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An Observational Study On The Accuracy Of Ultrasound-Based Estimated Fetal Weight In Small For Gestational Age Pregnancies At Sms Medical College, Jaipur

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ABSTRACT

Background: Reliable fetal weight estimation (EFW) is central to managing pregnancies, influencing both antenatal monitoring and delivery choices. Infants classified as Small for Gestational Age (SGA)—those with birth weights at or below the 10th percentile—bear higher risks of neonatal complications. Although ultrasound remains the principal method to determine EFW, its accuracy in SGA versus Appropriate for Gestational Age (AGA) term fetuses requires additional scrutiny.

Methods: Conducted between March 2020 and February 2021 at the Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur, this prospective randomized observational study enrolled 100 term pregnancies: 50 classified as AGA (control group) and 50 as SGA (test group). Ultrasound measurements predicting fetal weight were obtained within seven days before delivery, and neonatal weights were recorded at birth. Absolute and relative errors were used to evaluate the performance of ultrasound EFW in both groups.

Results: Ultrasound estimations generally overshot actual birth weight. However, underestimation was more apparent in the SGA group, whereas overestimation was frequently noted in the AGA group. The AGA group showed a greater mean absolute and relative error, but these discrepancies stayed within clinically permissible ranges and did not substantially affect management pathways.

Conclusion: Ultrasound-based fetal weight assessment displays comparable accuracy for both SGA and AGA fetuses at term, although clinicians should remain mindful of slight overestimations in AGA cases. Recognizing these subtle variations can help tailor obstetric decisions, especially when addressing suspected intrauterine growth restriction.

Keywords: *Ultrasound, Estimated Fetal Weight, Small for Gestational Age, Appropriate for Gestational Age, Fetal Growth Restriction, Accuracy*

1. INTRODUCTION

Precise fetal weight estimation is of significant value in obstetric practice, informing prenatal management and decisions regarding the timing and mode of delivery [1]. Birth weight is a prominent factor influencing neonatal health, with very low or very high weights conferring increased risks of morbidity and mortality [2]. When fetuses are considered Small for Gestational Age (SGA)—at or below the 10th percentile for gestational age—they face an increased risk of poor perinatal outcomes, such as stillbirth, respiratory distress, and long-term developmental deficits [3,4]. Conversely, infants who are Appropriate for Gestational Age (AGA)—between the 10th and 90th percentile—typically experience fewer growth-related complications [5].

Ultrasonography has, in the recent decades, become the primary imaging method for fetal weight estimation in antenatal care. Established formulas, i.e., biparietal diameter, head circumference, abdominal circumference, and femur length based (e.g., Hadlock's formula), allow relatively accurate fetal weight determination [6]. However, other factors—like operator expertise, fetal position, maternal body structure, and gestational age—can influence the accuracy of the measurements [7,8]. Although errors of 6–11% are usually considered to be within the bounds of normal for ultrasound weight estimations, even small biases can change clinical practice, potentially leading to under- or over-treatment of SGA fetuses [9,10].

Early detection and monitoring of SGA fetuses is crucial, as identifying growth restriction can prompt timely interventions (e.g., antenatal steroids, closer Doppler surveillance, or earlier delivery) [3,4]. However, whether ultrasound measurements remain equally precise across distinct weight percentiles—especially at the lower end—still incites debate. Overestimating fetal weight in an SGA pregnancy might mask genuine undernutrition, whereas an underestimated AGA fetus could be subjected to superfluous surveillance or interventions.

This study aims to assess how accurately ultrasound-derived weight estimates align with actual neonatal weights in SGA versus AGA term pregnancies at SMS Medical College, Jaipur. The primary outcome is to measure any systematic differences in absolute and relative errors across the two groups, thereby determining whether standard ultrasound formulas retain consistent reliability when evaluating potential intrauterine growth restriction.

2. MATERIALS AND METHODS

Study Setting and Design

This prospective randomized observational study was performed in the Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur, following the required institutional ethical approvals.

Study Period

Data collection for eligible participants took place from March 2020 through February 2021.

Study Population

A total of 100 pregnant women at term (>37 weeks) were enrolled, categorized into:

- **AGA group (Control, n=50):** Fetal weight above the 10th percentile but no more than the 90th percentile.
- **SGA group (Test, n=50):** Fetal weight at or below the 10th percentile, determined using growth standards reported by Alexander et al. [11].

All included pregnancies were singleton with living fetuses in cephalic presentation, and an ultrasound-based fetal weight assessment was performed within one week before childbirth.

