Accuracy of Different Ultrasonographic Parameters for Assessment of Fetal Weight in Term Pregnancy: A Cross-Sectional Study

Ahmed Mohammed Gamal Eldin[a], Mahmoud Ibrahim Elrashedy[a], Maha Talaat Mohammed[a], Ramadan Mohammed Ramadan[a*], Osama Ahmed Mohamed[a]

[a]Obstetrics and Gynecology Department, Faculty of Medicine, South Valley University, Qena, Egypt.

Abstract

Background: Estimating fetal weight is essential for managing labor, and high-risk pregnancies, including those complicated by diabetes, hypertensive disorders, and previous cesarean sections.

Objectives: To evaluate the accuracy of different ultrasound-measured fetal parameters in estimating fetal weight at term pregnancy.

Patients and methods: This study was conducted from August 1, 2023, to August 1, 2024, at South Valley University Hospital's Obstetric Department including 100 pregnant women with term singleton pregnancies confirmed by a reliable last menstrual period or early ultrasound, who delivered within two days of enrollment. The study compared fetal weight estimates from various sonographic formulas (Hadlock and Warsof) with actual birth weights measured on a digital baby scale.

Results: The mean age of participants was 26.66 years, equally split between urban and rural residences. Among the subjects, 29% had vaginal deliveries and 71% had cesarean sections, with 44% male and 56% female fetuses. The average gestational age was 38.08 weeks. The actual fetal weight was 3167.97 grams. Most Hadlock formulas accurately estimated fetal weight, with p-values > 0.05, except the AC/BPD formula, which significantly underestimated the weight ($p = 0.0434$). For gestational age, most formulas showed no significant differences, but the AC/BPD formula significantly underestimated it ($p = 0.0009$).

Conclusion: Most Hadlock formulas, particularly those using AC/BPD/FL/HC and AC/FL/HC, accurately estimated fetal weight with no significant differences from actual weights, except for the AC/BPD formula, which showed significant discrepancies and lower reliability.

Keywords: Estimated fetal weight; Actual fetal weight; BPD; AC; FL; HC.

DOI: 10.21608/SVUIJM.2024.309634.1955

***Correspondence:** Rammoh214@gmail.com

Received: 1 Augst,2024.

Revised: 22 Augst, 2024.

Accepted: 24 Augst, 2024.

Published: 5 February, 2025

Cite this article as Ahmed Mohammed Gamal Eldin, Mahmoud Ibrahim Elrashedy, Maha Talaat Mohammed, Ramadan Mohammed Ramadan, Osama Ahmed Mohamed.(2025). Accuracy of Different Ultrasonographic Parameters for Assessment of Fetal Weight in Term Pregnancy: A Cross-Sectional Study. *SVU-International Journal of Medical Sciences*. Vol.8, Issue 1, pp: 276-286.

Introduction

Fetal weight estimation is crucial for managing labor, deliveries, and evaluating high-risk pregnancies, such as those involving diabetes, post-term status, hypertensive disorders, previous cesarean sections, and fetal malpresentation. Clinical management decisions are often influenced by the estimated fetal weight (EFW) **(Aye et al., 2022).**

Advancements in ultrasonography (USG) have significantly enhanced prenatal care. As a non-invasive, non-ionizing, and cost-effective diagnostic tool, USG has gained widespread acceptance. It provides reliable and critical information about fetal growth and well-being through fetal biometry, measuring various fetal anatomical parts and tracking their growth throughout pregnancy **(Rumack and Levine, 2023).**

Fetal growth is defined by time-dependent changes in fetal body dimensions. Sonographic measurements offer valuable insights into fetal growth by comparing them against standardized fetal biometry for the gestational age **(Aggarwal and Sharma, 2020).** An ultrasound growth scan typically includes three primary biometry measurements: head circumference (HC), abdominal circumference (AC), and femur length (FL). These measurements follow specific standards and landmarks set by the National Health Service Fetal Anomaly Screening Programme to ensure accuracy and reproducibility while minimizing operator variability. Although the biparietal diameter (BPD) was once preferred for measuring the fetal head, this practice is now outdated in the UK, as advised by the British Medical Ultrasound Society (BMUS) **(Milner and Arezina, 2018).**

The aim of this study is to evaluate the accuracy of different fetal parameters measured by ultrasonography in estimating fetal weight at term pregnancy.

