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A Comparative Study of Fetal Weight Estimation by Symphysiofundal Height and Ultrasound Biometry in Women at Term

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Abstract: ***Introduction: Accurate fetal weight estimation is crucial for managing labor and delivery, influencing outcomes for both mothers and infants. Accurate fetal weight estimation aids in the identification of macrosomia, helping prevent complications such as shoulder dystocia, brachial plexus injuries, and postpartum hemorrhage (PPH). Aim & Objective: To compare the estimated fetal weight by Symphysiofundal height and ultrasound biometry and to compare both with actual birth weight. Methods: A prospective observational study was conducted at the Department of Obstetrics and Gynecology, SMS Medical College, Jaipur, involving 300 women at term (≥37 weeks gestation). Inclusion criteria comprised women with singleton, cephalic pregnancies, while those with obesity, fetal malformations, or abnormal amniotic fluid were excluded. Fetal weight was estimated using Johnson's formula and ultrasound biometry with Hadlock's formula. The estimated weights were compared to actual birth weights. Results: The mean age of participants was 26.34 years, with the most common estimated fetal weight range being 2501 - 3000 grams. A significant correlation was found between actual birth weight and estimated weight using both methods, with correlation coefficients of 0.114 (p = 0.048) for ultrasound and 0.129 (p = 0.025) for Johnson's formula. The mean differences in weight estimation were 104.97 grams (Johnson's formula) and 119.47 grams (USG), both statistically significant (p < 0.001). Conclusion: This study indicates that advanced techniques like ultrasound do not necessarily provide a significant advantage over simpler clinical methods for fetal weight estimation. Given the cost and resource constraints associated with ultrasound, the reliability and ease of clinical methods can facilitate effective decision - making in resource - limited settings, ensuring maternal and fetal well - being.***

Keywords: Fetal Weight Estimation, Symphysiofundal Height, Ultrasound Biometry.

1. Introduction

Fetal weight is a critical determinant of perinatal and maternal outcomes at full - term gestation. It serves as a key indicator of fetal health, influencing decisions related to labor and delivery management. Accurate fetal weight estimation aids in the identification of macrosomia, helping prevent complications such as shoulder dystocia, brachial plexus injuries, and postpartum hemorrhage (PPH).[1] As a result, routine antepartum fetal weight estimation has become common practice, especially in high - risk pregnancies. Both low and high birth weights carry significant risks, with low birth weight being associated with preterm delivery and intrauterine growth restriction (IUGR), while excessive weight can lead to complex deliveries and birth injuries.[1]

Estimating fetal weight is crucial in selecting the appropriate delivery method, particularly in cases of breech presentation or previous cesarean section. This ensures favorable pregnancy outcomes for both mother and baby. Two primary methods are used for estimating fetal weight: clinical and ultrasound - based methods. Clinical methods rely on physical examination, including symphysis - fundal height (SFH) and abdominal girth measurements, while ultrasound estimation uses biometric data.[2]

Various clinical formulas, such as those by Ojwang et al. and Dare et al., have been developed to predict fetal weight. Although these methods are widely used, clinical estimations may be subject to variation.[3, 4] Ultrasound - based estimations, including the Hadlock method, have gained prominence due to their reproducibility and accuracy. This method uses parameters like biparietal diameter (BPD), abdominal circumference (AC), and femur length (FL), making it more reliable in many cases.[5] However, challenges remain, particularly in low - resource settings where ultrasound access is limited.

The use of ultrasound in fetal weight estimation has revolutionized prenatal care, but in areas without access to such technology, clinical methods remain vital. Studies have shown that while ultrasound is generally more accurate, clinical methods can still provide reliable estimates, especially for fetuses within the normal weight range of 2500 - 4000g.[6]

This study aims to compare the accuracy of fetal weight estimation using clinical methods (symphysis fundal height) and ultrasound biometry.

2. Material and Methods

This prospective observational study was conducted at the Department of Obstetrics and Gynecology, SMS Medical College, Jaipur, from November 2022 until the sample size

was reached or up to one year. The study included 300 women at term (>37 weeks gestation).

Inclusion criteria

- Women with term Singleton live pregnancy.
- Cephalic presentation.
- Women understanding and willing to give written consent.
- Women not participating in any other study.

