Short Report

Sonographic foetal measurements in a cohort of population of Karachi, Pakistan

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Abstract

The purpose of this cross-sectional study was to establish reference intervals for sonographic measurements of foetal parameters in women with normal singleton pregnancies in a cohort of population of Karachi, Pakistan. It was conducted at the Ultrasound Clinic, and Ziauddin Memorial Hospital, Nazimabad, Karachi, from January 2003 to July 2004. The measurements of foetal biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) were carried out on commercially available ultrasound machines using a convex probe of 3.5 MHz frequency. Four hundred women were enrolled; 358 women completed the study. Mean ± SD, reference intervals and 5th and 95th centiles for the foetal parameters were computed. Regression equations calculated were BPD = -0.36 + 0.27 x GA, (R2 = 0.97); HC = -0.96 + 0.05 x GA, (R2 = 0.95); AC = -0.345 + 0.33 x GA, (R2 = 0.95) and for FL = -1.50 + 0.24 x GA, (R2 = 0.97). [GA= gestational age in weeks, R2 = coefficient of determination].

In this cross-sectional study, predominantly of Urdu-speaking "mohajirs" (67.9%) the reference intervals of commonly used foetal parameters for assessing gestational age i.e. BPD, HC, AC and FL, were established. A larger, multi-centered study to encompass the different ethnic groups of the population is required.

Introduction

Establishment of gestational age is important for the management of pregnancy, both normal and complicated. For this reason, as well as for the exclusion of congenital anomalies and multiple pregnancies, a routine scan between 18 - 20 weeks of pregnancy is usually carried out.

Many charts and tables for assessing gestational age have been established since Willocks et al. in 1964, published their paper on foetal cephalometry,[1] and several standard charts have been fed into ultrasound machines for ready reference.[2,3] These are from Western, mainly Caucasian, populations. Subsequent studies have shown that foetal anthropometric characteristics vary with ethnicity, social and nutritional status of a population. For example, Lim et al[4] in 2000 showed a significant difference in growth of Indian as compared to non-Indian (Malay and Chinese) foetuses; Ashrafunnisa,[5] Salomon[6] and Jung et al[7] found that the charts of Sabbagha[2] for BPD and those of Jeanty[8] for FL differed from the Bangladeshi, French and Korean populations respectively. Hanorvar et al[9] reported that in Iranian women, the mean difference in the values of FL, from those of Hadlock et al,[3] was 3.4 mm from 14-22 weeks, and 5 mm after 22 weeks. Thus the use of charts derived from a different population may lead to errors in diagnosis of gestational age, and over-diagnosis of intrauterine growth restriction.

A few studies have been reported from Pakistan, and standard charts of parameters are in use.[10] This study was designed to establish reference intervals of commonly used foetal parameters, viz. BPD, HC, AC and FL, in a cohort of local population.

Subjects, Methods and Results

This study was conducted at the Ultrasound Clinic, P.E.C.H.S., Karachi, and at the Ziauddin Memorial Hospital, Nazimabad, Karachi. A total of 400 healthy pregnant women with singleton pregnancy were recruited between January 2003 and July, 2004. There was no pre-selection on the basis of maternal age, parity or ethnicity.

A proforma was completed for each subject. The women recruited were certain of the date of the last menstrual period (LMP); had regular menstrual cycles of 26-33 days[2] for at least 3 cycles before conception; fundal height corresponded to duration throughout pregnancy; labour started spontaneously within one week of the expected date of delivery (EDD), the baby had a birth weight 2500 grams or above, and no congenital abnormality. The mode of delivery was vaginal or abdominal.

Exclusion criteria were a history of drug abuse, cigarette smoking before and during pregnancy; a history of maternal diabetes mellitus, hypertension; multiple gestations, and a major foetal congenital anomaly detected at ultrasound examination. Subjects later developing complications such as hypertension or diabetes mellitus or whose fundal heights did not correspond to dates were also excluded.

The duration of pregnancy was calculated and recorded as the number of completed weeks. Besides the subject's data, mailing address, telephone number, the name of the hospital and referring obstetrician was entered in order to obtain postnatal information regarding the onset of labour, mode of delivery, birth weight and gender of the newborn. The mother tongue of each subject and her husband, the level of education of both, and employment status and income was recorded, and

the height of the subject and that of the husband (when accompanying) was noted. Informed consent was taken.

The ultrasound examination was conducted by a single operator (SZ) using Nemio 17, EcoCee and PowerVision (Toshiba, Japan) at the Ultrasound Clinic, and Aloka SSD (at Ziauddin Memorial Hospital) using a convex probe of 3.5MHz frequency. Many subjects were examined more than once; however, for the purpose of this study, only the readings of the first examination were taken. Two readings of each parameter were recorded, and the mean calculated.

