Original Article

# Diagnostic Accuracy Of Transverse Cerebellar Diameter In Estimation Of Gestational Age Compared To Femur Length And Biparietal Diameter In The Second And Third Trimesters Of Pregnancy

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## Abstract

**Introduction:** The exact determination of gestational age is so important in management of the antepartum care, and for adequate planning of proper intervention or therapy. **Objective:** The aim of the present study is to assess the diagnostic accuracy of transversecerebellar diameter (T.C.D.) measurement in estimation of the gestational age during the second and third trimesters compared to the current fetal biometric measurements including femure length and biparietal diameter. **Patient and method:** The study included 300 pregnant women with sure and reliable dates fulfilling the inclusion criteria at department of Obstetrics and Gynecology, Kasr Alainy Hospital, Cairo University (inpatient & outpatient) from May 2017 till October 2018Regarding the study group, they were divided into three groups; 1st (14-20weeks), 2nd (21-30weeks),3rd (31-40week), the transcerebellar diameter, the biparietal diameter and femur length were measured for determination of gestational age. **Results:** The results of the conducted study showed that the transcerebellar diameter (TCD) is more accurate than the biparietal diameter (BPD), there were significant statistical difference between transcerebellar diameter (TCD)and biparietal diameter (BPD) and also there were significant statistical difference between transcerebellar diameter (TCD) and femure length (FL) for determination of gestational age in the second and third trimesters all those data were compared to the last menstrual period. **Conclusion:** Transcerebellar diameter is more reliable method of gestational age determination in the second and the third trimesters of pregnancy than biparietal diameter. Transcerebellar diameter (TCD) and femure length (FL) can be used as a tool to assist in the assessment of gestational age in the second and the third trimesters. **Kay word: (Transcerebellar Diameter- Femur Length- Biparietal Diameter – Gestational Age)**

## INTRODUCTION

The cerebellum, the largest part of the hind brain, lies in the posterior cranial fossa. It lies dorsal to the pons and the medulla, separated from them by the fourth ventricle. The Cerebellum is separated from the cerebrum by a fold of dura mater called the tentorium cerebelli. The cerebellum consists of a midline part called the vermis and two lateral hemispheres. It is roughly spherical but somewhat constricted in its median region and flattened, the greatest diameter being transverse [(1)].

The cerebellum develops from the dorsolateral part of the alar laminae of the metencephalon. In the embryo,the cerebellum appears at the end of the fifth week as a swelling overriding the fourth ventricle [(2)].

Assessment of the gestational age (G.A.) is important in the management of pregnancy and the most frequently used biometric parameters for the estimation of gestational age are the fetal biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL).
These parameters have few limitations as conditions altering the shape of skull well affect the BPD which is a well-accepted indicator of GA. So transverse cerebellar diameter (TCD) developed as an alternative parameter of fetal brain growth and for estimation of the gestaional age.
Several authors working on transverse cerebellar diameter have correlated it well with the gestaional age, even in the presence of growth retardation and found it as a better marker for gestational age estimation as compared to other clinical and biometric parameters [(3)].
To assess the diagnostic accuracy of transcerebellar diameter (T.C.D.) measurement in estimation of the gestational age during the second and third trimesters of pregnancy compared to femur length and biparietal diameter according to the last menstrual period.

## PATIENT AND METHOD

This study was conducted on 300 pregnant women were recruited from the department of Obstetrics and Gynecology, Kasr al-Aini medical school hospital, Cairo University attended (the outpatient clinic) seeking the antenatal care, routine ultrasound from May 2017 till October 2018.
Regarding the study group, they were divided into three groups; **Group 1:** 14-20weeks (early second trimesteric), **Group 2:** 21-29weeks (late second trimesteric) and **Group 3:** 30-40weeks (more than 30 weeks)
Regarding the patient included in our study they were subjected to: Trans-abdominal ultrasound for determination of the gestational age by the usual fetal biometric measurements (biparietal diameter and femur length) and also the measurement of transverse cerebellar diameter will be obtained.
The inclusion criteria were: Maternal age from 20-40 years (in childbearing period), gestational age confirmed by the first day of the last menstrual period in patients who were sure of theire dates/or early ultrasound scan and single tone uncomplicated pregnancy
The Exclusion criteria were: Patients who were unsure of dates, patients with associated fetal anomalies, patients with multiple gestation, patients with chronic medical disorders (diabetes mellitus or hypertension) and patients with pregnancy induced disorders (preeclampsia or gestational diabetes).