Inclusion Criteria

1. Written informed consent.
2. Term singleton pregnancy (>37 weeks).
3. Reliable last menstrual period with consistent menstrual cycles.

Exclusion Criteria

1. Maternal weight >90 kg.
2. Presence of polyhydramnios or oligohydramnios.
3. Ruptured membranes prior to scanning.
4. Malpresentation or abnormal fetal lie.
5. Antepartum hemorrhage.
6. Large for Gestational Age.
7. Major congenital anomalies.

Sample Size and Participant Selection

- **AGA group:** 50 term pregnant women.
- **SGA group:** 50 term pregnant women.

Each participant had standardized prenatal evaluations, and demographic/clinical data (e.g., maternal age, parity, weight) were documented at admission.

Data Collection and Statistical Analysis

Fetal biometry—biparietal diameter, abdominal circumference, head circumference, and femur length—was obtained to calculate EFW using widely recognized ultrasound formulas (commonly Hadlock's). Immediately following delivery, neonates were weighed on a calibrated scale. Data were recorded in a structured proforma.

Analyses utilized standard statistical packages. For continuous variables, descriptive measures (mean ± standard deviation) were provided, and frequencies/percentages summarized categorical variables. Between-group comparisons used the t-test

or Mann-Whitney U for continuous data, while Chi-square or Fisher's exact test was applied for categorical data. A p-value <0.05 denoted statistical significance. The deviation of ultrasound EFW from actual weight was captured via absolute error (EFW – actual birth weight) and relative error (EFW−ABWABW×100%)\left(\frac{\text{EFW} - \text{ABW}}{\text{ABW}} \times 100\% \right).

3. RESULTS

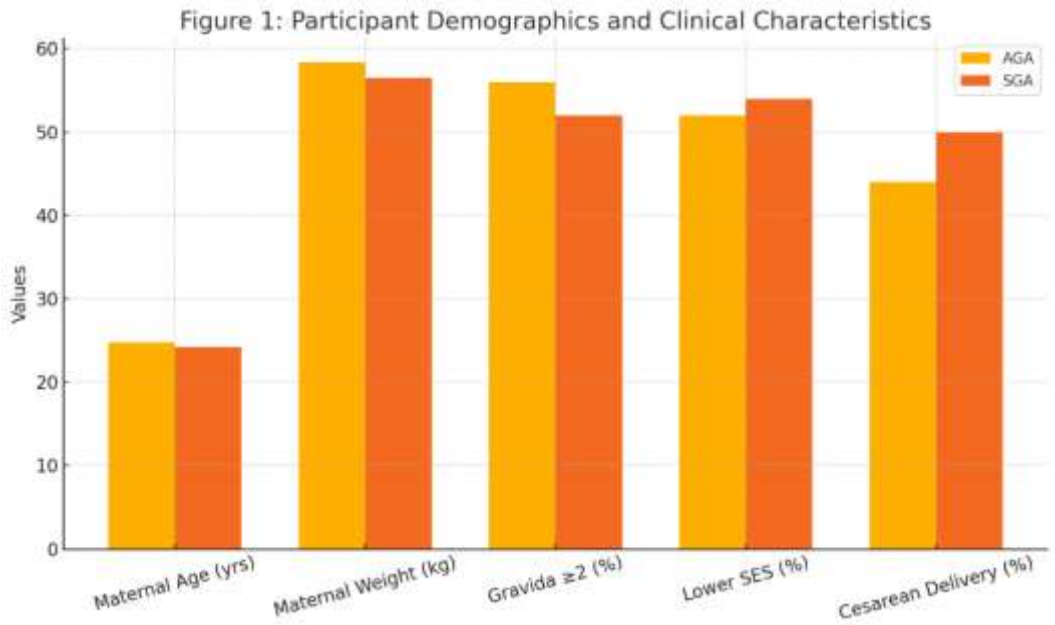
Participant Demographics and Clinical Profile

Out of 100 women, 50 had SGA fetuses and 50 had AGA fetuses. The two groups did not show significant differences in maternal age, gravidity, and socioeconomic background. Approximately half of the participants underwent cesarean deliveries due to obstetric factors such as non-reassuring fetal heart tracings or failure to progress. **Table 1** highlights these initial characteristics.