Well recognized landmarks and formulae[2-5] were used for taking measurements and calculating the foetal variables. Outer-to-outer measurements of the BPD and occipito-frontal diameter (OFD) were taken to calculate HC.

Statistical Analysis:

The data were entered and analyzed in a computer, using MsExcel and Statistical Package for Social Sciences (SPSS) version 10.0. The descriptive statistics (mean and standard deviation) were performed for continuous foetal variables; the reference intervals (normal ranges) were specified as the range of values encompassed by a pair of symmetrically placed extreme centiles[11] (5th and 95th) and calculated by using the formula:

$$\text{Centile} = \text{mean} \pm K \times SD$$

Where 'K' was the corresponding z´value of the standard Gaussian (normal) distribution. The value of K was ± 1.645 for the determination of 5th and 95th centiles. The regression equation for each foetal parameter was obtained. The categorical variables i.e. the mother tongue of the subject and her husband were reported as frequencies and percentages. The correlation of foetal parameters with gestational age was computed using scatter plots and correlation coefficient.

Of the 400 subjects recruited, 42 were excluded: refusing an ultrasound examination despite sharing data for the proforma 2, development of complications during pregnancy (gestational diabetes mellitus 9, and pregnancy-induced hypertension 11), history of maternal partial thyroidectomy 1, foetal hydrocephalus 1, induction of labour for postmaturity 12, and lost to follow-up 6.

The mean age of the 358 subjects was 26.3 ± 4.6 years (range 17 - 37 years); the mean height was 158.9 ± 6.2cm. The majority of the subjects were from the educated middle class group 15 (4.2%) had a master's degree or higher; 150 (41.9%) were graduates; 122 (34.1 %) had studied to intermediate level (12 years of education), 60 (16.8%) were matriculates (10 years of schooling), 6 (1.7%) had primary schooling, whereas 5 (1.4%) were illiterate. The vast majority, 328 (91.6%) were housewives (homemakers).

Table 1: Bipainetal Diameter, Head Circumference, Abdominal Circumference and Femur length for each gestational week. Values are expressed as Mean and Standard Deviation (SD).

Pregnancy duration in weeks	Number of subjects (n)	BPD in cm Mean ± SD	HC in cm Mean ± SD	AC in cm Mean ± SD	FL in cm Mean ± SD
14	13	2.98 ± 0.15	10.86±0.66	8.25±0.55	1.52±0.17
15	13	3.30 ±0.20	11.90±1.00	9.70±0.90	1.70±0.20
16	13	3.73±0.29	13.29±1.12	10.88±1.00	2.15±0.26
17	15	3.93±0.16	14.09±0.64	11.42±0.78	2.37±0.31
18	15	4.42±0.27	16.18±0.88	13.12±1.37	2.72±0.22
19	15	4.62±0.23	16.63±0.99	13.97±0.70	3.02±0.39
20	15	5.04±0.21	18.28±0.96	15.20±0.99	3.30±0.21
21	16	5.19±0.24	18.93±1.22	16.03±1.04	3.53±0.24
22	15	5.71±0.24	20.75±0.93	17.76±0.94	3.92±0.26
23	14	5.82±0.25	21.20±0.92	17.94±1.01	4.01±0.31
24	15	6.39±0.28	22.87±1.15	19.94±1.57	4.43±0.26
25	15	6.57±0.32	23.95±1.28	20.07±1.48	4.60±0.34
26	12	6.96±0.15	25.22±1.14	21.53±0.99	5.00±0.21
27	15	7.06±0.17	25.69±0.80	22.06±1.22	5.12±0.19
28	13	7.38±0.18	26.92±1.37	23.40±1.13	5.33±0.22
29	13	7.60±0.19	27.46±1.62	24.04±1.48	5.57±0.22
30	13	7.89±0.24	28.56±1.05	25.16±1.32	5.84±0.29
31	12	8.08±0.28	29.23±1.29	25.65±0.92	5.94±0.16
32	12	8.31±0.29	29.94±1.00	26.48±0.99	6.21±0.18
33	15	8.55±0.20	30.43±0.95	26.80±1.23	6.36±0.24
34	15	8.73±0.28	31.35±1.14	28.36±1.36	6.59±0.23
35	16	9.06±0.34	32.71±1.35	29.57±1.15	6.81±0.19
36	16	9.11±0.27	32.52±1.13	29.74±1.58	6.96± 0.25
37	13	9.08±0.30	31.94±1.61	29.80±1.59	6.88±0.27
38	12	9.10±0.24	32.70±1.40	29.51±1.75	7.19±0.16

