SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Udagi and Udagi, 2026
doi: 10.21276/SSR-IIJLS.2026.12.6.4

Original Article

open access

Correlation of Fetal TCD, AC and TCD/AC Ratio with Gestational Age

Chaitra Udagi[1]*, Sharanaprabhu Udagi[2]

[1]Consultant, Department of Radio-diagnosis, SKS Medical College, Durgapur, West Bengal, India
[2]Consultant, Department of Radio-diagnosis, SKS Medical College, Durgapur, West Bengal, India

***Address for Correspondence:** Dr. Chaitra Udagi, Consultant, Department of Radio-diagnosis, SKS Medical College, Durgapur, West Bengal, India
E-mail: chaitragv23@gmail.com

Received: 07 Jul 2026/ Revised: 01 Aug 2026/ Accepted: 28 Aug 2026

ABSTRACT

Background: Accurate assessment of gestational age and fetal growth is essential in antenatal care. Trans-cerebellar diameter (TCD) is relatively preserved in fetal growth restriction, whereas abdominal circumference (AC) is an early, sensitive indicator of impaired growth. This study aimed to correlate fetal TCD, AC and the TCD/AC ratio with gestational age.

Methods: This cross-sectional study included 100 women with uncomplicated singleton pregnancies (20–42 weeks) at SKS Medical College, Durgapur, from August 2025 to August 2026. TCD and AC were measured using transabdominal ultrasonography, and the TCD/AC ratio was calculated. Gestational age was assessed using the last menstrual period and ultrasonographic parameters. Data were analysed using descriptive and correlation statistics.

Results: Participants were aged 18–36 years, with a mean age of 23 ± 3.8 years; 57% were primigravida. TCD increased with gestational age and showed a significant positive linear correlation. AC also increased significantly with gestational age. The mean TCD/AC ratio was 14.11 ± 1.8 and showed no statistically significant correlation with gestational age ($p = 0.081$), suggesting that the ratio remained relatively stable across gestation. TCD values in millimetres approximately corresponded to gestational age in weeks between 20 and 23 weeks.

Conclusion: TCD and AC correlate positively with gestational age, while the TCD/AC ratio appears relatively independent of gestational age. The ratio may be useful in sonographic assessment for fetal growth restriction; however, its diagnostic performance requires evaluation in pregnancies affected by growth restriction.

Key-words: Abdominal circumference; Fetal growth restriction; Gestational age; Pregnancy; Trans-cerebellar diameter; Ultrasonography

INTRODUCTION

Assessment of fetal growth is an essential component of antenatal care, as impaired fetal growth is associated with increased perinatal morbidity and mortality. Clinical estimation of fetal growth may be inaccurate; therefore, prenatal ultrasonography provides a reliable method for assessing fetal growth, determining gestational age, detecting congenital anomalies, and evaluating fetal well-being [1].

How to cite this article
Udagi C, Udagi S. Correlation of Fetal TCD, AC and TCD/AC Ratio with Gestational Age. SSR Inst Int J Life Sci., 2026; 12(6): 11110-11116.

Access this article online
https://iijls.com/

Accurate assessment of gestational age is particularly important for interpreting fetal biometric measurements and identifying deviations from expected growth patterns.

The commonly used ultrasonographic parameters for assessing fetal growth include biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). These parameters correlate with gestational age and are routinely used in fetal biometry. However, individual biometric measurements may be influenced by fetal growth abnormalities, making the evaluation of additional parameters potentially useful in selected clinical situations.

Trans-cerebellar diameter (TCD) is an emerging sonographic parameter for assessing fetal growth and estimating gestational age. The fetal cerebellum is

Copyright © 2026| SSR-IIJLS by Society for Scientific Research under a CC BY-NC 4.0 International License

doi: 10.21276/SSR-IIJLS.2026.12.6.4

located in the posterior cranial fossa and is relatively protected by surrounding bony structures. TCD has been reported to remain relatively preserved in fetuses with intrauterine growth restriction (IUGR), even during late gestation, making it a potentially useful parameter for evaluating fetal growth [2]. Measurement of TCD may therefore complement conventional fetal biometric parameters, particularly when abnormal fetal growth is suspected.