Patients and methods

This was cross-sectional observational study conducted since August 1, 2023, to August 1, 2024, at South Valley University Hospital's Obstetric Department with ethical code: **SVU-MED-OBG024-1-23-8-703**. The study included all pregnant women admitted to the department.

The inclusion criteria were: women with a term pregnancy (37-40 weeks gestation) confirmed by either a reliable last menstrual period (LMP) or early ultrasonography before 12 weeks gestation, those with a singleton pregnancy, and patients who delivered within two days of initial enrollment.

Exclusion criteria were: congenital fetal anomalies, oligohydramnios or polyhydramnios, and intrauterine growth restriction (IUGR).

Study design: The procedure was explained to all women in the study and written consent was taken. The sonographic machine calculated fetal weight automatically by the equipment according to different formulae:

- **Hadlock formula (BPD, HC, AC, FL) (Malik et al., 2016): Log10 (EFW)**=1.3596 + 0.0064 x (HC) + 0.0424 (AC) + 0.174 (FL) + 0.00061 (BPD) (AC) - 0.00386 (AC) (FL)
- **Hadlock formula (HC, AC, FL) (Hiwale et al., 2019): Log10 (EFW)** = 1.326 -0.00326 (AC) (FL) + 0.0107 (HC) + 0.0438 (AC) + 0.158 (FL)
- **Hadlock formula (AC, FL) (Gratacos et al., 2007): Log 10 (weight)** = 1.304 + 0.05281 × AC + 0.1938 × FL -0.004 × AC × FL.
- **Warsof's formula (BPD, AC) (Malik et al., 2016): Log10 EFW =** – 1.599 + 0.144 BPD + 0.032 AC – 0.111 (BPD2×AC) / 1000).

The weight of each neonate after delivery was measured using a suitable digital baby scale, ensuring the infant was

not clothed, and recorded to the nearest 0.01 kg. The weight obtained was then compared with the estimated weights calculated by each formula. The comparative accuracy of the different formulas was assessed based on these comparisons.

Methods

All pregnant women included in the study underwent comprehensive assessments. Complete history taking included age and gestational age, calculated according to Naegele's rule by adding 7 days and 9 months to the date of the last menstrual period (LMP) and then subtracting three months.

Ultrasound evaluation was done using LOGIQ™ P9 XDclear™ Ultrasound machine (General Electric Company, USA) by and with supervision of DR. Maha Talaat Mohammed.

Ultrasound evaluation of fetal weight involved measuring the biparietal diameter (BPD) (**Fig.1**). Head measurements were taken in an axial view at the level of the thalami with an insonation angle close to 90° (**Fig.2**). The transducer was positioned perpendicular to the head's central axis, ensuring symmetrical hemispheres and calvaria. The ellipse was traced at the outer skull border. The head had to be oval, symmetrical, centrally positioned, and fill at least 30% of the monitor. The midline echo (falx cerebri) needed to be interrupted anteriorly by the cavum septi pellucidi, with the thalami symmetrically located on either side. Calipers were placed on the outer borders ('outer to outer') of the parietal bones at the skull's widest part to measure the BPD **(Napolitano et al., 2016)**.

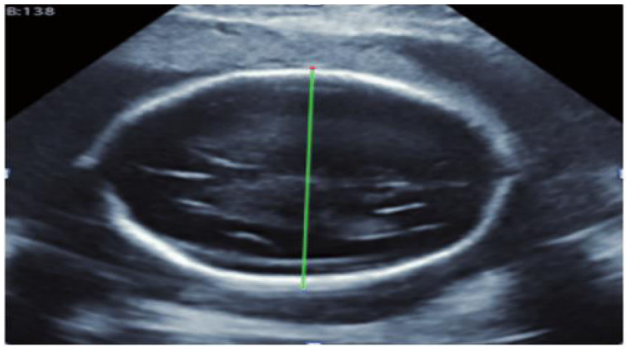

Fig.1. US biparietal diameter (BPD) plane.

