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Original Research Article

Analysis of Standard Fetal Biometric Parameters with that of Gestational Age

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Abstract:

Introduction: Ultrasonography (USG) is a common and economical diagnostic method for fetal growth and well-being during pregnancy. Fetal biometry, encompassing HC, AC, FL, and BPD, is the "gold standard" for determining gestational age. The objective and restrictions of the measurement determine the biometric parameter chosen. To accurately estimate fetal growth, each ethnic group should use its own charts. Modern prenatal care requires ultrasound growth charts.

Aim and objectives: The objective of this study was to establish a correlation between standard fetal biometric markers and gestational age.

Method: The cross-sectional study examined 800 healthy pregnant women getting prenatal treatment at ultrasonography clinics affiliated with Sharda University and L.L.R.M. Medical College for three years. The biometric parameters of fetuses between 12 and 41 weeks of gestation were assessed with high-resolution scanning, and mean values and standard deviations were calculated. An improved way of estimating a pregnant woman's due date was one of the main goals of the correlation study.

Result: Our result charte & diagram demonstrate various fetal characteristics at different stages of gestational age, along with demographic examination by age groups. In addition, they also discuss the correlation coefficients between variables are also illustrated, implying strong positive connections among them. The tabulated result provides valuable insights for prenatal care and study, improving our knowledge of fetal growth and monitoring.

Conclusion: In order to accurately estimate fetal growth, South Asian countries can benefit from analysing conventional biometric parameters in connection to gestational age.

Keywords: Ultrasonography, Fetal biometry, gestational age, Biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC).

Introduction

Due to their non-ionizing and non-invasive qualities as well as their affordability, which has increased their appeal, ultrasonography (USG) has made tremendous progress in its utilization as a diagnostic tool. The most trustworthy and significant data regarding fetal growth and well-being is provided by fetal biometry with the aid of USG. This methodology is focused on measuring the various fetal anatomical components and tracking their development during pregnancy. Fetal growth is defined by pregnancy-related, time-dependent fetal body size changes [1]. In comparison to established criteria of fetal biometry in accordance with the gestational age, Information about the fetus's growth can be learned from its sonographic measurements. Most USG machines employ these standard charts to determine the estimated fetal birth mass (EFBW), gestational age (GA), and anticipated time of delivery (EDOD), and to identify anomalies in fetal development. Accurate gestational age knowledge is essential for planning proper interventions and treatments throughout pregnancy as well as for optimal prenatal care. Among the fetal measures that may be used to determine the gestational age (GA) for a fetus is the measurement of the gestational sac, its crown-rump width, the fetal biparietal size, the top of the head diameter, the abdomen diameter, and the femur length. HC, AC, FL, and BPD are the parameters most frequently employed in the 2nd and third trimesters of pregnancy. These variables are regarded as the 'gold standard' because they accurately and thoroughly evaluate the GA as a whole [2,3].

The foundation for precise gestational age calculation and the diagnosis of fetal growth problems is sonographic studies of fetal ultrasonography parameters. The time, purpose, and restrictions of the measurement all have an impact on the choice of a particularly useful single biometric parameter. CRL, or crown-rump length, is the most accurate predictor of early pregnancy. Biparietal diameter (BPD) in the second trimester continues to have the strongest relationship with gestational age. Head circumference is a good substitute when the shape of a person's skull varies. The best parameter for assessing fetal growth is abdominal circumference, and the best parameter for assessing abnormalities in the skeletal system is femur length [4]. The accuracy of estimations is improved by the use of numerous predictors. To evaluate fetal growth, each pregnancy should be treated uniquely. It is important to take into account the various epidemiological elements that affect fetal growth, and whenever practical, utilize unique charts for each community. The fetal weight estimation techniques together with their drawbacks and probable inaccuracies. The clinical utility of fetal biometry in cases of small- as well as large-for-gestational-age fetuses, chromosomal abnormalities, and skeletal dysplasias is described [5,6].