**Method:** Consent was obtained from the pregnant women who were included in the study after explaining the aim of the study and the procedure to be done. Full History Taking which included the name, demographic distribution, full Obstetric history and menstrual history includes the 1st day of last menstrual period (LMP), gestational age documentation, medical and surgical history. Ultrasound examination (Trans abdominal) via GE voluson 730 was done at the clinic of Obstetrics and Gynecology Department- Kasral-Aini hospital -Faculty of Medicine-Cairo University, mainly to measure the fetal biparietal diameter, femur length and the transverse cerebellar diameter as parameters of gestational age estimation. The Technique of ultrasound conducted was included to perform a Trans-abdominal ultrasound on all patients while women were in a tilted position with the head of the bed raised 30 degrees and with a small pillow under the right loin, all scans were performed by dr: Mahmoud alalfy a single 3-year experienced sonographer. All measurements were taken three times; the average of which were noted.

### The following measurements were taken:

**Measurement of the Biparietal diameter**: **The lateral ventricles view was obtained:** The two anterior horns of the lateral ventricles symmetrically placed about the midline. All or part of the posterior horns of the lateral ventricles symmetrically placed about the midline. The BPD includes the thickness of only the upper parietal bone (outer to outer measurement).

**Regarding the measurement of the transcerebellar diameter,** obtaining the Trans thalamic view of BPD then rotation of the probe slightly downwards, toward the fetal neck, the posterior horns of the lateral ventricles would disappear from the view to be replaced by the cerebellum. The T.C.D was measured at 90 degree to the long axis of the cerebellum across its widest point, using the outer to outer method.

**Regarding the measurement of the femur length**, it is imaged optimally with both ends of the ossified metaphysis clearly visible. Measuring the femur was ideally obtained after the abdominal circumference has been measured.

**Statistical Methods:** Data were statistically described in terms of mean ± standard deviation (± SD), and range, or frequencies (number of cases) and percentages when appropriate. Comparison between the different methods of estimating gestational age was done using paired t test. Accuracy of different estimation parameters in relation to the LMP parameter was done within 1 week error. p values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).