Among ultrasound-derived fetal biometric measurements, abdominal circumference (AC) is considered an early and sensitive indicator of fetal growth restriction (FGR) [3]. AC reflects fetal abdominal size and may be reduced when fetal growth is impaired. Consequently, combining TCD, which may be relatively preserved, with AC, which may decrease in growth-restricted fetuses, provides a rationale for evaluating the TCD/AC ratio as an additional sonographic parameter.

Fetal growth restriction is defined as the failure of a fetus to achieve its genetic growth potential and is associated with an increased risk of prenatal morbidity and mortality [4,5]. Early identification of growth-restricted fetuses is important because timely surveillance and appropriate clinical management can help reduce adverse perinatal outcomes. Appropriate assessment of fetal growth and early recognition of IUGR remain important objectives in contemporary obstetric practice [6].

The TCD/AC ratio has been investigated as a potentially gestational age-independent parameter for assessing fetal growth. Evaluating its relationship with gestational age, alongside the individual correlations of TCD and AC with gestational age, may help establish its usefulness in antenatal ultrasonographic assessment.

The present study was undertaken to correlate fetal trans-cerebellar diameter (TCD), abdominal circumference (AC), and the TCD/AC ratio with gestational age in uncomplicated singleton pregnancies.

MATERIALS AND METHODS

Study Design and Setting- This cross-sectional study was conducted in the Department of Radio-diagnosis, SKS Medical College, Durgapur, West Bengal, from July 2025 to July 2026. A total of 100 pregnant women were included in the study.

Inclusion Criteria- The study included pregnant women with a known last menstrual period (LMP), no oral contraceptive pill use for at least three months before pregnancy, singleton uncomplicated pregnancies, and gestational ages between 20 and 42 weeks.

Exclusion Criteria- Women with irregular menstrual cycles, an uncertain or incorrect LMP, multiple gestations, or a fetus with congenital anomalies were excluded from the study.

Data Collection and Ultrasonographic Assessment- Informed consent was obtained from all participants, and relevant clinical histories were recorded. Transabdominal ultrasonography was performed with the participants in the supine position using ALOKA ProSound Alpha 7 and Philips HD11 XE ultrasound equipment with 3–5 MHz probes.

Measurement of Trans-cerebellar Diameter- The fetal cerebellum was identified in the transverse view of the posterior cranial fossa, with the thalamus centred to visualise both cerebellar hemispheres (Fig. 1). Trans-cerebellar diameter (TCD) was measured in millimetres by placing the callipers on the outer margins of the cerebellum in the appropriate plane.

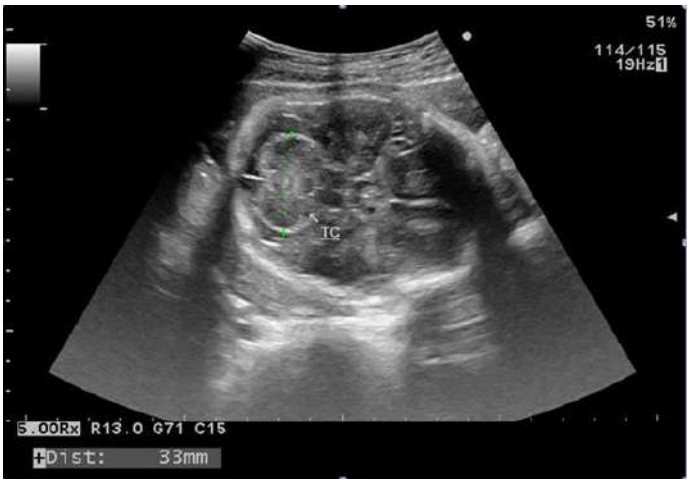


Fig 1: USG image showing plane at which TCD is measured

Measurement of Abdominal Circumference- Abdominal circumference (AC) was measured in the standard axial plane showing the fetal stomach, umbilical vein, and portal sinus (Fig. 2). The fetal kidneys and heart were excluded from the plane, and calipers were placed along the skin surface.