An essential component of contemporary prenatal care is the sonographic measurement of fetal size, whether for determining gestational age or identifying fetal growth abnormalities. Gestational age is frequently determined solely by sonographic measurements of the fetal parts, which include the femur length (FL), head circumference (HC), crown rump length (CRL), and biparietal diameter (BPD), among others as a significant portion of pregnant women are unsure of their last menstrual period. Foetal growth is influenced by a variety of factors, including maternal sickness, drug use, genetic abnormalities, congenital defects, placental insufficiency, and others. Ethnicity affects fetal growth, according to earlier studies (1). Geographical variations like altitude can have an impact on typical fetal size regardless of population (2). In order to offer appropriate assessments, each specific community or ethnic group ought to possess its own reference values regarding the various fetal anthropometric factors. As a result, it is required to update the outdated conventional growth charts for ultrasonography parameters [7,8].

Materials and Methods

Study design

The cross-sectional study examined fetal biometrics and gestational age. The study was conducted at Sharda University, Greater Noida, in cooperation with Sharda Hospital. Further study was done at Meerut's L.L.R.M. Medical College and AVBP Hospital. Ultrasound clinics in Meerut, Gurgaon, Noida, and Delhi have also participated in the study. 800 healthy pregnant women were followed for three years as they received prenatal care, including ultrasounds, at local clinics. Strict pregnancy dating guidelines were used to identify patients for accurate gestational age. High-resolution scanning was used to evaluate “gestational sac diameter (GSD)”, “crown-rump length (CRL)”, “biparietal diameter (BPD)”, “head circumference (HC)”, “abdominal circumference (AC)”, “femur length (FL)”, “clavicle and tibia length (CTL)”, and “foot length (FT)”. We determined mean values and standard deviations for each metric for gestational ages between 12 and 41 weeks. Using regression and correlation analysis, fetal biometric parameters and gestational age were correlated. The results were intended to help create more accurate methods for measuring a pregnant woman's gestational age.

Inclusion and exclusion criteria

Inclusion

- The pregnant woman receives antenatal treatment and ultrasounds.
- Regular menstruators.
- Patients with known last menstrual date.
- Pregnant patients at 7 weeks.
- 8-week pelvic exam patients.
- Sonogram-confirmed singleton pregnancies.
- Patients without recognised fetal-harming illnesses like diabetes mellitus.

Exclusion

- Women carry more than one baby at a time (twins, triplets, etc.).
- Inaccurate or unreliable menstruation history in patients.
- Patients who do not have a positive pregnancy test by the seventh week of pregnancy.
- Patients without a positive pregnancy test by 7 weeks.
- Women with major ultrasound-detected foetal malformations.
- Medical problems that could affect gestational age or foetal biometric characteristics.
- Women who were pregnant but did not give their permission to take part in the study.

Statistical analysis

SPSS 17.0 and Systat 12.0 were used for the statistical analysis. Graphs, charts, tables, and other graphical representations of the results were made using Microsoft Word and Microsoft Excel. Each biometric parameter was measured at a range of gestational ages, and descriptive statistics such as mean values and standard deviations were calculated. Foetal measures were correlated with maternal age using regression and correlation analysis, and the results were graphically shown.

Ethical approval

This cross-sectional study involving 800 healthy pregnant women was approved by the institutional review boards of the institutions that participated. The protocol's approval ensured that the study would be conducted in accordance with ethical guidelines and would protect the participants' privacy and safety.

Results

The data provided encompasses measurements of numerous foetal characteristics, such as “BIPARIETAL DIAMETER (BPD)”, “HEAD CIRCUMFERENCE (HC)”, “ABDOMINAL CIRCUMFERENCE (AC)”, “FEMUR LENGTH (FL)”, “clavicle(CL)”, “tibia (TB)”, and “FOOT (FT)”, at various stages of gestation. Furthermore, the dataset encompasses the quantitative representation of the total count of individuals throughout distinct age cohorts. The measurements provide information regarding the average values and variability, as indicated by the standard deviations, for each parameter throughout particular weeks of gestation. In addition, the data shows the breakdown of participants by age group: those aged 18 to 24, 25 to 30, and 31 to 38. The supplied data improve our understanding of the demographic breakdown of the sample by providing useful insights into the developmental patterns of foetal measurements across different stages of gestation. The following results are important benchmarks for the prenatal care and research sectors.

