Fetal Femur Length and Abdominal Circumference Ratio in Bangladesh

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Abstract

Objective: *The ratio of fetal femur length and abdominal circumference is one of the important ratios. But we do not have any study on it in our country so far. Therefore a study was conducted to prepare a table based on Bangladeshi population.*

Method: *Well dated pregnancies were included in a cross-sectional prospective study. By fitting Polynomial regression model a table and a graph were prepared. Nomograms of Caucasian population which were established before, were compared with this study.*

Results: *A chart of the raw data of 1223 subjects with superimposed fitted percentiles was produced. The quadratic model showed a good fit to the data. 3rd, 10th, 50th, 90th and 97th percentiles, means and two standard deviations of the data were derived.*

Conclusion: *These table and charts can be useful for accurate assessment of fetal femur length/abdominal circumference ratio to detect the type of fetal growth abnormality, symmetrical or asymmetrical. This study shows that there is similarity of this ratio with the western ratio unlike the individual fetal parameters.*

Key words: *Femur length/ abdominal circumference ratio, Bangladesh.*

Introduction

Ratio is a tool which shows if the fetal parts are growing proportionately or not. The most useful parameters are those that remain constant through some period, thus making them easier to remember. Ratios of the cranium are constant throughout the second and third trimesters.[1]

Various fetal ratios have been studied on western population. This ratio of fetal femur (FL) length with abdominal circumference (AC) is an important ratio to assess fetal growth. It gives an idea if the fetus is growing proportionately or not. The type of fetal growth restriction can be determined by it, whether it is symmetrical or asymmetrical. So far no study has been conducted on this ratio on Bangladeshi population.

In Bangladesh various studies have found that our fetal measurements are smaller than the Caucasian fetal measurements.[2-7] So we need reference tables from our own studies. This prospective study was carried out to produce a table with mean and 2 standard deviations (2SD) of this ratio based on our Bangladeshi population.

Subjects and Method:

This was a cross sectional study. It was conducted on pregnant ladies of 13 to 40 weeks gestational age. All study subjects were Bengalis. Structured questionnaires were filled up and well informed consent of the patients were obtained.

Inclusion criteria were- regular periods, no oral contraceptive for 3 months before conception, all patients gave a certain last menstrual period (LMP) date and had an ultrasound scan before 20 weeks gestational age to confirm the date within 2SD. No maternal malnutrition or any medical, surgical or obstetric complication and no uterine anomaly or large fibroid.

Ultrasonographic scans of fetal biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) using standard methodology were done on all patients who met the criteria. Electronic calipers were used for the measurements and they were made in mm. A 3.5 MHz curvilinear transducer was employed for the ultrasound scans.

The technique of measuring the femoral length involves an initial determination of the lie of the fetus and locating the femur. Once the femur has been located, an attempt is made to define both ends of the calcified portion. The image is then frozen and with multidirectional electronic calipers, the calcified portion is measured. The aim is a femur which is finely outlined and has clear-cut ends.[8] After 32 menstrual weeks, the distal femoral epiphysis is visible but not included in the measurements. [9]

Abdominal circumference measurements were obtained by tracing the appropriate circumference by calipers that open to the outline of fetal abdomen.

The section was as round as possible with porto-caval confluence in the section appearing like a 'hockey stick' or J-shape.

For data entry and analysis SPSS program in computer software was used. The ratio between the two parameters was calculated. A table and a graph were prepared after regression analysis of the data. Values were expressed as percentiles, mean and 2 standard deviations, for the estimates in the table. A graph showing 3rd, 10th, 50th, 90th and 97th percentiles was plotted on the raw data.

Results

Healthy pregnant ladies were included in this study after satisfying the required criteria. Sample size was 1223 subjects. Patient's demographics were as

follows with mean and standard deviation (SD): Mean maternal age was 26.95 (±4.49) with range of 17 to 40 years. Mean BMI was found to be 23.67 (±3.4). Mean maternal height was 156.73 (±5.1) cm and mean maternal weight in the first trimester was 57.92 (±9.2) kg. 96.9% were from middle class. 54.7% of the subjects were primipara and 45.3% were multipara.

Table I gives fitted percentiles of FL /AC ratio. It gives the number of cases in each week of gestation, the estimated values of 3rd, 10th, 50th, 90th and 97th percentiles and the mean with 2 standard deviations of the data. In this study at 13 weeks gestational age mean FL/AC ratio was 0.20 (± 0.03), at 36 weeks it was 0.23 (± 0.02) and at 40 weeks it was 0.24 (±0.02). Range of ratio was 20-24 or 22 ± 2. The coefficient of multiple correlation $R^2 = 0.454$, ($p<.001$).

Table I

Fitted percentiles of femur length/ abdominal circumference (FL/AC) ratio. Estimated values after fitting the model

Fitted Percentiles of FL/AC ratio (estimated)

