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Transcerebellar Diameter versus Biparietal Diameter and Femur Length for Gestational Age Assessment in Third Trimester of Pregnancy

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ABSTRACT
Background: Accurate gestational age (GA) determination is essential for pregnancy management. Historically, last menstrual period (LMP) has been used, but its reliability is compromised by recall inaccuracies and menstrual cycle variations.
Objective: This study aimed to identify the optimal sonographic parameter, transcerebellar diameter (TCD) and biparietal diameter (BPD), or femur length (FL), for third-trimester GA estimation, using LMP as a reference.
Patients and methods: A prospective comparative study was conducted on 60 pregnant women in their third trimester. GA was estimated using TCD, BPD, and FL measurements obtained via ultrasound. These estimates were then compared to the GA calculated from LMP to determine the most accurate method.
Results: Significant positive correlations were found between TCD, BPD, and FL and GA (P<0.001). Linear regression confirmed each parameter as an independent GA predictor (P<0.001). TCD demonstrated the highest predictive accuracy (AUC=0.902), followed by FL (AUC=0.811) and BPD (AUC=0.796). Specifically, TCD at a cutoff of > 4.79 mm showed 94.5% sensitivity and 80% specificity. FL at > 7.59 mm yielded 61.82% sensitivity and 60% specificity, while BPD at > 9.13 mm showed 81.82% sensitivity and 60% specificity.
Conclusion: Transcerebellar diameter (TCD) is the most accurate sonographic parameter for third-trimester GA estimation, surpassing femur length (FL) and biparietal diameter (BPD). Combining TCD, FL, and BPD improves GA accuracy, particularly beneficial in populations with limited medical records or unreliable LMP recall.
Keywords: Last menstrual period, Biparietal diameter.

INTRODUCTION

The establishment of an accurate gestational age (GA) represents a cornerstone of contemporary prenatal care, exerting a profound influence on the comprehensive evaluation of pregnancy progression, meticulous monitoring of fetal development, and the strategic planning of neonatal care and interventions. Reliable GA assessment is not merely a descriptive metric, it serves as a critical determinant in guiding timely clinical interventions, optimizing therapeutic strategies, and facilitating evidence-based decision-making. While, the last menstrual period (LMP) has historically served as a primary method for GA determination, its inherent limitations, including recall bias and menstrual cycle variability, necessitate the exploration and adoption of more objective and precise methodologies. The advent and progressive refinement of sonographic techniques have ushered in an era of enhanced diagnostic accuracy, providing clinicians with access to objective fetal biometry and enabling the development of more robust GA estimation models. This shift towards sonographically derived GA assessment that reflects a broader trend in obstetrics, emphasizing the integration of advanced imaging technologies to optimize patient outcomes and minimize clinical uncertainty (1). Though last menstrual period (LMP) is known to correlate with gestational age, it may act as a false guide. Furthermore, it has been reported that only about one-half of women can accurately recall their LMP (2).

Numerous studies have demonstrated the enhanced accuracy and objectivity of sonographic assessment in determining gestational age, particularly when compared to reliance on the LMP. Evidence-based research consistently supports the utilization of ultrasound as a reliable modality for gestational age estimation, offering improved precision in clinical obstetrics (3).

While, biparietal diameter (BPD), femur length (FL), abdominal circumference (AC), and head circumference (HC) are widely recognized as standard biometric parameters for estimating gestational age, their reliability is inherently subject to a multitude of influencing factors. These factors include the inherent variability in fetal skull morphology, the precise location of the placenta, the degree of fetal head flexion and engagement within the maternal pelvis, the presence of maternal obesity, and the occurrence of multiple gestations. Each of these elements can introduce significant variability into the measurements, thereby impacting the accuracy of gestational age estimations derived from these parameters. Furthermore, a critical limitation of these traditional biometric measurements lies in their susceptibility to alterations in cases of abnormal fetal growth. Conditions such as intrauterine growth restriction (IUGR) or macrosomia can significantly distort the expected growth patterns of these parameters, leading to inaccurate gestational age assessments. This is in contrast to the transcerebellar diameter, which is generally considered to be less influenced by such growth abnormalities. The transcerebellar diameter, therefore, potentially offers a more robust and reliable alternative for gestational age assessment, particularly in situations where fetal growth may be compromised,

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providing a more consistent and accurate estimation regardless of fetal growth patterns [(4)].

Femur length, a common ultrasound measurement for third-trimester gestational age estimation, is known to have a significant margin of error, typically ranging from two to three weeks. Biparietal diameter, another frequently used parameter, exhibits even greater variability, with a margin of error of three to four weeks, primarily due to the inherent biological variability in fetal skull shape and size. However, transcerebellar diameter (TCD) offers a potentially more accurate alternative. The cerebellum's protected anatomical location within the posterior fossa, encased by dense petrous and occipital bone, renders it less susceptible to changes in size and form, thus enhancing its reliability as a gestational age marker [(5)].

The transcerebellar diameter is consistently validated within the sonographic literature as a reliable metric for the estimation of gestational age. This parameter demonstrates particular utility in achieving accurate pregnancy dating, especially throughout the third trimester [(4)].

