

Content available at: <https://www.ipinnovative.com/open-access-journals>

Indian Journal of Clinical Anatomy and Physiology

Journal homepage: <https://www.ijcap.org/>

## Original Research Article

## Evaluation of biparietal diameter and femur length by ultrasonography method, its correlation with fetal gestational age a comparative study in Chhattisgarh state of India

M L Ganware<sup>1</sup>, Sidiqui Abdul Rafique<sup>2</sup>, Goyal Meena<sup>3</sup>, Netam S B S<sup>4</sup>, Rahule A S<sup>1,\*</sup>, Khute Prakash<sup>5</sup>

<sup>1</sup>Dept. of Anatomy, BRLSABVM Government Medical College, Rajnandgaon, Chhattisgarh, India

<sup>2</sup>Dept. of Surgery, BRLSABVM Government Medical College, Rajnandgaon, Chhattisgarh, India

<sup>3</sup>Dept. of Anatomy, Pandit JNM Government Medical College, Raipur, Chhattisgarh, India

<sup>4</sup>Dept. of Radio Diagnosis, Pandit JNM Medical College, Raipur, Chhattisgarh, India

<sup>5</sup>Dept. of Medicine, BRLSABVM Government Medical College, Rajnandgaon, Chhattisgarh, India



## ARTICLE INFO

## Article history:

Received 22-10-2021

Accepted 25-11-2021

Available online 07-12-2021

## Keywords:

Gestational age

Biparietal diameter

Femur length

## ABSTRACT

**Background:** There few studies which tried to correlate biparietal diameter and gestational age in which an increase in biparietal diameter with the increase in gestational age was found but there was a discrepancy between 17<sup>th</sup> week of pregnancy and term and which is approximately 3 weeks. We conducted the present study to compare the gestational age and femur length and biparietal diameter in the population of Chhattisgarh state of India.

**Materials and Methods:** A total of 380 pregnant females were enrolled for the study. They were between the 20 weeks to 38 weeks of gestation with their age ranging from 18-35 years.

**Results:** In the present study we observed a total of 158 cases in 2<sup>nd</sup> trimester i.e. ranging from 20 to 27 weeks and 220 cases were in 3<sup>rd</sup> trimester of pregnancy. Mean of BPD and FL observed was 73.1 and 56.2 respectively. The standard deviation and standard error of mean for biparietal diameter and femur length were 12.8, 11.6 and 0.63, 0.57 respectively.

**Conclusion:** All parameters of present study are found to be highly correlated with gestational age. ( $r=$ , 0.987, 0.980 for, FL and BPD respectively).

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: [reprint@ipinnovative.com](mailto:reprint@ipinnovative.com)

## 1. Introduction

Gestation is the period between conception and birth of a baby, during which the fetus grows and develops inside the mother's uterus. Gestational age is the time measured from the first day of the woman's last menstrual cycle to the current date and is measured in weeks. A pregnancy of normal gestation is approximately 40 weeks, with a normal range of 38 to 42 weeks. For estimation of gestational age and to evaluate the fetal development, study of fetal

biometry is most commonly used. Gestational sac diameter and volume and crown rump length measurements are used to determine the gestational age. Biparietal diameter, Head circumference, Abdominal circumference and Femur length, Fetal biometry and the Fetal kidney length are most commonly used in second and third trimester of pregnancy.<sup>1</sup>

Depending upon the biparietal diameter and last menstrual period, gestational age is determined which is evaluated in many studies and biparietal diameter found to be superior in estimation of gestational age.<sup>2</sup> There few studies which tried to correlate biparietal diameter and

\* Corresponding author.

E-mail address: [rahuleanil@yahoo.co.in](mailto:rahuleanil@yahoo.co.in) (Rahule A S).

gestational age in which an increase in biparietal diameter with the increase in gestational age was found but there was a discrepancy between 17<sup>th</sup> week of pregnancy and term and which is approximately 3 weeks.<sup>3</sup> It is well established that in the 1<sup>st</sup> half of pregnancy, the accurate estimators of gestational age is ultrasound measurement of femur length and biparietal diameter but the ultrasound measurement of both the parameters become less accurate in the alter half of the pregnancy.<sup>4</sup>

In this background we conducted the present study at Pandit Jawaharlal Nehru Medical College and Dr. B.R. Ambedkar Hospital, Raipur Chhattisgarh to evaluate and compare the gestational age and femur length and biparietal diameter in the population of Chhattisgarh state of India.

