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ORIGINAL ARTICLE

Comparative Study Between Transcerebellar Diameter and Head Circumference in Assessment of Gestational Age

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Abstract

Background: **Accurately determining the gestational age of a pregnant woman is crucial for optimizing the care she receives and the health of her unborn child. Despite the fact that several biometric markers were shown to be reliable in estimating gestational age, it was discovered that these estimates were impacted by aberrant fetal growth patterns.**

Aim: **Comparing transcerebellar diameter (TCD) to head circumference (HC) for determining gestational age in the third trimester.**

Patients and methods: **One hundred and fifty pregnant women were observed during their third trimester. Patients were recruited from the obstetrics and gynecology outpatient clinics and causalities at Al-Azhar University Hospital, Kafr Shokr Central Hospital, and private specialized ultrasonography units.**

Results: **The current research showed that the mean of TCD (mm) was 31 mm in 28−32 weeks, 35 mm in 32−36 weeks, and 39.4 mm in 36−40 weeks. Additionally, the mean HC (cm) was 26.5 ± 0.69 cm in 28−32 weeks, 29.3 ± 0.6 in 32−36 weeks, and 31.7 ± 37 cm in 36−40 weeks. The mean gestational age by last menstrual period (LMP) was 33.92 with minimum 28 and maximum 40 weeks, the mean gestational age by TCD was 33.74 with minimum 28 and maximum 40 weeks, and the mean gestational age by HC was 33.56 with minimum 28 and maximum 40 weeks. Weeks by TCD and weeks by LMP had a statistically significant positive relationship ($P < 0.005$). The two measures of gestational age, TCD, and HC, were positively connected ($P < 0.005$). Additionally, there was a statistically significant positive correlation among weeks by LMP and weeks by HC ($P < 0.005$).**

Conclusion: **Cerebellar transverse diameter TCD has potential as a robust third-trimester biomarker of gestational age.**

Keywords: Head circumference and last menstrual period, Transcerebellar diameter, Ultrasonography

1. Introduction

It is crucial for antenatal examinations and the effective planning of suitable therapy or intervention for an obstetrician to have an accurate understanding of the patient's gestational age. Iatrogenic preterm, which can occur if the procedure fails, is a known risk factor for perinatal mortality and morbidity.[1]

Ultrasonography has substantially improved the evaluation of fetal growth and development, allowing for the prenatal diagnosis of a wide variety of congenital disorders. Ultrasonographic fetal biometry provides a high degree of reliability in the first and second trimesters of pregnancy. However, the accuracy of ultrasound techniques degrades dramatically after the first trimester. By the third trimester, the reliability of a single ultrasound measure is poor absent connection with other data.[2,3]

Predicting surgical births and unplanned cesarean sections based on fetal head circumference (HC). With an HC measuring 37−41 cm, labor is greatly extended, and the likelihood of having a surgical birth or an emergency cesarean operation increases.[4]

These types of deliveries cause more maternal and fetal complications and involve higher costs compared with uncomplicated vaginal births.[5]

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Dolichocephaly and brachycephaly are two examples of fetal head shape variations that can be accounted for with more accuracy by measuring transcerebellar diameter (TCD) rather than relying on ultrasound. If determining the biparietal diameter is too challenging or unattainable, or if it is not appropriate due to the head's exaggerated shape, then the TCD can be used instead. This is due to the immutability of cerebellar structure and the association between cerebellar volume and maternal age at birth and cerebral hemisphere size.[6]

When measured earlier in pregnancy, biparietal diameter is also a potential indicator of an accurate gestational age.[7]

2. Patients and methods

After ethical committee approval, a total of 150 females were evaluated in this study in Al-Azhar University Hospital, Kafr Shokr Central Hospital, and private specialized ultrasonography units. The study was done in 150 normal pregnancies with known last menstrual period (LMP).

2.1. Inclusion criteria

Congenital fetal malformation anomalies of fetal head (hydrocephalus brachycephaly, dolichocephaly ventricular anomaly, medical disorder of the fetus, and intrauterine fetal demise).

Intrauterine growth restriction: hydrops fetalis multiple pregnancies.

2.2. Exclusion criteria

Patients who have anomalous fetuses, intrauterine death, and medical disorders like diabetes, hypertension, and intrauterine growth restriction.