Weeks of gestation (w)	No. of fetuses	3rd	10th	50th	90th	97th	Mean	2SD
13	15	0.17	0.18	0.20	0.22	0.23	0.20	0.03
14	27	0.18	0.19	0.20	0.22	0.23	0.20	0.03
15	32	0.18	0.19	0.21	0.23	0.24	0.21	0.03
16	34	0.19	0.20	0.22	0.24	0.25	0.22	0.03
17	27	0.20	0.20	0.22	0.24	0.25	0.22	0.03
18	42	0.20	0.20	0.22	0.24	0.25	0.22	0.03
19	34	0.20	0.20	0.22	0.24	0.25	0.22	0.03
20	38	0.20	0.20	0.22	0.24	0.25	0.22	0.03
21	43	0.20	0.20	0.22	0.24	0.25	0.22	0.03
22	45	0.20	0.20	0.22	0.24	0.25	0.22	0.03
23	39	0.20	0.20	0.22	0.24	0.25	0.22	0.03
24	36	0.20	0.20	0.22	0.24	0.25	0.22	0.03
25	42	0.20	0.20	0.22	0.24	0.25	0.22	0.03
26	46	0.20	0.20	0.22	0.24	0.25	0.22	0.03
27	44	0.20	0.20	0.22	0.24	0.25	0.22	0.03
28	49	0.20	0.20	0.22	0.24	0.25	0.22	0.03
29	50	0.20	0.20	0.22	0.24	0.25	0.22	0.03
30	51	0.20	0.21	0.23	0.25	0.26	0.23	0.03
31	52	0.20	0.21	0.23	0.25	0.26	0.23	0.03
32	50	0.21	0.22	0.23	0.25	0.25	0.23	0.02
33	55	0.21	0.22	0.23	0.25	0.25	0.23	0.02
34	56	0.21	0.22	0.23	0.25	0.25	0.23	0.02
35	59	0.21	0.22	0.23	0.25	0.25	0.23	0.02
36	57	0.21	0.22	0.23	0.25	0.25	0.23	0.02
37	54	0.21	0.22	0.23	0.25	0.25	0.23	0.02
38	56	0.22	0.23	0.24	0.26	0.26	0.24	0.02
39	55	0.22	0.23	0.24	0.26	0.26	0.24	0.02
40	35	0.22	0.23	0.24	0.26	0.26	0.24	0.02

Graph 1, shows the raw data for FL/AC ratio with fitted 3rd, 10th, 50th, 90th and 97th percentile curves superimposed on it. The ratio was lower in early pregnancy, and then it rises up to a platform. The graph given is of 95% confidence interval (CI).

In the graph, the lowest curve gives the 3rd percentile boundary, next curve gives 10th percentile, next one gives 50th, next 90th and the last curve gives 97th percentile boundary of the data.
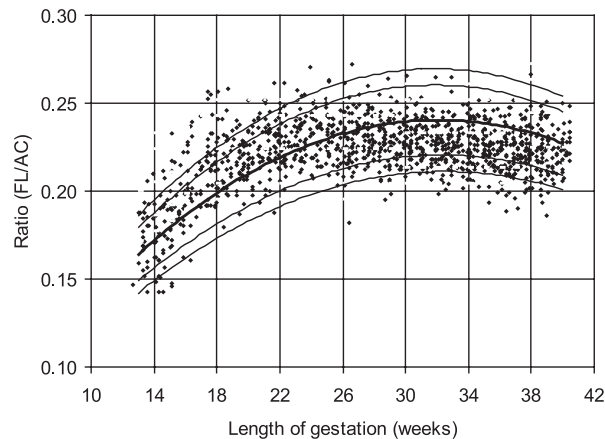
Graph 1: *Raw data of femur length/ abdominal circumference (FL/AC) ratio with fitted 3rd, 10th, 50th, 90th and 97th percentile curves. It covers 95% of the population. The lowest curve gives the 3rd percentile boundary, next curve gives 10th percentile, next one gives 50th, next 90th and the last curve gives 97th percentile boundary.*

Discussion

Ratios are an important method of comparing two parameters, as long as one of the parameters can be determined to be normal. Some ratios remain constant through some period, so they are easier to remember.

The estimated values after fitting a model were deduced. At 13 week gestational age mean FL/AC ratio was 0.20 (±0.03) and at 40 week it was 0.24 (±0.02) with 95 % confidence interval of 0.22 to 0.26. The coefficient of multiple correlation $R^2 = 0.454$, with a *p* value of <.001.

The ratio in this study was more or less constant. At 13 week it was 20 and at 40 week it was 24. That is, from 13 to 40 weeks the ratio was 20-24 or 22 ±2. The 3rd, 10th, 50th, 90th and 97th percentile curves derived by fitting the model were superimposed on the observed raw data. Regression analysis was used and the quadratic model showed a good fit to the data.

This was similar to a western study where, at 21 week gestational age FL/AC was 0.20- 0.24 and at 40 week it was 0.20- 0.24 [10], i.e. it was constant at 22 ±2.

Femur length/abdominal circumference ratio is a time-independent body proportionality ratio. Fetuses with FL/AC values less than 10th centile and newborns with birth weights above 90th percentile were classified as macrosomic, both prenatally and postnatally. [11] It was suggested that these parameters might better be applied in diabetic pregnancies where asymmetric macrosomia is more likely. [12]

Sonographic criteria for large for gestational age (LGA) in Diabetic mothers: performance characteristics of low FL/AC– Sensitivity is 58-79%, specificity 75-80%, Positive predictive value 68-83%, and Negative predictive value 75-76%. [13]

Limitations

One limitation was, this study was conducted in Dhaka city only, as it was carried out by one person. Another limitation was, the study population was predominantly of middleclass, as poor patients usually deliver at home and seldom go to see doctors.

Conclusion and Recommendations

Ultrasonography is an important tool to assess fetal growth, development and body proportionality. This study found that unlike individual fetal body parameters, this fetal ratio is the same as the western studies found. FL/AC was found to be 22 ±2, from 13-40 weeks gestational age.

More such studies should be carried out on different parameters of the fetus to prepare Bangladeshi standards.

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