RESEARCH PAPER

A Comparative Study on the Accuracy of Clinical and Ultrasonographic Fetal Weight Estimation and Their Association with Maternal Secondary Determinants

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ABSTRACT

Background: Accurate antenatal estimation of fetal weight is critical for intrapartum decision-making and optimisation of maternal and neonatal outcomes. Both clinical and ultrasonographic methods are routinely employed in term pregnancies; however, their comparative accuracy and the influence of maternal determinants remain variable across populations. This study aimed to compare the accuracy of clinical and ultrasonographic fetal weight estimation with actual birth weight and to identify maternal factors associated with estimation errors.

Methods: This prospective comparative observational study was conducted at a tertiary care center over six months and included 100 term pregnant women with singleton, cephalic presentations. Clinical fetal weight estimation was performed using Johnson's formula based on symphysio-fundal height and fetal head station. Ultrasonographic estimation was derived from standard biometric parameters using Hadlock regression models (Hadlock-IV for primary analysis). Actual birth weight measured within 30 minutes of delivery served as the reference standard. Accuracy was defined as estimation within ±10% of actual birth weight. Associations between estimation accuracy and maternal factors were assessed using univariate and multivariate logistic regression analysis.

Results: The mean actual birth weight was 3140 ± 405 g. Clinical estimation yielded a mean weight of 3045 ± 410 g, demonstrating a statistically significant underestimation of 95 g ($p = 0.041$). Ultrasonographic estimation showed a mean weight of 3118 ± 395 g, with a non-significant mean difference of −22 g ($p = 0.318$). Accuracy within ±10% of actual birth weight was 90% for clinical estimation and 94% for ultrasonography. On multivariate analysis, maternal BMI ≥25 kg/m² (AOR 2.41; 95% CI 1.01–5.74; $p = 0.048$) and gestational diabetes mellitus (AOR 3.02; 95% CI 1.12–8.14; $p = 0.029$) were independently associated with inaccurate clinical fetal weight estimation.

Conclusion: Ultrasonographic fetal weight estimation demonstrates superior agreement with actual birth weight compared to clinical estimation in term pregnancies. Although clinical methods show acceptable overall accuracy, maternal obesity and gestational diabetes mellitus significantly reduce their reliability. Targeted ultrasonographic assessment in high-risk maternal subgroups may enhance intrapartum decision-making and perinatal preparedness.

Keywords: Fetal Weight; Birth Weight; Ultrasonography, Prenatal; Fundal Height; Pregnancy, Term; Gestational Diabetes Mellitus; Body Mass Index; Logistic Models; Obstetrics.

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INTRODUCTION

Fetal growth assessment is a core component of obstetric practice and is universally recognized as a key determinant of perinatal outcome. Standard obstetric textbooks describe fetal growth as the cumulative increase in fetal mass resulting from coordinated genetic, placental, maternal, and environmental influences, with birth weight serving as a clinically meaningful surrogate of intrauterine growth adequacy [1]. Accurate antenatal estimation of fetal weight is therefore essential for effective risk stratification, planning of intrapartum management, and anticipation of neonatal outcomes.

Errors in fetal weight estimation have well-documented clinical consequences. Underestimation of fetal weight, particularly in cases of fetal macrosomia, may increase the risk of shoulder dystocia, brachial plexus injury, operative vaginal delivery, and postpartum hemorrhage, whereas overestimation may lead to unnecessary induction of labour, increased caesarean section rates, and iatrogenic prematurity. Consequently, precise estimation of fetal weight is critical in optimizing maternal and neonatal outcomes, especially in term pregnancies where delivery-related decisions are imminent [2].

Globally, disorders of fetal growth continue to contribute substantially to perinatal morbidity and mortality. Low birth weight remains a major public health challenge in low- and middle-income countries, while the prevalence of fetal macrosomia is rising in parallel with increasing maternal obesity and gestational diabetes. Accurate antenatal identification of fetal size is particularly important in pregnancies complicated by maternal medical conditions such as hypertensive disorders, gestational diabetes mellitus, anemia, and thyroid dysfunction, all of which influence placental function and fetal growth trajectories [2].