2.3. Head circumference

Was taken with the transducer at right angles to the skull's longitudinal axis, on a plane that runs across the brain's thalamus and septum pellucidum. The cerebellar hemispheres should be obscured from view and the cerebral hemispheres and calvaria should look symmetrical. The ellipse should be measured with calipers and drawn around the periphery of the skull.

2.4. Ultrasound device

Voluson E6 (GE Healthcare, Austin gmbh, South Korea) convex, and Mindray DC3 with transabdominal transducer 3–5 MHz.

2.5. Statistical analysis

All data obtained will be entered into SPSS (IBM, Chicago, IL) for thorough tabulation and statistical analysis before being displayed graphically.

2.6. Data management and statistical analysis

IBM's Social Science Software (SPSS), version 20, was used for data entry once it was collected, coded, evaluated, and entered. Quantitative information was represented as mean ± SD range for parametric data, median interquartile range for nonparametric data, and raw numbers and percentages for qualitative information.

Two quantitative parameters were compared using the Spearman correlation coefficient to determine whether or not there was a statistically significant relationship among them.

The margin of error allowed was 5 %, and the confidence interval was set to 95 %. Therefore, the following cutoffs were established for the significance of the *P* value: *P* value more than 0.05 for nonsignificance, *P* value less than 0.05 for significance, and *P* value less than 0.01 for high significance.

3. Results

The study includes 150 patients admitted in Al-Azhar University Hospital and Kafr Shoker Hospital.

Table 1 shows that mean of age was 26.273 with range from 18 to 43 years.

In total, 51 (34 % of total) patients had only one child, 35 (23.3 %) patients had two children, 17 (11.3 % of total) patients and two (1.3 %) patients had four children, and two (1.3 %) patients had five children, as shown Table 2 (Fig. 1).

Table 3 shows mean TCD 31 mm at 28–32 week, 35.1 mm at 32–36 weeks, and 39.4 mm at 36–40 weeks.

Table 1. Age.

	Minimum	Maximum	Mean	SD
Age	18	43	26.273	5.493

Table 2. Parity.

	n (%)
One time	51 (34.0)
Two times	35 (23.3)
Three times	17 (11.3)
Four times	2 (1.3)
Five times	2 (1.3)

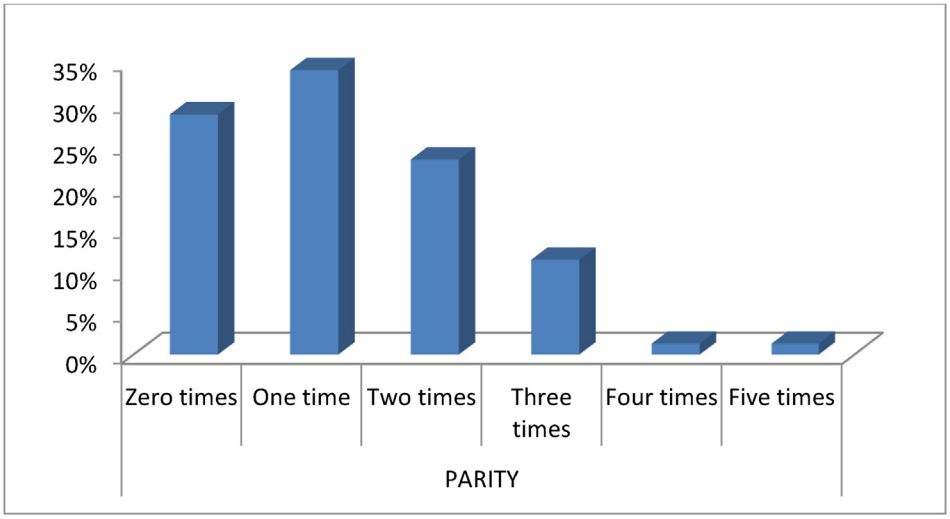

Fig. 1. Parity.

Table 3. Transcerebellar diameter (in mm) during different gestational weeks compared with mean last menstrual period, transcerebellar diameter (in mm) during different gestational weeks compared with mean last menstrual period.

Gestational age (in weeks)	Number of cases	Minimum TCD (in mm)	Maximum TCD (in mm)	Mean TCD (in mm)
28–32	32	28.7	33.3	31
32–36	74	32.8	37.4	35.1
36–40	44	37.5	41.3	39.4

TCD, transcerebellar diameter.