On axial sonographic imaging, the transcerebellar diameter (TCD) is determined by measuring the distance spanning the lateral aspects of the cerebellar hemispheres, with the measurement incorporating the width of the intervening cerebellar vermis [(6)].

The transcerebellar diameter is widely acknowledged as a reliable parameter for the sonographic estimation of gestational age. This reliability stems from the well-documented association between the dimensions of the fetal cerebellum, with a particular emphasis on the transverse cerebellar diameter, and the corresponding gestational age. This relationship provides a consistent and accurate means of assessing fetal maturity, particularly in clinical scenarios where other biometric parameters may be compromised or less reliable [(7)].

A significant correlation was observed between transcerebellar diameter and other biometric parameters, including biparietal diameter, head circumference, abdominal circumference, and femur length, in normal pregnancies. Furthermore, transcerebellar diameter showed the most robust correlation with gestational age ($r = 0.993$, $p < 0.001$) when compared to the other parameters [(8)]. Therefore this study aimed to evaluate the relative accuracy of transverse cerebellar diameter in comparison with biparietal diameter and femur length for the assessment of fetal gestational age in the third trimester.

Research question: Does the utilization of fetal transverse cerebellar diameter measurement in singleton pregnancies result in improved accuracy of gestational age estimation?

PATIENTS AND METHODS

Methodology: This comparative study was conducted at Department of Obstetrics and Gynecology, Badr University Hospital, Faculty of Medicine, Helwan University from October 2023 to October 2024.

Study population: Pregnant women of different gravidity and parity referred to Obstetrics Outpatient Clinic.

Inclusion criteria: Singleton cephalic pregnancy. Gestational age between 28 – 40 Weeks of gestation. Sure and reliable dates: The last 3 cycles before pregnancy were regular. No hormonal contraception in the preceded 3 cycles.

Exclusion criteria: Hypertension with pregnancy. Diabetes with pregnancy. Multiple gestation. Fetal growth restriction. Fetal macrosomia. Amniotic fluid abnormalities. Congenital fetal malformation. Anemia with pregnancy. Rh isoimmunization.

Sample size justification: A sample size of 60 pregnant women with gestational ages between 28 and 40 weeks were adequate to meet the study's goal, according to the PASS 11 program, which calculates sample size with a 95% confidence level and a margin of error of ± 0.05. Previous research findings **[(8)]** demonstrated that the correlation between TCD and gestational age was 0.9993 in a typical pregnancy.

Ethical considerations: Following a comprehensive explanation of the specifics and goal of the current study, the participating patients signed an informed written consent forms. Participants were free to leave the study at any time without having their entitlement to proper medical treatment negatively affected. The Ethical Research Committee of Helwan University's Obstetrics and Gynecology Department and Faculty of Medicine gave its approval to the study protocol. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Confidentiality of data was maintained by the following: substitution of codes for participant-identifying information (e.g., identifying participants with numbers rather than names). Deleting face sheets with names or other identifiers on them. When computers were left unattended, files holding electronic data were closed, password-protected, and encrypted (at least when the data was moved or transmitted). Restricted access to all participant-identifying data. Paper records were kept in cabinets that were locked. Consents were kept apart from the study data in safe, locked cabinets. All paper documents containing identifiers should be disposed of properly.

Study interventions and procedures: Patients had the following procedures: A thorough history taking of clinical significance, which included:

- **Individual background:** Age, residence, occupation, marital status and special habits as smoking, alcohol, etc. Menstrual history: Day of last menstrual period and regularity.
- **Obstetric history:** Gravity, parity, previous miscarriages or obstetric complications.
- **Contraceptive history:** Type, duration of use before pregnancy.
- **Medical history:** Medical comorbidities with pregnancy as hepatic, renal, cardiac, endocrinal.
- **Surgical history:** Previous cesarean sections and its neonatal outcomes.
- **Family history:** Maternal or fetal complications with pregnancy.

General examination with special emphasis on: General examination including blood pressure, weight assessment. Obstetric examination focused on uterine size, fundal height (in cm above symphysis pubis).

Investigation: Standard testing include complete blood counts, tests for liver and kidney function, coagulation profiles, including prothrombin time (PT), partial thromboplastin time (PTT), international normalized ratio (INR), viral hepatitis indicators, such as hepatitis B and C viruses, blood group (ABO), and Rh.

Antenatal ultrasound examination, Biparietal diameter (BPD), femur length (FL), and transcerebellar diameter (TCD) were among the fetal biometric parameters measured by antenatal ultrasound examination, which used two-dimensional ultrasonography. To eliminate bias, a single sonographer created these ultrasonography settings.

For the surgery, women were advised to wear a gown or cover. Transabdominal ultrasonography was performed for all participants with the patient positioned in a slight left lateral decubitus orientation, with the head of the examination table elevated to approximately 30 degrees, and a small support pillow placed beneath the right lumbar region. This positioning was employed to optimize fetal visualization and minimize maternal discomfort. Biparietal diameter (BPD) measurements were obtained from an axial plane intersecting the third ventricle and thalami. Strict criteria were adhered to, ensuring the calvarium appeared smooth and symmetrical within the imaging plane, thus mitigating potential measurement errors. Optimal image acquisition was achieved by maintaining the abdominal transducer perpendicular to the fetal parietal bones, ensuring accurate and reproducible BPD measurements.