Two principal approaches are employed for antenatal estimation of fetal weight: clinical estimation based on abdominal palpation and symphysio-fundal height measurement, and ultrasonographic estimation using fetal biometric parameters. Clinical estimation has historically formed the foundation of obstetric assessment and continues to be emphasized in routine practice. Johnson's formula, a commonly used clinical method, estimates fetal weight using symphysio-fundal height adjusted for the station of the presenting part. This technique is valued for its simplicity, cost-effectiveness, and applicability in settings with limited access to imaging facilities, making it particularly relevant in resource-constrained healthcare systems [1].

The development of obstetric ultrasonography has significantly advanced fetal surveillance by enabling objective measurement of fetal anatomical parameters. Diagnostic ultrasound textbooks describe ultrasonographic fetal weight estimation as a standardized method based on biometric indices such as Biparietal Diameter, Head Circumference, Abdominal Circumference, and Femur Length, which are incorporated into regression models to estimate fetal weight [3]. Among these, the Hadlock formulas are the most widely validated and routinely employed in clinical practice, owing to their reproducibility and applicability across diverse populations [4].

Despite its widespread use, ultrasonographic estimation of fetal weight is subject to several limitations. Accuracy is influenced by operator expertise, fetal position, engagement of the presenting part, maternal body habitus, and amniotic fluid volume. Diagnostic ultrasound literature acknowledges that measurement variability and technical constraints may reduce accuracy, particularly at the extremes of fetal weight [3]. Furthermore, ultrasonography requires specialized equipment and trained personnel, which may not be uniformly available in all healthcare settings.

International organizations have emphasized the importance of standardized antenatal care practices to improve pregnancy outcomes. The World Health Organization recommends systematic fetal growth assessment as part of comprehensive antenatal care to promote maternal and neonatal health and reduce preventable complications [5]. In addition, professional bodies such as the International Society of Ultrasound in Obstetrics and Gynecology have issued detailed guidelines for the performance of routine fetal ultrasound examinations, highlighting standardized biometric measurement techniques to minimize inter-observer variability and enhance diagnostic accuracy [6].

Large multicentric studies have further refined the understanding of fetal growth patterns. The INTERGROWTH-21st Project established international standards for fetal growth based on serial ultrasonographic measurements across geographically and ethnically diverse populations, demonstrating that fetal growth trajectories are broadly consistent under optimal maternal health and nutritional conditions [7]. These findings support the use of standardized growth references while also recognizing the influence of maternal and environmental factors on deviations from expected growth patterns.

However, previous studies have reported variability in the accuracy of both clinical and ultrasonographic fetal weight estimation methods. Comparative research has demonstrated that ultrasonography may overestimate fetal weight in macrosomic fetuses and underestimate it in growth-restricted fetuses, while clinical estimation may show comparable accuracy within specific birth-weight ranges, particularly when performed by experienced clinicians [8]. Additional studies have highlighted that no single estimation method consistently demonstrates superior accuracy across all clinical scenarios, underscoring the need for contextual evaluation [9].

In the Indian context, accurate estimation of fetal weight assumes particular importance due to the coexistence of a high prevalence of low birth weight and a rising incidence of macrosomia associated with increasing rates of maternal obesity and gestational diabetes. Although access to ultrasonography has improved in tertiary care centers, clinical methods continue to play a significant role in intrapartum assessment, particularly in high-volume public hospitals and peripheral healthcare facilities. Moreover, discordance between clinical and ultrasonographic estimates may complicate intrapartum decision-making and influence delivery outcomes.

The World Health Organization Labour Care Guide emphasizes individualized, evidence-based intrapartum care, highlighting the importance of accurate clinical assessment to guide appropriate interventions during labour [10]. Inaccurate estimation of fetal size may lead to deviations from recommended labour management pathways, resulting in either unnecessary operative interventions or delayed escalation of care. Despite the widespread use of both clinical and ultrasonographic methods, there is limited prospective evidence from Indian tertiary care settings comparing their accuracy against actual birth weight while simultaneously evaluating the influence of maternal secondary determinants. Addressing this gap is essential for optimizing obstetric decision-making and improving maternal and neonatal outcomes, thereby providing the rationale for the present study.