We studied the relationship among gestational age and various ultrasound parameters and found a positive correlation between weeks by TCD and weeks by LMP and a positive correlation between weeks by HC and weeks by LMP (Table 4).

The mean HC (cm) was 26.5 ± 0.69 cm in 28–32 weeks, 29.3 ± 0.6 in 32–36 weeks, and 31.7 ± 37 cm in 36–40 weeks. The mean gestational age by LMP was 33.92 with minimum 28 and maximum 40 weeks, the mean gestational age by TCD was 33.74 with minimum 28 and maximum 40 weeks, and the mean gestational age by HC was 33.56 with minimum 28 and maximum 40 weeks (Table 5, Figs. 2–4).

4. Discussion

It is crucial to correctly estimate the pregnant woman's gestational age in order to provide better antenatal care and better manage pregnancy outcomes. Although certain biometric markers have been shown to be accurate for estimating gestational age, their estimates have been found to be impacted by aberrant fetal growth patterns.[8]

The mean age of the study population was 26.273 with minimum 18 and maximum 43 years. As regard to parity of the study population, 43 (28.7 %) pregnant women were nulliparous, 51 (34.00 %) pregnant women were *P*1, 35 (23.3 %) pregnant women were *P*2, 17 (11.3 %) pregnant women were *P*3, two (1.3 %) pregnant women were *P*4, and two (1.3 %) pregnant women were *P*5.

The current results showed that the mean of TCD (mm) was 31 mm in 28–32 weeks, 35 mm in 32–36 weeks, and 39.4 mm in 36–40 weeks. Additionally, the mean HC (cm) was 26.5 ± 0.69 cm in 28–32 weeks, 29.3 ± 0.6 in 32–36 weeks, and 31.7 ± 37 cm in 36–40 weeks.

Similarly, Bavini et al.[9] indicated that fetal growth is seen in increases in all biometric indicators as the pregnancy progresses. Third-trimester TCD

Table 4. Relationship among gestational age and ultrasonography parameters includes head circumference and transcerebellar diameter.

Parameters	Correlation coefficient (*R*)	Determination coefficient (R^2)	*P* value
Transverse cerebellar diameter	0.965	0.952	<0.005
Head circumference	0.972	0.934	<0.005

Table 5. Descriptive statistics of head circumference, measurement (cm) for each gestational age (28–40 weeks).

Gestational age (in weeks)	Number of patients	HC (cm) (minimum)	HC (cm) (maximum)	HC (cm) (mean ± SD)
28	8	23	27.4	25.2 ± 0.32
29	10	25.1	27.9	26.53 ± 0.69
30	4	26.4	29.6	27.75 ± 0.76
31	10	26.9	29.6	28.42 ± 0.66
32	15	27.9	31.6	29.15 ± 0.83
33	20	27.0	31.3	29.16 ± 0.89
34	18	28.4	32.2	30.17 ± 1.06
35	21	29.0	33.0	30.64 ± 0.87
36	13	28.6	33.16	31.17 ± 1.10
37	12	29.6	33.22	31.17 ± 0.81
38	8	29.6	33.28	31.75 ± 0.99
39	4	29.8	33.31	31.76 ± 0.84
40	7	29.8	33.36	31.79 ± 0.78

HC, head circumference.

averages were 35 ± 0.98 mm in weeks 28–32, 40 ± 1.04 mm in weeks 32–36, and 43 ± 0.88 mm in weeks 36–40.

Eze et al.[10] conducted a cross-sectional survey on cases of singleton normal pregnancy between 16 and 40 weeks of gestation and found that TCD had a strong positive linear relationship with gestational age ($R = 0.988$, $R^2 = 0.975$, $P < 0.001$) during the second and third trimesters. The mean TCD was 32.0 ± 11.6 mm.