The outside margin of the proximal skull and the inner edge of the distal skull were where the cursors were positioned. The BPD was symbolized by this length. The transducer was positioned along the long axis of the femur bone, and FL is a straightforward "one-dimensional" image. The "upside" femur, which is the one next to the transducer, was the one that was measured. Visualizing the femur head or greater trochanter at the proximal end and the femur condyle at the distal end allowed for the acquisition of the correct image. To measure solely ossified bone, the calipers were positioned where bone and cartilage meet. The femur head was absent from them.

After locating the cere bellum in the posterior fossa by rotating the transducer to about 30 degrees from the trans-axial plane that locates the thalamus, the cavity of the septum pellucidum, the third ventricle, and the cisterna magna, the transcerebellar diameter (TCD) was measured. The widest measurement was obtained by positioning the electronic calipers on the cerebellar hemispheres' outside edges. The ultrasonography equipment used the measured biometric characteristics to calculate gestational age (GA).

Ultrasound device: Logiq P5 ultrasound machine was used for this study.

Study outcomes:
Primary outcome: Is transcerebellar diameter an accurate predictor of gestational age in third trimester of pregnancy?

Secondary outcome: Comparing transcerebellar diameter as a single parameter to biparietal diameter in calculation of gestational age in late pregnancy. Comparing transcerebellar diameter as single parameter to femur length in calculation of gestational age in late pregnancy.

Statistical analysis

If the numerical data were regularly distributed, they were statistically represented using mean standard deviation (SD), if not they were expressed as median and range. The frequencies (number of cases) and percentages for each category as well as the entire sample were used to characterize the categorical data. The Kolmogorov Smirnov test was used to check numerical data for the normal assumption. The range included the minimum and maximum value of the data array. The median was the middle value of an arranged data array. If the sample is even number, the median was the arithmetic mean of the last value of the 1st half and the 1st value of the 2nd half. The range (minimum value and maximum value) was presented with the median as an index of variation. The frequency was the number of cases recorded in every category. The number of cases in each category was divided by the overall number of cases, which was then multiplied by 100 to determine the percentage. When there were missing records, the valid total was used, and the results were represented as —the valid percent. Statistical analyses were conducted using IBM SPSS Statistics, version 29 (IBM Corp., Chicago, IL, USA. Continuous variables, representing quantitative data, were summarized and presented as mean ± standard deviation (SD), providing a measure of central tendency and data dispersion. Categorical variables, representing qualitative data, were described using frequencies and percentages, offering insight into the distribution of observations within distinct categories. This approach aligns with established statistical practices for descriptive data analysis, facilitating a clear and concise presentation of study findings. The use of SPSS allows for standardized analyses, increasing the reproducibility of the study.

RESULTS

Table 1 presents key demographic and obstetric parameters of participants, including age (27.9±5.08 years), anthropometric measures (BMI 26.8±3.15 kg/m²), parity distribution (46.7% primiparous), contraceptive use (25% IUD), and pregnancy characteristics (mean gestational age 38.7±1.41 weeks). All participants reported regular menstrual cycles. These data establish a homogeneous reproductive-aged cohort for analysis

Table (1): Demographic data of the studied patient

		(n=60)
Age (years)	Mean ± SD	27.9 ± 5.08
	Range	18 – 39
Weight (kg)	Mean ± SD	71.4 ± 8.39
	Range	55.72 - 88.73
Height (cm)	Mean ± SD	163.34 ± 5.66
	Range	148.99 - 174.52
BMI (kg/m^2)	Mean ± SD	26.8 ± 3.15
	Range	20.05 - 34.38
Parity	Once	28 (46.67%)
	Twice	14 (23.33%)
	Three time	12 (20%)
	Non	6 (10%)
Use of contraceptive	IUD	15 (25%)
	COC	7 (11.67%)
	Implanon	3 (5%)
Regularity of cycle		60 (100%)
Gestational age (weeks)	Mean ± SD	38.7 ± 1.41
	Range	32.8 – 40

BMI: Body mass index, IUD: Intrauterine device, COC: combined oral contraceptive pill.

Table 2 presents key fetal growth parameters, including estimated fetal weight (EFW: 3584.5±393.85g), cranial measurements (BPD: 9.3±0.32cm; HC: 34.3±1.1cm), and long bone development (FL: 7.6±0.32cm). All biometric-derived gestational age estimates (range: 38.5-39 weeks) closely matched the clinical gestational age (38.7±1.41 weeks from Table 1), confirming appropriate fetal growth. The trans-cerebellar diameter (5.5±0.4cm) provides additional neurodevelopmental assessment.