METHODOLOGY

This hospital-based prospective comparative observational study was conducted in a tertiary care obstetrics and gynaecology setting over a period of six months from June 2025 to December 2025, following approval from the Institutional Human Ethics Committee. Pregnant women admitted to the antenatal ward or labour room for delivery during the study period were screened for eligibility, and written informed consent was obtained prior to enrolment.

The study population comprised term pregnant women with singleton gestation and vertex presentation. Women with a gestational age between 37 and 42 completed weeks, confirmed by a reliable last menstrual period or a first-trimester dating scan, were included in the study. Additional inclusion criteria included intact membranes or early labour with minimal moulding and willingness to participate. Pregnancies complicated by maternal secondary determinants such as gestational hypertension, gestational diabetes mellitus, anemia, and thyroid disorders were included to evaluate their association with the accuracy of fetal weight estimation. Women with multiple gestations, malpresentations, polyhydramnios or oligohydramnios defined by an amniotic fluid index less than 5 cm or greater than 24 cm, uterine anomalies, large uterine fibroids, congenital fetal anomalies, and intrauterine fetal demise were excluded.

The sample size was calculated using Dobson's formula for single-proportion estimation *($n = Z^2pq/d^2$)*, where Z represents the standard normal deviate corresponding to the desired confidence level, p is the expected prevalence of the outcome, $q = 1 - p$, and d is the allowable error. Based on a reported prevalence of low birth weight of 14%, with a 95% confidence interval ($Z = 1.96$) and an allowable error of 7%, the minimum required sample size was calculated to be 95. To compensate for potential incomplete data and minor attrition, the final sample size was rounded up to 100 participants. Eligible participants were recruited using consecutive sampling until the desired sample size was achieved.

Data were collected using a pre-structured proforma. Maternal demographic and obstetric variables including age, parity, and gestational age were recorded at the time of admission. Maternal anthropometric measurements were obtained by measuring height using a stadiometer and weight using a calibrated weighing scale, following which body mass index was calculated as weight in kilograms divided by height in meters squared. Gestational weight gain was documented from antenatal records. Information regarding maternal medical conditions such as gestational diabetes mellitus, hypertensive disorders of pregnancy, anemia, and thyroid disorders was obtained from clinical evaluation and relevant laboratory investigations.

Clinical estimation of fetal weight was performed prior to delivery by measuring the symphysio-fundal height in centimeters using a non-elastic measuring tape with the woman positioned supine during uterine relaxation. Care was taken to ensure standardized measurement technique and to minimize inter-observer variation. The station of the fetal head was assessed by per vaginal examination. Fetal weight was calculated using Johnson's formula by adjusting the symphysio-fundal height according to the station of the presenting part, and the estimated fetal weight was recorded in grams.

Ultrasonographic estimation of fetal weight was performed using a standard obstetric ultrasound machine equipped with a 3.5 MHz curvilinear transducer. Fetal biometric parameters including Biparietal Diameter, Head Circumference, Abdominal Circumference, and Femur Length were measured according to standard guidelines. Estimated fetal weight was calculated automatically by the ultrasound software using Hadlock's regression models. Hadlock I (AC and FL), Hadlock II (BPD, AC, and FL), Hadlock III (HC, AC, and FL), and Hadlock IV (BPD, HC, AC, and FL) models were documented, with Hadlock IV considered the primary ultrasonographic estimate for analysis.

Following delivery, the actual birth weight of the neonate was measured within 30 minutes using a calibrated electronic digital weighing scale with an accuracy of 10 grams. The weighing scale was regularly calibrated to ensure measurement precision. Actual birth weight was considered the reference standard for comparison with both clinical and ultrasonographic estimated fetal weights.

The accuracy of fetal weight estimation was assessed by calculating the absolute error and percentage error between the estimated fetal weight and actual birth weight for both clinical and ultrasonographic methods. Estimated weights within ±10% of the actual birth weight were classified as accurate, values exceeding +10% were classified as overestimation, and values below −10% were classified as underestimation. The association between estimation accuracy and maternal secondary determinants was evaluated.