The abdominal circumference (AC) was measured using an ellipse tracing on an image plane that included part of the fetal liver, stomach, portal sinus of the umbilical vein, three bony points of a vertebra in cross-section, a circular abdominal appearance, a circular aorta, and a short rib length (**Fig.3**). The AC was obtained by placing the ultrasound cursor in the middle of the fetal abdomen and expanding a circle to encompass the entire abdominal circumference using the device's radius feature. The total AC was then calculated using the formula: circumference = $2\pi r$, where r is the radius measured by the handheld ultrasound device **(Haragan et al., 2015)**

The head circumference was determined at the level of the BPD with measurements from outer to outer margins. The fetal BPD was determined at the level of the thalami and was measured from leading edge to leading edge (outer to inner skull table). Circumferences were determined with the formula D1 + D2 X 1.57 on the basis of two diameters at right angles to one another **(Yeh et al., 1982)**

Fig.2.US head circumference

The femur length (**Fig.4**) was measured according to the technique of O'Brien and Queenan. 10 The thigh circumference was measured according to the technique of Vintzileos et al. 8 The long axis of the femur was first imaged; the transducer was then rotated 90 degrees to obtain a cross-sectional profile of the middle of the thigh at a position that the bone profile was as round as possible and the boundary of the thigh profile was well defined. Circumferences were determined with the formula D1 + D2 X 1.57 on the basis of two diameters at right angles to one another **(Yeh et al., 1982)**

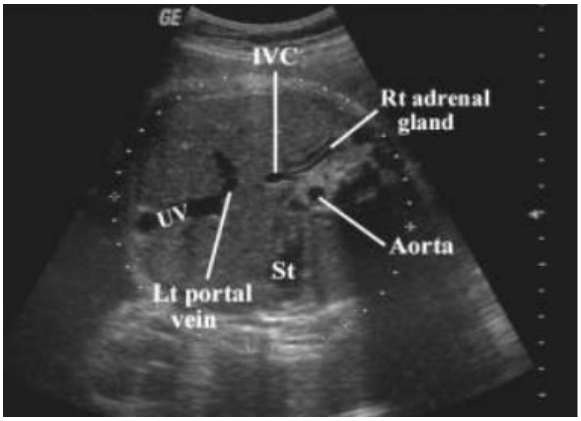

Fig.3. US Abdominal Circumference.

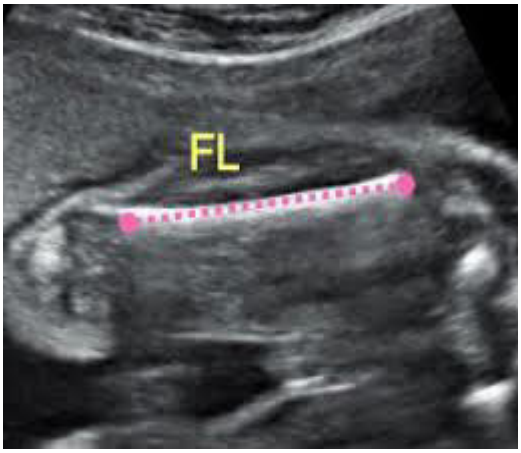

Fig.4. US femur length (FL) plane.

All US measurements were recorded in centimeters and comparing the results with the actual weight after delivery.

Statistical analysis

The data were analyzed using SPSS version 26. Descriptive statistics included numbers and percentages for qualitative variables and mean ± SD for continuous variables. Ordinal variables were represented as median and range. The analysis comprised calculating the arithmetic mean for central tendency and standard deviation (SD) for dispersion. Comparison utilized the Mann-Whitney test for non-normally distributed data. The significance level was set at $p < 0.05$, with smaller p-values indicating greater significance.

Results

(**Table.1**) show that: The mean age was 26.66 years with a standard deviation of 3.17 years. Among them, 50% resided in urban areas and 50% in rural areas. Regarding occupation, 51% of the subjects were employed.

In the obstetric history analysis of the included subjects (N = 100), the parity distribution was as follows: 39 (39%) had a parity of 1, 26 (26%) had a parity of 2, 17 (17%) had a parity of 3, and 18 (18%) had a parity greater than 3. Regarding abortion history, 56 (56%) had no history of abortion, 22 (22%) had one abortion, 5 (5%) had two abortions, and 17 (17%) had three or more abortions. In terms of mode of previous delivery, 60 (60%) had undergone vaginal delivery while 40 (40%) had undergone cesarean section.

