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A PROSPECTIVE STUDY ON BIPARIETAL DIAMETER AND FEMUR LENGTH UTILISING ULTRASONOGRAPHIC TECHNIQUES, ALONG WITH ITS CORRELATION TO FOETAL GESTATIONAL AGE.

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Abstract

Background

The prenatal evaluation is crucial during pregnancy for evaluating the growth and development of the fetus. Ultrasonography is an accessible screening method for monitoring prenatal growth using fetal parameters and gestational age (GA). Femur length (FL) and biparietal diameter (BPD) are frequently utilized in the second trimester to evaluate fetal growth and ascertain precise gestational age. Studies indicated discrepancies in the reliability of FL and BPD for determining gestational age and fetal growth by ultrasonography. The purpose of the current study was to compare biparietal diameter and femur length with gestational age.

Materials and Methods

The study included 190 pregnant women in total. The participants ranged in age from 18 to 35 years, and their gestational ages ranged from 20 to 38 weeks.

Results

This investigation examined 79 cases in the second trimester, specifically between 20 and 27 weeks, and 110 instances in the 3rd trimester of pregnancy. The observed means of FL and BPD were 56.19 and 73.09, respectively. The standard error (SE) and the standard deviation (SD) of the mean for BPD and FL were 0.629, 0.569, and 12.79 and 11.59, respectively.

Conclusion

The study demonstrates a significant link between FL and BPD, with FL exhibiting good accuracy in assessing gestational age, while the correlation diminishes from 20 to 38 weeks.

Recommendation

Analyzing the growth patterns of FL and BPD by sonography will lead to better results.

Keywords: *Gestational Age, Biparietal Diameter, Femur, Ultrasonography.*
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Introduction

Ultrasonography is a fundamental and standard examination conducted in early pregnancy to assess fetal growth, gestational age, and related abnormalities [1]. In clinical practice, metrics such as the mean diameter of the gestational sac and crown-rump length are routinely utilized during the first trimester at various weeks to ascertain the GA of the fetus [2]. In the following trimesters, the ongoing development of the fetal head and femur length (FL) at a consistent pace during gestation rendered ultrasonographic evaluation of FL and biparietal diameter (BPD) particularly effective for estimating gestational age and fetal growth [3,4,5]. Nonetheless, fetal age assessed in the latter weeks of gestation undermines the accuracy of fetal age estimation due to varying BPD values and cranial shape deformation resulting from fetal positioning [6.7].

Consequently, early second-trimester ultrasound is essential for determining gestational age and assessing fetal growth rate. Nonetheless, BPD measurement continued to provide a challenge due to several anomalies such as microcephaly, anencephaly, abnormal cranial shape, and a profoundly engaged fetal head. Consequently, the observable femur during ultrasonographic imaging in the early weeks of the second trimester has rendered the calculation of fetal femur length significant for evaluating gestational age and fetal development. This would ultimately assist in interpreting disorders such as congenital limb malformations and dwarfism in fetuses [8, 9, 10]. Documented investigations indicate that FL and BPD were utilized to evaluate gestational age and fetal growth [11, 12].

The purpose of the current study was to compare biparietal diameter and femur length with gestational age.

Materials and Methods

Study Design

A prospective study was carried out for one year.

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Study Setting
This study was conducted at SRM MCH, Bhawanipatna, Kalahandi

Participants
A total of 190 persons participated in the investigation.

Inclusion Criteria
The participants were in the gestational period of 20 to 38 weeks, with ages spanning from 18 to 35 years. The study included pregnant women who were carrying a single living, normal fetus and exhibiting complete visibility of at least one kidney. The study included patients who had verified the dates of their preceding menstrual periods and exhibited regular menstrual cycles.

Exclusion Criteria
The following conditions were excluded from the study: anemia, fetal chromosomal abnormalities, polyhydramnios, fetal anomalies, before 18 weeks of pregnancy, oligohydramnios, an erroneous or unclear last menstruation date, a mother with diabetes, preeclampsia, twin pregnancy, eclampsia, and irregular menstrual cycles.