**Fig. (1) TCD measured in pregnant woman 23 years old with gestational age =34wks + 3days (from the current study)**

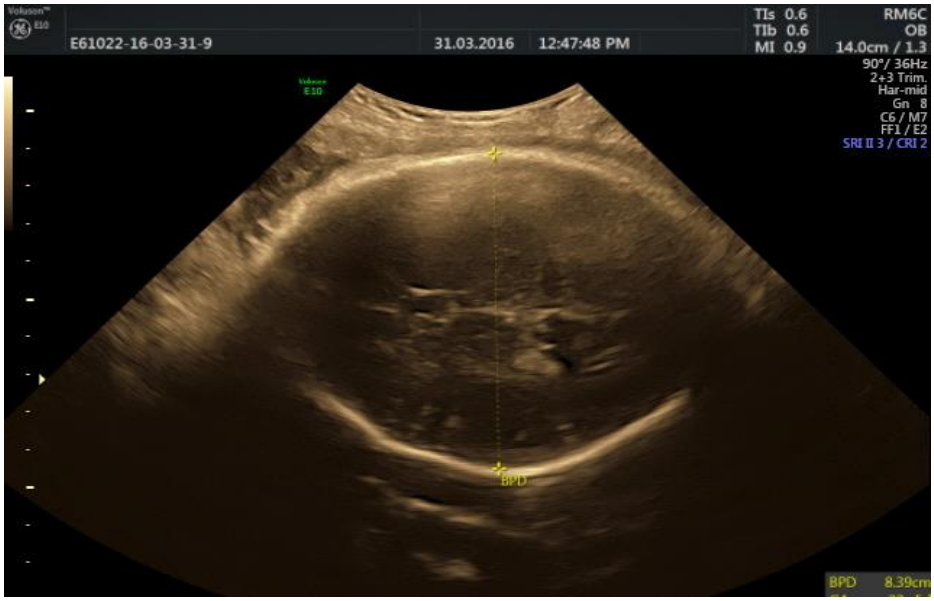


**Fig. (2) BPD measurement in pregnant women 33wks+5days of gestation (from the current study)**

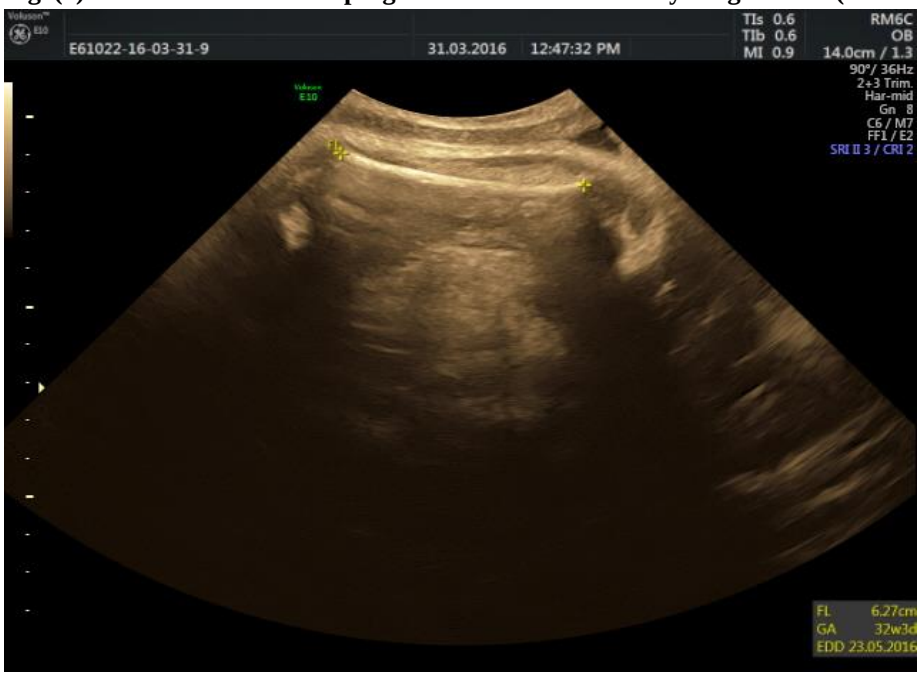


**Fig. (3) FL measured in pregnant woman 23 years old, 32wks+3days of gestation (from the current study)**

## RESULTS

In the present study, the demographic data revealed that the age range of the pregnant ladies was from 20 – 40 years.

The EFW of the fetuses ranges from 145 gm at the early second trimester to 3025 gm at late gestation as shown in (Table 1).

**Table 1: Description of all groups**

| | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| **GA BY LMP (weeks)** | 25.59 | 5.75 | 15.71 | 36.00 |
| **BPD GA (weeks)** | 24.81 | 5.90 | 15.71 | 36.29 |
| **HC GA (weeks)** | 25.84 | 6.33 | 15.57 | 38.43 |
| **AC GA (weeks)** | 26.16 | 6.04 | 16.14 | 38.14 |
| **FL GA (weeks)** | 25.75 | 5.84 | 15.86 | 37.00 |
| **TCD GA (weeks)** | 25.59 | 5.59 | 15.71 | 36.00 |

The measurements of BPD, HC, AC, FL and TCD in the early second trimester in weeks when correlated to GA by LMP shows a statistically significant P values, that was <0.001, <0.001, <0.001, <0.001, <0.001 respectively as shown in (Table 2).