Exclusion criteria

- Obesity
- Fibroids or adenexal masses
- Known fetal malformations
- Poly or oligohydramnios

Statistical Analysis:

For statistical analysis, an unpaired T - test, one - way ANOVA, and Pearson correlation coefficient were used to analyze continuous variables, while Fisher's Exact test or Chi - square test was applied to nominal/categorical data. A p - value of < 0.05 was considered statistically significant. All calculations were performed using MedCalc version 16.4 software.

3. Methodology

After obtaining proper history and informed consent, detailed general physical examinations were performed, and routine investigations were carried out. Women were asked to empty their bladders, and symphysis - fundal height (SFH) was measured on a relaxed uterus. A pelvic examination was performed to assess cervical dilation and fetal head descent. Fetal weight was estimated using Johnson's formula: estimated fetal weight = (SFH - x) * 155, where "x" is the fetal head station. Ultrasound biometry was performed to measure bi - parietal diameter (BPD), abdominal circumference (AC), femur length (FL), and fetal weight using Hadlock's formula. The estimated fetal weights from both SFH and ultrasound were compared to the actual birth weight of the newborns recorded after delivery. The women were monitored during labor according to department protocol.

4. Result

Among the 300 patients surveyed, 22 were aged 18 - 21 years, while the majority (98) were between 22 - 25 years, with a mean age of 26.34 years. Most patients (257) were booked, and 43 were unbooked. Socio - economic status distribution included 57 from the lower class, 74 from the lower middle class, 28 from the upper lower class, 54 from the upper middle class, and 87 from the upper class. In terms of pregnancy history, 101 patients were primigravida, 93 had two pregnancies, 74 had three, and 24 had four pregnancies. Gestational age data revealed that 201 were in early term (37 - 38 weeks), and 99 were in late term (39 - 40 weeks). Regarding BMI, 22 were underweight (BMI < 18.5), 172 were normal weight (BMI 18.5 - 24.9), 102 were overweight (BMI 25 - 29.9), and 4 were obese (BMI > 30). The sample included 147 females and 153 males.

Table 1: Correlation of Actual Birth Weight and Johnson's Formula Weight (in grams).

Actual Birth Weight (in grams)	Johnson's Formula Weight (in grams)					Total
	≤2000	2001 - 2500	2501 - 3000	3001 - 3500	>3500	
≤2000	0	2	3	1	0	6
2001 - 2500	0	11	27	31	1	70
2501 - 3000	1	13	39	52	4	109
3001 - 3500	0	13	40	34	4	91
>3500	0	4	6	11	3	24
Total	1	43	115	129	12	300

The most common estimated fetal weight range was 2501 - 3000 grams, involving 115 patients, followed by 129 patients in the 3001 - 3500 grams range, and 12 patients estimated to weigh over 3500 grams. Actual birth weights showed similar trends: 109 patients fell in the 2501 - 3000 grams range, 91 in the 3001 - 3500 grams range, and 70 in the 2001 - 2500 grams range. Fewer patients were recorded in the ≤2000 grams (6 patients) and >3500 grams (24 patients) categories.

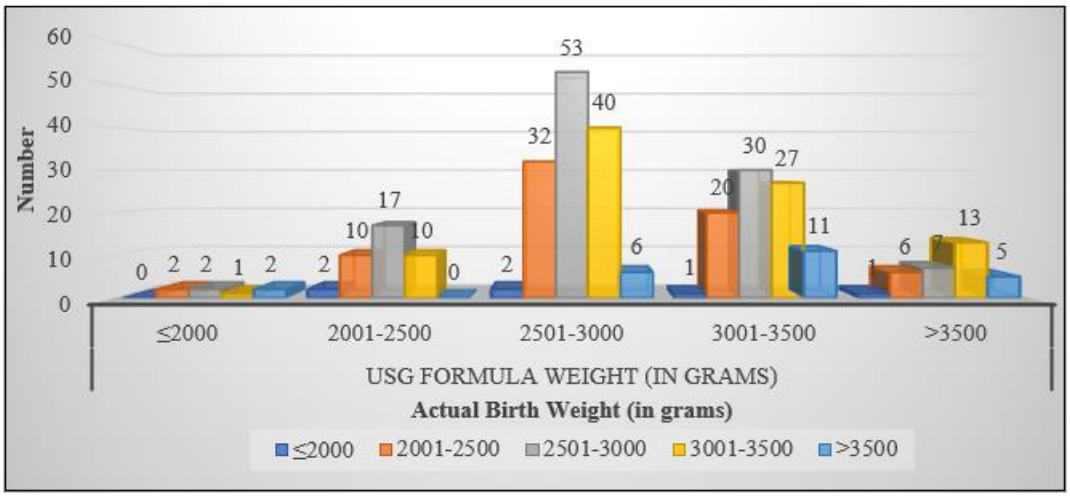

Figure 1: Correlation of Actual Birth Weight and USG Formula Weight (in grams)

