

# Reference Ranges for Corpus Callosum and Cerebellar Vermis Measurements in Fetuses Between 18-36 Weeks of Gestation

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## ABSTRACT

**OBJECTIVE:** To establish gestational age-specific nomograms for the corpus callosum (CC) and cerebellar vermis (CV) using two-dimensional (2D) ultrasound in a Turkish population between 18 and 36 weeks of gestation.

**STUDY DESIGN:** This cross-sectional study was conducted at the Maternal–Fetal Medicine Unit of a tertiary care centre. A total of 714 low-risk singleton pregnancies between 18+0 and 36+0 weeks of gestation were included. Standardised midsagittal cranial sections were obtained using 2D ultrasound, and measurements were performed by maternal–fetal medicine specialists. Assessed parameters included CC length; thickness of the genu, body, and splenium; and CV anteroposterior (CVAPD) and cranio-caudal (CVCCD) diameters. Statistical analysis included descriptive statistics and polynomial regression. Pearson correlation coefficients were calculated to assess the relationship between gestational age and each measurement.

**RESULTS:** Nomograms with 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles were created for each parameter. All measurements showed significant positive correlations with gestational age ( $p < 0.001$ ). The CC length increased from a mean of 15.96 mm at 18 weeks to 43.12 mm at 36 weeks. The 50<sup>th</sup> percentile values for CVAPD and CVCCD were 8.91 mm and 10.17 mm at 18 weeks, rising to 20.13 mm and 22.10 mm, respectively, at 36 weeks. Thicknesses of the genu, body, and splenium also showed consistent growth patterns.

**CONCLUSION:** The nomograms developed in this study provide normative data for fetal midline brain structures and may aid in the prenatal detection of neurodevelopmental abnormalities.

**Keywords:** 2D ultrasound; Cerebellar vermis; Corpus callosum; Fetal neurosonography

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## Introduction

The corpus callosum (CC) and cerebellar vermis (CV) can be visualised in the midsagittal section of the fetal cranium. Assessment of these midsagittal components during second-trimester anatomy screening is not routinely recommended by professional organisations (1,2); targeted neurosonography should include midsagittal, coronal, and parasagittal planes (3).

CC is the largest white matter structure in the brain and is critical for interhemispheric communication via commissural neuronal fibres. On ultrasound, it appears hypoechoic and consists of four segments: rostrum, genu, body, and splenium. CC development starts at 13 weeks of gestation and is usually complete by 18 weeks. All segments are visible with both transabdominal and transvaginal ultrasound.

The CV connects the cerebellar hemispheres and supports motor coordination, postural control, and cardiovascular regu-

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lation. It appears echogenic on ultrasound above the brainstem and is involved in several posterior fossa anomalies and genetic syndromes.

In the present study, we evaluated CC and CV between 18 and 36 weeks of gestation and developed nomograms for CC length, genu, body, and splenium thicknesses, and the cranio-caudal and anteroposterior diameters of the CV in the Turkish population.

### Material and Method

This cross-sectional study was conducted at the Maternal-Fetal Medicine Unit of a tertiary care centre and analysed data collected between July 2020 and January 2025. A total of 714 singleton pregnancies with gestational ages ranging from 18+0 to 36+0 weeks were included after meeting the inclusion criteria. The study design and reporting followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies. Ethical approval for the study was obtained from the hospital’s institutional review board (Approval Date: 11/07/2025; Decision no: 173). Written informed consent was not obtained due to the study’s retrospective nature. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Gestational age was calculated based on the first day of the last menstrual period and verified by crown-rump length measurements during the first-trimester ultrasound. Singleton pregnancies between 18 and 36 weeks with normal fetal growth and good maternal health were included in the study cohort. Pregnancies were excluded if there was a diagnosis of pregestational or gestational diabetes,

chronic maternal illness, multiple gestation, pregnancy-related disease (e.g., preeclampsia), structural or genetic fetal abnormalities, or fetal growth restriction; or if there was insufficient or unclear visualisation and shadowing artefacts of the midline structures due to technical challenges or absence of a first-trimester crown-rump length measurement for verification of gestational age. The flow diagram of the study, according to the STROBE statement for cross-sectional studies, is shown in figure 1.