Table 1. Demographic data of included subjects

Variables	Value (N = 100)
Demographic data	
Age (Years)	26.66 ± 3.17
Residence	
Urban	50 (50%)
Rural	50 (50%)
Occupation	51 (51%)
Obstetric history	
Parity	
1	39 (39%)
2	26 (26%)
3	17 (17%)
>3	18 (18%)
Abortion	
0	56 (56%)
1	22 (22%)
2	5 (5%)
≥3	17 (17%)
Mode of previous delivery	
Vaginal Delivery	60 (60%)
Cesarean Section	40 (40%)

(**Table.2**) show that: among them, 29% underwent vaginal deliveries, while 71% had cesarean sections. In terms of fetal sex, 44% were male and 56% were female.

The gestational age (GA), measured in weeks, averaged at 38.08 with a standard deviation of 0.78 weeks, and in days, averaged at 2.25 with a standard deviation of 2.13 days

.**Table 2. Current delivery evaluations among included subjects**

Variables	Value (N = 100)
Mode of current delivery	
Vaginal Delivery	29 (29%)
Cesarean Section	71 (71%)
Fetus Sex	
Male	44 (44%)
Female	56 (56%)
GA (AUA)	
Week	38.08 ± 0.78
Day	2.25 ± 2.13

(**Table.3**) show that: the actual fetal weight was determined to be 3167.97 grams with a standard deviation of 173.52 grams. Various estimations of fetal weight were calculated using different parameters. The estimated fetal weight using the parameters Hadlock formula (AC/BPD/FL/HC) was 3168.54 grams ± 144.81 grams, with a p-value of 0.9318 according to the Mann-Whitney U test. Similarly, the estimated fetal weight using Hadlock formula (AC/FL/HC) was 3106.28 grams ± 142.63 grams with a p-value of 0.4569. Estimates based solely on AC/BPD was 3070.39 ± 460.45 grams (p-value: 0.0434*) with significant decrease compared with actual weight and AC/FL was 3141.1 grams ± 165.58 grams (p-value: 0.6087) respectively (**Fig.5**).

Table 3. Actual and Estimated weights among included subjects

Variables	Value (N = 100)	P. Value
Actual Fetal Weight (g)	3167.97 ± 173.52	
Estimated Fetal Weight (g) by US		
AC/BPD/FL/HC(Headlock 1)	3168.54 ± 144.81	0.9318[MWU]
AC/FL/HC(Headlock 3)	3106.28 ± 142.63	0.4569[MWU]
AC/BPD (Headlock 2)	3070.39 ± 460.45	0.0434*[MWU]
AC/FL(Headlock 1)	3141.1 ± 165.58	0.6087[MWU]