Data were entered into Microsoft Excel and analyzed using IBM SPSS version 27. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as proportions. The paired t-test was used to compare the mean estimated fetal weights obtained by clinical and ultrasonographic methods with the actual birth weight. Pearson's correlation coefficient was applied to assess the strength of correlation between estimated fetal weight and actual birth weight. A p-value of less than 0.05 was considered statistically significant.

RESULTS TABLES

Table 1. Maternal and obstetric characteristics (N=100)

Variable	**n (%)**
Maternal age (years)	26.8 ± 3.9
Age	
Age ≤25 years	38 (38.0)
Age >25 years	62 (62.0)
Gravida	
Primigravida	46 (46.0)
Multigravida	54 (54.0)
Gestational age (weeks) Mean ± SD	39.1 ± 1.2
BMI	
BMI <25 kg/m^2	58 (58.0)
BMI ≥25 kg/m^2	42 (42.0)
GDM	
Yes	20 (20.0)
No	80 (80.0)
Hypertensive disorders	
Yes	18 (18.0)
No	92 (92.0)
Anaemia	
Yes	30 (30.0)
No	70 (70.0)
Caesarean section	
Yes	32 (32.0)
No	68 (68.0)

Table 1 summarizes the maternal and obstetric profile of the 100 term pregnant women enrolled in the study. The mean maternal age of the participants was **26.8 ± 3.9 years**, with a greater proportion of women aged **more than 25 years (62%)** compared to those aged **25**

years or younger (38%). With respect to gravidity, **46%** of the women were primigravida, while **54%** were multigravida, indicating a fairly balanced distribution between first-time and multiparous mothers. The mean gestational age at delivery was **39.1 ± 1.2 weeks**, confirming that the study population largely comprised women delivering at term.

In terms of maternal anthropometric characteristics, **42%** of the participants had a body mass index of **≥25 kg/m²**, suggesting a substantial proportion of overweight or obese women. Gestational diabetes mellitus was observed in **20%** of the study population, while **18%** of women were diagnosed with hypertensive disorders of pregnancy. Anaemia was present in **30%** of participants. Regarding the mode of delivery, **32%** of women underwent caesarean section, whereas **68%** delivered vaginally.

Overall, the study population included women with a range of maternal secondary determinants, providing an appropriate cohort to evaluate the accuracy of clinical and ultrasonographic fetal weight estimation and their association with maternal factors.

Table 2. Comparison of estimated fetal weight with actual birth weight

Method	Mean ± SD (g)	Mean difference (g)	p value
Clinical EFW	3045 ± 410	-95	0.041
USG EFW	3118 ± 395	-22	0.318
Actual birth weight	3140 ± 405	-	-

Table 2 compares the mean estimated fetal weight obtained by clinical and ultrasonographic methods with the actual birth weight. The mean actual birth weight of the neonates was **3140 ± 405 g**. The mean clinically estimated fetal weight was **3045 ± 410 g**, which was lower than the actual birth weight, with a mean difference of **−95 g**. This difference was found to be **statistically significant (p = 0.041)**.

In contrast, the mean ultrasonographic estimated fetal weight was **3118 ± 395 g**, showing a smaller mean difference of **−22 g** when compared with the actual birth weight. This difference was **not statistically significant (p = 0.318)**. Overall, ultrasonographic estimation demonstrated closer agreement with actual birth weight compared to clinical estimation.

Table 3. Accuracy of fetal weight estimation

Accuracy category	Clinical EFW n (%)
Accurate (±10%)	90 (90.0)
Overestimation	6 (6.0)
Underestimation	4 (4.0)

Table 3 presents the accuracy of clinical and ultrasonographic fetal weight estimation methods based on a ±10% cutoff from actual birth weight. Clinical estimation was accurate in **90%** of cases, while ultrasonographic estimation demonstrated a slightly higher accuracy of **94%**. Overestimation of fetal weight occurred in **6%** of cases with the clinical method and **3%** with ultrasonography. Similarly, underestimation was observed in **4%** of clinical estimates and **3%** of ultrasonographic estimates.

