Original Research Article

An Ultrasonographic Study of Fetal Development from 36 to 42 Weeks

Gautam A. Shroff [1*], Manisha B. Rajale[2]

[1]Associate. Professor, Department of Anatomy, MGM Medical College, Aurangabad.
[2]Assistant Professor, Department of Anatomy, MVPs Dr. V.P. Medical College, Nashik.

*Correspondence Email: gashroff2006@gmail.com

ABSTRACT

Interest in human intrauterine development is widespread largely because of curiosity about our beginnings and the desire to improve the quality of life. In the present study, ultrasonographic evaluation of fetal growth has been calculated. 213 normal pregnancy are been studied for BPD, HC, FL and AC are calculated. Despite growth rate is slower in late pregnancy in Asian subjects than other White population but gestational maturity is earlier in Indian neonates. Abdominal circumference becomes much slower which effects on lower fetal weight drastically in Asian than White population. Univerient Equations are derived with R value > 0.7 gives accurate results for calculation of Gestational age and age.

Key Words: BPD: Biparital diameter; HC: Head circumference; AC: Abdominal circumference; FL: Femur length.

INTRODUCTION

Interest in human intrauterine development is widespread largely because of curiosity about our beginnings and the desire to improve the quality of life.

Forthcoming progeny of humans has more challenges both intellectual and environmental. Mankind wishes to have a perfect progeny. This has given rise to study of human and its growth and development in utero. It has proven value for a better birth outcome, to treat infertility, to understand birth defects and causes of long standing chronic diseases.

Ultrasonography at a late gestational age plays an important role. There is an inverse association between the size of an infant at birth and maternal and neonatal morbidity and mortality. [1]

In the present study, ultrasonographic evaluation of fetal growth has been calculated. Each centre must select the equations that are most appropriate for its patients' population. [1] Construction of ultrasound biometry charts for fetal aging now take into account the ethnic population under consideration. [2] These parameters are studied by various workers all over the world. It is important to standardize growth charts so as to estimate gestational age and fetal weight by various regression equations.

In this study ultrasonography is done from second trimester till birth. In this study an attempt is made to prepare standardized

chart of various fetal parameters for Marathwada region so as to estimate of gestational age in this region.

Aims and Objectives
1. To study growth pattern of various ultrasonographic parameters with gestational age in patients between 36 to 42 weeks of gestation.
2. To correlate growth of above parameters with advancing gestational age.
3. To derive regression equation for various fetal parameters from gestational age and compare with actual sonographic values of said parameters.
4. To compare results of present study with previous workers.

MATERIALS AND METHODS
The study was carried out at Department of Anatomy, MGM Medical College, Aurangabad. Data was collected from private hospital Magan clinic and Nursing Home, Machali Khadak, Aurangabad. 213 normal pregnant females in IIIrd trimesters were examined by ultrasonography for estimation of gestational age of the fetus and fetal growth parameters and fetal weight. Neonatal weight is measured. Patient's consent and Approval from Ethical committee was obtained.

Selection Criteria
Ultrasonographic fetal parameters were calculated when patient was admitted to hospital in pre labour. Gestational age is between 36 to 42 weeks of gestational age.

Gestational age was established by reference to the last menstrual period in patients with history of regular menses and also confirmed with first trimester scan of crown to rump length.

Inclusion criteria:
1. Females with 36 wks to full term gestation
2. Hemoglobin concentration - more than 10
3. Normotensive
4. Non- diabetics

Exclusion criteria:
A. **Maternal:**
1. Pregnancy induced hypertension,
2. Gestational diabetes,
3. Severe anemia in early pregnancy.
4. Chronic medical disorders which may hamper fetal growth will be excluded.

B. Fetal:
1. Fetuses with congenital anomalies.
2. intra-uterine growth restriction.
3. multiple gestation are also be excluded.

Following fetal ultrasonographic parameters were selected such as
- BPD:- Biparietal Diameter measured in millimeters.
- HC:- Head Circumference measured in millimeters.
- AC:- Abdominal Circumference measured in millimeters.
- FL:- Femur Length measured in millimeters.