Table 1. Baseline Characteristics

Variable	AGA Group (n=50)	SGA Group (n=50)	p-value
Mean Maternal Age (years)	24.8 ± 3.1	24.2 ± 2.7	0.32
Mean Maternal Weight (kg)	58.36 ± 6.35	56.50 ± 7.78	0.21
Gravida ≥2	28 (56%)	26 (52%)	0.68
Lower Socioeconomic Status*	26 (52%)	27 (54%)	0.84
Cesarean Delivery	22 (44%)	25 (50%)	0.53

*Per institutional criteria for classification.



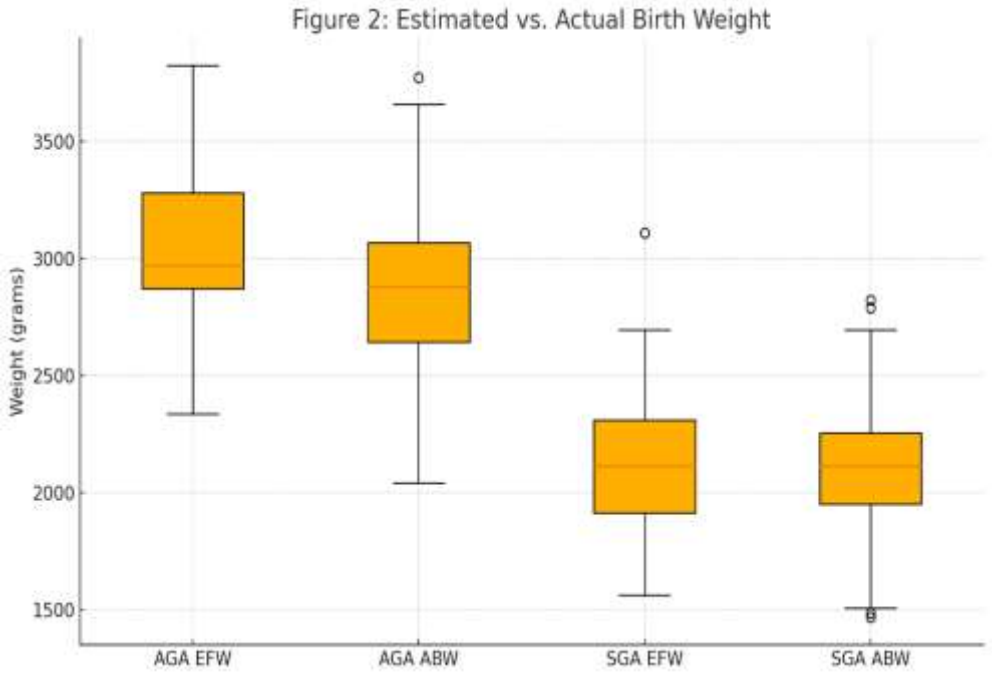
Ultrasound EFW vs. Actual Birth Weight

Table 2 provides mean EFW, mean actual birth weight (ABW), and their mean differences. The AGA group displayed a slightly larger positive difference (EFW – ABW) compared to the SGA group, though this difference did not consistently reach statistical significance.

Table 2. Mean EFW vs. Actual Birth Weight

Group	Mean EFW (g)	Mean ABW (g)	Difference (g)	p-value
AGA	3099 ± 322	2944 ± 380	+155	0.06
SGA	2192 ± 290	2146 ± 310	+46	0.09
Overall	2646 ± 346	2545 ± 350	+101	0.07