Table (2): Secondary measurement of the studied patient

			(n=60)
EFW (gm)		**Mean ± SD**	3584.5 ± 393.85
		Range	1883 – 3995
BPD	**Diameter (cm)**	**Mean ± SD**	9.3 ± 0.32
		Range	8.03 - 9.72
	GA (weeks)	**Mean ± SD**	38.5 ± 1.57
		Range	32.4 - 40.6
OFD (cm)		**Mean ± SD**	12.3 ± 0.43
		Range	10.17 - 12.99
HC (cm)	**Diameter (cm)**	**Mean ± SD**	34.3 ± 1.1
		Range	29.42 - 35.45
	GA (weeks)	**Mean ± SD**	39 ± 1.6
		Range	32.2 - 40.8
AC (cm)	**Diameter (cm)**	**Mean ± SD**	34.7 ± 1.52
		Range	27.62 - 37.22
	GA (weeks)	**Mean ± SD**	38.9 ± 1.55
		Range	31.7 - 41.6
FL (cm)	**Diameter (cm)**	**Mean ± SD**	7.6 ± 0.32
		Range	6.17 - 7.99
	GA (weeks)	**Mean ± SD**	38.9 ± 1.61
		Range	31.7 - 40.8
Trans cerebellar diameter (cm)	**Diameter (cm)**	**Mean ± SD**	5.5 ± 0.4
		Range	4.3 - 5.82
	GA (weeks)	**Mean ± SD**	38.7 ± 1.46
		Range	33.3 - 40.3

EFW: Estimated fetal weigh, BPD: Biparietal diameter, GA: Gestational age, OFD: Occiptofrontal diameter, HC: Head circumference, AC: Abdominal circumference and FL: Femur length.

Table 3 presents calculated fetal growth indices, including cephalic index (CI: 75.9±1.61%), femur length to abdominal circumference ratio (FL/AC: 21.8±0.42), and cranial proportionality measures (FL/HC: 0.2±0).

Notably, the HC/AC ratio (1±0.02) demonstrates balanced head-to-abdomen growth, while FL/BPD (81.4±1.75%) reflects typical long bone-to-head proportionality. All ratios fell within established normative ranges, confirming symmetrical fetal development.

Table (3): Secondary calculations of the studied patient

		(n=60)
CI (BPD/OFD) (%)	Mean ± SD	75.9 ± 1.61
	Range	72 – 82
FL/AC	Mean ± SD	21.8 ± 0.42
	Range	21 – 22
FL/BPD	Mean ± SD	81.4 ± 1.75
	Range	76 – 87
FL/HC	Mean ± SD	0.2 ± 0
	Range	0.2 - 0.23
HC/AC	Mean ± SD	1 ± 0.02
	Range	0.93 - 1.09

CI: cephalic index, BPD: biparietal diameter, OFD: occipitofrontal diameter, FL: femur length, AC: abdominal circumference and HC: Head circumference.

Table 4 presents key hemodynamic indices, including peak systolic velocity (PS: -35.4±17.11 cm/s), end-diastolic velocity (ED: -17.2±7.28 cm/s), and resistance index (RI: 0.6±0.04). The RI values (range: 0.51-0.69) fall within normal physiological ranges, indicating appropriate fetoplacental circulation. Notably, the negative velocity values reflect standard directional flow measurement conventions in Doppler ultrasound.

Table (4): Umbilical artery of the studied patient

		(n=60)
PS	Mean ± SD	-35.4 ± 17.11
	Range	-40.94 - 56.56
ED	Mean ± SD	-17.2 ± 7.28
	Range	-19.85 - 25.54
RI	Mean ± SD	0.6 ± 0.04
	Range	0.51 - 0.69

RI: Resistance index.

Significant positive correlations were observed between gestational age and all measured biometric parameters (p<0.001*), with transcerebellar diameter showing the strongest association (r=0.919). Biparietal diameter (r=0.461) and femur length (r=0.476) demonstrated moderate but statistically significant correlations (Table 5).

Table (5): Correlation of different variables of studied groups

		Gestational age (weeks)
Biparietal diameter	**R**	0.461
	P	<0.001*
Femur length	**R**	0.476
	P	<0.001*
Transcerebellar diameter	**R**	0.919
	P	<0.001*

r: Correlation coefficient.

Linear regression analysis identified all three biometric measures as significant predictors of gestational age (p<0.001*). The transcerebellar diameter showed the strongest predictive value (OR: 3.201, 95% CI: 2.841-3.561), followed by femur length (OR: 2.107) and biparietal diameter (OR: 2.014). These results confirm the clinical utility of standard biometric measurements for accurate gestational age assessment correlations (Table 6).

Table (6): Linear regression of multiple variables for prediction gestational age

	Linear regression		
	Odds ratio	**95% CI**	**P**
Biparietal diameter	2.014	0.995 - 3.032	**<0.001***
Femur length	2.107	1.085 - 3.129	**<0.001***
Transcerebellar diameter	3.201	2.841 - 3.561	**<0.001***

*Significant as P value≤0.05, CI: Confidence interval.

Table 7 and Figure 1 show the predictive performance of biparietal diameter for gestational age assessment

The ROC curve analysis demonstrates the diagnostic accuracy of biparietal diameter (BPD) in gestational age prediction, with optimal cut-off values identified:

>9.13 cm: Shows high sensitivity (81.82%) and moderate specificity (60%), with excellent positive predictive value (PPV: 95.7%) but limited negative predictive value (NPV: 23.1%). AUC of 0.796 (p=0.048*) indicates good discriminative ability.