Among singleton pregnancies for which the gestational age is known, a recent study by Bavini et al.[9] found that after 36 weeks of pregnancy, the mean discrepancy between the TCD's estimate of gestational age and that by first-trimester ultrasonography had grown from 6 days to 6 days (from a

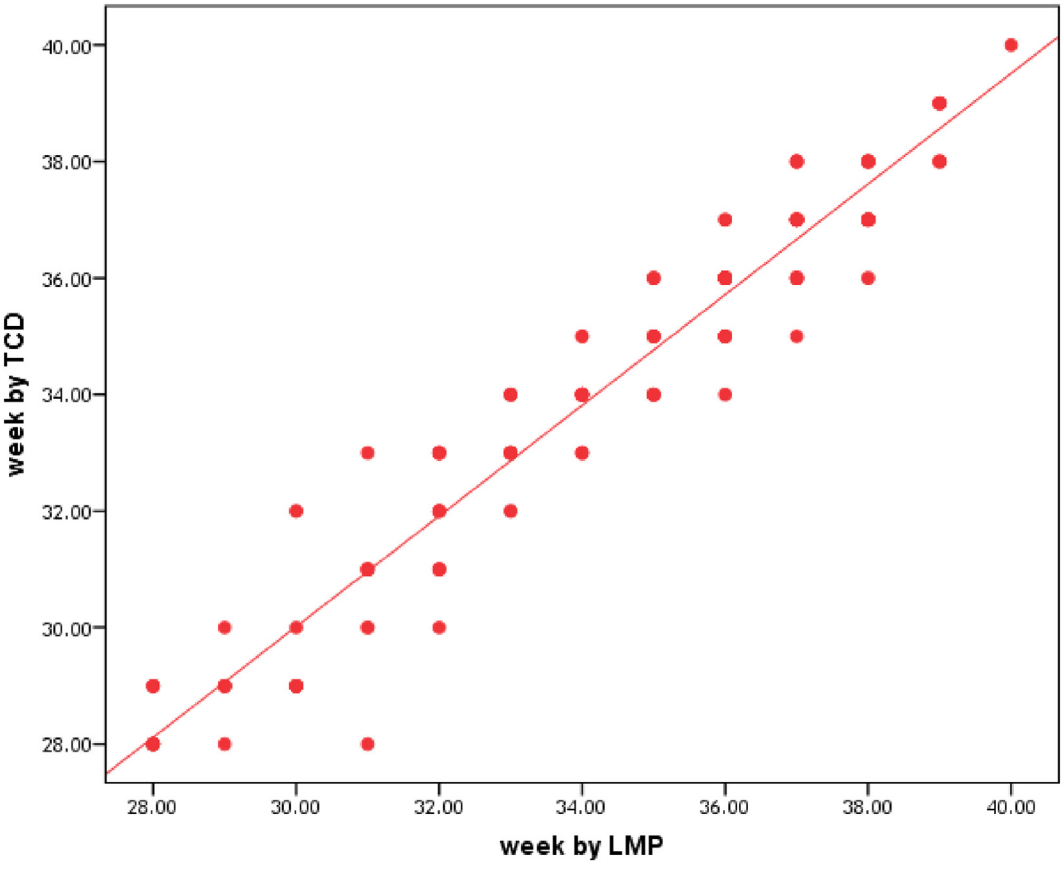

Fig. 2. Correlation between weeks by TCD and weeks by LMP. LMP, last menstrual period; TCD, transcerebellar diameter.