**Table (2): Correlation of fetal biometries with GA by LMP in early second trimester group**

| Early 2nd trimester | | GA BY LMP (days) |
|---|---|---|
| **BPD GA (weeks )** | **r** | 0.818 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **HC GA (weeks )** | **r** | 0.893 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **AC GA (weeks )** | **r** | 0.865 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **FL GA (weeks )** | **r** | 0.884 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **TCD GA (weeks )** | **r** | 0.934 |
| | **P value** | <0.001 |
| | **N** | 100 |

The measurements of BPD, HC, AC, FL and TCD in the late second trimester in weeks when correlated to GA by LMP shows a statistically significant P values that was <0.001, <0.001, <0.001, <0.001, <0.001 respectively as shown in (Table 3).

**Table (3): Correlation with GA by LMP in late second trimester group**

| late 2nd trimester | | GA BY LMP (days) |
|---|---|---|
| **BPD GA (days)** | **r** | 0.924 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **HC GA (days)** | **r** | 0.921 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **AC GA (days)** | **r** | 0.893 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **FL GA (days)** | **r** | 0.915 |
| | **P value** | <0.001 |

| | | |
|---|---|---|
| | **N** | 100 |
| **TCD GA (days)** | **r** | 0.979 |
| | **P value** | <0.001 |
| | **N** | 100 |

The measurements of BPD, HC, AC, FL and TCD in the third trimester in weeks when correlated to GA by LMP shows a statistically significant P-values, that was <0.001, <0.001, <0.001, <0.001, <0.001 respectively as shown in (Table 4).

**Table (4): Correlation of fetal biometries with GA by LMP in >30 weeks**

| **>30 weeks** | | **GA BY LMP (days)** |
|---|---|---|
| **BPD GA (days)** | **r** | 0.711 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **HC GA (days)** | **r** | 0.785 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **AC GA (days)** | **r** | 0.683 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **FL GA (days)** | **r** | 0.694 |
| | **P value** | <0.001 |
| | **N** | 100 |
| **TCD GA (days)** | **r** | 0.949 |
| | **P value** | <0.001 |
| | **N** | 100 |

The measurements of BPD, HC, AC, FL and TCD in the second and third trimesters in weeks when correlated to GA by LMP shows a statistically significant P-values, that was <0.001, <0.001, <0.001, <0.001, <0.001 respectively as demonstrated in (Table 5)

**Table 5: Correlation of fetal biometries with GA by LMP in all second and third trimesters**

| | | **GA BY LMP (days)** |
|---|---|---|
| **BPD GA (days)** | **r** | 0.983 |
| | **P value** | <0.001 |
| | **N** | 300 |
| **HC GA (days)** | **r** | 0.979 |
| | **P value** | <0.001 |
| | **N** | 300 |
| **AC GA (days)** | **r** | 0.975 |
| | **P value** | <0.001 |
| | **N** | 300 |
| **FL GA (days)** | **r** | 0.979 |
| | **P value** | <0.001 |
| | **N** | 300 |
| **TCD GA (days)** | **r** | 0.996 |
| | **P value** | <0.001 |
| | **N** | 300 |

Linear regression analysis to detect accuracy of BPD in estimation of GA when correlated to GA by LMP shows a statistically significant P values in the early second trimester, late second trimester and

in GA more than 30 weeks and shows R square values as follows 0.669 , 0.855 and 0.505 respectively as shown in (**Figure** 4, 5).

