length and BPD. Table 1 shows the number of fetuses examined for each week of gestation. The correlation coefficients for femur length model and for BPD were 0.97. Figure 1 demonstrates the estimated 5th, 50th and 95th centiles for each week, between the 13th and the 41st week of gestation for femur length. Figure 2 shows the estimated 5th, 50th and 95th centiles for BPD for each week.

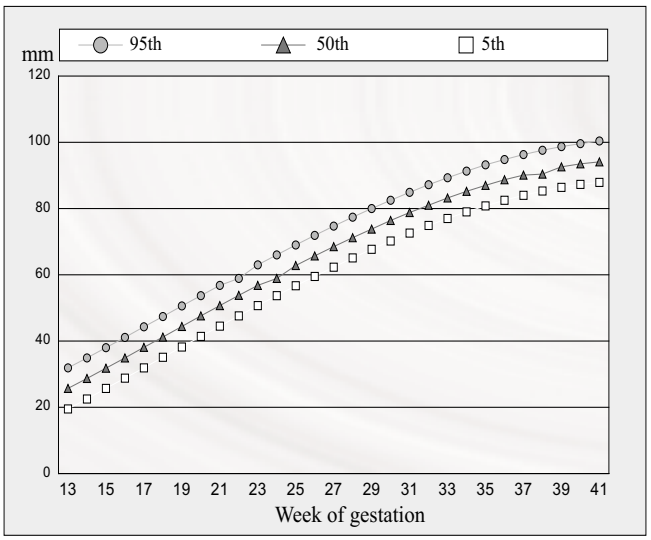

Figure 2. Fitted 5th, 50th, and 95th centiles for biparietal diameter

Discussion

In this cross-sectional study we established normal ranges for femur length and BPD for the Israeli population. Each woman contributed one set of measurements, taken during a routine ultrasound examination. Despite methodological differences between the various studies, comparison between the chart derived from the present study for the 50th centile of the outer-inner BPD and previously published charts by Chitty et al. [2] revealed close agreement. As expected, it was different from the outer-outer measurements published by Snijders and Nicolaides [4]. A close agreement was found between the chart derived from the present study for the 50th centile of the femur and previously published charts [3,4].

Ethnic group differences in fetal growth patterns have been documented in previous studies [5–8]. Substantial differences in fetal growth patterns were found in a study of a black indigent population in Atlanta [5]. The fetuses in that study had larger heads, smaller abdomens and shorter femurs compared with previously reported measurements from other populations. The authors suggested that these differences could be attributed to racial factors, socioeconomic status or region of residency. In a study of Indians and Caucasians in Britain, measurements of abdominal circumference were smaller in Indians than in white Europeans, while there were no significant differences in the BPD between those groups [6]. Jacquemyn et al. [7] reported differences in head circumference, abdominal circumference and femur length between women of Belgian origin and migrant women from Morocco and Turkey, but no differences in fetal BPD were found between these groups. No significant differences were found for BPD, head circumference, abdominal circumference and femur length in another study where sonographic data from a middle-class white population were

compared with data from a black/Hispanic population in Texas [8]. The results of the present study support the current use of fetal measurement charts from other Caucasian populations.

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Correspondence: Dr. T. Shohat, Israel Center for Disease Control, Gertner Institute, Sheba Medical Center, Tel-Hashomer 52621, Israel. Phone: (972-3) 534-9595, Fax: (972-3) 534-9881,
email: shohat@trendline.co.il

List of participating physicians

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