## 2. Materials and methods

A total of 380 pregnant females were enrolled for the study. They were between the 20 weeks to 38 weeks of gestation with their age ranging from 18-35 years. Uncomplicated pregnant women having single live, normal fetus and only singleton fetus with complete visualization of at least one kidney were included in the study. The patients who were sure of the dates of their last menstrual period with regular menstrual cycle were also included in the study.

Irregular menstrual cycles, Oligohydramnios, Polyhydramnios, before 18 weeks of gestation age, unknown or inaccurate date of last menstrual period, Diabetic mother, Eclampsia, Preeclampsia, Twin pregnancy, Fetal chromosomal abnormalities, Fetal anomalies, Intrauterine growth restriction and Anemia were excluded from the study. Informed consent was obtained for the study from the enrolled patients.

The examination was carried out with the help of Seimensononline G50 ultrasonographic machine with curvilinear probe 3.5Mhz. To measure the biparietal diameter a longitudinal section of the fetus was obtained by placing the transducer on the maternal abdomen to obtain a midline longitudinal section of the uterus. The transducer was slide to each side of the maternal abdomen until the fetal head was visualized. Also the longitudinal section of the fetal spine was visualized. The transducer was rotated in such a way that the fetal head and body were visualized on the screen together. After knowing the longitudinal axis of the fetus to the maternal abdomen, fetal lie was established. By rotating the transducer through 90 degrees a transverse section of the fetal head was obtained. After assessing the ovoid shape of the fetal skull BPD was measured on a frozen image. Horizontal component of the first caliper was placed on the outer aspect of the proximal surface and the second caliper was placed on the inner aspect of the distal skull surface at right angles to the midline and at the widest diameter (Figure 1).

The transverse section of the fetal abdomen was found and the transducer was slide caudally until the iliac bones



Fig. 1: Measurement of biparietal diameter

were visualized. At this point, a cross section of the femur was usually seen. By keeping this bright echo from the femur in view, the transducer was rotated until the full length of the femur was obtained. The soft tissue was visible beyond both the ends of the thigh at any point. The measurement of the femur was made from the centre of the U shape at each end of the bone. This represents the length of the metaphysis. At least 3 readings were taken and the average was taken as femur length. (Figure 2)



Fig. 2: Measurement of femur length

## 3. Results

In the present study we observed a total of 158 cases in 2<sup>nd</sup> trimester i.e. ranging from 20 to 27 weeks and 220 cases were in 3<sup>rd</sup> trimester of pregnancy. Mean of BPD and FL observed was 73.1 and 56.2 respectively. The standard deviation and standard error of mean for biparietal diameter and femur length were 12.8, 11.6 and 0.63, 0.57 respectively (Table 1).

There was a strong positive correlation between gestational age and BPD (0.980). Correlation was statistically highly significant ( $P = 0.000$ ). Correlation was maximum between 20 to 24 weeks of gestation ( $r=0.987$ ) and minimum between 35 to 38 weeks of gestation ( $r=0.947$ ). Correlation was consequently decreased according to gestational age from 20 to 38 weeks of gestation.(Table 2).

Femur length was highly positively correlated with gestational age especially later weeks of pregnancy ( $r = 0.987$ ). Correlation between femur length and gestational age was statistically highly significant ( $P = 0.000$ ). Correlation consequently increased according to gestational age from 20 to 38 weeks. Correlation was maximum between 35 to 38 weeks i.e. 0.977 and minimum between 20 to 25 weeks of pregnancy i.e. 0.921 (Table 3). Correlation of gestational age was higher for FL (0.987) than BPD (0.980). Correlation coefficient of determination was lowest for BPD i.e. 0.961. All the fetal biometric indices had a p value  $<0.05$  in our study and were statistically highly significant.