Copyright © 2026| SSR-IIJLS by Society for Scientific Research under a CC BY-NC 4.0 International License

doi: 10.21276/SSR-IIJLS.2026.12.6.4

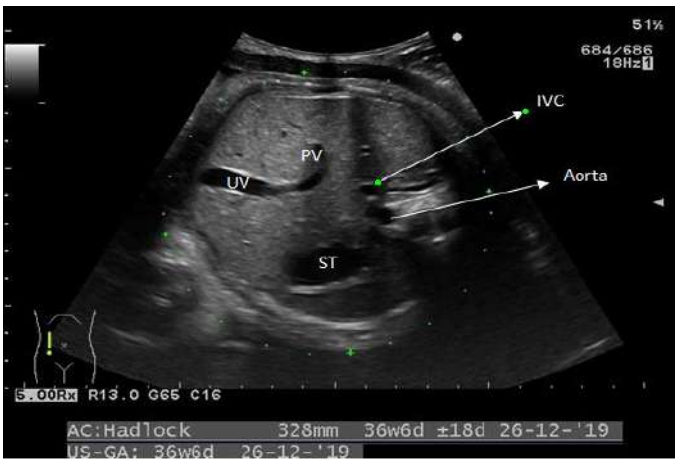


Fig 2: USG image showing plane at which AC is measured.

UV: Umbilical vein, PV: Portal vein, ST: Stomach, IVC: Inferior vena cava

Calculation of TCD/AC Ratio and Gestational Age- TCD/AC ratio was calculated by dividing TCD by AC and multiplying the result by 100. Gestational age was recorded using the LMP and routinely used ultrasonographic parameters. The relationships of TCD, AC, and the TCD/AC ratio with gestational age were subsequently evaluated.

Statistical Analysis- Data from 100 pregnant women were analysed using descriptive and inferential statistical methods. Continuous variables were summarised as means and standard deviations (SD), with ranges where appropriate. Categorical variables were expressed as frequencies and percentages. Pearson's correlation was used to assess relationships between gestational age and the measured parameters when assumptions were satisfied; Spearman's rank correlation was considered otherwise. Simple linear regression was used where appropriate. Correlation coefficients, 95% confidence intervals, p-values, regression coefficients, and coefficients of determination (R^2) were assessed as applicable. All tests were two-sided, and $p < 0.05$ was considered statistically significant.

Ethical Approval- Ethical approval was obtained from the Institutional Ethics Committee of SKS Medical College, Durgapur, West Bengal, India, on 25 August 2025.

RESULTS

A total of 100 patients were included in the study. Minimal age of the patient was 18 years and maximum age was 36 years with mean age of 23+/-3.8 years. Most of the women were primigravida accounted for 57% as shown in pie chart in Fig. 3.

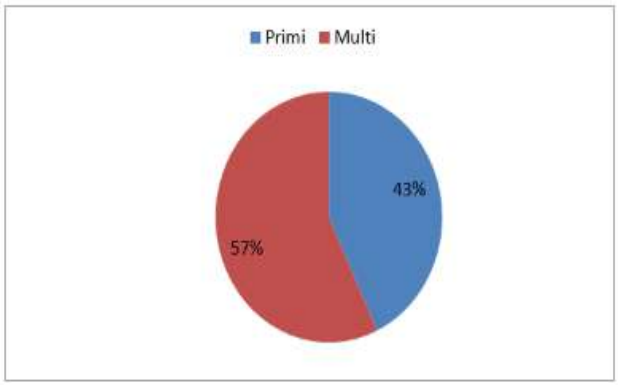


Fig. 3: Distribution based on Gravida of study subjects.

Table 1 shows number of cases in each gestational age from 20-39 weeks with corresponding range and mean of TCD measured in mm at each gestational week.TCD almost corresponded to gestational age in weeks from 20 to 23 weeks,and later on TCD in mm exceeded gestational age in weeks.

Table 1: Correlation between TCD and gestational age in study group

Gestational age (Weeks)	n (Number of cases)	Range of TCD	Mean TCD (mm)
20	11	20-21	20.090
21	15	20-22	21
22	8	21-23	22.125
23	12	22-27	23.833
24	5	21-25	23.600
25	2	25-29	27
26	5	26-28	27.200
27	3	27-29	28
28	2	34-37	35.500
29	3	35-37	36.333
30	4	38-46	40
31	5	37-44	40
32	4	41-48	44.500
33	4	41-49	45.250
34	3	43-55	50
35	3	48-55	51.666
36	3	47-52	49.333
37	4	52-59	56.250
38	2	53-60	58.500
39	2	53-58	55.500
Total	100	20-60	37.920

Copyright © 2026| SSR-IIJLS by Society for Scientific Research under a CC BY-NC 4.0 International License

doi: 10.21276/SSR-IIJLS.2026.12.6.4

As the gestational age increases the TCD values also increased. Significant positive linear correlation was noted between gestational age determined by LMP and TCD(R^2= 0.940, p value=0.0001) according to pearson's correlation as shown in Fig. 4.