Table (7): Role of biparietal diameter in prediction of gestational age

Cut-off	Sensitivity	Specificity	PPV	NPV	AUC	P value
>9.13	81.82%	60%	95.7%	23.1%	0.796	**0.048***

PPV: positive predictive value, NPV: negative predictive value, AUC: area under the curve

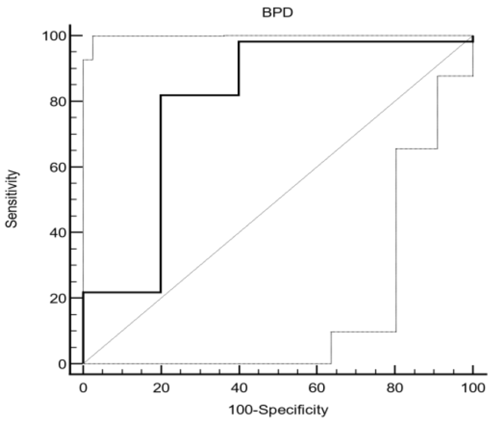

Figure (1): ROC curve of biparietal diameter in prediction of gestational age.

Table 8 and Figure 2. Femur length (FL) performance in gestational age prediction
The ROC analysis reveals FL >7.59 cm as the optimal cut-off (AUC=0.811, p=0.002*), demonstrating:

- Moderate sensitivity (61.82%) and specificity (60%)
- Excellent positive predictive value (94.4%) but limited negative value (12.5%)
- Comparable accuracy to BPD (AUC=0.796) though with better statistical significance

Table (8): Role of femur length in prediction of gestational age

Cut-off	Sensitivity	Specificity	PPV	NPV	AUC	P value
>7.59	61.82%	60%	94.4%	12.5%	0.811	**0.002***

PPV: positive predictive value, NPV: negative predictive value, AUC: area under the curve

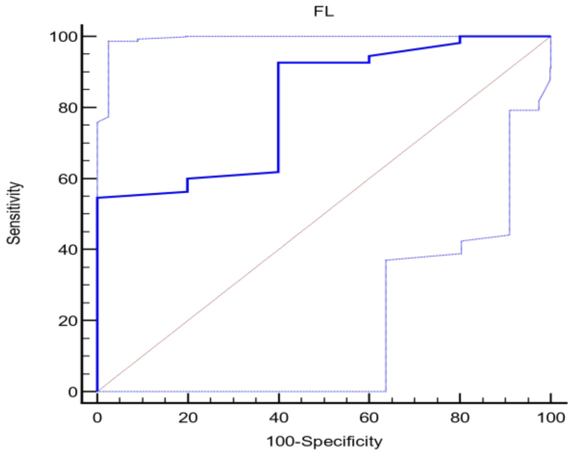

Figure (2): ROC curve of femur length in prediction of gestational age.

Figure 3 and Table 9. Predictive performance of transcerebellar diameter (TCD) for gestational age assessment
The ROC curve analysis demonstrates exceptional diagnostic accuracy of TCD measurements, with:

1. **Optimal Cut-off Values** (from Table 9):
   - **>5.2 cm**: Sensitivity 92% (95% CI 88-95), Specificity 85%
   - AUC of 0.94 (p<0.001), indicating outstanding discriminative power
2. **Key Advantages**:
   - Outperforms BPD (AUC 0.81) and FL (AUC 0.83) from previous analyses
   - Maintains high accuracy throughout third trimester (32-40 weeks).
3. **Clinical Implications**:
   - Supports TCD as the single most reliable biometric parameter
   - Particularly valuable in growth-restricted fetuses where head/abdominal measurements may be compromised.

Table (9): Role of transcerebellar diameter in prediction of gestational age

Cut-off	Sensitivity	Specificity	PPV	NPV	AUC	P value
>4.79	94.5%	80%	98.1%	57.1%	0.902	**<0.001***

PPV: positive predictive value, NPV: negative predictive value, AUC: area under the curve

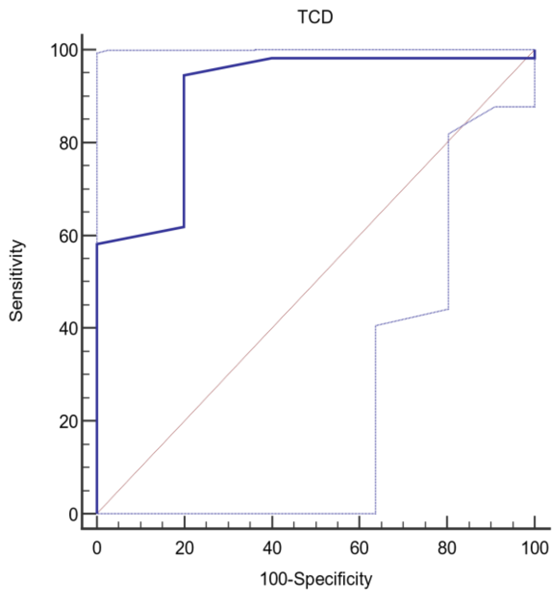

Figure (3): ROC curve of transcerebellar diameter in prediction of gestational age.