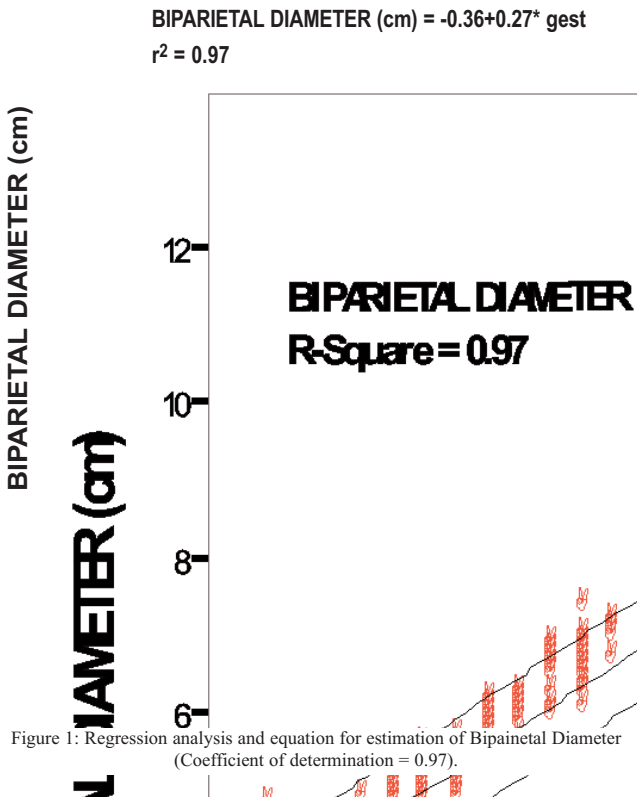

Figure 1: Regression analysis and equation for estimation of Bipainetal Diameter (Coefficient of determination = 0.97).

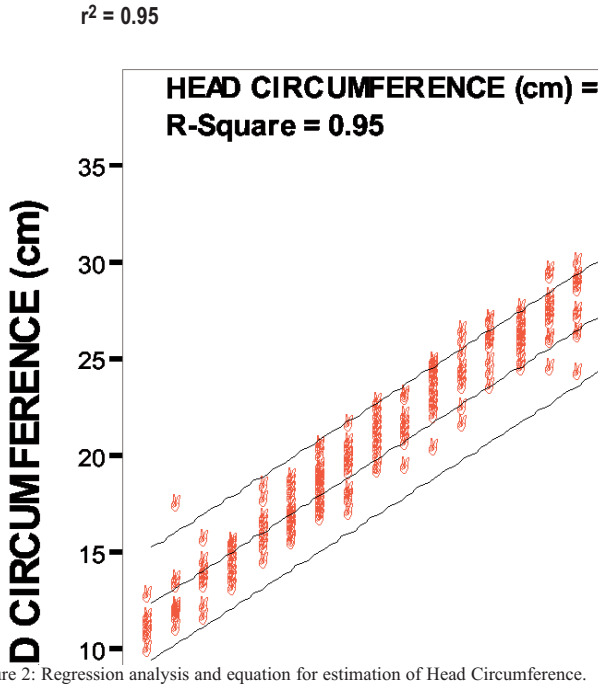

Figure 2: Regression analysis and equation for estimation of Head Circumference. (Coefficient of determination = 0.95).

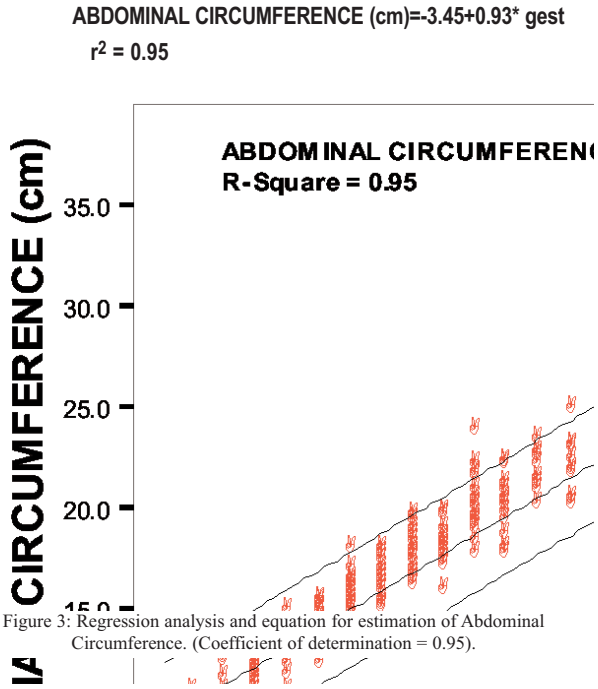

Figure 3: Regression analysis and equation for estimation of Abdominal Circumference. (Coefficient of determination = 0.95).