All examinations were performed by using a commercially reliable linear array real-time ultrasound system with a 3.5-MHz focused transducer.

Ultrasonographic Measurement of Fetal Parameters
Biparietal Diameter:-
Fetal Biparietal diameter is first measurement carried out. It is good indicator and its growth is collinear with gestational age. It is measured through plane transverses through third ventricle, paired thalami and septum pellucidum and tentorial hiatus shows as a arrow head as shown in fig. no. 1. This is the plane where cranial thickness is equal on both side with better symmetry.

Figure- 1. Biparietal Diameter.

Figure- 2 Head Circumference
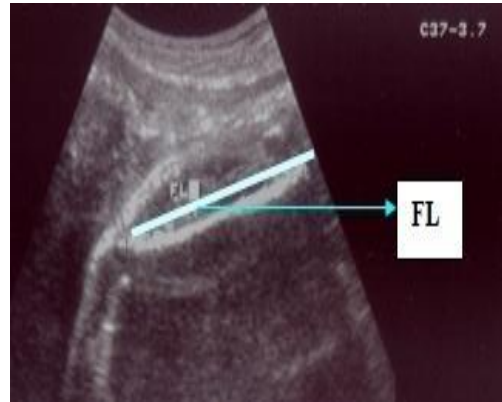

Figure- 3 Abdominal Circumference.

Figure- 4. Femur Length.

Head circumference:

Head circumference is also measured through plane transverses through third ventricle, paired thalami and septum pellucidum and tentorial hiatus shows as a arrow head. The entire cranial perimeter is taken excluding soft tissue by ellipse tool as shown in Fig no. 2.

Abdominal Circumference:

The fetal abdominal circumference is taken as the length of the outer perimeter of the fetal abdomen, measured on transverse scan at the level of the stomach, intrahepatic portion of umbilical vein and appearance of lower fetal ribs symmetrically as shown in fig no 3.

Femur length:

Femur length measurement is taken from greater trochenter till condyle excluding epiphysical cartilage as shown in fig no 4.

Statistical Analysis

With all this data,statistical analysis was done by using SPSS.[3] Data and regression equations were compared with other investigators. Difference between values of a parameter at particular gestation were found and reliability of regression equations for given population was studied.

OBSERVATION

All Four parameters were measured and recorded by using the methods described earlier. These observations were tabulated and discussed systematically.

Biparietal Diameter

In table 1 BPD shows faster growth in early gestational age till 39 weeks. Rate of growth slows down in later gestation seen in Graph 1. Range overlaps standard deviation. Average SD is 3.00 mm. Coefficient of correlation is calculated to define relationship between two variables.

Table 1: Statistical analysis of Biparietal Diameter and with Gestational age.

GEST. AGE	MEAN BPD (MM)	S.D.	MIN	MAX
36	86.7	3.3	81.50	91.20
37	87.55	3.73	82.20	97.00
38	89.70	2.37	84.40	95.20
39	90.64	3.03	81.50	97.70
40	91.04	3.57	82.60	98.10
41	91.15	2.97	82.60	97.40
42	91.37	1.92	88.60	94.10

Table 2: Statistical analysis of Head circumference and graph showing with Gestational age.

GEST. AGE	MEAN HC (MM)	S.D.	MIN	MAX
36	315.22	8.01	302.00	325.00
37	316.00	12.27	292.00	335.00
38	319.08	12.09	300.00	338.00
39	322.85	11.52	299.00	345.00
40	324.10	13.09	297.00	353.00
41	325.37	10.12	308.00	345.00
42	326.77	5.26	320.00	336.00

Head circumference

In table 2 HC shows faster growth in early gestational age till 39 weeks. Rate of growth slows down in later gestation seen in Graph 2. Range overlaps standard deviation. Average SD is 10.34 mm. Coefficient of correlation is calculated to define relationship between two variables.