MWU: Mann-Whitney U Test

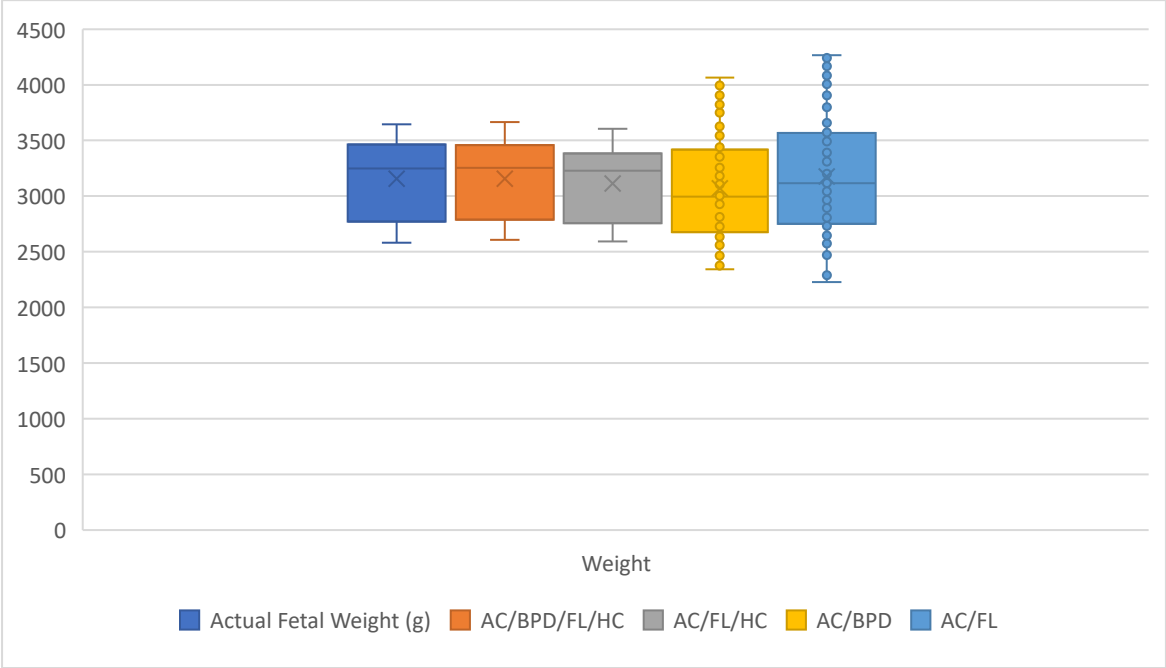

Fig.5. Actual and Estimated weights among included subjects

(**Table.4**) show that: actual gestational age (GA) was determined to be 38.08 weeks ± 0.78 weeks, corresponding to 268.81 days ± 5.11 days. Various estimations of gestational age were compared. The estimation based on AC/BPD/FL/HC resulted in 268.31 days ± 36.32 days, with a p-value of 0.1285, suggesting no statistically significant difference. Hadlock formula (AC/FL/HC) estimated a gestational age of 266.6 days ± 36.11 days, showing non significant decrease (p = 0.1471). Conversely, AC/BPD estimated a gestational age of 254.63 days ± 37.04 days, indicating a highly significant decrease (p = 0.0009). The estimation based on AC/FL yielded 267.6 days ± 41.13 days, with a non-significant p-value of 0.1211 (**Fig. 6**).

Table 4. Actual and Estimated ages among included subjects

Age	Week	Day	Total Days	P. Value
GA(AUA)	38.08 ± 0.78	2.25 ± 2.13	268.81 ± 5.11	
Estimated				
AC/BPD/FL/HC	37.89 ± 5.17	3.08 ± 1.96	268.31 ± 36.23	0.1285[MWU]
AC/FL/HC	37.7 ± 5.16	2.7 ± 2.07	266.6 ± 36.11	0.1471[MWU]
AC/BPD	35.91 ± 5.25	3.26 ± 1.92	254.63 ± 37.04	0.0009*[MWU]
AC/FL	37.84 ± 5.89	2.72 ± 2.15	267.6 ± 41.13	0.1211[MWU]