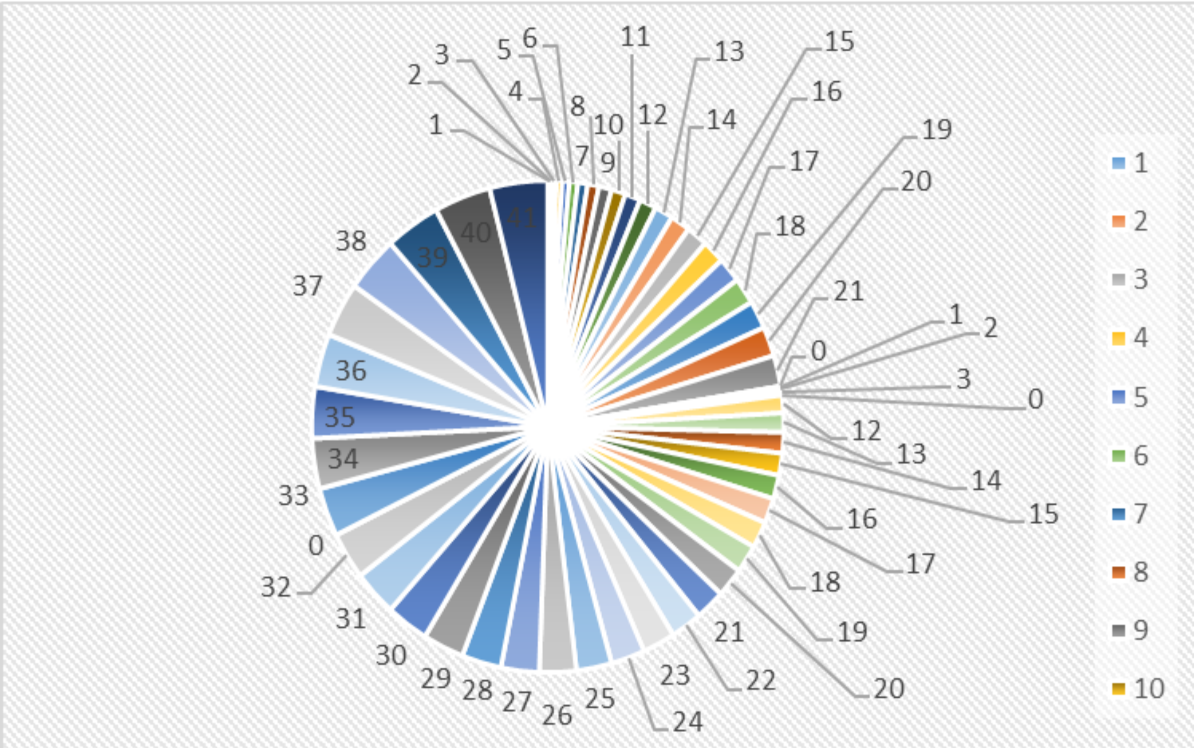

Figure 1: Numerous fetal characteristics

Measurements of the BIPARIETAL DIAMETER (BPD) and the FOOT are shown in Figure 2 for a range of gestational ages. Correlation coefficients from numerous studies by various researchers, including USHA, MERCER, CHITTY, and JEANTY, are also included.

The biparietal diameter (BPD) is used to evaluate the size of the fetus' head at various times in its development, whereas the foot (FOOT) measures are used to evaluate the size of the fetus' feet. The amount and orientation of linear relationships between variables in each study are revealed by the correlation coefficients. Strong positive correlations between USHA and MERCER are seen in the initial correlation table, as are positive correlations between USHA and CHITTY and MERCER and CHITTY. There are significant positive connections between USHA and CHITTY, USHA and JEANTY, and CHITTY and JEANTY, as seen in the second correlation table. It is clear that these results provide useful insights into the correlations between the measured parameters when applied to the context of foetal development and monitoring.