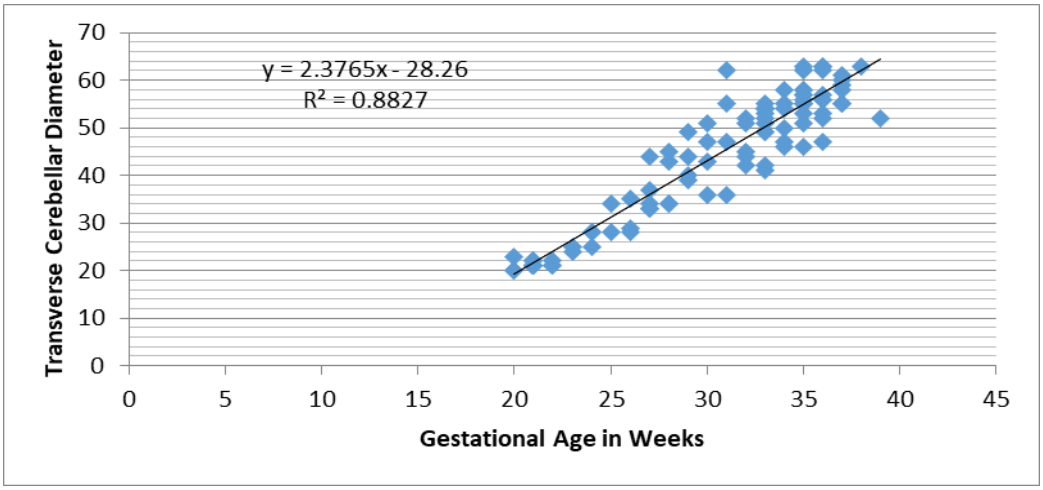


Fig. 4: Significant positive linear correlation between TCD and Gestational Age

As the gestational age increases,the AC also increases.Significant positive linear correlation was noted between gestational age determined by LMP and AC (R^2 = 0.967, p = 0.0001) according to pearson's correlation as shown in Fig. 5.

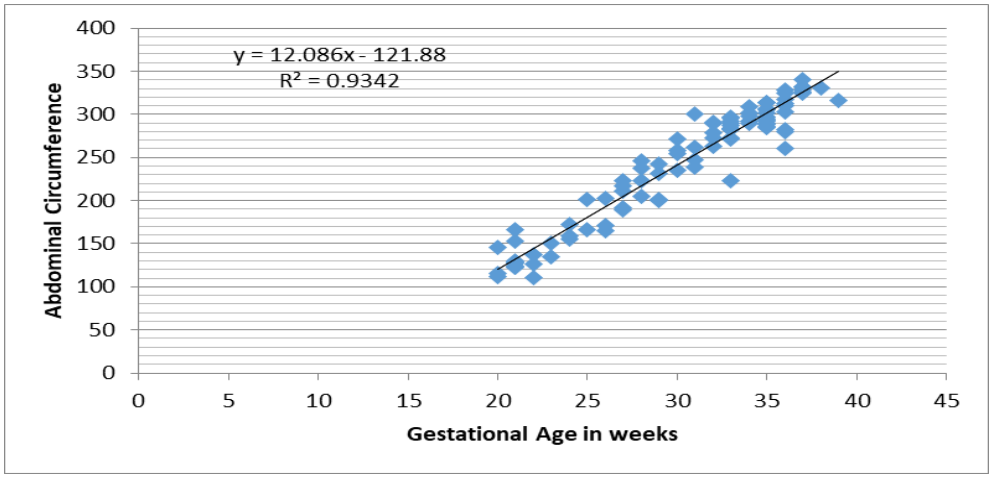


Fig. 5: Significant positive linear correlation between Abdominal Circumference and Gestational Age.

