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Original Research Article

Role of Ultrasound in Assessment of Antenatal Fetal Weight and Correlation of it with Postnatal Weight

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Conflict of interest: Nil

Abstract:

Background: Monitoring fetal growth is one of the most important aspects of antenatal care, as it helps identify babies at risk of complications or mortality. Ultrasound-based estimation of fetal weight is widely practiced, but its accuracy remains uncertain, especially when formulas developed in non-Indian populations are applied in Indian settings.

Aim: The present study was undertaken to assess the accuracy of prenatal ultrasound in estimating fetal weight during the third trimester and to compare these estimates with actual birth weights in a tertiary care hospital in Rajasthan, India.

Materials and Methods: This was a descriptive, observational study involving 73 pregnant women in their third trimester. Estimated fetal weight (EFW) was calculated using the Hadlock-2 formula (based on biparietal diameter, abdominal circumference, and femur length) and compared with actual birth weight (ABW) after delivery. Statistical tools such as Spearman's correlation and paired t-test were applied.

Results: A significant positive correlation was observed between EFW and ABW (Spearman's rho = 0.615, $p < 0.001$). However, the difference between sonographic estimates and actual weights was statistically significant ($t = 3.094$, $df = 144$, $p < 0.002$). The mean percentage error was 11.9%, with 67.1% of cases showing more than 10% error.

Conclusion: The study highlights that currently used foreign population-based ultrasound formulas tend to show considerable error when applied to Indian pregnancies. Variability may result from genetic, anthropometric, and technical factors. There is a need to develop and validate population-specific models to improve accuracy in fetal weight estimation in Indian clinical practice.

Keywords: Fetal Weight, Ultrasound, Prenatal Growth Assessment, Actual Birth Weight.

Introduction

Accurate assessment of fetal growth plays a central role in antenatal care, as it allows timely recognition of fetuses at risk of adverse outcomes. Identifying fetal growth restriction (FGR), defined as birth weight below the 10th percentile, is critical since it represents the strongest risk factor for stillbirth. Conversely, large-for-gestational-age (LGA) fetuses, with birth weights above the 90th percentile, face complications such as shoulder dystocia and birth trauma. [1-3]

For clinical practice, ultrasound-based fetal biometry remains the most widely used tool for estimating fetal weight. Parameters such as biparietal diameter (BPD), abdominal circumference (AC), femur length (FL), and head circumference (HC) are commonly employed. Among several available models, those proposed by Hadlock are extensively used. [4]

However, no single formula has proven universally accurate across all populations. Factors such as maternal nutrition, socioeconomic status, ethnicity, and body build contribute to inter-population variability in fetal growth patterns. Most Indian centers rely on models designed for Western populations, which may not be well-suited to local conditions. Previous research indicates higher error rates when these formulas are applied to Indian pregnancies. [5]

The present study aimed to evaluate the reliability of ultrasound-derived fetal weight estimates during the third trimester by comparing them with actual birth weights, thereby assessing their applicability in an Indian context. [6-10]

Materials and Methods

Study Design and Setting: This was a hospital-based, cross-sectional observational study conducted in the Department of Radiodiagnosis, Zenana Hospital, SMS Medical College, Jaipur, from March 2020 to September 2022.

Ethical Considerations: Approval was obtained from the institutional ethics committee. The study adhered to the principles of the Helsinki Declaration. Written informed consent was taken from all participants. Confidentiality was maintained, and sex determination was not performed or disclosed.

Study Population: Inclusion criteria included pregnant women in the third trimester with live singleton fetuses and adequate amniotic fluid index. Exclusion criteria included pregnancies where delivery did not occur within 7 days of ultrasound and cases with detected fetal anomalies.

Sample Size: Seventy-three women fulfilling the inclusion criteria were enrolled using convenience sampling.

Equipment and Measurements: All examinations were performed using a Philips Affinity 70G ultrasonography system with a 5 MHz convex transducer. The Hadlock-2 formula was applied:

$$\text{Log10 EFW} = 1.335 - 0.0034(AC)(FL) + 0.0316(BPD) + 0.0457(AC) + 0.1623(FL).$$

Fetal parameters measured included BPD, AC, and FL, following standardized techniques.

Birth Weight Measurement: Newborns were weighed naked within one hour of delivery using a calibrated crown weighing scale, and values were recorded to the nearest 10 grams.

Data Analysis: Data were compiled using pre-structured proformas. Both descriptive statistics (mean, standard deviation) and inferential tests (Spearman's correlation, paired t-test) were applied. Percentage errors were calculated. A p-value <0.05 was considered significant.