All scans were performed by Maternal-Fetal Medicine specialists. Voluson E10 and Voluson S8 ultrasound machines (GE Healthcare, Zipf, Austria) equipped with both curvilinear and transvaginal transducers. Two-dimensional ultrasound was used to obtain a complete midsagittal image of the fetal cranium. If the fetus was in cephalic presentation and transabdominal imaging was not feasible due to fetal position, transvaginal sonography was performed. To acquire the midsagittal view of the corpus callosum, the anterior transfontanelle approach was employed. For optimal visualisation of the cerebellar vermis, fourth ventricle, brainstem, and choroid plexus, the posterior transfontanelle approach was used.

Once an optimal midsagittal section was obtained, clearly identifying all parts of the corpus callosum (CC) and cerebellar vermis (CV), the measurements were performed. The CC appeared as a hypoechoic structure bordered by two hyperechogenic lines. The length of the CC was measured from the most anterior point of the genu to the most posterior point of the splenium. Callipers were placed on the outer edges of the hyperechogenic borders, and the measurement was taken from

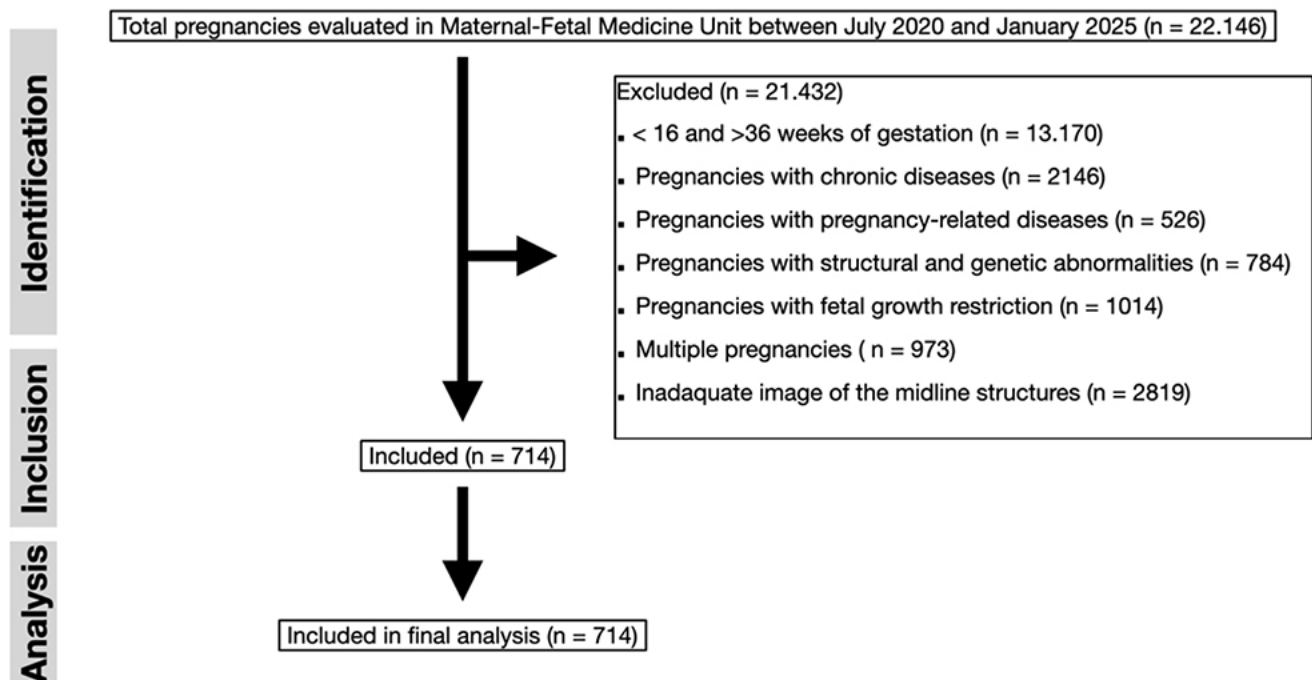


Figure 1: STROBE flow chart

outer edge to outer edge (Figure 2). The thickness of the genu was measured from the most anterior point of the inner echogenic border to the most anterior point of the outer echogenic border. The thickness of the body was measured just above the most anterior aspect of the fornix, an echogenic structure forming the inferior border of the cavum septum pellucidum. The thickness of the splenium was measured from the most posterior point of the inner echogenic border to the most posterior point of the outer echogenic border. For all thickness measurements of the CC, callipers were placed on the inner margins of the hyperechogenic borders, and the measurements were taken from inner to inner (Figure 2).