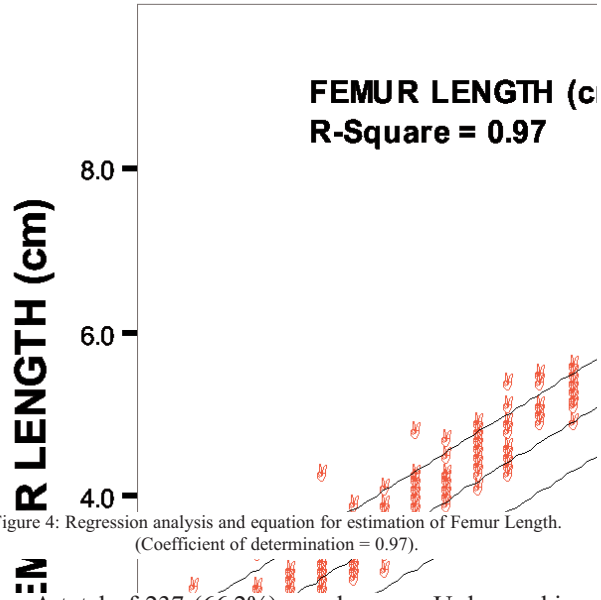

Figure 4: Regression analysis and equation for estimation of Femur Length. (Coefficient of determination = 0.97).

A total of 237 (66.2%) couples were Urdu-speaking; 26 (7.3%) Punjabi-speaking, 13 (3.6%) Sindhi-speaking, 8 (2.2%) Pushto-speaking, and 2 (0.6%) Balochi-speaking; 72 (20.1%) were mixed; these included 6 women who were Urdu-speaking, thus bringing the total of Urdu-speaking subjects to 243 (67.9 %).

Table 1 shows the week-wise distribution of subjects,

and the mean ± SD of value of the foetal variables. Figures 1-4 show the reference intervals of the foetal parameters (expressed as 5th and 95th centiles).

Regression equations for the parameters were calculated, and were as follows:

BPD = -0.36 + 0.27 x GA in weeks: (Coefficient of determination = 0.97)

HC = -0.96 + 0.05 x GA in weeks: (Coefficient of determination = 0.95)

AC = -0.345 + 0.33 x GA in weeks: (Coefficient of determination = 0.95)

FL = - 1.50 + 0.24 x GA in weeks: (Coefficient of determination = 0.97)

Conclusion

In this cross-sectional study, the reference intervals of commonly used foetal parameters for assessing gestational age i.e. BPD, HC, AC and FL, were established. It included a predominance of subjects from a particular ethnic community viz. Urdu-speaking "mohajirs" (mostly second and third generation immigrants from North India) which comprised 67.9% of the cohort. The results, therefore, cannot be applied to the whole of Pakistani population. In addition, the sample size is small. A larger sized, multi-centered study to encompass the different ethnic groups (and mother tongue distribution) of the population is required.

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References

1. Willocks J, Donald I, Duggan TC, Day N. Fetal cephalometery by ultrasound. J Obstet Gynaecol Br Commonw 1964; 71: 11-20.
2. Sabbagha RE, Hughey M. Standardization of sonar cephalometry and gestatonal age. Obstet Gynecol 1978; 52:402-6.
3. Hadlock FP, Deter RL. Estimating fetal age: Effect of head shape on biparietal diameter. AJR Am J Roentgenol 1981; 137:83-5.
4. Lim JM, Hong AG, Raman S, Shyamala N. Relationship between fetal femur diaphysis length and neonatal crown-heel length: the effect of race. Ultrasound Obstet Gynecol 2000; 15:131-7.
5. Ashrafunnisa, Jehan AH, Chowdhury SB, Sultana F, Haque JA, Khatun S, Karim MA. Construction of fetal charts for biparietal diameter, fetal abdominal circumference and femur length in Bangladeshi population. Bangladesh Med Res Counc Bull 2003; 29: 67-77.
6. Salomon LJ, Duyme M, Crequat J, Brodaty G, Talmant C, Fries N, Althuser M. French fetal biometry: reference equations and comparison with other charts. Ultrasound Obstet Gynecol 2006; 28:193-8.
7. Jeanty P, Romero R. Obtaining the head perimeter. In: Obstetrical ultrasound. 1st ed. New York: McGraw- Hill Book Company 1984; pp 87-90.
8. Akram M. Ultrasound assessment of foetal age in Pakistan using BPD and FL (Dissertation). Lahore: College of Physicians and Surgeons, Pakistan (CPSP) 1993.
9. Pal JA. Intrauterine foetal growth profile in Pakistan. Specialist, 1992; 8: 5-12.
10. Royston P, Wright EM. How to construct 'normal ranges' for fetal variables. Ultrasound Obstet Gynecol 1998; 11: 30-8.