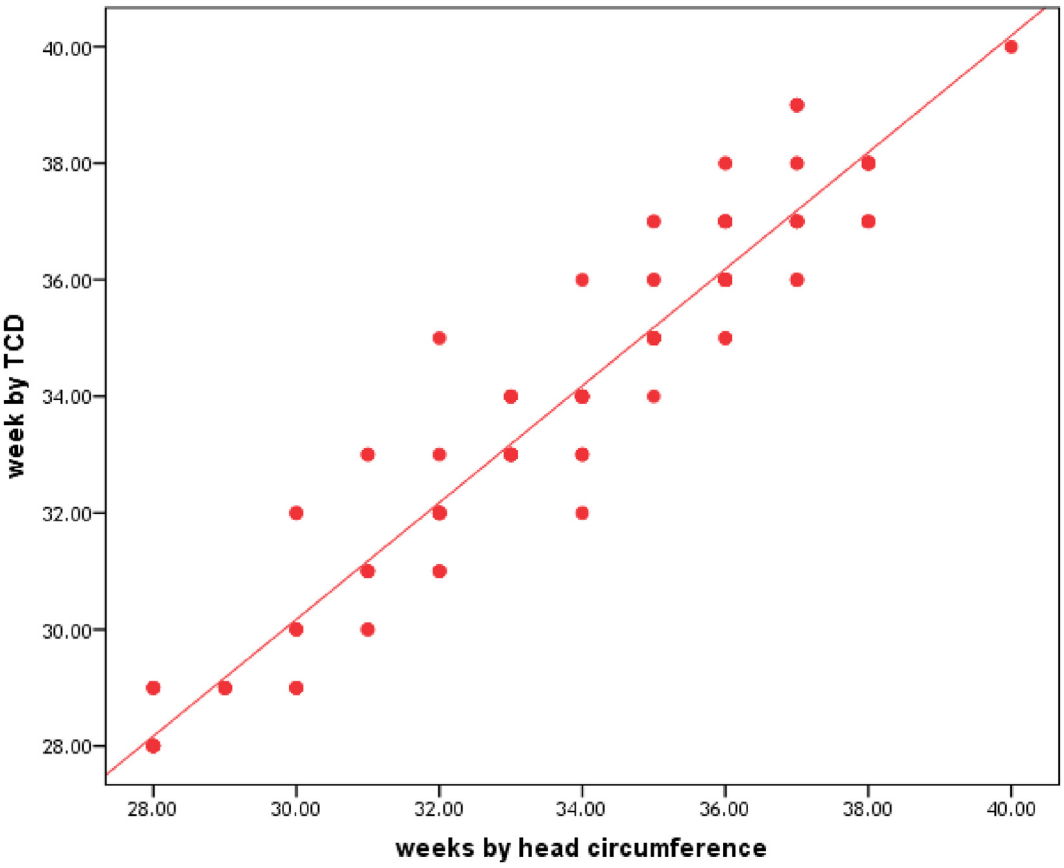

Fig. 3. Correlation between weeks by TCD and weeks by head circumference. TCD, transcerebellar diameter.

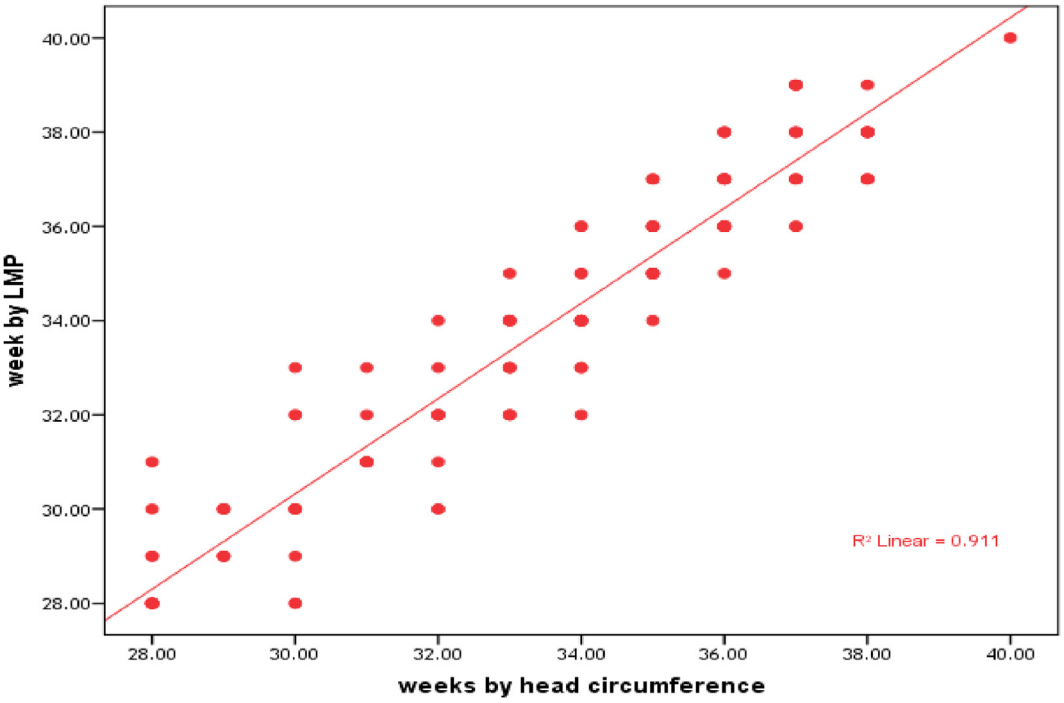

Fig. 4. Correlation between weeks by LMP and weeks by head circumference (HC), there is a positive correlation between weeks by LMP and weeks by HC. LMP, last menstrual period.

difference of 1 day at 28–32 weeks to ±1–2 days at 32–36 weeks). This demonstrated that the TCD could accurately predict the gestational age of a pregnant woman within 6 days. With routine biometry and the TCD, it was possible to estimate the gestational age to within 6 days of the due date, making the TCD a viable alternative for assessing the gestational age when the LMP is unknown.