The CV is located above the brainstem and appears as an echogenic structure on ultrasound. The fastigium and primary fissure were used as landmarks to identify the optimal midsagittal image. The anteroposterior diameter (APD) of the CV was measured from the most anterior point of the inferior vermis to the most posterior point of the tuber. The craniocaudal diameter (CCD) was measured from the most superior point, known as the culmen, to the most inferior point, called the uvula (Figure 2).



**Figure 2:** Measurement of corpus callosum length; thickness of the genu, body, and splenium; and anteroposterior and craniocaudal diameters of the cerebellar vermis, as demonstrated on

CCL: Corpus callosum length, Gt: Thickness of the genu, Bt: Thickness of the body, St: Thickness of the splenium, CVAPD: Anteroposterior diameter of the cerebellar vermis, CVCCD: Craniocaudal diameter of the cerebellar vermis a midsagittal cranial section obtained using 2D ultrasound.



**Figure 3.** Development of the corpus callosum and cerebellar vermis, as visualised in midsagittal ultrasound images from 20 to 32 weeks of gestation

Each parameter was measured twice, and the two values were averaged for the final measurement. Freeze-frame and cine-loop functions with on-screen callipers were used for image acquisition and measurement. Values were measured to the nearest 0.1 mm.

### Statistical Analysis

Data were analysed using IBM SPSS Statistics, version 21 (IBM Corp., Armonk, NY, USA). For each parameter, the mean and standard deviation (SD) were calculated and presented in tables by weekly gestational age. The 5<sup>th</sup> percentile, mean, and 95<sup>th</sup> percentile values specific to gestational age were also computed. Polynomial regression analysis was applied, and these percentiles were plotted against gestational age. Pearson correlation coefficients were calculated (two-tailed test), with  $p \leq 0.05$  considered significant.

### Results

The development of the corpus callosum and cerebellar vermis, as visualised in midsagittal ultrasound images from 20 to 32 weeks of gestation, is shown in figure 3. The mean  $\pm$  SD and 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile values for corpus callosum length by gestational age are shown in table I. The mean  $\pm$  SD and 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile values for the thicknesses of the genu, body, and splenium of the corpus callosum are presented in Table II.

The mean  $\pm$  SD and 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile values for the anteroposterior and craniocaudal diameters of the cerebellar vermis are provided in table III. Reference curves for corpus callosum length (Figure 4), thicknesses of the genu, body, and splenium (Figures 5-7), and vermis anteroposterior and craniocaudal diameters (Figures 8 and 9) are illustrated accordingly.

There was a very strong correlation between gestational age and corpus callosum (CC) length, vermis APD, and vermis CCD. Pearson correlation coefficients were 0.939, 0.946, and 0.937, respectively. A strong correlation was also observed between gestational age and the thicknesses of the genu, body, and splenium of the CC, with Pearson r-values of 0.703, 0.751, and 0.702, respectively.

**Table II:** Thickness of the genu, body, and splenium of the corpus callosum by gestational age, presented as mean ± SD and 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles

| GA<br>(weeks) | N   | CC Genu   |      |      | CC Body   |      |      | CC Splenium |      |      |
|---------------|-----|-----------|------|------|-----------|------|------|-------------|------|------|
|               |     | Mean±SD   | 5%   | 95%  | Mean±SD   | 5%   | 95%  | Mean±SD     | 5%   | 95%  |
| 18+0-19+6     | 50  | 1.6±0.36  | 1.1  | 1.51 | 1.51±0.3  | 1.04 | 1.5  | 1.68±0.4    | 1.16 | 1.55 |
| 20+0-21+6     | 222 | 2.1±0.55  | 1.41 | 2    | 1.94±0.44 | 1.34 | 1.9  | 2.23±0.62   | 1.48 | 2.11 |
| 22+0-23+6     | 241 | 2.69±0.59 | 1.71 | 2.7  | 2.35±0.43 | 1.65 | 2.34 | 2.78±0.62   | 1.8  | 2.81 |
| 24+0-25+6     | 51  | 3.04±0.56 | 1.97 | 3.03 | 2.63±0.41 | 1.87 | 2.67 | 3.21±0.59   | 1.96 | 3.23 |
| 26+0-27+6     | 45  | 3.12±0.58 | 2.2  | 3.1  | 2.76±0.43 | 2.05 | 2.76 | 3.30±0.61   | 2.31 | 3.26 |
| 28+0-29+6     | 43  | 3.23±0.56 | 2.37 | 3.21 | 2.77±0.33 | 2.19 | 2.8  | 3.36±0.54   | 2.54 | 3.27 |
| 30+0-31+6     | 22  | 3.57±0.51 | 2.67 | 3.75 | 3.16±0.32 | 2.64 | 3.03 | 3.79±0.52   | 2.82 | 3.9  |
| 32+0-33+6     | 20  | 3.67±0.32 | 3.28 | 3.62 | 3.38±0.26 | 2.78 | 3.42 | 3.91±0.52   | 3.01 | 4.02 |
| 34+0-36+0     | 20  | 3.98±0.41 | 3.35 | 4    | 3.74±0.48 | 3.13 | 3.85 | 4.16±0.35   | 3.56 | 4.18 |