Table 2 shows a number of cases in each gestational age from 20-39 weeks with corresponding range and mean of TC/AC ratio at each gestational week.Mean TCD/AC ratio in study group overall was 14.11+/-1.8.

Table 2: Range, mean and standard deviation of TCD/AC ratio in study group of all gestational age .

Gestational age (Weeks)	N	Range of TC/AC	Mean TC/AC	Std Deviation
20	11	12.5-14.2	13.10	0.526
21	15	12.4-14.1	13.168	0.538
22	8	12.4-14.5	12.90	0.841
23	12	12.4-14.4	12.841	0.758
24	5	12.2-13.2	12.58	0.376
25	2	13.2-13.6	13.40	0.282
26	5	11.8-13.5	12.60	0.751

Copyright © 2026| SSR-IIJLS by Society for Scientific Research under a CC BY-NC 4.0 International License

doi: 10.21276/SSR-IIJLS.2026.12.6.4

27	3	11.5-12.6	12.20	0.608
28	2	14.9-15.8	15.35	0.636
29	3	14.3-15.2	14.80	0.458
30	4	13.-15.7	14.55	1.184
31	5	14.1-16.2	15.02	0.88
32	4	15.2-16.3	15.77	0.6
33	4	14.2-16	15.37	0.809
34	3	13.7-15.6	14.86	1.021
35	3	15.1-16	15.63	0.472
36	3	15.4-15.9	15.8	0.251
37	4	15.2-16.3	15.55	0.519
38	2	15.4-15.9	15.65	0.353
39	2	15.4-16	15.70	0.424
Total/Mean	100	11.5-16.3	14.11	1.8

Mean TCD/AC ratio in study group was 14.11+/-1.8

As the gestational age increased,TCD/AC ratio remained fairly constant.TCD/AC ratio showed no statistical significant correlation with gestational age(R^2= 0.034, p=0.081), ratio remained constant through out gestational age as shown in Fig. 6.

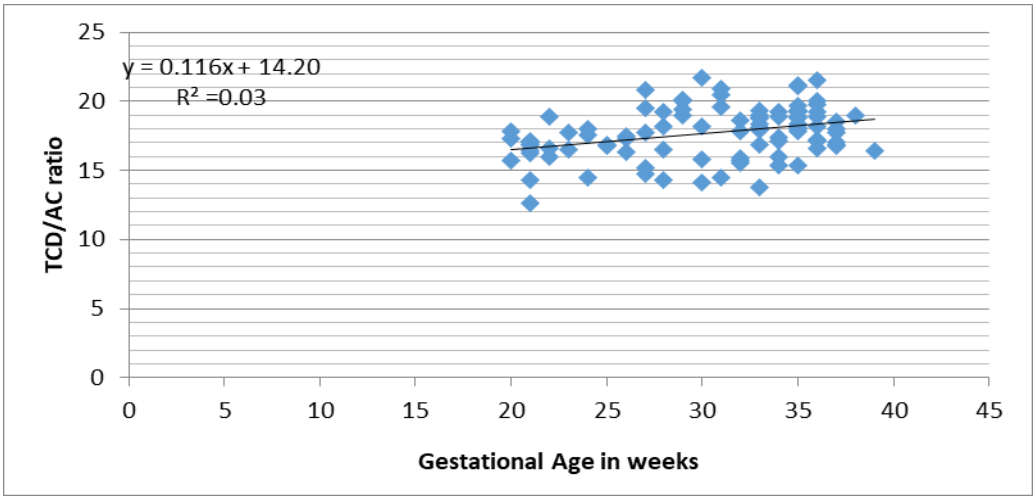


Fig. 6: TCD/AC ratio showed no statistical significant correlation with GA,ratio remained constant through out gestational age

DISCUSSION

Many fetal parameters has been used in ultrasonographic evaluation of fetal growth and its deviation. Most commonly and currently used parameters are Head circumference (HC), Biparetal diameter (BPD), abdominal circumference (AC) and Femur length (FL). All these parameter correlate with gestational age.

TCD is emerging parameter which correlates well with gestational age and helps in accurate estimation of gestational age. Due to the fact that cerebellum being placed in posterior fossa protected by strong bony wall relatively resistant to external compression [1,7].