MWU: Mann-Whitney U Test

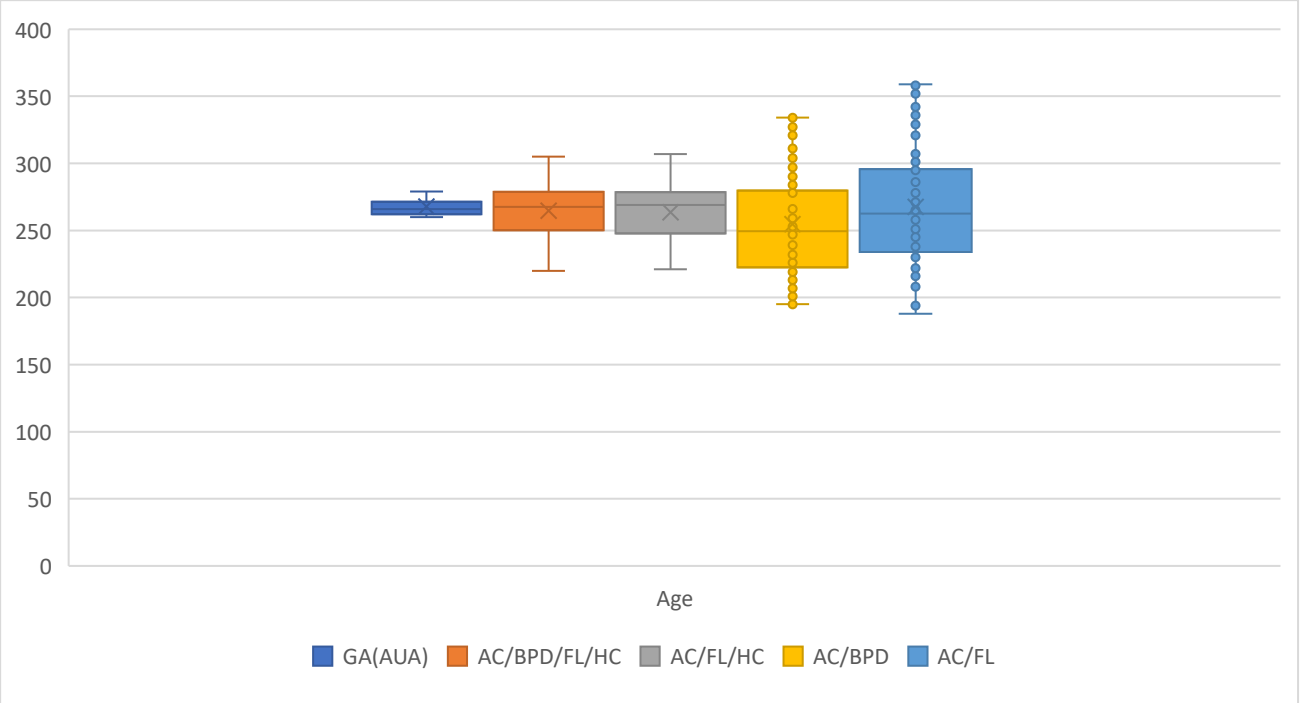

Fig.6.Actual and Estimated ages among included subjects

Discussion

Our study findings are supported by **Yadav et al. (2016),** who assessed fetal weight in term pregnancies. They found most women aged 21-30 (85%), with 59% Primigravida and 41% Multigravida.

Among our subjects (N = 100), parity distribution was: parity 1 (39%), parity 2 (26%), parity 3 (17%), and parity >3 (18%). Abortion history: none (56%), one (22%), two (5%), three or more (17%). Vaginal delivery: 60%; cesarean section: 40%.

Aggarwal and Sharma (2020) studied 425 pregnant females. Second trimester: 51%, third trimester: 49%. Age: 18-39 years; gravida: 1-6; parity: 1-5.

Current delivery evaluations showed 29% vaginal deliveries and 71% cesarean sections. Fetal sex: male (44%), female (56%). Gestational age: weeks (mean = 38.08, SD = 0.78), days (mean = 2.25, SD = 2.13).

Our study aligns with **Yadav et al. (2016),** with 26% of cases at 37-38 weeks, 27% at 38.1-39 weeks, 37% at 39.1-40 weeks, and 10% at 40.1-42 weeks. Normal Vaginal Delivery: 52.5%; Lower Segment Cesarean Section: 47.5%.

Average of actual fetal weight in our study was 3167.97 grams (SD = ±173.52). Estimations based on various parameters yielded different results. AC/BPD/FL/HC: 3168.54 grams ± 144.81 grams (p = 0.9318). AC/FL/HC: 3106.28 grams ± 142.63 grams (p = 0.4569). AC/BPD: 3165.71 grams ± 163.9 grams (p = 0.0714). AC/FL: 3141.1 grams ± 165.58 grams (p = 0.6087).

Our study findings are in line with **Eze et al. (2015),** who found sonographically estimated fetal weight correlated with actual birth weight in a Nigerian population. Mean estimated weight: 3378g; actual: 3393g.

Yadav et al. (2016) reported actual birth weights ranged from 2000g to 4300g, with a mean of 3100g (SD = 455.8). Majority fell in the 2501-3000g range (35.5%). Mean estimated weights: AG×SFH: 2971g (SD = 337.9), USG: 3240g (SD = 389.7), Johnson's formula: 2911g (SD = 364).

Sunkara (2016) found ultrasonography closely estimated birth weight in 47% of cases, followed by Dares formulae (38.3%). J and T method had the largest difference. Population-specific mean birth weight: 2876g.

Bonti Bora (2015) observed no significant difference between ultrasonographic and neonatal birth weights in primipara and multipara. Ultrasonographic birth weight: 2.8971±0.33889; Neonatal birth weight: 2.9286±0.30654. Correlation between the two showed no significance ($p > 0.05$).