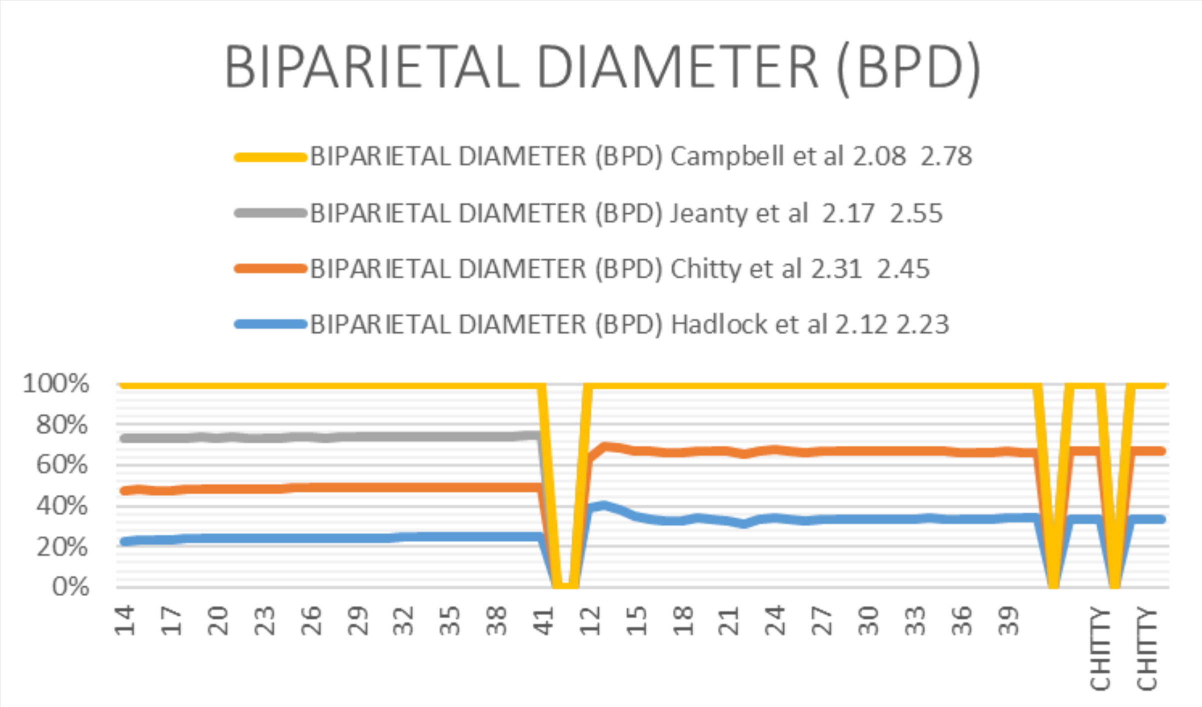

Figure 2: Biparietal Diameter (BPD)

Multiple correlation coefficients between the variables USHA, SHERER, YARKONI, CHITTY, JEANTY, and MERCER are displayed in Table 1. The correlation coefficient is a quantitative value, typically between -1 and 1, that measures the degree and direction of a linear relationship between two variables. A correlation coefficient of -1 suggests an extremely negative relationship, while a value of 1 indicates an extremely positive one. The values recorded in the table exhibit a significant magnitude, nearing a value of 1, signifying strong positive correlations among the bulk of variables. This discovery implies a positive correlation between the two variables, where an increase in one measure is accompanied by a comparable increase in the other. The findings of this research demonstrate a significant correlation between the variables, providing useful insights into their interrelationships or patterns of occurrence within the investigated context.

Table 1: correlation coefficients among various variables

Correlation	**Usha**	**Sherer**	**Yarkoni**
Usha	1	0.9895	0.999
Sherer	0.9895	1	0.9884
Yarkoni	0.999	0.9884	1
Correlation	Usha	Chitty	Jeanty
Usha	1	0.9982	0.9975
Chitty	0.9982	1	0.9991
Jeanty	0.9975	0.9991	1
Correlation	Usha	Mercer	Chitty
Usha	1	0.997981	0.997968
Mercer	0.997981	1	0.995163
Chitty	0.997968	0.995163	1

Discussion

A technique called foetal biometry is used to gauge the development of various foetal anatomical components.

The current study's objective was to establish gestational age during pregnancy second and third trimesters of pregnancy in the community at large (Jaipur Zone) of Rajasthan using ultrasonographic measurements that measured four foetal biometric parameters: femur length (FL), biparietal diameter (BPD), circumference of the head (HC), and abdominal circumference (AC). Additionally, the effectiveness and significance of these four foetal biometric parameters in predicting the outcome of gestational age by ultrasound were assessed. The difference in anthropometry between the two groups as a result of racial, genetic, dietary, and socioeconomic factors is thought to be the cause of the variation in anticipated gestational age by ultrasonography (USG) [9].