EFW: Estimated Fetal Weight; ABW: Actual Birth Weight

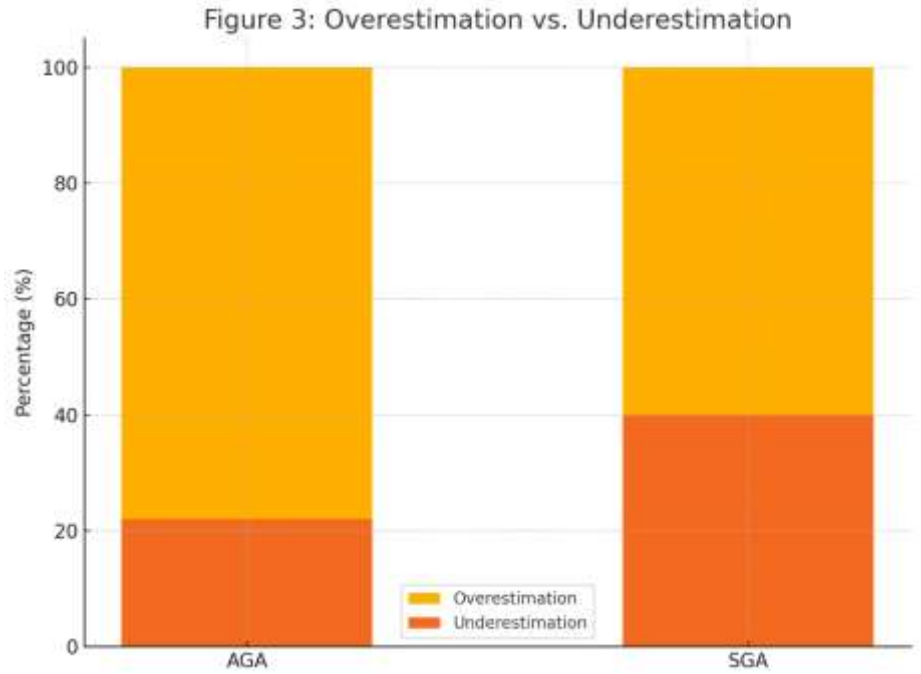


Patterns of Overestimation and Underestimation

As indicated by **Table 3**, the overall trend was an overestimation of fetal weight. Yet, underestimation occurred more frequently among SGA fetuses, whereas in the AGA group, overestimation was significantly more common.

Table 3. Overestimation vs. Underestimation

Group	Overestimation, n (%)	Underestimation, n (%)
AGA (n=50)	39 (78%)	11 (22%)
SGA (n=50)	30 (60%)	20 (40%)
Overall	69 (69%)	31 (31%)