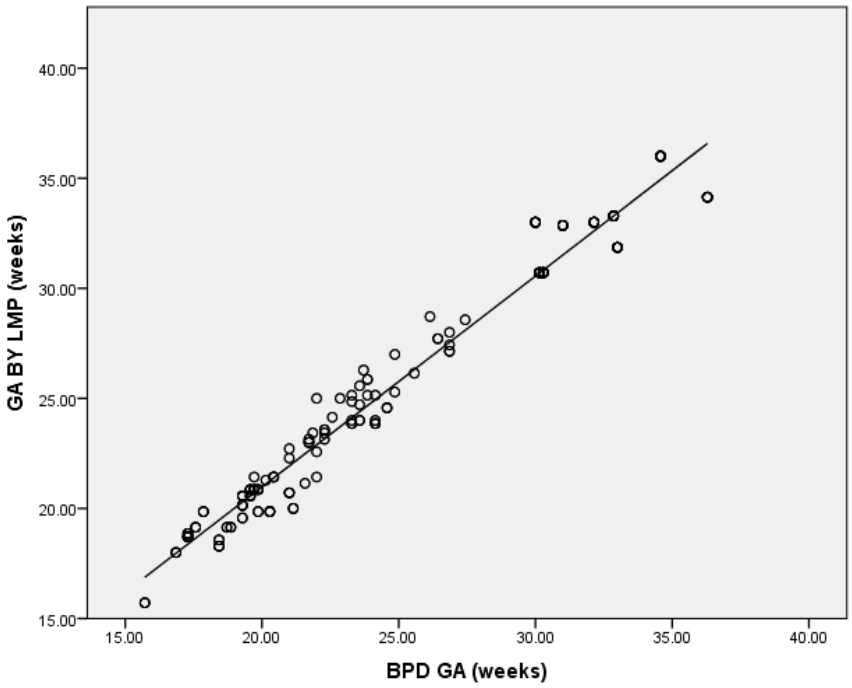


**Figure (4): Scatter dot curve for correlation between GA LMP and BPD in weeks in all patients**

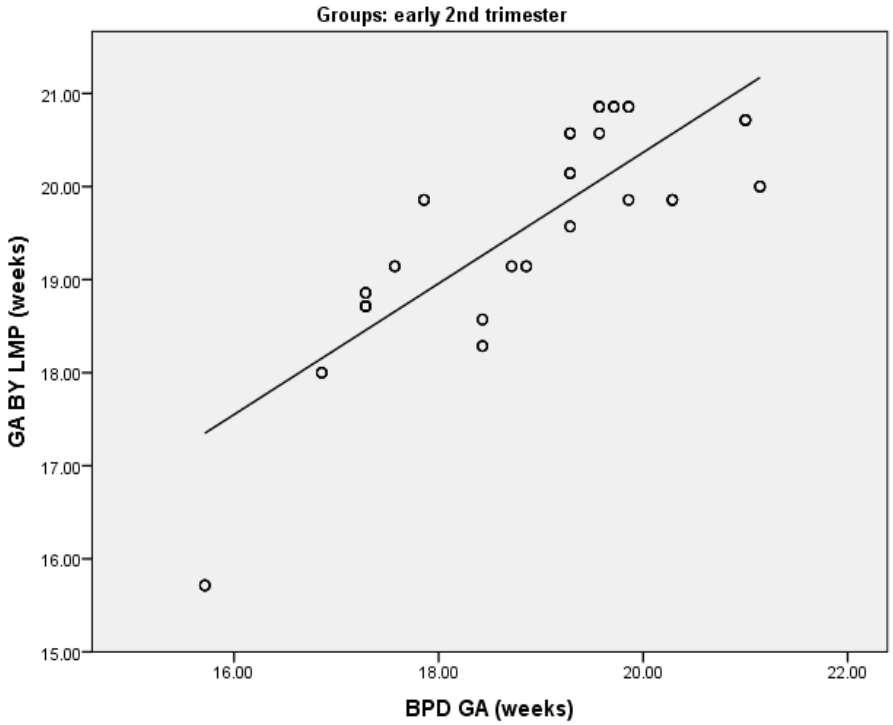


**Figure (5): Scatter dot curve for correlation between GA LMP and BPD in early second trimester group**

Linear regression analysis to detect accuracy of TCD in estimation of GA when correlated to GA by LMP shows a statistically significant P values in the early second trimester, late second trimester and in GA more than 30 weeks and shows the highest R square values that denotes better accuracy in estimating GA by TCD as follows 0.872 , 0.959 and 0.900 respectively as shown in (Table 6)