Among the patient population, 7 patients were estimated to weigh 2000 grams or less, and 39 patients were in the 2001 - 2500 grams range. The most common estimated weight range was 2501 - 3000 grams, involving 133 patients. Additionally, 89 patients were estimated to weigh between 3001 - 3500 grams, and 32 patients had an estimated weight exceeding 3500 grams.

Table 2: Comparison of Actual Birth Weight and Johnson Formula

Parameter	Johnson (n=300)		Actual Birth Weight (n=300)		P - Value
	Mean	SD	Mean	SD	
Weight (Grams)	2960.65	351.35	2855.68	437.99	0.001
Mean difference	104.97				

The mean weight estimated using the Johnson Weight Formula was 2960.65 grams, with a standard deviation of 351.35 grams, while the mean actual birth weight was 2855.68 grams, with a standard deviation of 437.99 grams. A p - value of 0.001 indicates that the difference in mean weights between the two groups is statistically significant, highlighting a notable discrepancy between the weight estimates from the Johnson Weight Formula and the actual birth weight.

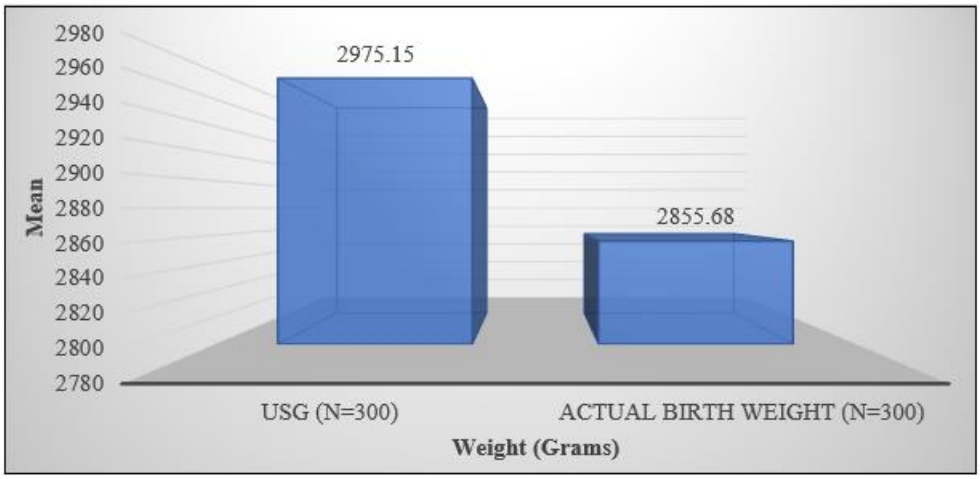

Figure 2: Comparision of Actual Birth Weight and USG Formula.

The mean weight estimated using the USG Formula was 2975.15 grams, with a standard deviation of 434.65 grams. In comparison, the mean actual birth weight was 2855.68 grams, with a standard deviation of 437.99 grams. A p - value of 0.0008 indicates that the difference in mean weights between the two groups is statistically significant, demonstrating a notable discrepancy between the weight measurements obtained from the USG Formula and the actual birth weight.

Table 3: Pearson's correlation of actual birth weight with Johnson's and USG Weight formula.

Parameter	USG (n=300)		Johnson (n=300)	
	r - value	p - value	r - value	p - value
Actual Birth Weight	0.114	0.048	0.129	0.025

In the study, the correlation coefficient (r - value) between actual birth weight and estimated weight using the USG Formula was 0.114, with a p - value of 0.048, indicating a statistically significant correlation. For the Johnson Formula, the correlation coefficient was 0.129, with a p - value of 0.025, also signifying a meaningful relationship. The mean difference in weight estimation was 104.97 grams for the Johnson Formula and 119.47 grams for the USG Formula, with both methods showing statistically significant p - values (0.001 for Johnson and 0.0008 for USG), confirming the significance of the observed mean differences.