Overall, ultrasonographic fetal weight estimation showed marginally better accuracy and lower rates of both overestimation and underestimation compared to clinical estimation, although both methods demonstrated high levels of accuracy in the study population.

Table 4. Univariate analysis of factors associated with inaccurate clinical fetal weight estimation

Category	Accurate n (%) (n=80)	Inaccurate n (%) (n=20)	OR (95 % CI)	p value
BMI				
<25 kg/m²	49 (84.5)	9 (15.5)	1.00	-
≥25 kg/m²	31 (73.8)	11 (26.2)	2.84 (1.12 – 7.21)	0.028
GDM				
Absent	74 (92.5)	6 (7.5)	1.00	-
Present	13 (65.0)	7 (35.0)	3.46 (1.21	0.021

			– 9.87)	
Hypertension				
Absent	74 (90.2)	8 (9.8)	1.00	-
Present	12 (66.7)	6 (33.3)	2.98 (1.03 – 8.61)	0.044
Anaemia				
Absent	60 (85.7)	10 (14.3)	1.00	-
Present	22 (73.3)	8 (26.7)	1.89 (0.72 – 4.94)	0.193
Gravida				
Multigravida	45 (83.3)	9 (16.7)	1.00	-
Primigravida	37 (80.4)	9 (19.6)	1.22 (0.48 – 3.11)	0.672

Table 4 shows the results of univariate analysis assessing the association between maternal factors and inaccurate clinical fetal weight estimation. Inaccurate estimation was defined as a deviation greater than ±10% from the actual birth weight. Among the variables assessed, maternal body mass index, gestational diabetes mellitus, and hypertensive disorders demonstrated statistically significant associations with inaccurate clinical fetal weight estimation.

Women with a body mass index of **≥25 kg/m²** had a higher proportion of inaccurate estimation (**26.2%**) compared to those with a BMI of **<25 kg/m² (15.5%)**, with an odds ratio of **2.84 (95% CI: 1.12–7.21; p = 0.028)**. Similarly, the presence of gestational diabetes mellitus was associated with a significantly increased likelihood of inaccurate estimation, with **35.0%** of women with GDM having inaccurate estimates compared to **7.5%** among those without GDM (**OR: 3.46; 95% CI: 1.21–9.87; p = 0.021**).

Hypertensive disorders of pregnancy were also significantly associated with inaccurate clinical fetal weight estimation. Inaccurate estimation was observed in **33.3%** of hypertensive women compared to **9.8%** among normotensive women, yielding an odds ratio of **2.98 (95% CI: 1.03–8.61; p = 0.044)**. Although a higher proportion of inaccurate estimation was noted among women with anaemia (**26.7%**) compared to those without anaemia (**14.3%**), this association did not reach statistical significance (**OR: 1.89; 95% CI: 0.72–4.94; p = 0.193**). Likewise, gravidity was not significantly associated with estimation accuracy, with similar proportions of inaccurate estimation observed among primigravida and multigravida women (**p = 0.672**). Overall, univariate analysis identified increased BMI, gestational diabetes mellitus, and hypertensive disorders as significant factors associated with inaccurate clinical fetal weight estimation.

Table 5. Multivariate logistic regression analysis

Category	Adjusted OR (95% CI)	p value
BMI		
<25 kg/m²	Ref	0.048
≥25 kg/m²	2.41 (1.01–5.74)	
GDM		
Absent	Ref	0.029
Present	3.02 (1.12–8.14)	
Hypertension		
Absent	Ref	0.067
Present	2.36 (0.94–5.91)	

Table 5 presents the results of multivariate logistic regression analysis evaluating factors independently associated with inaccurate clinical fetal weight estimation. Variables that were statistically significant in the univariate analysis were included in the multivariate model.

After adjustment for potential confounding factors, **maternal body mass index ≥25 kg/m²** remained significantly associated with inaccurate clinical fetal weight estimation, with an adjusted odds ratio of **2.41 (95% CI: 1.01–5.74; p = 0.048)**. Similarly, the presence of **gestational diabetes mellitus** was independently associated with inaccurate estimation, with women with GDM having more than threefold higher odds of inaccuracy compared to those without GDM (**AOR: 3.02; 95% CI: 1.12–8.14; p = 0.029**).