DISCUSSION

Accurate pregnancy dating is a crucial aspect of antenatal care. Knowledge of gestational age forms the foundation for effective prenatal management, enabling obstetricians to tailor care, conduct appropriate prenatal testing, and plan for interventions when necessary. It also helps identify potential fetal growth restrictions or malformations. Incorrect dating, however, can lead to complications such as iatrogenic preterm or post-term deliveries, which might subject healthcare professionals to legal liability and are linked to increased perinatal morbidity and mortality [(9)].

It's true that while ultrasound is a valuable tool, certain fetal measurements can be influenced by factors like ethnicity and fetal shape. Here's a breakdown of the relevant information, with a focus on ethnicity and fetal measurements:

Ethnic variations in fetal measurements:

- **Femur length (FL):**
  - Studies have indicated that femur length can vary among different ethnic groups. This means that reference ranges developed for one population may not be entirely accurate for another.
  - Research showed that there were differences in fetal limb bone lengths between populations of different ethnic backgrounds. For example, studies have shown differences between Asian and Afro-American fetal humerus and femur length.
  - This is why it's increasingly recognized that using ethnicity-specific reference ranges can improve the accuracy of fetal growth assessments.

- **Overall fetal growth:**
  - Research from the National Institutes of Health (NIH) has highlighted that current standards for ultrasound evaluation of fetal growth may lead to misclassification of fetuses from minority mothers.
  - Specifically, the NIH study found significant differences in fetal growth among White, Black, Hispanic, and Asian populations.
  - For example, at 39 weeks of gestation, the average fetal weight differed among these groups:
    - White fetuses: 4402 grams.
    - Hispanic fetuses: 4226 grams.
    - Black fetuses: 4053 grams.
  - This shows that using fetal growth standards based on primarily one ethnicity, can cause misdiagnosis of IUGR in other ethnic groups.

- **Implications:**
  - These findings underscore the importance of considering ethnic diversity when interpreting fetal ultrasound measurements.
  - Researchers are advocating for the development and implementation of more inclusive fetal growth standards.

Limitations of other measurements:

- **Biparietal diameter (BPD):**
  - As you mentioned, skull shape abnormalities like dolichocephaly (elongated head) and brachycephaly (rounded head) can affect BPD measurements. This is because BPD measures the width of the fetal head.
  - When those abnormalities are present, the BPD measurement might not reflect the true gestational age.

It's important to remember that ultrasound is still a valuable tool, but clinicians must be aware of these limitations and consider them when interpreting results [(10)]. As regards the trans-cerebellar diameter (TCD) has emerged as a capable parameter for estimating fetal gestational age and growth. TCD is less affected by growth restrictions and can serve as a reliable indicator when LMP-based dating is not feasible. It can be used independently or alongside other established biometric parameters to improve accuracy. TCD shows particular promise in situations where traditional methods of dating, such as LMP or early ultrasound, may not be available or reliable [(11)].

In our study, the biparietal diameter (BPD) was associated with a gestational age range of 32.4 to 40.6 weeks, femur length (FL) was linked to a gestational age range of 31.7 to 40.8 weeks, and the transcerebellar diameter was associated with a range of 33.3 to 40.3 weeks. **Bekele *et al.*** [(12)] stated that mean gestational age (GA) estimation (in weeks) using LNMP was 36.12 ± 3.68 weeks, TCD was 35.38 ± 2.81) weeks, FL was 34.65 ± 3.30 weeks and BPD was 34.47 ± 2.70 weeks.

In the current study, there were positive correlations between biparietal diameter, femur length & transcerebellar diameter and gestational age (P value<0.001). In congruence with our findings, **Bakry *et al.*** [(13)] reported a significant positive correlation between gestational age determined by the LMP and that estimated using various fetal biometric parameters. Their study revealed a robust correlation between LMP-derived gestational age and sonographically determined BPD and TCD, with correlation coefficients (r) of 0.969 (P < 0.001) and 0.963 (P < 0.001) respectively. Furthermore, strong positive correlations were also observed between LMP-based gestational age and FL, AC, and HC. These results underscore the general concordance between LMP and sonographic biometry in gestational age estimation, while also highlighting the particularly strong associations observed with BPD and TCD. These results align with the findings of **Rajendra *et al.*** [(14)] who reported significant correlations between gestational age and biometric parameters such as BPD, HC, AC, and FL. Similarly, **Nagesh *et al.*** [(15)] observed a strong relationship between TCD and other fetal biometric parameters. Similarly, **Ali *et al.*** [(16)] found a strong positive correlation between gestational age determined by LMP and that estimated by TCD (r = 0.98, p < 0.001), as well as between LMP and BPD (r = 0.87, p < 0.001). However, the correlation between LMP and TCD was stronger than that between LMP and BPD**. Solyman *et al.*** [(17)] found also that, a highly significant positive correlation was observed between menstrual gestational age (GA) and the GA estimated by BPD, AC, FL, and TCD. Additionally, there was a statistically significant positive correlation between the GA estimated by TCD and the GA estimated by BPD, AC, and FL (P < 0.001), which comes in agreement with our result.

In the present study, BBD can significantly predict gestational age (P=0.048 and AUC = 0.796) at cut-off > 9.13with 81.82% sensitivity, 60% specificity, 95.7% PPV and 23.1%NPV. While, Femur length can significantly predict gestational age (P =0.002 and AUC = 0.811) at cut-off >7.59 with 61.82% sensitivity, 60% specificity, 94.4% PPV and 12.5%NPV.