**Table 6: Linear regression to detect GA LMP in each group using TCD**

| Groups | R Square | | Unstandardized Coefficients | | Standardized Coefficients | t | P value |
|---|---|---|---|---|---|---|---|
| | | | B | Std. Error | Beta | | |
| **early 2nd trimester** | **0.872** | **(Constant)** | 2.420 | 0.664 | | 3.646 | <0.001 |
| | | **TCD GA (days)** | 0.867 | 0.034 | 0.934 | 25.874 | <0.001 |
| **late 2nd trimester** | **0.959** | **(Constant)** | 0.169 | 0.509 | | 0.332 | 0.741 |
| | | **TCD GA (days)** | 0.990 | 0.021 | 0.979 | 47.677 | <0.001 |
| **>30 weeks** | **0.900** | **(Constant)** | 6.150 | 0.900 | | 6.835 | <0.001 |
| | | **TCD GA (days)** | 0.819 | 0.028 | 0.949 | 29.724 | <0.001 |

Dependent Variable: GA BY LMP (weeks)

## DISCUSSION

This study was conducted to evaluate accuracy of predicting GA using Fetal Transcerebellar Diameter (TCD) and to compare between TCD and other existing parameters in evaluating GA from 14 to 40 weeks of gestation

This study was conducted on 300 pregnant women who were recruited from the department of Obstetrics and Gynecology, Kasr al-Aini medical school hospital, Cairo University attended (the outpatient clinic) seeking the antenatal care from May 2017 till October 2018.

Regarding the patient included in our study they were subjected to: Trans-abdominal ultrasound for determination of the gestational age by the usual fetal biometric measurements (biparietal diameter and femur length) and also the measurement of transverse cerebellar diameter was obtained.

Accurate knowledge of gestational age is required for proper management in obstetric care [(3)].

In modern era of advanced imaging, ultrasound is used in foetal biometry and LMP is used where early pregnancy scans are not available

Routine biometric parameters for GA assessment such as BPD, HC, AC and FL have their own limitations like BPD and HC because of moulding of head in third trimester. Similarly, femur length is not reliable in cases of achondroplasia.

In this study, when mean GA based all parameters were compared with that of LMP; all parameters in second trimester showed GA which was near to that of LMP. TCD had mean GA in second trimester which was near to that GA by LMP. In third trimester, TCD showed mean GA which correlated better with GA by LMP. When we compared overall mean GA also, TCD showed better correlation with that of LMP as following: In the early second trimester, the mean GA in the early second trimester by LMP was 19.56 weeks, in comparison to the mean GA in the early second trimester of BPD was 18.85 weeks Whereas the mean GA of the HC was 19.5, the mean GA of the FL was 19.75 and the mean GA by TCD was 19.76.

In the late second trimester, the mean GA by LMP was 24.35 weeks in comparison to the mean GA obtained by BPD which was 23.29 weeks, the mean GA by HC was 24.29 weeks while the mean GA by AC was 24.8 weeks, FL mean GA was 24.51 weeks whereas mean GA by TCD was 24.42 weeks.

In the third trimester, with GA more than 30 weeks, the mean GA by LMP was 32.85 weeks While BPD mean GA was 32.29 weeks, mean GA obtained by HC was 33.71 weeks, Mean GA of FL was 32.98 weeks and the mean GA by TCD was 32.6 weeks this was conistant with the work of **Ramireddy. H et al.,** [(4)] where the mean GA based all parameters were compared with that of LMP; all parameters in second trimester were showing GA which was near to that of LMP. TCD had mean GA of 21.12 in second trimesters which was near to that GA by LMP. In third trimester, TCD showed mean GA which correlated better with GA by LMP. When we compared overall mean GA also, TCD showed better correlation with that of LMP

In our study by comparing the gestational age by LMP and the gestational age by TCD, we obtained a Pearson's coefficient of correlation (r) of all parameters. In second trimester all parameters were having nearly equal r-values. TCD had highest correlation among all. In third trimester, there was considerable difference in r-value with TCD being parameter having high correlation as following: In the present study

the intra-class correlation between the TCD and the actual gestational age showed excellent agreement. In second trimester, all parameters were showing nearly equal values. In third trimester, TCD had intra-class correlation which was higher than other parameters and this goes with the work of **Naseem et al., [5]** who did a study in 228 patients with gestational age of 36 weeks measuring TCD and BPD by ultrasonography. They compared GA by TCD and BPD with LMP. In this study, they observed that in 228 patients, when compared with GA by LMP, TCD had given accurate gestational age in 209 patients and BPD had given accurate gestational age in 176 patients.