Abdominal Circumference

In Table 3 AC shows faster growth in early gestational age till 39 weeks. Rate of growth slows down in later gestation seen in Graph 3. Range overlaps standard deviation. Average SD is 13.33 mm.

Coefficient of correlation is calculated to define relationship between two variables.

Femur Length

In Table 4 FL shows faster growth in early gestational age till 39 weeks. Rate of growth slows down in later gestation seen in Graph 4. Range overlaps standard deviation. Average SD is 3.00 mm. Coefficient of correlation is calculated to define relationship between two variables.

Linear regression equation has been calculated for individual parameter by given gestational age in table 5.
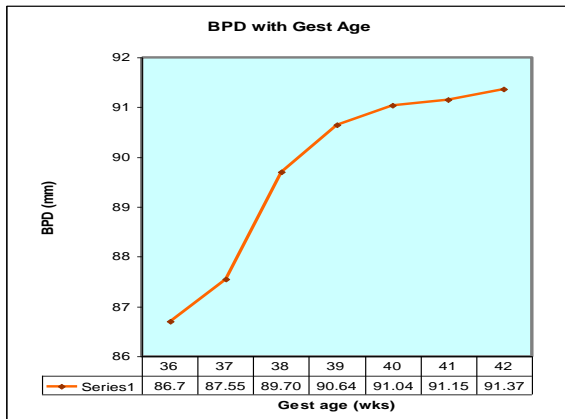
Graph 1:- Biparietal Diameter plotted against Gestational age.

Graph 2:- Head Circumference plotted against Gestational age.

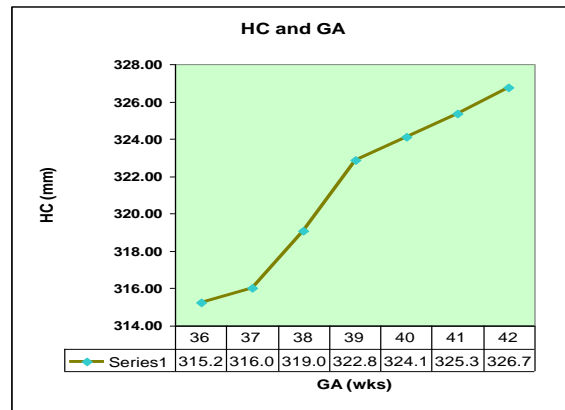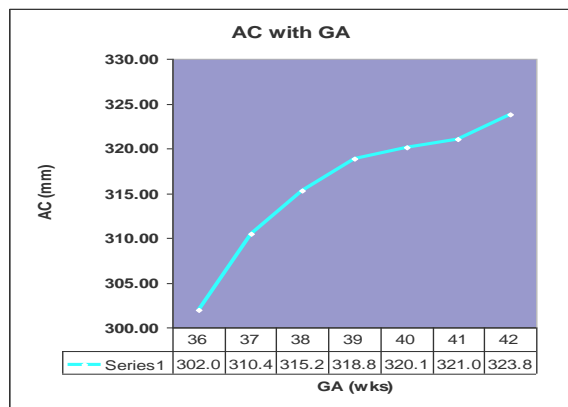**Table 2: Statistical analysis of Head circumference and graph showing with Gestational age.**
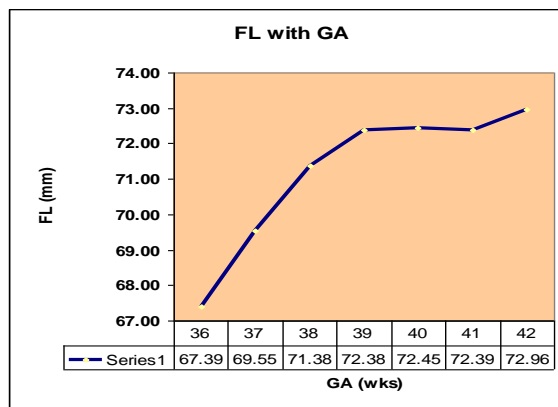
GEST. AGE	MEAN HC (MM)	S.D.	MIN	MAX
36	315.22	8.01	302.00	325.00
37	316.00	12.27	292.00	335.00
38	319.08	12.09	300.00	338.00
39	322.85	11.52	299.00	345.00
40	324.10	13.09	297.00	353.00
41	325.37	10.12	308.00	345.00
42	326.77	5.26	320.00	336.00

Table 3: Statistical analysis of abdominal circumference and graph showing with Gest. age.