We detected a statistically significant positive correlation between TCD weeks and LMP weeks ($P < 0.005$). The connection between weeks by TCD and weeks by HC was positive and statistically significant ($P < 0.005$). Furthermore, weeks by LMP and weeks by HC were positively related ($P < 0.005$).

These findings corroborated those of an earlier study by Ali et al.[11] There was no statistically significant difference among LMP and each of TCD ($P = 0.106$), Femur Length (FL) ($P = 3$), and Abdominal Circumference (AC) ($P = 0.496$) in the third trimester of pregnancy, while a significant difference was detected among LMP and Biparietal Diameter (BPD) ($P < 0.001$). Eleven studies compared LMP to each of these other methods of determining gestational age.

Similarly, Varsha et al.[12] study found gestational age and HC to be statistically highly significantly positively correlated during the third trimester of pregnancy.

Additionally, previously, Naseem et al.[13] measured TCD and FL using ultrasound in a group of 327 patients whose gestational ages ranged from 28 to 40 weeks. TCD and FL were compared with LMP to determine the gestational age. TCD correctly estimated the gestational age in 80.1 % of patients, while FL estimated it in just 70 % of cases.

While most biometric parameters assessed via ultrasonography were considerably impacted by the overall growth retardation, a prior study by Matur and Chauhan[14] showed that the TCD remained unchanged.

Bassiouny and Hassan[15] found that TCD was accurate in 88.3 % of instances, FL was accurate in 65.5 % of cases, and BPD was accurate in 51.5 % of cases when comparing the accuracy of biometric data taken during the third trimester of pregnancy.

El-Ebeisy et al.[16] studied one thousand pregnant females between 14 and 40 weeks of pregnancy and found that TCD accuracy was the highest in the late second trimester (91.6 %), lowest in the late third trimester (68.1 %), and intermediate in the early third trimester (82 %).

The TCD accurately predicts the time of pregnancy. Ultrasonography of the fetal skull by Leibovitz et al.[17] demonstrated that the cerebellar diameter is a more accurate indicator of gestational age than the biparietal diameter in the presence of aberrant skull shapes like brachycephaly or dolichocephaly.

Uikey et al.[18] found a link between TCD and BPD ($r = 0.960$), HC ($r = 0.979$), AC ($r = 0.980$), and FL ($r = 0.976$), which is consistent with our findings. TCD was found to be an accurate method of determining gestational age in the second and third trimesters of pregnancy, independent of aberrant fetal growth patterns, in the same study.

In a study comparing the fetal TCD to other established gestational age measures from 15 to 40 weeks of gestation, Reddy et al.[19] found that the TCD is a reliable indicator of gestational age, especially during the second trimester.

The accuracy of TCD as a biometric assessment for estimating gestational age, which is unaffected by growth restriction, was verified in another study by Dashottar et al.[20]

When comparing TCD to BPD, FL, and AC, George et al.[21] found that TCD provides the most accurate estimate of gestational age. The linear association among TCD and gestational age as determined by LMP can be seen across all gestational ages. TCD correlates highly with FL and also has a good connection with BPD and AC, two additional traditional criteria.

It has also been shown by El-Refaie et al.[22] that when it comes to estimating the gestational age in the third trimester, TCD is the gold standard, followed by FL, BPD, and finally AC. Furthermore, by combining the accuracy of TCD (91 %) and that of FL (82 %), we may be fairly certain of our patients' gestational ages even if they are unclear of their dates. Comparing TCD and GA by the Hadlock equation, the former was more accurate in the range of 35 weeks, while the latter was more accurate in the range of 36 weeks.

4.1. Conclusion

TCD could serve as a reliable indicator of gestational age in the third trimester.

Conflicts of interest

There are no conflicts of interest.

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