In our study, actual gestational age (GA) was 38.08 weeks (SD = 0.78), equivalent to 268.81 days (SD = 5.11). Estimations using different parameters yielded varied results. AC/BPD/FL/HC: 266.78 days ± 36.32 days ($p = 0.0516$). AC/FL/HC: 264.75 days ± 36.08 days ($p = 0.0356$). AC/BPD: 250.39 days ± 36.64 days ($p < 0.0001$). AC/FL: 266.65 days ± 41.19 days ($p = 0.0838$).

Our study findings are in line with **Joshi et al. (2017),** comparing clinical and ultrasound estimates of fetal weight. They found significant differences in mean error between methods at gestational ages 38 and 39 weeks. Clinical estimation had a higher mean percentage error (13.72% ± 11.01%) compared to ultrasound (9.58% ± 7.68%). Within a 10% error margin, clinical estimation had 42.5% accuracy, while ultrasound had 55.7%.

In our study Accuracy and PPV were identical in our study due to the absence of true negatives. NPV and Specificity were 0. Sensitivity for all formulas was 100%, indicating accurate identification of positives. AC/BPD/FL/HC: Achieved 96% Accuracy and PPV, showing high reliability for predictions within ±5% of actual fetal weight. AC/FL/HC: Showed 92% Accuracy and PPV, indicating good reliability. AC/BPD: Presented lower Accuracy and PPV at 49%, suggesting less reliability. AC/FL: Showed 80% Accuracy and PPV, reasonably reliable for predictions within ±5%.

Our study aligns with **Hammami et al. (2018),** revealing formulas with ≥3 measurements provided the most accurate fetal weight estimations, with HC, AC, and FL showing significant correlation with birth weight ($r = 0.959$; $p < 0.0001$).

Similarly, **Milner and Arezina (2018)** found ultrasound overestimated fetal weight; Hadlock A formula showed the lowest random error. Methods with two measurements showed inconsistent results.

Joshi et al. (2017) favored ultrasound for term fetal weight estimation, showing a stronger correlation with actual birth weight ($r = 0.54$; $p < 0.001$) compared to clinical methods. Sensitivity and specificity were superior for ultrasound.

Mgbafulu et al. (2019) favored ultrasound over clinical methods for fetal weight estimation, reporting 68.2% accuracy within 10% of actual birth weight.

Lanowski et al. (2017) favored ultrasound over clinical examination for fetal weight estimation, especially with trained ultrasound examiners. BMI and gestational age influenced accuracy.

Preyer et al. (2019) found ultrasound more accurate than clinical examination, particularly in overweight pregnant women.

Khatri et al. 2024 reported ultrasound as the most accurate method for predicting fetal birth weight, with 90.8% accuracy within a 10% range of actual birth weight.

Our study findings differ from **Hiwale et al. (2017),** who found most Western population-based models overestimated fetal weight. Woo's (AC-BPD) model performed best, followed by other models with AC or AC-BPD combinations, showing statistically

significant lesser mean percentage error ($p < 0.05$).

Conclusion

For fetal weight estimation, the Hadlock formulas using different combinations of parameters were evaluated. Most formulas, including those using combinations of abdominal circumference (AC), biparietal diameter (BPD), femur length (FL), and head circumference (HC), provided estimates that were not significantly different from the actual fetal weights, indicating high accuracy. In particular, the formulas using AC/BPD/FL/HC and AC/FL/HC parameters were highly accurate, showing no significant difference from the actual weights. However, the formula based solely on AC/BPD showed a statistically significant difference, suggesting that this combination is less reliable for accurate fetal weight estimation.