Procedure
The examination was conducted using Siemens Sonoline G50 ultrasonographic equipment equipped with a 3.5 MHz curvilinear probe. To get a midline longitudinal picture of the uterus, the transducer is placed on the mother's belly, and a longitudinal section of the fetus was obtained to measure the biparietal diameter. The transducer was moved laterally over the mother's abdomen until the head of the fetus was visible. The longitudinal portion of the fetal spine was also visualized. The transducer was orientated to simultaneously display the fetal head and body on the screen. After determining the fetus's longitudinal axis about the mother's belly, fetal lying was ascertained. A transverse section of the fetal head was acquired by rotating the transducer 90 degrees. Following the evaluation of the ovoid morphology of the fetal skull, BPD was quantified from a static image.
The horizontal component of the first caliper was situated on the external aspect of the proximal surface, whereas the second caliper was placed on the internal aspect of the distal cranium surface, oriented perpendicularly to the midline and at the maximum diameter. After identifying the fetal abdomen's transverse section, the transducer was moved caudally to view the iliac bones. At this juncture, a cross-section of the femur was typically observed. To record the femur's whole length, the transducer was rotated while maintaining focus on the prominent echo from the femur. Beyond both thigh extremities, the soft tissue was always visible. The center of the bone's U-shaped ends was used to measure the femur. This indicates the extent of the metaphysis. A minimum of three measurements were obtained, and the average was recorded as the FL.

Ethical Consideration
Informed consent was obtained from all patients.

Results
This study examined 79 cases in the second trimester, specifically between 20 and 27 weeks, and 110 cases in the 3rd trimester of gestation. The means of FL and BPD noted were 56.249 and 73.09, respectively. The SD and SE of the mean for BPD and FL were 12.79, 11.59 and 0.629, 0.569 respectively (Table 1).

Table 1: Mean of different parameters

GA in weeks	FL (mm)	BPD (mm)
20	32.69	46.69
21	38.19	50.99
22	45.39	56.99
23	45.49	62.39
24	46.59	63.99
25	48.89	67.99
26	51.59	69.49
27	54.29	71.49
28	54.89	72.19
29	55.49	72.79
30	58.79	76.29
31	59.79	79
32	62.29	80.49
33	63.69	81.39
34	63.89	82.09
35	68.29	85.69
36	71.49	89.29

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37	72.49	89.79
38	74.39	91.49
Mean	56.19	73.09
SD	11.59	12.79
SE	0.569	0.629

A robust positive connection existed between BPD and GA (0.979). At P = 0.000, the relationship was statistically significant. Between weeks 20 and 24 of pregnancy, the association was highest (r=0.990), while between weeks 35 and 38 of pregnancy, it was lowest (r=0.950). As GA increased from 20 to 38 weeks, the association decreased (Table 2).

Table 2: The relationship between BPD and GA.

GA in weeks	BPD (mm)	p	r	r^2
20	40.69			
21	50.99			
22	56.99	0.0019	0.990	0.969
23	62.39			
24	63.99			
25	67.99			
26	69.49			
27	71.49	0.0049	0.969	0.950
28	72.19			
29	72.79			
30	76.29			
31	78.89			
32	80.49	0.0079	0.959	0.930
33	81.39			
34	82.09			
35	85.69			
36	89.29	0.0529	0.950	0.900
37	89.79			
38	91.49			
Total	73.09	0.000	0.979	0.959

Particularly in the later weeks of pregnancy, there was a significant positive connection between FL and GA (r = 0.990). FL and GA had a statistically significant relationship (P = 0.000). As gestational age increased from 20 to 38 weeks, the link got stronger. According to Table 3, the correlation was lowest between weeks 20 and 25 (0.919) and highest between weeks 35 and 38 (0.980). The link of GA was greater for femur length (FL) at 0.990 compared to biparietal diameter (BPD) at 0.979. The correlation coefficient of determination for BPD was the lowest, at 0.959. All foetal biometric parameters in our investigation exhibited a p-value <0.05, indicating great statistical significance.

Table 3: The relationship between FL and GA

GA in weeks	Mean FL (mm)	p	r	r^2
20	32.69			
21	38.19			
22	45.39	0.850	0.919	0.0269
23	45.49			
24	46.59			
25	48.89			
26	51.59			
27	54.29	0.900	0.950	0.0139
28	54.89			
29	55.49			
30	58.79			

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31	59.79			
32	62.29	0.940	0.970	0.0069
33	63.69			
34	63.89			
35	68.29			
36	71.49	0.949	0.980	0.0229
37	72.49			
38	74.39			
Total	56.249	0.000	0.990	0.980