GA: Gestational age, CC: Corpus callosum, SD: Standard deviation

**Table I:** Corpus callosum length by gestational age, presented as the mean±SD and 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles

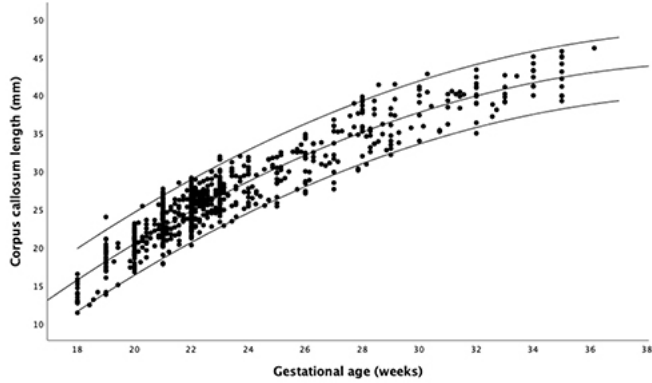
| GA<br>(weeks) | N   | Mean±SD    | CC Length | CC h       | CC Length | CC Length |
|---------------|-----|------------|-----------|------------|-----------|-----------|
|               |     |            | (mm) 5%   | Lengt (mm) | (mm) 50%  | (mm) 95%  |
| 18+0-19+6     | 50  | 16.99±2.86 | 12.55     |            | 17.38     | 21.08     |
| 20+0-21+6     | 222 | 22.23±2.35 | 18.12     |            | 22.15     | 26.32     |
| 22+0-23+6     | 241 | 26.03±2.19 | 22.35     | 26         |           | 29.93     |
| 24+0-25+6     | 51  | 29.15±2.43 | 25.42     |            | 29.6      | 32.71     |
| 26+0-27+6     | 45  | 32.51±2.93 | 27.47     |            | 32.16     | 37.53     |
| 28+0-29+6     | 43  | 35.93±2.61 | 32.03     |            | 35.6      | 41.07     |
| 30+0-31+6     | 22  | 38.83±2.25 | 34.18     |            | 39.58     | 42.55     |
| 32+0-33+6     | 20  | 39.74±2.1  | 35.07     |            | 39.83     | 43.33     |
| 34+0-36+0     | 20  | 42.74±2.12 | 39.3      |            | 42.76     | 46.19     |

GA: Gestational age, CC: Corpus callosum, SD: Standard deviation

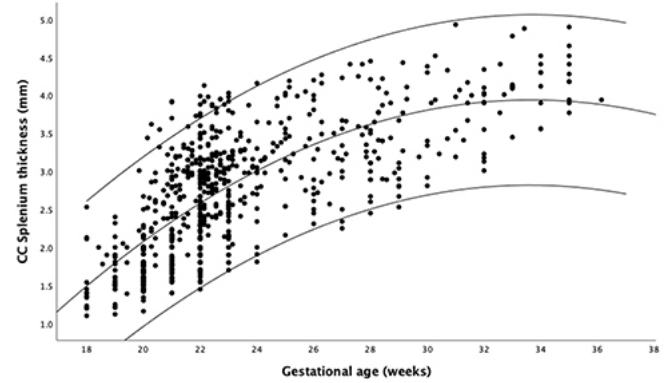
**Table III:** Anteroposterior and craniocaudal diameters of the cerebellar vermis by gestational age, presented as mean ± SD and 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles

| GAN<br>(weeks) | Anteroposterior diameter (mm) |       |       | Craniocaudal diameter (mm) |       |       |
|----------------|-------------------------------|-------|-------|----------------------------|-------|-------|
|                | Mean±SD                       | 5%    | 95%   | Mean±SD                    | 5%    | 95%   |
| 18+0-19+6      | 8.87±0.93                     | 7.22  | 8.91  | 10.04±0.8                  | 8.27  | 10.17 |
| 20+0-21+6      | 10.2±0.79                     | 8.81  | 10.24 | 11.41±0.9                  | 10.18 | 11.32 |
| 22+0-23+6      | 11.03±0.76                    | 9.87  | 10.92 | 12.26±1.03                 | 10.76 | 12.25 |
| 24+0-25+6      | 12.45±0.88                    | 11.07 | 12.49 | 13.59±1.09                 | 11.98 | 13.37 |
| 26+0-27+6      | 13.4±0.79                     | 12.15 | 13.43 | 15.78±1.32                 | 13.76 | 15.94 |
| 28+0-29+6      | 15.7±1.11                     | 13.7  | 15.55 | 18.65±1.38                 | 16.6  | 18.67 |
| 30+0-31+6      | 17.62±0.81                    | 16.13 | 17.76 | 19.91±0.91                 | 18.26 | 19.94 |
| 32+0-33+6      | 17.66±0.97                    | 16.57 | 17.85 | 20.01±0.86                 | 19    | 20.03 |
| 34+0-36+0      | 20.33±1.33                    | 18.43 | 20.13 | 22.12±0.79                 | 20.41 | 22.1  |

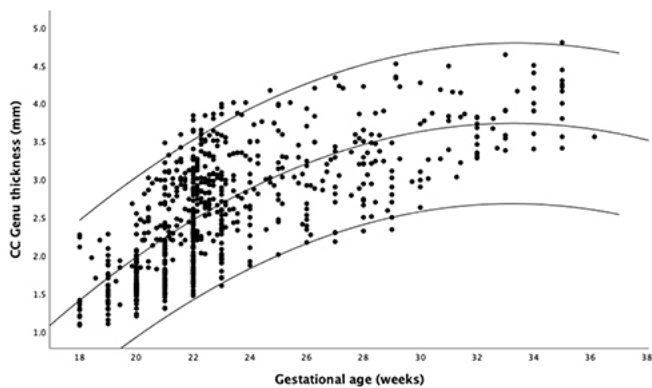
GA: Gestational age, SD: Standard deviation



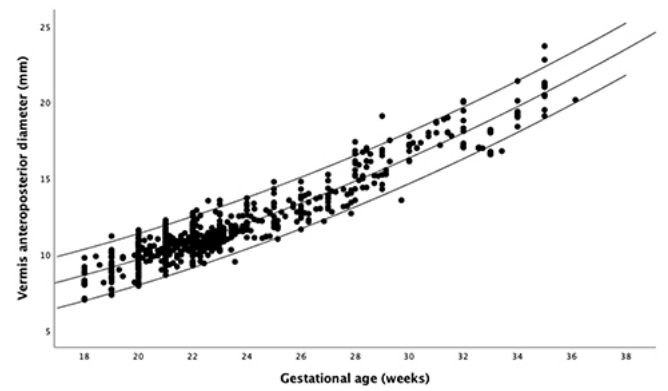
**Figure 4:** Reference curves between 18 and 36 gestational weeks for corpus callosum length, with the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles



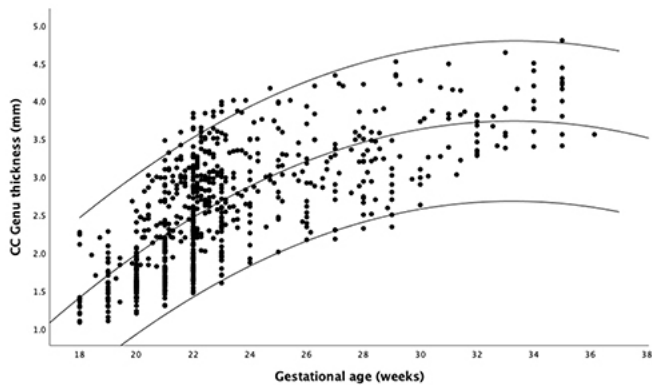
**Figure 7:** Reference curves between 18 and 36 gestational weeks for splenium thickness of corpus callosum, with the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles



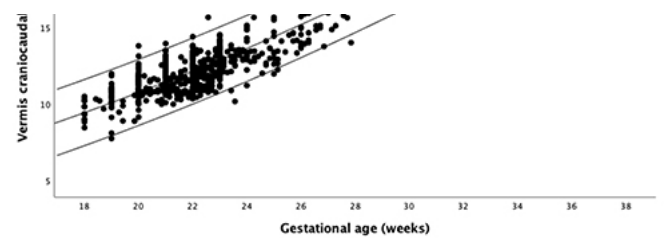
**Figure 5:** Reference curves between 18 and 36 gestational weeks for genu thickness of corpus callosum, with the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles



**Figure 8:** Reference curves between 18 and 36 gestational weeks for the anteroposterior diameter of cerebellar vermis, with the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles



**Figure 6:** Reference curves between 18 and 36 gestational weeks for the body thickness of the corpus callosum, with the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles



**Figure 9:** Reference curves between 18 and 36 gestational weeks for the craniocaudal diameter of cerebellar vermis, with the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles

## Discussion

In the present study, the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile values for CC length were 11.4 mm, 13.6 mm, and 16.18 mm at 18 weeks, increasing to 39.27 mm, 43.12 mm, and 46.21 mm at 36 weeks. Several nomograms for CC length covering different gestational periods have previously been published (8-17). The most recent and, to date, most comprehensive reference is the

multicenter study by Paladini et al. (17), in which all measurements were obtained transvaginally by expert operators. They reported 5<sup>th</sup>-, 50<sup>th</sup>-, and 95<sup>th</sup>-percentile values of 9.43 mm, 11.82 mm, and 14.25 mm at 18 weeks, rising to 37.87 mm, 42.01 mm, and 46.15 mm at 37 weeks. In most previously published nomograms, CC length measurements are generally comparable after 24 weeks of gestation. However, before 24 weeks, several studies have reported differing mean CC

lengths. There are several possible underlying reasons for these discrepancies. Although the corpus callosum is histologically fully formed by approximately 18 weeks of gestation, not all of its parts may be clearly identifiable—even with the most advanced imaging techniques (12). This limitation may lead to an underestimation of the actual CC length during earlier gestational weeks. Therefore, caution is warranted when comparing studies during this gestational period. Another contributing factor to these discrepancies may be the imaging technique employed: some studies used 2D ultrasound, while others utilised 3D probes to visualise the corpus callosum, which can affect the accuracy and consistency of measurements.

The 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile values for corpus callosum (CC) thickness at the level of the genu were 1.1 mm, 1.51 mm, and 2.27 mm at 18 weeks, increasing to 3.35 mm, 4.00 mm, and 4.78 mm at 36 weeks of gestation. At the body level, the corresponding values were 1.04 mm, 1.50 mm, and 2.04 mm at 18 weeks, rising to 3.13 mm, 3.85 mm, and 4.58 mm at 36 weeks.

For the splenium, the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles were 1.16 mm, 1.55 mm, and 2.45 mm at 18 weeks, increasing to 3.56 mm, 4.18 mm, and 4.88 mm at 36 weeks. Consistent with our findings, Achiron et al. evaluated CC thickness at the mid-body level in the coronal plane and reported a mean thickness of 1.3 mm at 18 weeks, increasing to 2.76 mm at 35 weeks.

Similarly, in a study from Turkey, Gunakan et al. assessed CC thickness at the body level and stated that the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles were 1.0 mm, 1.4 mm, and 2.0 mm at 19 weeks, increasing to 1.1 mm, 1.6 mm, and 2.2 mm at 21 weeks of gestation (13). Establishing normative data for these regions may be valuable for assessing dysgenetic or abnormal CC development. The normal formation and length of the CC are considered more clinically significant than its thickness, as there is no established association between increased CC thickness and adverse neurocognitive outcomes (18). Conversely, reduced CC thickness may be associated with hypoplasia, but this finding should be interpreted in the context of other neuroanatomical and clinical features (19).

Several nomograms have been published for CV height, area, CCD and APD measurements (20-24). However, the studies used different measurement methods and reference points. Due to these methodological differences, we were unable to compare the AP measurements of the CV. Our nomogram of CCD measurements, however, is consistent with the literature (21). Malinger et al. conducted their study exclusively with transvaginal ultrasound, whereas our study employed a mixed approach including both transvaginal and transabdominal imaging (21). Despite this methodological difference, our findings were consistent with theirs. Furthermore, two studies from Turkey evaluated the CC diameter of the CV, and our results are also in agreement with those reports (23,24).

A key strength of this study is that all measurements were

performed by maternal–fetal medicine specialists using standardised 2D ultrasound protocols in multiple planes, ensuring technical consistency. Additionally, the study population consisted of low-risk pregnant women, which helped minimise potential confounding factors. Despite these strengths, the study has some limitations. First, its retrospective design may introduce inherent biases. Second, the lack of intra- and inter-observer variability analysis limits the ability to assess the reproducibility of the measurements. Future prospective, longitudinal studies are warranted to confirm these findings.