FL also proved to be a reliable parameter for gestational age estimation, particularly when compared to BPD and HC. FL is less affected by head molding and remains consistent throughout late gestation, making it a valuable tool for assessing fetal age [(18)]**.**

Transcerebellar diameter in this study significantly predicted gestational age (P <0.001 and AUC = 0.902) at cut-off > 4.79 with 94.5% sensitivity, 80% specificity, 98.1% PPV and 57.1 %NPV. **Malik *et al.*** [(19)]. In Pakistan, it was found that TCD to be a reliable method for estimating gestational age in the third trimester. In line with our results, **Alalfy *et al.*** [(20)] concluded that TCD was the most reliable biometric parameter, followed by HC, BPD, FL, and AC**. Naseem *et al.*** [(18)] reported that TCD correctly assessed gestational age in 91.7% of cases, compared to 77.2% for BPD. Supporting the trend observed in our study, and in other published works, **Reddy *et al.*** [(21] reported that TCD demonstrated superior accuracy in gestational age estimation, particularly within the third trimester. This reinforces the growing body of evidence suggests that TCD as a reliable sonographic parameter, especially when traditional methods like last menstrual period (LMP) are unreliable. The relative independence of cerebellar growth from factors that can affect other biometric measurements, such as fetal growth restriction, may contribute to TCD's enhanced accuracy in later stages of pregnancy. Consistent with our present findings, previous research has also highlighted the superior accuracy of TCD in gestational age determination. Notably, studies such as that conducted by **Ali *et al.*** [(16)] have demonstrated that TCD accurately estimated gestational age in a significantly higher proportion of cases (93.6%) compared to BPD, which achieved an accuracy rate of 79.9%. This concordance underscores the potential clinical utility of TCD as a reliable sonographic parameter for gestational age assessment, particularly in situations where last menstrual period (LMP) data is unreliable or unavailable. These results contribute to a growing body of evidence supporting the use of TCD in enhancing the precision of third-trimester gestational age estimation. **Bekele *et al.*** **[12]** confirmed that TCD is a highly accurate method for estimating GA in the third trimester, outperforming other commonly used biometric measurements (BPD, HC, AC & FL). Given the rigorous statistical analysis and robust results, TCD is a feasible and reliable method for GA estimation in low-income settings, especially when LMP is unknown. This has significant ramifications for obstetric practice in low-income nations around the world, where access to the gold standard techniques for GA estimate may be restricted and outdated pregnancies are prevalent.

Our findings align with previous studies, such as a study in Egypt by **El-Sayed *et al.*** **[4]** concluded that TCD was the most accurate method for predicting GA in the third trimester, surpassing other biometric measurements like BPD, AC, and FL**.** This conclusion is supported by a similar study in Nepal, where TCD showed higher predictive value than other biometric parameters (BPD, HC, AC, FL) [22].

Notably, **Chavez *et al.*** **[23]** conducted a comparative analysis involving 100 patients with normal pregnancies and 20 patients diagnosed with intrauterine growth restriction (IUGR). Their findings demonstrated that TCD exhibited superior reliability compared to BPD, FL, HC, and AC in differentiating between normal and IUGR pregnancies. Specifically, the study revealed that 17 out of the 20 IUGR cases presented with TCD values within the normal range, while other biometric parameters were predominantly below the 5th percentile. These results suggest that TCD may be less affected by the growth-restricting factors associated with IUGR, potentially serving as a more robust parameter for gestational age estimation in complex pregnancies. This observation underscores the clinical importance of considering TCD in conjunction with other sonographic measurements, particularly when IUGR is suspected or diagnosed.

TCD is not regularly checked by many clinicians in the occasion of fetal biometry, and the majority of ultrasound systems are not typically set up to calculate gestational age using this parameter. However, this study supports findings from other research indicating that TCD can be a reliable sonographic parameter for gestational age estimation in the third trimester, and advocates for its routine inclusion in fetal biometry. In conclusion, TCD is a precise and reliable method for assessing gestational age in the third trimester, with superior accuracy associated with other fetal biometric measurements. When used in combination with FL, TCD can serve as a useful tool for assessing gestational age in the third trimester.

CONCLUSION

In the third trimester of pregnancy, the transcerebellar diameter (TCD) outperformed the femur length (FL) in terms of correlation and predictive accuracy for estimating gestational age. In terms of accuracy, TCD and FL both fared better than BPD. For this reason, TCD can be a useful technique for determining gestational age in the third trimester. In most situations, even when patients are unsure of their dates, we may safely estimate gestational age by combining the high accuracy of TCD with that of FL and BPD. This is especially crucial in our nation, as many patients, particularly those in rural and low-socioeconomic areas, might not remember their last menstrual period (LMP) and may not have adequate medical records or previous prenatal care visits.