Discussion

Historically, the biparietal diameter was the initial metric employed to evaluate the GA of the fetus. Its accuracy was determined to be optimal between 12 and 20 weeks in multiple trials. The link between BPD and GA at 20-24 weeks was r = 0.990, which decreased to r = 0.950 at 35-38 weeks of gestation. To evaluate the precision of the approach for determining GA, we analyzed a total of 190 pregnant women aged 18 to 35 years. The parity considered in the investigation ranged from the first to the third pregnancy. Consequently, in this investigation, the assessment of kidney length was performed after 19 weeks, as this timing is deemed more technically feasible. Multiple pregnancies were eliminated from this investigation due to the non-uniform growth of the fetuses. Maternal conditions such as gestational hypertension, diabetes, and intrauterine growth restriction diagnosed during the trial were excluded. Historically, investigations were conducted to exclude urinary tract anomalies by assessing kidney length. Additionally, it was deemed beneficial for assessing gestational age in typical instances. The current study identified the highest incidence of cases among 190 normal pregnant females within the maternal age cohort of 24 to 26 years, totaling 58 instances, while the lowest incidence occurred within the demographic of 33 to 35 years, with 9 cases.

In our investigation, 99 cases pertained to primipara, representing the highest number among the 190 cases, while the lowest number, 16 cases, was observed in the third party. This investigation indicated the highest incidence of cases in primipara due to the greater awareness of sonographic evaluation among primipara for confirming intrauterine pregnancy, preventing birth difficulties, and detecting fetal abnormalities.

The current study revealed that the correlation coefficient (r) for BPD ranged from 0.990 to 0.950, while for FL, it ranged from 0.919 to 0.980, indicating a strong linear connection with GA. Compared to Schlesinger et al.. (r=0.859), Gloor et al.. (r=0.90), and Cohen et al.. (r=0.82), our study's correlation coefficient was higher [13–15].

Comparing GA with other biometric markers, the correlation coefficients were higher than those found in previous studies. In our study, the correlation coefficient for FL is 0.990, and for BPD, it is 0.979. The current investigation revealed a regression model demonstrating a link between FL(r^2 = 0.980) and BPD(r^2 = 0.959). The coefficient of determination found in our investigation was superior to that reported by J.J. Kansaria et al.. (r^2 = 94.84 and 90.91 for FL and BPD, respectively). These discrepancies could be explained by several factors. Observer bias (non-blind vs. blind study), subject characteristics, ultrasonography equipment quality, study style (longitudinal vs. cross-sectional), and the number of sinologists are some of these. In research involving 58 women who were pregnant, Konje et al. showed a strong association between GA and renal length. The researchers determined that fetal kidney length might be utilized reliably for the estimate of GA. The findings of the current investigation were consistent with those of the referenced study. Sagi et al.. evaluated fetal renal architecture in 660 ostensibly normal fetuses. A link between fetal kidney length and GA was demonstrated. A linear increase in fetal kidney length was observed, resulting in a growth curve analogous to that of the biparietal diameter (BPD) [16]. The findings were in line with our investigation, indicating a substantial association between fetal kidney length and GA, which can serve as a valid indicator for labor dates. The study by Mete G et al.. revealed a robust positive connection between GA and fetal kidney length (r= 0.947, p= 0.001) [17].

Conclusion

The investigation concludes that the observed Standard Errors for FL and BPD are 0.569 and 0.6329, respectively. All indicators of the current investigation exhibit a strong correlation with GA. r = 0.990 and 0.979 for FL and BPD, respectively. The link between BPD and GA diminishes from 20 weeks to 38 weeks of gestation. The association is highest between ages 20 and 24, specifically 0.980. All fetal biometric parameters exhibit a P value < 0.05, indicating statistical significance. During the initial weeks of gestation, an analysis of the mean and standard deviation indicates that all indicators are dependable for assessing GA. At term, FL is highly accurate for determining gestational age.

Limitations

The limitations of this study include the small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation to this study's findings.

Recommendation

Analysing the growth patterns of FL and BPD by sonography will lead to better results.

Acknowledgment
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Data Availability
Data is available upon request.

Author contributions
All authors contributed to the design of the research. SSG collected and analyzed the data. SSM wrote the manuscript. All authors edited the paper.

List of abbreviations
GA- Gestational age
FL- Femur length
BPD- Biparietal diameter
SE- standard error
SD- standard deviation

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Conflict of interest
The authors have no conflicting interests to declare.

Conflict of interest
No Conflict of interest

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