GEST. AGE	MEAN AC (MM)	S.D.	MIN	MAX
36	302.00	13.05	289.00	324.00
37	310.42	21.90	260.00	360.00
38	315.29	8.01	290.00	326.00
39	318.83	14.57	276.00	346.00
40	320.10	11.32	300.00	340.00
41	321.00	11.38	292.00	340.00
42	323.85	13.09	302.00	346.00

Graph 3:- Abdominal Circumference plotted against Gestational age.

Graph4:- Femur length plotted against Gestational age.

Table 4:- Statistical analysis of Femur Length and graph showing with Gestational age.

GEST. AGE	MEAN FL (MM)	S.D.	MIN	MAX
36	67.39	3.51	62.40	71.80
37	69.55	3.57	64.50	77.90
38	71.38	2.85	66.70	77.20
39	72.38	2.72	63.80	78.80
40	72.45	2.86	66.70	77.90
41	72.39	3.14	65.60	78.60
42	72.96	2.41	71.00	79.70

Table 5: Linear regression equations.

Parameter	Regression equation
BPD	$BPD_{Et} = 70.771 + 0.476\ (GA)$
HC	$HC_{Et} = 306.96 + 0.3\ (GA)$
AC	$AC_{Et} = 276.63 + 0.92\ (GA)$
FL	$FL_{Et} = 57.66 + 0.351\ (GA)$

DISCUSSION

Measurement of fetal parameters by ultrasonography has an important role to play in the prognosis of the child after birth. With it one can get an idea about rate and pattern of growth whether normal or abnormal. Changes in body proportions such as proportion of head circumference with abdominal circumference.

All the samples were of known gestational age confirmed by first trimester CRL (Crown to rump length). Some parameters were used to derive ratios. All the results were compared with study results of other investigators. It is observed that fetal parameters differ in different ethnic groups.

While comparing BPD with other investigators it has been found that BPD is smaller in present study than Hadlock and Doubilet as their study was in white subjects.[4,5] It is comparable with Kumar and larger than Rajan.[6,7] As there is more difference between Hadlock and present study that indicates smaller fetus in Indian people as shown in Table no. 6.

In the above table Hadlock shows higher HC especially in late gestation. Difference increases as gestational age

advances.[4] Again it indicates a larger fetus at birth in white population than in present study as shown in Table no. 7.

Hadlock shows marked increase in abdominal circumference than present study in later part of late pregnancy. Rajan shows slightly higher abdominal circumference. Lei shows initially same AC as in present study, but increases in later part on a lesser side Rajan. Kumar show AC less than present study.[4,6-8] As AC is a good indicator of fetal weight, weight of fetus in present study is lesser than Hadlock and western studies, including Lei's Oriental population as shown in Table no. 8.

Jeanty shows very high values for femur length than other studies.[9,10] Hadlock, Doubilet and Lei are on a higher side than present study values,[4,5,8] But Rajan, Kumar, Bhusari and Sabhirwal show almost equal values with present study.[6,7,11,12] Rate of growth is reduces at late gestational age as compared with Jeanty, Hadlock and Doubilet.[4,5,9,10] This also suggests short but normal babies in present study as shown in Table no. 9.

Table 6:- Comparison of BPD with other investigators.

Gest Age (wks)	BPD (present Study)	Derived Eq[9]	HADLOCK [4]	RAJAN [7]	Kumar [6]	Doubilet [5]	Lei [8]
36	86.7	87.90	88.31	85	86	87	88
37	87.55	88.41	90.10	86	87	88	90
38	89.70	88.86	91.52	87	89	90	91
39	90.64	89.35	92.95	88	90	92	93
40	91.04	89.80	94.13	89	91.2	93	93
41	91.15	90.26	95.20	90	91.3	95	
42	91.37	90.82	96.30	91	91.4	97	

BPD:- Biparietal diameter; BPD$_{Et}$ Estimated BPD. All values are in mm.