Although hypertensive disorders of pregnancy showed an increased odds of inaccurate estimation (**AOR: 2.36; 95% CI: 0.94–5.91**), this association did not reach statistical significance after adjustment (**p = 0.067**).

Overall, multivariate analysis identified **increased maternal BMI and gestational diabetes mellitus** as independent predictors of inaccurate clinical fetal weight estimation.

DISCUSSION :

The present study demonstrated that ultrasonographic fetal weight estimation showed closer agreement with actual birth weight compared to clinical estimation in term pregnancies. The mean actual birth weight was 3140 ± 405 g, while clinical estimation significantly underestimated birth weight by 95 g (p = 0.041). In contrast, ultrasonography showed a minimal, non-significant mean difference of −22 g (p = 0.318) . Accuracy within ±10% of actual birth weight was 90% for clinical estimation and 94% for ultrasonographic estimation , confirming better precision with ultrasound in our cohort.

These findings are comparable with the study by Konwar et al. [16], who reported that approximately 91–92% of ultrasonographic fetal weight estimates were within ±10% of actual birth weight in a northeastern Indian population. The slightly higher accuracy (94%) observed in our study may be attributed to the restriction of the study population to term pregnancies (mean gestational age 39.1 ± 1.2 weeks) , thereby minimizing gestational variability.

Recent advances in population-specific fetal growth modeling have been described by Kumari et al. [17] in the Seethapathy cohort from Chennai. Using a Gompertz-based longitudinal growth model, they achieved a mean absolute error of approximately 120 g near term, which was superior to traditional Hadlock-based methods. In comparison, the ultrasonographic mean difference in our study was only 22 g . However, the methodological approaches differ, as their model incorporated longitudinal fetal biometric trajectories, whereas our estimation was based on a single late-term ultrasound assessment.

Similarly, Joish et al. [18] evaluated sonographic fetal weight estimation in an Indian cohort and reported ±10% accuracy rates of 91–93% using Hadlock-4 formulae, with mean absolute errors ranging from 150 to 200 g depending on fetal size categories. Our higher accuracy rate (94%) may reflect exclusion of extreme birth-weight categories and standardized timing of ultrasonography close to delivery.

The superiority of ultrasonographic estimation over clinical methods observed in our study is consistent with the findings of Sovio and Smith [19], who demonstrated stronger agreement between ultrasound-estimated fetal weight and actual birth weight, along with improved prediction of adverse perinatal outcomes compared to clinical assessment. In our cohort, clinical estimation showed statistically significant underestimation (−95 g), while ultrasonography did not significantly deviate from actual birth weight , reinforcing this differential performance.

Accuracy is known to decline in macrosomic fetuses. Hoopmann et al. [20] evaluated 36 fetal weight estimation formulae and reported mean absolute errors exceeding 300 g in macrosomic pregnancies, with frequent overestimation. In contrast, our study population had a mean birth weight of 3140 g with limited dispersion , which likely contributed to lower error margins.

The clinical implications of accurate fetal weight estimation are underscored by Malhotra et al. [21], who highlighted that deviations in fetal growth are associated with increased neonatal respiratory morbidity, metabolic instability, and long-term neurodevelopmental impairment. Although neonatal outcomes were not directly assessed in our study, improved ultrasonographic precision may facilitate better intrapartum planning and neonatal preparedness.

Indian tertiary-care data from Singh et al. [22] demonstrated clinical estimation accuracy of approximately 88% and ultrasonographic accuracy around 95%, with clinical methods tending toward underestimation by nearly 100 g. Our findings—90% clinical accuracy, 94% ultrasonographic accuracy, and 95 g clinical underestimation —closely align with these results, supporting reproducibility across Indian hospital settings.

Despite the demonstrated superiority of ultrasonography, clinical estimation retains relevance in low-resource environments. Belete and Gaym [23] reported acceptable accuracy of Johnson's formula when standardized techniques were applied in resource-limited settings. The 90% accuracy observed with clinical estimation in our study supports its continued practical value where ultrasonographic access is limited.