**Table 1:** Mean of various parameters

Gestational age in weeks	BPD(mm)	FL(mm)
20	46.70	32.70
21	51	38.20
22	57	45.40
23	62.40	45.50
24	64	46.60
25	68	48.90
26	69.5	51.60
27	71.5	54.30
28	72.2	54.90
29	72.8	55.50
30	76.3	58.80
31	78.9	59.80
32	80.5	62.30
33	81.4	63.70
34	82.1	63.90
35	85.7	68.30
36	89.3	71.50
37	89.8	72.50
38	91.5	74.40
Mean	73.1	56.2
SD	12.8	11.6
SE	0.63	0.57

#### 4. Discussion

Historically, BPD was the first parameter used to assess the gestational age of the fetus. Its accuracy was found to be maximal between 12 to 20 weeks in various studies. Correlation between BPD and gestational age at 20-24 weeks was  $r= 0.987$  and reduced to  $r=0.947$  at 35-38 weeks of pregnancy.

**Table 2:** Correlation between biparietal diameter with gestational age

Gestational age in weeks	BPD(mm)	r	p	r <sup>2</sup>
20	40.70			
21	51.00			
22	57.00	0.987	0.002	0.974
23	62.40			
24	64.00			
25	68.00			
26	69.50			
27	71.50	0.973	0.005	0.947
28	72.20			
29	72.80			
30	76.30			
31	78.90			
32	80.50	0.964	0.008	0.929
33	81.40			
34	82.10			
35	85.70			
36	89.30	0.947	0.053	0.898
37	89.80			
38	91.50			
Total	73.1	0.980	0.000	0.961

**Table 3:** Correlation between femur length with gestational age

Gestational age in weeks	Mean FL (mm)	r	p	r <sup>2</sup>
20	32.70			
21	38.20			
22	45.40	0.921	0.847	0.027
23	45.50			
24	46.60			
25	48.90			
26	51.60			
27	54.30	0.948	0.898	0.014
28	54.90			
29	55.50			
30	58.80			
31	59.80			
32	62.30	0.968	0.937	0.007
33	63.70			
34	63.90			
35	68.30			
36	71.50	0.977	0.954	0.023
37	72.50			
38	74.40			
Total	56.25	0.987	0.975	0.000

To assess the accuracy of method for determination of gestational age, we examined total of 380 pregnant females between 18-35 years of age. The parity included in the study was from 1<sup>st</sup> – 3<sup>rd</sup> number of pregnancy. Hence in our study the kidney length estimation has been done after 19 weeks as it is more technically feasible. Multiple gestations were excluded from the present study, as growth is not uniform for both the fetus. Maternal diseases like gestational hypertension, diabetes, IUGR diagnosed in the course of the study were also not included. In the past, studies were done to rule out anomalies of the urinary tract by measuring the kidney length. Further it was also found useful for gestational age assessment in normal cases. In the present study the maximum number of cases out of total 380 normal pregnant female, were found in the maternal age group between 24 -26 years i.e. 116 cases, and minimum cases were in the age group of 33 – 35 years i.e. 17 cases. In our study 197 cases belongs to primipara i.e. maximum number of cases out of 380 cases, and minimum number of cases i.e. 32 cases were found in 3<sup>rd</sup> parity. This study showed the maximum number of cases in primipara because of fact that, the awareness for the sonographic examination is more in primipara to confirm the intrauterine pregnancy, secondly to avoid birth complications and to detect fetal malformations.

In the present study, we found that the coefficient of correlation (r) of BPD, varying between (r = 0.987 to 0.947) and FL, varying between (r = 0.921 to 0.977) showed a high degree of linear relationship with gestational age. The correlation coefficient observed in our study was higher as compared to Cohen et al. (1991),<sup>5</sup> (r=0.82), Schlesinger et al(1987)<sup>6</sup> (r=0.859), Gloor et al (1997)<sup>7</sup> (r=0.90. Correlation coefficients between GA and other biometric indices were also higher as compared to previous studies. (for FL r=0.987, for BPD r=0.980 found in our study).

In present study, it was observed that calculation by regression model relationship between Femur length (r<sup>2</sup>= 0.975) and Biparietal diameter (r<sup>2</sup>= 0.961). The coefficient of determination observed in our study was higher as compared to J.J. Kansaria et al. (r<sup>2</sup>=, 94.84, 90.91 for, FL and BPD respectively).

A number of reasons could explain these differences. These include number of sonologists, type of study (longitudinal vs. cross-sectional), quality of ultrasonography machine, characteristics of subjects and observer bias (non-blind vs. blind study).