Results

Demographic Characteristics: Among 73 participants, the mean maternal age was 24.52 ± 3.18 years (range: 18–33 years). About 64.4% (47/73) were aged between 18–25 years. Urban residents comprised 60.3% of the sample. Hypertension was noted in 6.8% (5/73), and one case (1.4%) had diabetes.

Estimated vs. Actual Birth Weight: The mean ultrasound-estimated fetal weight was 2.83 ± 0.40 kg, whereas the mean actual birth weight was 3.06 ± 0.42 kg. The difference was statistically significant ($t = 3.094$, $df = 144$, $p < 0.002$).

Percentage Error: <5% error in 4.1% cases, 5–10% error in 28.8% cases, 10–15% error in 43.8% cases, and 15–20% error in 23.3% cases. Overall, 67.1% of cases showed more than 10% error, with a mean percentage error of 11.9%.

Table 1: Percentage error in calculation of EFW and ABW

Percentage error	Number of Cases	Percentage
< 5 %	3	4.1
5 to < 10 %	21	28.8
10 to < 15 %	32	43.8
15 to < 20 %	17	23.3
Total	72	100

Correlation Analysis: A significant positive correlation was found between EFW and ABW (Spearman's rho = 0.615, $p < 0.001$).

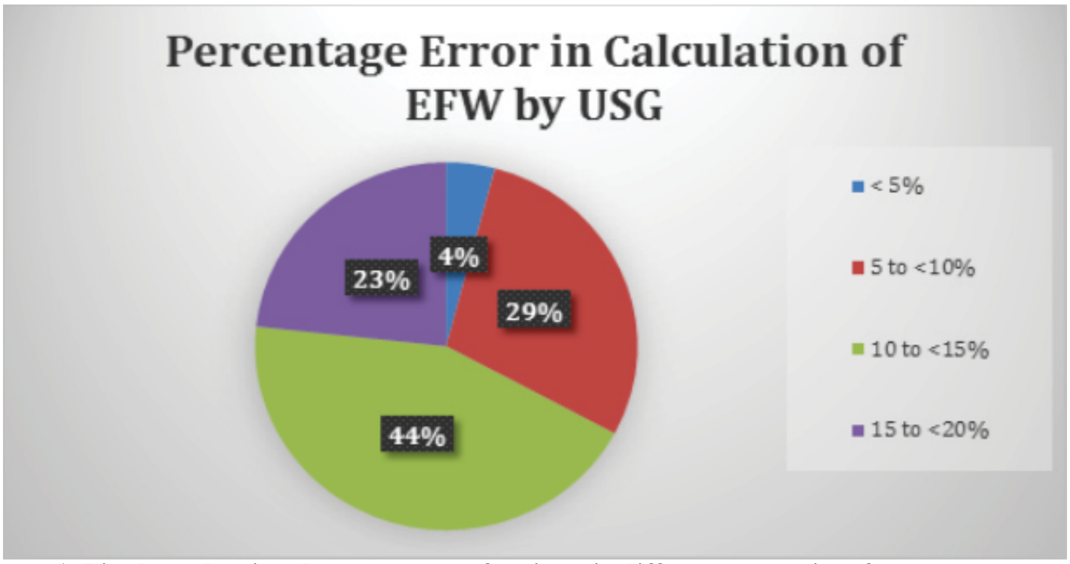

Figure 1: Pie chart showing the percentage of patients in different categories of percentage error in calculation of effective fetal weight (EFW) by USG in comparison to actual birth weight (ABW).