5. Discussion

Birth weight is a key predictor of neonatal outcomes, making prenatal estimation essential for managing high - risk pregnancies. Accurate fetal weight estimation is crucial due to the risks linked with low birth weight and macrosomia, which can lead to increased perinatal morbidity, mortality, and long - term neurological issues. Ultrasound, a non - invasive technique, offers vital information on biophysical profiles, gestational age, position, and potential abnormalities. While ultrasound is generally more precise for assessing fetal growth, clinical examination can be sufficient for normal assessments, especially for weights above 4000 grams. Some studies indicate that clinical examination and ultrasound have similar accuracy, though ultrasound is typically more reliable.7 Methods for estimating fetal weight near delivery include Johnson's formula, Dare's formula, and Hadlock's formula. This study aimed to estimate fetal weight using Johnson's formula and ultrasonography, correlating these estimations with actual birth weight.

The most common estimated fetal weight was 2501 to 3000 grams (115 patients), followed by 3001 to 3500 grams (129 patients). **Chahar S et al.8** reported accurate estimates for weights ≤2000 grams and minor overestimations for 2001 - 2500 grams. For 2501 - 3000 grams, 27 estimates were accurate, while 24 for 3001 - 3500 grams showed slight inaccuracies. Johnson's formula misclassified 36 patients, with 19.5% underestimated and 80.5% overestimated,

consistent with findings by **S. Aruna et al.9 and Aemiro Yihesis et al.[10]**

Statistical analysis indicated a mean weight from Johnson's Formula of 2960.65 grams (SD 351.35) versus an actual mean birth weight of 2855.68 grams (SD 437.99), with a significant p - value of 0.001, highlighting a notable discrepancy**. Durgaprasad B K et al.[11]** found a predicted mean birth weight of 3296.15 grams compared to an actual mean of 2902.89 grams (p=0.00005), with a mean difference of 393.26 grams and **Yadav S S et al.[12]** reported a mean clinical weight of 2747 grams (SD 459.5).

In the patient population, fetal weight estimates were: 7 patients at ≤2000 grams, 39 at 2001 - 2500 grams, 133 at 2501 - 3000 grams, 89 at 3001 - 3500 grams, and 32 at >3500 grams. **Chahar S et al.8** found varying accuracy in ultrasound estimates: for weights ≤2000 grams, one was accurate; in the 2001 - 2500 grams range, seven were accurate with some underestimations. For the 2501 - 3000 grams group, 35 estimates were accurate; in the 3001 - 3500 grams category, 29 were accurate with minimal discrepancies. Among infants >3500 grams, five were accurate and two were overestimated. Overall, the ultrasound formula was effective, especially in middle weight ranges. **Yadav S S et al.[12]** found a mean USG estimated weight of 2751.6 grams (range: 1655.0 to 4159.0 grams). **Parvathavarthini K et al.[13]** reported a mean USG estimated weight of 3175.1 ± 483.3 grams versus an actual birth weight of 2984.21 ± 490.3 grams.

The correlation coefficients between estimated and actual birth weights revealed that the USG Formula had an r - value of 0.114 (p = 0.048), indicating a weak positive relationship. The Johnson Formula showed an r - value of 0.129 (p = 0.025), suggesting a slightly stronger correlation. Both methods demonstrated meaningful associations with actual birth weights. **Parvathavarthini K et al.[13]** found Dare's method had the highest correlation (0.69), followed by USG (0.66) and Johnson's method (0.61) and **Ali F et al.[14]** reported a correlation of 0.575 for USG fetal weight estimation (p = 0.000).

6. Conclusion

Our study challenges the notion that advanced techniques like ultrasonography (USG) are inherently more accurate for predicting birth weight. While commonly used, USG requires significant financial investment and skilled manpower, making it less feasible in resource - limited settings. In contrast, simpler methods using easily measurable obstetric parameters proved equally accurate. Both USG and Johnson's formula showed statistically significant p - values of 0.0008 and 0.001, respectively, indicating no substantial advantage of USG over clinical methods. These findings support the reliability, cost - effectiveness, and ease of teaching clinical methods, which can enhance decision - making in resource - constrained environments while ensuring maternal and fetal safety.

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