In conclusion, abnormalities in midline brain structures are associated with a range of chromosomal and genetic disorders, highlighting the importance of their evaluation during prenatal assessment. The nomograms presented in this study, derived from a Turkish population, may serve as a useful reference for identifying deviations from normal development in these structures.

#### *Declarations*

*Ethics approval and consent to participate:* All participants provided written informed consent before enrollment in the study. The study was reviewed and approved by the ethics committee of Istanbul Training and Research Hospital (Approval Date: 11/07/2025; Decision no: 173). All procedures were performed in accordance with the Declaration of Helsinki.

*Availability of data and materials:* The data supporting this study are available through the corresponding author upon reasonable request.

*Competing interests:* The authors declare that they have no competing interests.

*Funding:* The authors declare that no funding was received for this study.

*Author's Contribution:* GA and RM designed the study; GA conducted the analyses. All authors contributed to the data collection. GA developed the first draft of the manuscript. GA and RM contributed to the writing of the paper. All authors have read and approved the final manuscript. RM provided supervision and oversight for all aspects of the study.

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#### **References**

1. Robertis V, Sen C, Tritsch IT, Volpe P, Galindo A, Khalil A, et al. Clinical practice guidelines and recommendations by World Association of Perinatal Medicine and Perinatal Medicine Foundation: reporting suspected findings from fetal central nervous system examination. *Perinatal Journal*. 2024;32(1):9-20. Doi: 10.59215/prn.24.0321006.
2. Malinger G, Paladini D, Haratz KK, Monteagudo A, Pilu GL, Timor-Tritsch IE. ISUOG Practice Guidelines (updated): sonographic examination of the fetal central nervous system. Part 1: performance of screening examination and indications for targeted neurosonography. *Ultrasound Obstet Gynecol*. 2020;56(3):476-84. Doi:10.1002/uog.22145. Erratum: *Ultrasound Obstet Gynecol*. 2022; 60(4):591. Doi:10.1002/uog.26067. PMID:3287059 1.