References

- **Aggarwal N, Sharma G. (2020).** Fetal ultrasound parameters: Reference values for a local perspective. Indian Journal of Radiology and Imaging, 30(02): 149-155.
- **Aye AA, Agida TE, Babalola AA, Isah AY, Adewole ND. (2022).** Accuracy of ultrasound estimation of fetal weight at term: A comparison of shepard and hadlock methods. Annals of African Medicine, 21(1): 49-53.
- **Bonti Bora U. (2015).** A comparative study of ultrasonographic birth weight with neonatal birth weight in a first referral unit of Guwahati. International Journal of Medical Science and Public Health, 4(9): 1223-1227.
- **Eze CU, Abonyi LC, Njoku J, Okorie U, Owonifari O. (2015).** Correlation of ultrasonographic estimated fetal weight with actual birth weight in a tertiary hospital in Lagos, Nigeria. African health sciences, 15(4): 1112-1122.
- **Gratacos E, Lewi L, Munoz B, Acosta-Rojas R, Hernandez-Andrade E, Martinez JM, et al. (2007).** A classification system for selective intrauterine growth restriction in monochorionic pregnancies according to umbilical artery Doppler flow in the smaller twin. Ultrasound in obstetrics and gynecology. 30(1): 28-34.
- **Hammami A, Mazer Zumaeta A, Syngelaki A, Akolekar R, Nicolaides KH. (2018).** Ultrasonographic estimation of fetal weight: development of new model and assessment of performance of previous models. Ultrasound in obstetrics and gynecology, 52(1): 35-43.
- **Haragan AF, Hulsey TC, Hawk AF, Newman RB, Chang EY. (2015).** Diagnostic accuracy of fundal height and handheld ultrasound-measured abdominal circumference to screen for fetal growth abnormalities. American journal of obstetrics and gynecology, 212(6): 820-e1.
- **Hiwale S, Misra H, Ulman S. (2019).** Fetal weight estimation by ultrasound: development of Indian population-based models. Ultrasonography. 38 (1):50-55.
- **Hiwale SS, Misra H, Ulman S. (2017).** Ultrasonography-based fetal weight estimation: finding an appropriate model for an Indian population. Journal of medical ultrasound, 25(1): 24-32.
- **Joshi A, Panta OB, Sharma B. (2017).** Estimated fetal weight: Comparison of clinical versus Ultrasound estimate, 15(35): 51-5.
- **Khatri R, Bhardwaj G, Rawal S, Kumar RR, Malik N. (2024).** A comparative study of clinical methods and ultrasound methods for prediction of fetal birth weight at term gestation, 10(2): 349 – 356.
- **Lanowski JS, Lanowski G, Schippert C, Drinkut K, Hillemanns P,**

Staboulidou I, et al. (2017). Ultrasound versus clinical examination to estimate fetal weight at term. Geburtshilfe und Frauenheilkunde, 77(03): 276-283.

- **Malik R, Thakur P, Agarwal G. (2016).** Comparison of three clinical and three ultrasonic equations in predicting fetal birth weight. International Journal of reproduction, contraception, obstetrics, and gynecology. 5(1): 210-216.
- **Mgbafulu C, Ajah L, Umeora O, Ibekwe P, Ezeonu P, Orji M. (2019).** Estimation of fetal weight: a comparison of clinical and sonographic methods. Journal of Obstetrics and Gynaecology, 39(5): 639-646.
- **Milner J, Arezina J. (2018).** The accuracy of ultrasound estimation of fetal weight in comparison to birth weight: A systematic review. Ultrasound, 26(1): 32-41.
- **Milner J, Arezina J. (2018).** The accuracy of ultrasound estimation of fetal weight in comparison to birth weight: A systematic review. Ultrasound, 26(1): 32-41.
- **Napolitano R, Donadono V, Ohuma EO, Knight CL, Wanyonyi SZ, Kemp B, et al. (2016).** Scientific basis for standardization of fetal head measurements by ultrasound: a reproducibility study. Ultrasound in Obstetrics and Gynecology, 48(1): 80-85.
- **Preyer O, Husslein H, Concin N, Ridder A, Musielak M, Pfeifer C, et al. (2019).** Fetal weight estimation at term–ultrasound versus clinical examination with Leopold's manoeuvres: a prospective blinded observational study. BMC pregnancy and childbirth, 19(1): 1-9.
- **Rumack CM, Levine D. (2023).** Diagnostic ultrasound: Elsevier Health Sciences, 1-80.
- **Sunkara A. (2016).** Comparative study of various methods of fetal weight estimation in term pregnancy. Rajiv Gandhi University of Health Sciences (India), 5(1): 22-25.
- **Yeh MN, Bracero L, Reilly KB, Murtha L, Aboulafia M, Barron BA, et al. (1982).** Ultrasonic measurement of the femur length as an index of fetal gestational age. American Journal of Obstetrics and Gynecology, 144(5): 519-522.