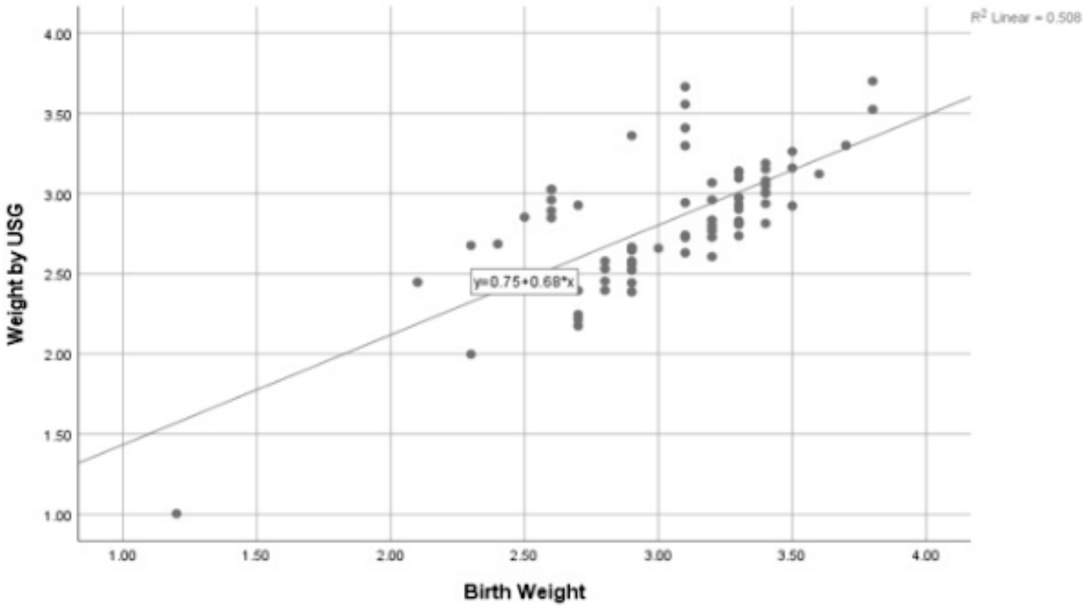

Figure 2: Correlation of Effective fetal weight measured by USG and Actual birth weight

Discussion

Fetal weight estimation during pregnancy is a critical aspect of antenatal care, as it directly influences decisions regarding timing and mode of delivery. Ultrasound has become the most widely used tool for this purpose because of its accessibility, reproducibility, and non-invasive nature. However, accuracy varies widely depending on the formula used, gestational age, maternal characteristics, and technical limitations. [11]

Our study found a statistically significant positive correlation between estimated fetal weight (EFW) and actual birth weight (ABW) using the Hadlock-2 formula, though the mean percentage error was 11.9%. Importantly, over two-thirds of cases showed more than 10% error, suggesting that reliance on formulas developed for Western populations may not be ideal in Indian settings.

The findings of our study are consistent with earlier Indian studies. Hiwale et al. [12] (2017) reported that the Hadlock-2 formula systematically overestimated fetal weight in Indian populations, with a mean percentage error of 11.02%, which is similar to our result. Another study from Bengaluru, Karnataka, demonstrated that Woo's AC-BPD model performed slightly better than Hadlock, though even this model had higher error margins compared to its performance in Western cohorts. [13]

Internationally, several studies have demonstrated lower error rates. Hadlock's original work in the United States reported mean percentage errors of less than 5% in most cases. Similarly, Barel et al. [14] (2013) showed that formulas incorporating three or more biometric parameters yielded the highest accuracy, often with mean errors below 7%. The discrepancy highlights how population-specific anthropometric factors—such as maternal stature, body composition, and nutritional background—play a critical role in determining fetal growth patterns.

There are multiple reasons why fetal weight estimation by ultrasound may be inaccurate: [15-17]

1. **Technical factors:** Machine resolution, operator expertise, and probe quality can influence measurements.
2. **Maternal factors:** High body mass index (BMI), abdominal scarring, or restlessness during scans may reduce accuracy.
3. **Fetal factors:** Position of the fetal head within the pelvis, excess or reduced amniotic fluid, and fetal movement can distort measurements.
4. **Biological variability:** Genetic and nutritional differences across populations influence fetal growth trajectories, making universal formulas less reliable.

Clinical Implications

Accurate fetal weight estimation is vital for clinical decision-making. Overestimation may lead to unnecessary cesarean deliveries, while underestimation may delay necessary interventions, increasing the risk of complications such as shoulder dystocia, birth asphyxia, or neonatal intensive care admission. Dudley and colleagues suggested that errors within ±10% are acceptable, but in our study, more than 67% of cases exceeded this threshold, underscoring the practical limitations of current formulas in India.

The Need for Indigenous Models

Several researchers have argued for the development of population-specific models. For example, Louis et al. [18] (2015) demonstrated that ethnic-specific fetal growth standards improved prediction accuracy in U.S. populations. Similar initiatives are urgently needed in India, where maternal anthropometry and fetal growth patterns differ substantially from Western populations. The creation of Indian-specific formulas, possibly aided by modern machine learning techniques, could greatly enhance reliability.

In summary, our results support previous evidence that foreign population-based fetal weight formulas do not translate effectively to Indian cohorts. While ultrasound remains indispensable in fetal monitoring, the interpretation of estimated fetal weights should be approached with caution in Indian clinical practice.

Conclusion

Prenatal ultrasound remains indispensable in monitoring fetal well-being, but existing fetal weight estimation models show limitations when applied to Indian populations. This study demonstrated a statistically significant difference between ultrasound-estimated fetal weights and actual birth weights, with a considerable proportion of cases exceeding acceptable error margins.

Future research should focus on developing and validating population-specific models tailored to Indian demographics to improve reliability. Until then, clinicians should interpret fetal weight estimations cautiously when planning obstetric management.

Limitations

The study's limitations include a relatively small sample size and data collection from a single tertiary care center, limiting generalizability. Larger multicentric studies with diverse populations are needed to validate findings and create region-specific models.

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