Table 7 :- Comparison of head circumference with other workers.

Gest. Age (wks)	HC (present study)	Derived Eq	RAJAN	HADLOCK	Kumar	Bhusari [11]
36	315.2222	317.755	309	327.8255	288.00	316.70
37	316	318.0782	313	333.6459		318.30
38	319.0833	318.3583	315	338.1595	292.00	321.10
39	322.8542	318.6678	321	342.5585		323.70
40	324.1042	318.9536	322	346.0556	305.00	327.60
41	325.3667	319.2441	324	349.0426		
42	326.7692	319.593	325	351.8526		

HC:- Head circumference HC$_{Et}$:- Derived value of Head circumference in mm.

Table 8:- Comparison of abdominal circumference with other workers.

Gest. Age (wks)	AC (Present study)	Derived Eq	RAJAN	HADLOCK	Kumar	Bhusari	Lei
36	302.00	309.73	301.00	317.11	301.00	308.10	301
37	310.42	310.73	313.00	326.60		305.40	309
38	315.29	311.58	325.00	334.64	308.00	314.30	316
39	318.83	312.53	327.00	343.32		314.20	325
40	320.10	313.41	328.00	351.15	315.00	311.80	325
41	321.10	314.30	329.00	358.92			
42	323.85	315.37	330.00	368.00			

AC:- Abdominal circumference. AC$_{Et}$:- Derived value. All values are in mm.

Table 9:- Comparison of Femur length with other workers.

Gest Age	FL (Present Study)	Derived Eq	RAJAN	HADLOCK	Kumar	Sabhirwal [12]	Doubilet	Jeanty	Bhusari	Lei
36	67.39	70.29	67.00	70.00	67.00	67.70	68.00	79.00	69.70	69.00
37	69.55	70.67	69.00	72.00		69.10	70.00	81.00	69.90	72.00
38	71.17	71.00	70.00	74.00	70.00	70.40	72.00	83.00	71.80	73.00
39	72.38	71.36	71.00	75.00		71.50	73.00	85.00	73.00	74.00
40	72.45	71.69	71.50	77.00	72.00	72.30	75.00	87.00	73.50	75.00
41	72.39	72.03	72.00	78.00			76.00			
42	72.96	72.44	72.20	78.50			78.00			

FL:- Femur Length. FL$_{Et}$:- Derived value. FL in (mm).

SUMMARY AND CONCLUSION

Gestational age and fetal weight estimation are important parameters to decide fetal prognosis after birth. Ultrasonography is an easy, accurate, safe, non teratogenic, cheap and non invasive method of measuring fetal parameters.

In this study 213 patients with gestation period varying from 36 to 42 weeks, admitted at Magan Clinic, Aurangabad for delivery were examined Ultrasonographically. Gestational age was calculated either by LMP or confirmed with ultrasonography in the first trimester by measuring CRL. Four fetal parameters were measured Ultrasonographically before delivery.

Growth Pattern: While studying growth pattern it has been observed that all the parameters show positive linear growth with gestational age and weight at a given time. Only difference found is that rate of growth slows as gestational age advances.

Comparative study: It is observed that individual parameter values in present study are smaller compared to similar studies carried out in white population. Where as they are comparable to other studies conducted in Asian population.

It has been observed that fetal size in Indian population is smaller in present study. That indicates ethnic, environmental and nutritional status of present population of study. Findings are similar with Rajan for Indian and Lei for Chinese population.

In present study duration of gestation shows early maturity of fetus. Babies delivered at 36 weeks did not require neonatal care despite having lower birth weight. Gestational maturity of fetus is practically one week earlier than other white ethnic group but is comparable to Lei who carried out his study in Chinese population.[8]

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