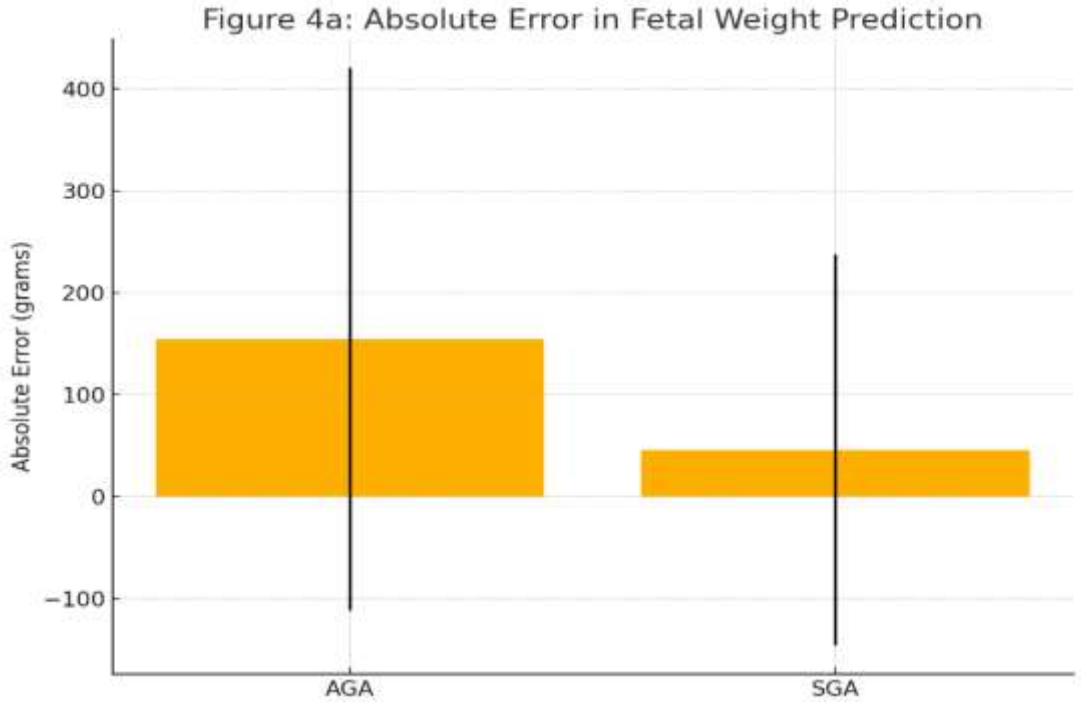


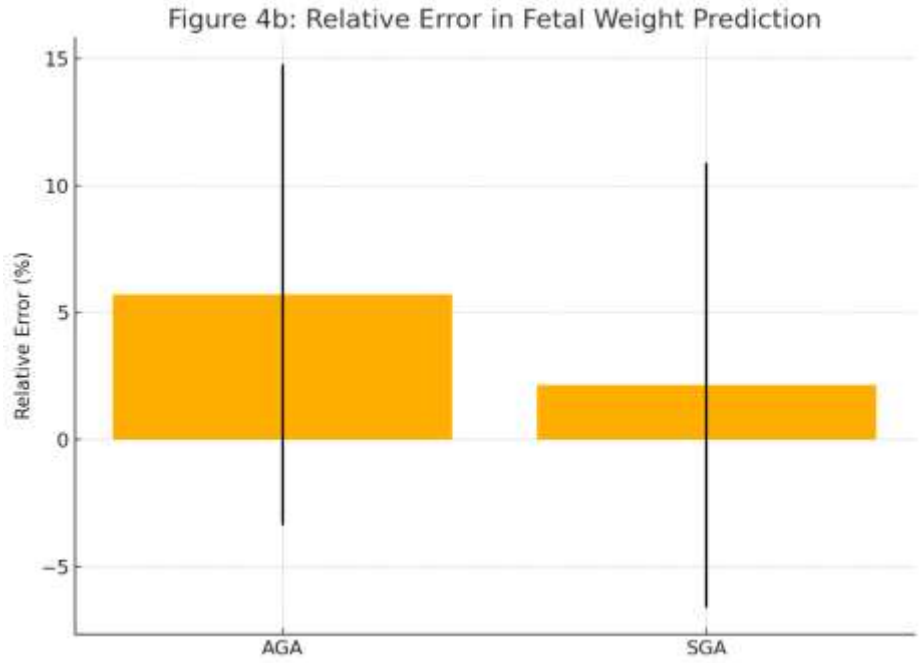
Absolute and Relative Errors

Table 4 summarizes error metrics. The AGA group exhibited a higher mean absolute and relative error compared with the SGA group. Both differences were statistically significant.

Table 4. Error Measurements in Fetal Weight Prediction

Group	Mean Absolute Error (g)	Mean Relative Error (%)	p-values
AGA	154.4 ± 266.2	5.70 ± 9.08	0.021 (Absolute), 0.049 (Relative)
SGA	45.96 ± 191.3	2.15 ± 8.75	—





4. DISCUSSION

Our findings indicate that ultrasound-based fetal weight predictions near term remain broadly reliable, aligning with studies suggesting that such estimations deviate from actual birth weight by an acceptable margin [1,9,12]. Nevertheless, we detected several specific trends. In SGA pregnancies, underestimating birth weight was relatively frequent, which may stem from smaller abdominal circumferences and restricted fluid levels, factors often linked to fetal growth restriction [13,14]. Conversely, in AGA pregnancies, overestimation dominated, potentially reflecting larger and more variable biometric parameters.

Although the mean absolute and relative errors were both higher in the AGA group, the differences observed generally hovered within a range that would not profoundly alter routine obstetric decisions. This is critical, as interventions might be triggered for fetuses deemed borderline low weight, and an error margin of roughly 100–150 g may not typically drive drastic changes in clinical management unless a fetus nears a threshold for neonatal complications [15].

Scanning participants within a short period (within seven days) before delivery possibly contributed to enhanced accuracy by minimizing the time frame for significant fetal weight changes [4,18]. Similarly, excluding patients whose weight exceeded 90 kg helped mitigate the impact of poor ultrasound visibility seen in higher maternal adiposity [5,17].

Despite these influences, ultrasound estimation remains a principal, noninvasive technology to evaluate fetal growth, largely guiding perinatal care [14,19,20]. Emerging tools like 3D/4D ultrasound or improved Doppler applications might refine the precision of weight estimation further [21,22,23]. Moreover, adopting local growth charts reflecting population-specific maternal and fetal patterns could lower systematic biases inherent in generic formulas [24,25].

In conclusion, even though we found a tendency to overestimate in AGA fetuses and understate in SGA pregnancies, the magnitude of these errors typically stayed within acceptable limits. Awareness of these distinctions is crucial, particularly when distinguishing a fetus at genuine risk. Overall, our data reinforces the value of ultrasound for fetal weight appraisal, enabling well-informed interventions that safeguard both maternal and neonatal welfare.

5. CONCLUSION

The study shows that ultrasound estimation of fetal weight in SGA and AGA term pregnancies provides comparably strong accuracy. Although the AGA group was more likely to be overestimated and the SGA group more likely to be underestimated, these measurement biases did not generally approach a level necessitating major clinical re-evaluation. Recognizing such patterns, especially in the context of growth-restricted fetuses, allows healthcare professionals to interpret ultrasound results more prudently. Overall, ultrasonography remains a crucial component of obstetric care, helping clinicians decide on suitable antenatal surveillance and plan the timing and mode of delivery to optimize neonatal outcomes.

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