Phenomena of brain sparing effect in fetal chronic hypoxemia, where there is preservation of blood flow to brain at expense of trunk, makes TCD least affected in fetal growth restriction.[2,3]

Depletion of hepatic glycogen and subcutaneous fat stores in IUGR fetuses causes early reduction in AC, hence AC is an early and sensitive predictor of IUGR.[3,7]

Many previous studies have used ratios like FL/AC, HC/AC, TCD/FL and TCD/HC for establishing gestational independent parameter to assess fetal growth.[6]

We chose a parameter which is least and most affected by fetal growth restriction *i.e.* TCD and AC as used by many previous studies [8-11]. Ratio of TCD/AC would be

Copyright © 2026| SSR-IIJLS by Society for Scientific Research under a CC BY-NC 4.0 International License

doi: 10.21276/SSR-IIJLS.2026.12.6.4

most sensitive gestational age independent parameter to assess fetal growth and its deviation [7].

In this study 100 uncomplicated (with no systemic or obstretric disorders) singleton pregnancy were selected after fulfilling the inclusion and exclusion criteria. In the present study the women between 18-36 years were included with mean age of 23years and most of the women were primigravida accounted for 57%. TCD/AC ratio remained constant through out the gestation age, the mean value in study group was 14.11+/-1.80, similar to mean obtained in studies conducted by Campbell *et al.* [12] and Sarojmourya *et al.*[2]

In our study strong positive linear correlation was noted between gestational age determined by LMP and TCD (R^2=0.940, p= 0.0001), similar to the studies conducted by Meyer *et al.*[3] (pearsoncorrelation r = 0.94), Haller *et al.*[8] (pearson correlation r= 0.91) by Dilmen *et al.*[9] (pearson correlation r=0.976) and Vinstein *et al.*[11] (pearson correlation r=0.96). TCD corresponded to Gestational age from 20- 23 weeks in our study, and from 15-20 weeks in study conducted by Nagesh *et al.*[1]

In the study conducted by Mourya *et al.* [2] and Bhimarao *et al.* [7], no statistical significant difference was found between TCD of control group and TCD of true SGA in study group, suggesting TCD is not affected in IUGR cases. In our study significant positive linear correlation was noted between gestational age determined by LMP and AC (R^2=0.967, p=0.0001), similar to the study conducted by Meyer *et al.*[3] (pearson correlation, r = 0.96) and Haller *et al.*[8] (pearson correlation, r = 0.89).

In this study, TCD/AC ratio showed poor correlation with gestational age (R^2= 0.034, p =0.081), similar to study conducted by Meyer *et al.*[3] (R^2=0.008, p =0.024), and Haller *et al.*[8] (pearson correlation, r = 0.157). Hence TCD/AC ratio was proved to be constant throughout the gestational age.

Difficulty in visualising the cerebellar borders may occur in near-term patients, particularly in vertex presentation with the occiput posterior, potentially leading to overestimation of TCD and a falsely elevated TCD/AC ratio. A similar difficulty was reported by Meyer *et al.* [3]. Furthermore, ultrasonographic assessment is operator-dependent, and variations in the planes used to measure TCD and AC between observers may influence the measurements and lead to differences in the results.

CONCLUSIONS

The TCD/AC ratio is considered a useful sonographic parameter for the early prediction of intrauterine growth restriction (IUGR). The ratio is reported to remain relatively constant throughout gestation, making it potentially valuable for identifying abnormal fetal growth before it becomes clinically evident. Early recognition of IUGR may facilitate timely clinical assessment and appropriate management, thereby helping reduce the risk of associated perinatal complications. Among the fetal biometric parameters, TCD is relatively less affected by pathological conditions associated with IUGR, whereas AC is more significantly affected. This difference in their responses to impaired fetal growth provides the rationale for assessing the TCD/AC ratio during antenatal ultrasonography. Furthermore, TCD measured in millimetres has been reported to correspond approximately to gestational age in weeks between 20 and 23 weeks of pregnancy. These observations suggest that combined assessment of TCD, AC, and their ratio may contribute to fetal growth evaluation. However, the diagnostic accuracy of the ratio for predicting IUGR should be established through appropriate clinical studies.