3. Paladini D, Malinger G, Birnbaum R, Monteagudo A, Pilu G, Salomon LJ, et al. ISUOG Practice Guidelines (updated): sonographic examination of the fetal central nervous system. Part 2: performance of targeted neurosonography. *Ultrasound Obstet Gynecol.* 2021;57(4):661-71. Doi: 10.1002/uog.23616. Erratum in: *Ultrasound Obstet Gynecol.* 2022;60(4):591. Doi: 10.1002/uog.26067. PMID: 33734522.
4. Fitsiori A, Nguyen D, Karentzos A, Delavelle J, Vargas MI. The corpus callosum: white matter or terra incognita. *Br J Radiol.* 2011;84(997):5-18. Doi: 10.1259/bjr/21946513. PMID: 21172964, PMCID: PMC3473808.
5. Hewitt W. The development of the human corpus callosum. *J Anat.* 1962;96(Pt 3):355-8. PMID: 13907098, PMCID: PMC1244119.
6. Stiedl O, Hager T. Cardiovascular Conditioning: Neural Substrates. In *Reference Module in Neuroscience and Biobehavioral Psychology*, Elsevier, 2017. ISBN: 9780128093245.
7. Cotes C, Bonfante E, Lazor J, Jadhav S, Caldas M, Swischuk L, et al. Congenital basis of posterior fossa anomalies. *Neuroradiol J.* 2015;28(3):238-53. Doi: 10.1177/1971400915576665. PMID: 26246090, PMCID: PMC4757284.
8. Friszer S, Bernard JP, Bultez T, Metzger U, Bessis R, Lamourdedieu C, et al. New reference charts for fetal ultrasound corpus callosum length with emphasis on the third trimester. *J Gynecol Obstet Hum Reprod.* 2025;54(2):102884. Doi: 10.1016/j.jogoh.2024.102884. PMID: 39586540.
9. Alemdaroglu S, Baran SY, Dogan Durdag G, Yüksel Simsek S, Çoban Serbetcioglu G, Kalayci H. Nomogram for second trimester corpus callosum measurements: are nomograms reliable? *Perinatal Journal.* 2020;28(3):196-201. Doi: 10.2399/prn.20.0283011
10. Weissbach T, Massarwa A, Hadi E, Lev S, Haimov A, Katorza E, et al. Early fetal corpus callosum: demonstrating normal growth and detecting pathologies in early pregnancy. *AJNR Am J Neuroradiol.* 2023;44(2):199-204. Doi: 10.3174/ajnr.A7757. PMID: 36657951, PMCID: PMC9891336.
11. Goldstein I, Tamir A, Reece AE, Weiner Z. Corpus callosum growth in normal and growth-restricted fetuses. *Prenat Diagn.* 2011;31(12):1115-9. Doi: 10.1002/pd.2840. PMID: 21905052.
12. Rosenbloom JI, Yaeger LH, Porat S. Reference ranges for corpus callosum and cavum septi pellucidi biometry on prenatal ultrasound: systematic review and meta-analysis. *J Ultrasound Med.* 2022;41(9):2135-48. Doi: 10.1002/jum.15905. PMID: 34877699.
13. Gunakan E, Azami A, Tohma YA, Esin S. Nomogram of corpus callosum length and thickness in Turkish population. *Ann Med Res.* 2022; 29(3):240-3. Doi: 10.5455/annalsmedres.2021.09.557.
14. Bayraktar B, Taner CE. Fetal cavum septum pellucidum nomogram and its relationship with fetal Doppler: a prospective study of a Turkish population. *J Health Sci Med/ JHSM.* 2023;6(1):87-92. Doi:10.32322/jhsm.1200856.
15. Bozbay N, Taşpınar MN, Tazegül Pekin A. Reference charts for fetal corpus callosum length in the early second trimester: a prospective cross-sectional study. *Arch Gynecol Obstet.* 2024;310(5):2507-13. Doi: 10.1007/s00404-024-07730-9. PMID: 39298005.
16. Plasencia W, Dagklis T, Borenstein M, Csapo B, Nicolaides KH. Assessment of the corpus callosum at 20-24 weeks' gestation by three-dimensional ultrasound examination. *Ultrasound Obstet Gynecol.* 2007;30(2):169-72. Doi: 10.1002/uog.4035. PMID: 17487942.
17. Paladini D, Parodi S, Xie H, Viñals F, Haratz K, Birnbaum R, et al. Transvaginal ultrasound assessment of corpus callosal length in the fetus: multicenter cross-sectional study. *Ultrasound Obstet Gynecol.* 2025;65(6):703-11. Doi: 10.1002/uog.29227. PMID: 40321147, PMCID: PMC12127717.
18. Shinar S, Har-Toov J, Lerman-Sagie T, Malinger G. Thick corpus callosum in the second trimester can be transient and is of uncertain significance. *Ultrasound Obstet Gynecol.* 2016;48(4):452-7. Doi: 10.1002/uog.15678. PMID: 26282069.
19. Wu FT, Chen CP. Anomalies of the corpus callosum in prenatal ultrasound: a narrative review for diagnosis and further counseling. *J Med Ultrasound.* 2023;32(2):99-103. Doi: 10.4103/jmu.jmu\_49\_23. PMID: 38882617, PMCID: PMC11175368.
20. Alpay V, Davutoglu EA, Kaymak D, Madazli R. Establishment of nomograms for fetal vermis and brainstem structures in the midsagittal cranial plane by ultrasonography. *J Clin Ultrasound.* 2021;49(9):947-55. Doi: 10.1002/jcu.23053. PMID: 34363244.
21. Malinger G, Ginath S, Lerman-Sagie T, Watemberg N, Lev D, Glezerman M. The fetal cerebellar vermis: normal development as shown by transvaginal ultrasound. *Prenat Diagn.* 2001;21(8):687-92. Doi: 10.1002/pd.137. PMID: 11536272.
22. Rosenbloom JI, Yaeger LH, Porat S. Reference ranges for vermis biometry on prenatal ultrasound: systematic review and meta-analysis. *Ultraschall Med.* 2023;44(1):e25-e38. Doi: 10.1055/a-1408-1998. PMID: 33836547.
23. Gezer C, Ekin A, Sinem Gezer N, Solmaz U, Ozeren M. Quantitative evaluation of the fetal cerebellar vermis using the median view on two-dimensional ultrasound. *Iran J Radiol.* 2016;13(2):e34870. Doi: 10.5812/iranjradiol.34870. PMID: 27703661, PMCID: PMC5037970.
24. Imamoglu EY, Gursoy T, Ovali F, Hayran M, Karatekin G. Nomograms of cerebellar vermis height and transverse cerebellar diameter in appropriate-for-gestational-age neonates. *Early Hum Dev.* 2013;89(12):919-23. Doi: 10.1016/j.earlhumdev.2013.10.001. PMID: 24183100.