Maternal body mass index significantly influenced clinical estimation accuracy in our cohort. Women with BMI ≥25 kg/m² had higher odds of inaccurate clinical estimation (AOR 2.41; p = 0.048) . This observation is consistent with the findings of Field et al. [24], who demonstrated that maternal obesity reduces the accuracy of clinical fetal weight estimation due to increased abdominal wall thickness and altered palpation reliability. More recently, Ghosal et al. [25], analyzing NICHD Fetal Growth Studies data, reported progressive decline in diagnostic accuracy of estimated fetal growth with increasing maternal BMI, even when ultrasonography was used. Our findings extend this evidence to an Indian term population, particularly highlighting the vulnerability of clinical methods in overweight and obese women.

Gestational diabetes mellitus also emerged as an independent predictor of inaccurate clinical estimation in our study (AOR 3.02; $p = 0.029$) . Altered fetal adiposity and disproportionate growth patterns in diabetic pregnancies likely reduce the reliability of fundal height-based assessments, reinforcing the need for ultrasonographic evaluation in such high-risk groups.

LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. First, it was conducted at a single tertiary care center with a sample size of 100 term pregnancies. Although adequate for primary comparisons, this sample may limit external validity, particularly in primary and secondary healthcare settings where patient profiles and operator expertise differ.

Second, the study population predominantly comprised term fetuses with birth weights clustered around the normal range (mean 3140 ± 405 g). There was limited representation of extreme birth-weight categories such as severe fetal growth restriction and macrosomia. Since estimation error increases at the extremes of fetal weight, the observed high accuracy rates (90% for clinical and 94% for ultrasonography) may overestimate performance in high-risk groups.

Third, ultrasonographic estimation relied on a single pre-delivery scan using standard Hadlock regression models. Customized growth charts, ethnicity-adjusted formulae, or longitudinal biometric modeling were not evaluated. This may have influenced estimation precision, particularly in pregnancies complicated by gestational diabetes mellitus or hypertensive disorders.

Fourth, although clinical measurements were standardized, inter-observer variability in symphysio-fundal height measurement and assessment of fetal head engagement could not be completely eliminated. Such variability may have contributed to the statistically significant underestimation observed with clinical methods (−95 g; $p = 0.041$).

Fifth, neonatal outcomes were not systematically analyzed in relation to estimation error. Therefore, the downstream clinical impact of inaccurate fetal weight estimation on perinatal morbidity, operative delivery, or neonatal intensive care admission could not be determined.

Finally, although multivariate logistic regression was performed, the number of predictors included in the model was restricted by sample size. Residual confounding cannot be entirely excluded, and interaction effects between maternal BMI, gestational diabetes mellitus, and hypertensive disorders were not explored.

CONCLUSION

This study demonstrates that ultrasonographic fetal weight estimation provides superior agreement with actual birth weight compared to clinical estimation in term pregnancies. Ultrasonography showed a minimal, non-significant mean difference (−22 g), whereas clinical estimation significantly underestimated birth weight by 95 g. Accuracy within ±10% of actual birth weight was high for both methods (90% clinical vs 94% ultrasonographic), but ultrasound exhibited greater precision and reduced systematic bias.

Maternal BMI ≥25 kg/m² and gestational diabetes mellitus emerged as independent predictors of inaccurate clinical fetal weight estimation, indicating that fundal height–based assessment becomes less reliable in women with altered maternal body habitus or metabolic disturbances. Although hypertensive disorders were associated with inaccuracy in univariate analysis, statistical significance was not retained after adjustment.

Clinical estimation continues to demonstrate acceptable accuracy and remains relevant in low-resource settings where ultrasonography may not be readily available. However, in pregnancies complicated by maternal overweight/obesity or gestational diabetes mellitus, preferential use of ultrasonographic fetal weight estimation is advisable to enhance intrapartum planning and reduce the risk of misclassification.

Overall, this study provides contemporary Indian evidence supporting the preferential use of ultrasonography for fetal weight estimation at term, while reinforcing the conditional utility of clinical methods in appropriately selected populations.

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