CONTRIBUTION OF AUTHORS

Research concept- Chaitra Udagi
Research design- Chaitra Udagi
Supervision- Sharanaprabhu Udagi
Materials- Chaitra Udagi
Data collection- Chaitra Udagi
Data analysis and interpretation- Chaitra Udagi, Sharanaprabhu Udagi
Literature search- Chaitra Udagi
Writing article- Chaitra Udagi
Critical review- Sharanaprabhu Udagi
Article editing- Sharanaprabhu Udagi
Final approval- Chaitra Udagi

REFERENCES

[1] Nagesh R, Pramila VV, Shukla AK. Transverse cerebellar diameter–an ultrasonographic parameter for estimation of fetal gestational age. Int J Contemp Med Res., 2016; 3(4): 1029-31.

[2] Mourya S, Mourya HK, Makwana M, Gahlot H, Verma S, et al. Evaluation of transverse cerebellar diameter to abdominal circumference ratio in prediction of

Copyright © 2026| SSR-IIJLS by Society for Scientific Research under a CC BY-NC 4.0 International License

doi: 10.21276/SSR-IIJLS.2026.12.6.4

intrauterine growth retardation. Int J Reprod Contracept Obstet Gynecol., 2017; 6: 2466-70.

[3] Meyer WJ, Gauthier DW, Goldenberg B, Santolaya J, Sipos J, et al. The fetal transverse cerebellar diameter/abdominal circumference ratio: a gestational age-independent method of assessing fetal size. J Ultrasound Med., 1993; 12(7): 379-82.

[4] Lees CC, Stampalija T, Baschat AA, da Silva Costa F, Ferrazzi E, et al. ISUOG Practice Guidelines: diagnosis and management of small-for-gestational-age fetus and fetal growth restriction. Ultrasound Obstet Gynecol., 2020; 56: 298-312.

[5] Lubchenco LO, Hansman C, Boyd E. Intrauterine growth as estimated from liveborn birth-weight data at 24-42 weeks of gestation. Pediatr., 1963; 32: 793.

[6] Meyer WJ, Gauthier D, Ramakrishnan V, Sipos J. Ultrasonographic detection of abnormal fetal growth with the gestational age-independent transverse cerebellar diameter/abdominal circumference ratio. Am J Obstet Gynecol., 1994; 171: 1057.

[7] Bhimarao, Nagaraju RM, Bhat V, Gowda PV. Efficacy of transcerebellar diameter/abdominal circumference versus head circumference/ abdominal circumference in predicting asymmetric intrauterine growth retardation. J Clin Diagn Res., 2015; 9(10): TC01-TC05.

[8] Haller H, Petrović O, Rukavina B, et al. Fetal transverse cerebellar diameter/abdominal circumference ratio in assessing fetal size. Int J Gynaecol Obstet., 1995; 50(2): 159-63. doi: 10.1016/0020-7292(95)02423-a.

[9] Dilmen G, Toppare MF, Turhan NO, et al. Transverse cerebellar diameter and transverse cerebellar diameter-abdominal circumference index for assessing fetal growth. Fetal Diagn Ther., 1996; 11: 50.

[10] Tongsong T, Wanapirak C, Thongpadungroj T. Sonographic diagnosis of intrauterine growth restriction (IUGR) by fetal transverse cerebellar diameter (TCD)/abdominal circumference (AC) ratio. Int J Gynaecol Obstet., 1999; 66(1): 1-5.

[11] Vinkesteijn AS, Mulder PG, Wladimiroff JW. Fetal transverse cerebellar diameter measurements in normal and reduced fetal growth. Ultrasound Obstet Gynecol., 2000; 15: 47-51. doi: 10.1046/j.1469-0705.2000.00024.x.

[12] Campbell WA, Vintzileos AM, Rodis JF, Turner GW, Egan JF, et al. Use of the transverse cerebellar diameter-abdominal circumference ratio in pregnancies at risk for intrauterine growth retardation. J Clin Ultrasound, 1994; 22: 497-502. doi: 10.1002/jcu.1870220807.

Open Access Policy:
Authors/Contributors are responsible for originality, contents, correct references, and ethical issues. SSR-IIJLS publishes all articles under Creative Commons Attribution- Non-Commercial 4.0 International License (CC BY-NC). https://creativecommons.org/licenses/by-nc/4.0/legalcode