In a study on 58 pregnant women, Konje et al. showed that there was a significant correlation between gestational age and kidney length. They concluded that fetal kidney length could be used reliably for estimation of gestational age. Results of the present study were in good agreement with that study.

Sagi et al.<sup>8</sup> assessed fetal kidney anatomy in 660 apparently normal fetuses. A correlation of fetal kidney

length and gestational age was presented. They found a linear progression of fetal kidney length which produce a growth curve similar to that seen with BPD.<sup>8</sup>

These finding were consistent with our study, that there was a strong correlation between fetal kidney length and Gestational age, which can use as an eligible parameter in dating labor. There was a very strong positive correlation between gestational age and fetal kidney length (r= 0.947, p= 0.001) in the study of Mete G et al.<sup>9</sup>

## 5. Conclusion

It can be concluded from the study that observed Standard Error of, FL, BPD is, 0.57, 0.63 respectively. All parameters of present study are found to be highly correlated with gestational age. (r=, 0.987, 0.980 for, FL and BPD respectively). Correlation between Biparietal Diameter (BPD) and Gestational age is consequently decreases according to gestation age from 20 weeks to 38 weeks. Correlation is maximum between 20 to 24 i.e. 0.979. All the fetal biometric indices have a P value < 0.05 and these are statistically significant. In early weeks of gestation based on the mean and standard deviation, it can be inferred that all parameters are reliable for gestational age assessment. At term however, FL closely accurate for dating pregnancy.

## 6. Source of Funding

None.

## 7. Conflict of Interest

The authors declare no conflict of interest.

## References

1. Kumar K, Lalwani R, Babu R, Aneja S. Ultrasonographic estimation of fetal gestational age by fetal kidney length. *J Anatomical Soc India*. 2013;62:33–6.
2. Larsen T, Nguyen TH, Greisen G, Engholm G, Møller H. Does a discrepancy between gestational age determined by biparietal diameter and last menstrual period sometimes signify early intrauterine growth retardation? *BJOG*. 2000;107(2):238–44.
3. Kurtz AB, Wapner RJ, Kurtz RJ, Dershaw DD, Rubin CS, Cole-Beuglet C, et al. Analysis of biparietal diameter as an accurate indicator of gestational age. *J Clin Ultrasound*. 1980;8(4):319–26.
4. Egley CC, Seeds JW, Cefalo RC. Femur length versus biparietal diameter for estimating gestational age in the third trimester. *Am J Perinatol*. 1986;3(2):77–9.
5. Cohen HL, Cooper J, Eisenberg P, Mandel FS, Gross BR, Goldman MA, et al. Normal length of fetal kidneys: Sonographic study in 397 Obstetrics patients. *Am J Roentol*. 1991;157(3):545–8.
6. Schlesinger A, Hedlund G, Pierson WP, Null DM. Normal standards for kidney length in premature infants. Determination with US. *Radiology*. 1987;164:127–9.
7. Gloor JM, Breekle RJ, Gehrking WC, Rosenquist RG, Mulholland TA, Bergstrakh EJ, et al. Fetal renal growth evaluated by prenatal ultrasound examination. *Mayo Clin Proc*. 1997;72(2):124–9. doi:10.4065/72.2.124.
8. Sagi J, Vagman I, David MP, Dongen LGV, Gondie E, Butterworth A, et al. Fetal kidney size related to gestational age. *Gynecol Obstet Invest*. 1987;23(1):1–4.

9. Mete G, Ugur, Md A, Mustafa, Md HC, Ozcan, et al. MD Fetal kidney length as a useful adjunct parameter for better determination of gestational age. *Saudi Med J*. 2016;37(5):533–537.

**Netam S B S**, Professor and HOD

**Rahule A S**, Professor and Head

**Khute Prakash**, Assistant Professor

### Author biography

**M L Ganware**, Assistant Professor

**Sidiqui Abdul Rafique**, Assistant Professor

**Goyal Meena**, Retired Professor

**Cite this article:** Ganware ML, Rafique SA, Goyal Meena, Netam S B S, Rahule A S, Prakash K. Evaluation of biparietal diameter and femur length by ultrasonography method, its correlation with fetal gestational age a comparative study in Chhattisgarh state of India. *Indian J Clin Anat Physiol* 2021;8(4):305-309.