In a retrospective study, the length of the femur as measured by sonography in 314 individuals treated for 19 to 32 completed weeks of pregnancy was compared to gestational age for Hispanic, Black, Oriental, & Caucasian patients. Known past singleton pregnancy, monthly cycle, and a history of no mother diabetes, hypertension, renal illness, or foetal malformations were among the selection criteria. If the date of the last regular period compared to the gestational age was determined through the foetal biparietal size as well as assessment of the infant, the gestational age was used to determine the femur length. There were no racial femur length and gestational age discrepancies that were statistically significant [10].

Its purpose is between the 24th and the 38th week of pregnancy, to evaluate the precision of kidney length measurements in estimating gestational age and to compare this to other foetal biometric indicators. from 24 to 38 weeks of pregnancy, kidney length is a more reliable way to estimate compared to the biparietal diameter, brain size, femur length, & belly circumference indices for foetal biometrics. The accuracy of dating is increased by two days when biparietal diameter, head size, and femur length are included. the standard for dating following 24-week gestational periods pregnancies might readily incorporate this measurement because it is simple to do, especially when measuring the biparietal diameter as well as the head circumference is challenging [11].

Modern prenatal care practice revolves around the ultrasound measurement of foetal size. It makes accurate pregnancy dates and foetal growth problem screening easier. This article covers evidence-based suggestions for biometric assessments and dating pregnancies. We clarify several ambiguous phrases like "standards" and "references" for foetal growth, as well as the distinctions between prescriptive as well as descriptive Growth charts that compare those determined by birth weight to those based on anticipated foetal weight. However, since the publishing of the Intergrowth 21st research, we are now in a position that allows us able to assess development and growth in a globally standardised manner, from foetal life up to 5 years of age. Opinions on which charts are best to use are still disputed [12].

The study's objective was to establish a reference range based on the fetal biparietal length (BPD), crown rump length (CRL), the circumference of the head (HC), the circumference of the abdomen (AC), as well as femur length (FL) of the Lithuanian population and to compare it to the latest international standards as well as both the before local and local reference values. In order to compare our findings with those of two other studies, we created and published Tables, charts, and regression formulas for the centiles corresponding to the Lithuanian population's fetal biometry. The stark contrasts between our own centile charts as well as those from INTERGROWTH-21 suggest the need for regional foetal biometry standards, and the differences between our findings and those of the earlier The need for updated foetal biometry standard charts is highlighted by research in the same population on a regular basis [13].

Exact gestational age dating is essential for providing the best prenatal care. The accuracy of the current methods for estimating Following the first trimester, the gestational age drops as gestational age increases. Because knowledge about first-trimester crown-rump height is still not widely available, the development of exact methods of gestational age estimate in the 2nd and 3rd trimesters of gestation remains a problem in foetal medicine challenging in many countries owing to delayed reservations, limited possibilities for prenatal care, & a lack of prompt ultrasound examination availability. In this study, we compared the accuracy of a new artificial intelligence method for estimating the gestational age at which conventional cranial ultrasonography slices of the unborn brain are subjected to automated investigation of prenatal brain morphology. In comparison to foetal biometric data, Using standard sonographic foetal planes, an automated machine learning system generated a similar or smaller inaccuracy in estimating gestational age, particularly in the third trimester. These findings encourage additional studies to enhance the effectiveness of these techniques in larger investigations [14].

Conclusion

In conclusion, it is possible to provide an accurate assessment of fetal growth and development by analysing the relationship between standard foetal biometric indicators and gestational age. This research improves the accuracy of estimating gestational ages in India and other South Asian nations by using data acquired from the local population. There may be advantages to assessing foetal age using non-standard measures, such as tibia (TB), clavicle (CL), and foot (FT). To guarantee precise gestational age assessment, obstetricians should be wary of blindly following established guidelines based simply on bi-parietal diameter (BPD).

Despite its relevance, it is important to note its caveats, such as the need to confirm results with bigger and more diverse samples and the possibility of unreliable BPD assessment in certain circumstances. However, the thorough design and statistically significant outcomes of this study make it a strong candidate for clinical applications in the North Indian population.

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