The measurements of BPD, HC, AC, FL and TCD in the early second trimester in weeks when correlated to GA by LMP shows a statistically significant P values, that was <0.001, <0.001, <0.001, <0.001, <0.001 respectively.

The measurements of BPD, HC, AC, FL and TCD in the late second trimester in weeks when correlated to GA by LMP shows a statistically significant P values, that was <0.001, <0.001, <0.001, <0.001, <0.001 respectively

The measurements of BPD, HC, AC, FL and TCD in the third trimester in weeks when correlated to GA by LMP shows a statistically significant P values, that was <0.001, <0.001, <0.001, <0.001, <0.001 respectively

A study was carried out by **Goel et al., [6]** on 50 antenatal patients (20–40 years of age) between 14 and 40 weeks of pregnancy attended to the clinic for routine ultrasound examination. Measurement of Ultrasonograph of TCD was performed to assess the gestational age. The regression analysis indicated a significant relationship between TCD and GA, indicating that TCD is a good marker for the estimation of GA as the same was shown in the present study: The intraclass correlation coefficient of Fetal biometry and TCD when correlated to GA by LMP shows that TCD had the highest by BPD with a value equal to 0.983 then FL with a vlue of 0.979 then HC with a value equal to 0.975 and the less accuracy was for the AC with a value equal to 0.974

The intraclass correlation coefficient of Fetal biometry and TCD when correlated to GA by LMP in the GA more than 30 weeks , shows that TCD had the highest intraclass correlation coefficient with a value equal to 0.939 followed by BPD with a value equal to 0.683 followed by HC with a value equal to 0.652 followed by FL with a value of 0.630 then AC with a value equal to 0.603 and the same was meeting the work done by **Holanda Filho et al., [7]** who found a close correlation between cerebellar dimensions and GA using fetal growth parameters including BPD, head circumference, FL, and estimated fetal weight, this relationship had been found to be independent on fetal gender

Another study was conducted by **Mahmoud Alalfy et al., [8]** To measure the accuracy of the transcerebellar diameter (TCD) in accurately determining the gestational age (GA) of fetuses in comparison to other fetal biometric measurements (BPD, HC, AC, FL) in pregnant women with no medical disorders and in hypertensive gestations that have IUGR fetuses, in diabetic women with macrosomic fetuses, in fetuses with congenital structural abnormalities not involving cerebellum and in congenital anomalies of cerebellum that resulted in that (IQR)the interquartile range of the discrepancy between menstrual and sonographic gestational ages was the least when Transcerebellar diameter, in comparison to Biparieteal Diameter, Head Circumference, Abdominal Circumference and Femur Length (0.43 mm, 1.27 mm, 1.0 mm, 1.56 mm and 1.28 mm, respectively).

So, from our research results and data obtained, we settled and concluded that the most, reliable, precise showing superiority in accurate analysis and assessment of fetal gestational age was the TCD followed by the HC then the BPD followed by the FL and the least precise tool of calculating fetal gestational age was AC this finding is similar to other research studies which strengthens and augments our research study findings and results reliability [9].

## CONCLUSION

This study showed that TCD is an accurate predictor of the gestational age in the second and third trimesters. The correlation between the LMP derived gestational age and the gestational age by TCD seems to decrease from second to third trimester. Even in the third trimester TCD is fairly accurate and

better predictor of gestational age in comparison to the other ultrasound parameters as BPD, HC, AC, FL.

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