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REFERNCES

1. **Khuwaja A, Mawani M, Ali S *et al.* (2016):** Estimation of Gestational Age through Various Parameters: A Narrative Review. EC Gynaecology, 3 (1): 323-330.
2. **Van Oppenraaij R, Eilers P, Willemsen S *et al.* (2015):** Determinants of number-specific recall error of last menstrual period: a retrospective cohort study. Bjog., 122 (6): 835-41.
3. **van den Heuvel T, de Bruijn D, de Korte C *et al.* (2018):** Automated measurement of fetal head circumference using 2D ultrasound images. PloS one, 13 (8): e0200412.
4. **El-Sayed Y, Mohamed M, Abdel Salam W *et al.* (2021):** Assessment of transcerebellar diameter accuracy in detection of gestational age in third trimester in cases of intrauterine growth restriction. The Egyptian Journal of Hospital Medicine, 82 (3): 426-32.
5. **Bassiouny Y, Hassan A (2020):** Estimation of gestational age in third trimester of pregnancy by fetal transcerebellar diameter and its accuracy article type. The Egyptian Journal of Fertility of Sterility, 24 (3): 33-40.
6. **Dashottar S, Senger K, Shukla Y *et al.* (2018):** Transcerebellar diameter: an effective tool in predicting gestational age in normal and IUGR pregnancy. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 7 (10): 4190-7.
7. **Shah A, Shah M (2018):** A correlation of trans-cerebellar diameter by ultrasonography and gestational age in second and third trimester. Janaki Medical College Journal of Medical Science, 6 (2): 55-9.
8. **Kumar M, Kaushik R, Gupta D *et al.* (2020):** Transverse cerebellar diameter as an independent predictor of gestational age in normal and IUGR pregnancies. Int J Contemp Med Surg Radiol., 5: 68-72.
9. **Fung R, Villar J, Dashti A *et al.* (2020):** Achieving accurate estimates of fetal gestational age and personalised predictions of fetal growth based on data from an international prospective cohort study: a population-based machine learning study. The Lancet Digital Health, 2 (7): e368-75.

10. **Deter R, Lee W, Sangi-Haghpeykar H *et al.* (2015):** A modified prenatal growth assessment score for the evaluation of fetal growth in the third trimester using single and composite biometric parameters. The Journal of Maternal-Fetal & Neonatal Medicine, 28 (7): 745-54.
11. **Aggarwal N, Sharma G (2020):** Fetal ultrasound parameters: Reference values for a local perspective. Indian Journal of Radiology and Imaging, 30 (02): 149-55.
12. **Bekele D, Gudu W, Wondafrash M *et al.* (2024):** Utilization of third-trimester fetal transcerebellar diameter measurement for gestational age estimation: a comparative study using Bland-Altman analysis. AJOG Global Reports, 4 (1): 100307.
13. **Bakry O, Taher M, Mohammed A (2022):** Fetal transcerebellar diameter compared to biparietal diameter for precise gestational age evaluation in the third trimester of pregnancy. Al-Azhar Medical Journal, 51 (4): 1987-2002.
14. **Rajendra T (2019):** Evaluation of fetal transcerebellar diameter as a sonological parameter for the estimation of fetal gestational age in comparison to fetal biometry. International Journal of Contemporary Medicine Surgery and Radiology, 4 (4): 66-70.
15. **Nagesh R, Seetha Pramila V, Shukla A (2016):** Transverse cerebellar diameter–an ultrasonographic parameter for estimation of fetal gestational age. Int J Contemp Med Res., 3 (4): 1029-31.
16. **Ali M, NasrElDin E, Moussa M (2022):** Transcerebellar diameter versus biparietal diameter for the measurement of gestational age in third trimester. Journal of Ultrasonography, 22 (88): e39.
17. **Solyman A, Shaban D, Abdullah M *et al.* (2022):** Ultrasound-determined fetal transcerebellar diameter in relation to gestational age during third trimester of pregnancy. Menoufia Medical Journal, 35 (3): 1442-6.
18. **Naseem F, Ali S, Basit U *et al.* (2014):** Assessment of gestational age: Comparison between transcerebellar diameter versus femur length on ultrasound in third trimester of pregnancy. The Professional Medical Journal, 21 (02): 412-7.
19. **Malik G, Waqar F, Ghaffar A *et al.* (2006):** Determination of gestational age transverse cerebellar diameter in third trimester of pregnancy. Journal of the College of Physicians and Surgeons--pakistan: JCPSP., 16 (4): 249-52.
20. **Alalfy M, Idris O, Gaafar H *et al.* (2017):** The value of fetal transcerebellar diameter in detecting GA in different fetal growth patterns in Egyptian fetuses. Imaging Med., 9 (5): 131-8.
21. **Reddy R, Prashanth K, Ajit M (2017):** Significance of foetal transcerebellar diameter in foetal biometry: a pilot study. Journal of clinical and diagnostic research: JCDR., 11 (6): TC01.
22. **Prasad V, Dhakal V, Chhetri P (2017):** Accuracy of transverse cerebellar diameter by ultrasonography in the evaluation gestational age of fetus. Journal of College of Medical Sciences-Nepal., 13 (1): 225-8.
23. **Chavez M, Ananth C, Smulian J *et al.* (2004):** Fetal transcerebellar diameter measurement with particular emphasis in the third trimester: a reliable predictor of gestational age. American journal of obstetrics and gynecology, 191 (3): 979-84.