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Estimation of expected fetal weight using symphysio- fundal height and ultrasonography and comparison of it with actual birth weight – A prospective study

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Abstract

Background: Fetal weight estimation is a crucial component of obstetric planning and management. Accurate estimation assists clinicians in making informed decisions regarding the timing and mode of delivery, thereby optimizing maternal and neonatal outcomes. **Aim:** To assess fetal weight by clinical methods using Johnson's formula and Dare's formula. To assess fetal weight by ultrasonography (USG) using Hadlock's formula. To compare the accuracy of estimated fetal weight (EFW) by USG and clinical methods with the actual birth weight. **Materials and Methods:** This study was conducted on 90 pregnant women attending the Department of Obstetrics and Gynaecology for routine antenatal check-up between 2024 and 2025. Data collection involved obtaining a detailed history, performing a thorough general and systemic examination, and conducting an abdominal examination in the supine position. **Results:** In our study, multigravidas (42.2%) had a higher mean birth weight (2970 g) compared to primigravidas (57.8%) with a mean birth weight of 2902 g, a difference that was statistically significant ($p = 0.0001$). **USG (Hadlock's formula):** In 53% of cases, 39% had overestimated and 55% had underestimated fetal weight. **Johnson's formula:** 53% of estimates were within ±250 g and 100% were within ±1000 g of the actual birth weight. Overall, 47% underestimated and 52% overestimated the fetal weight. **Dare's formula:** 52% of estimates were within ±250 g; all cases were included only when the birth weight was >1 kg. In this group, 72% overestimated and 28% underestimated fetal weight. Johnson's method showed the least mean error per kg of birth weight and the smallest difference between the mean estimated and actual birth weights. However, USG-based estimation was found to be closer to the actual birth weight overall.

Conclusion: In this study, fetal weight estimations by both clinical methods and USG were compared with actual birth weight. USG (Hadlock's formula) provided the most accurate estimations, although Johnson's method performed better among the clinical approaches.

Keywords: Birth weight, USG, Hadlock's formula, Dare's formula.

Introduction

Assessment of fetal weight is a vital and universal component of antenatal care, essential for managing labor and delivery, as well as monitoring high-risk pregnancies and fetal growth. Birth weight is the single most important determinant of newborn survival, and both low and excessive fetal weights are associated with increased risks of complications during labor and the puerperium. Accurate antenatal estimation of fetal weight enables timely interventions, optimizes delivery planning, and reduces morbidity and mortality for both mother and neonate.

Fetal weight, in conjunction with gestational age, serves as a key predictor of pregnancy outcome. Extremes of birth weight—whether due to small-for-gestational-age (SGA) or large-for-gestational-age (LGA) status, fetal growth restriction (FGR), macrosomia, or preterm birth—can lead to complications such as respiratory morbidity, shoulder dystocia, and neonatal distress. Accurate estimation is particularly crucial in cases of preterm premature rupture of membranes, previous cesarean delivery, and pregnancies requiring precise planning of the timing and route of delivery.

The main challenge in fetal weight assessment lies in the inaccessibility of the fetus. Nevertheless, accurate estimation is critical for successful intrapartum management and neonatal care, particularly to prevent complications associated with macrosomia and low birth weight, thereby decreasing perinatal morbidity and mortality. Two main approaches are available for fetal weight estimation: **clinical methods** and **ultrasonography (USG)**. While some studies report superior accuracy of sonographic estimates, others suggest comparable performance of clinical examination. Certain reports even indicate that physician-performed clinical estimates may outperform ultrasound in specific contexts.

Fetal growth is influenced by maternal, fetal, placental, and environmental factors, including race, maternal age, parity, socioeconomic status, infections, chromosomal anomalies, and fetal sex. Abnormal growth patterns can be detected clinically or via USG. In low-resource settings where ultrasound is not widely available due to cost, equipment, or trained personnel constraints, simple clinical measurements—such as symphysio-fundal height (SFH) and abdominal girth (AG)—remain valuable.

Several clinical formulae have been developed for fetal weight estimation. **Johnson's formula** estimates fetal weight in vertex presentations using SFH, while **Dare's formula** calculates weight as the product of SFH (cm) and AG (cm) measured at the umbilicus. Both have shown acceptable predictive value, though with variations in accuracy.

Given the need for practical and reliable fetal weight estimation, especially in resource-limited settings, this study was conducted on 90 full-term pregnancies in early labor to compare the accuracy of Johnson's and Dare's clinical formulae against ultrasound (Hadlock's formula) estimates and actual birth weights.

Here's a revised and polished version of your **Materials and Methods** section, improving flow, grammar, and clarity while keeping all details intact.

Materials and Methods

This cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, Sree Mookambika Institute of Medical Sciences, Kulasekharam, over a period of 18 months (2024–2025). A total of 90 pregnant women fulfilling the selection criteria were included.

Inclusion Criteria:

- Singleton pregnancy
- Cephalic presentation
- Live fetus
- Known last menstrual period (LMP) or ultrasound scan with confirmed expected date of delivery
- Gestational age between 37 and 42 weeks

Exclusion Criteria:

- Multiple gestations
- Fetal anomalies
- Non-cephalic presentation
- Intrauterine fetal death
- Coexisting fibroids or ovarian cysts
- Diagnosed liquor abnormalities

Procedure:
Ethical approval for the study was obtained from the Institutional Research and Human Ethics Committees. Written informed consent was taken from all participants.

Detailed demographic and clinical histories were recorded, including education, occupation, socioeconomic status, menstrual history, obstetric history, past medical and surgical history, and personal history. A thorough general physical examination was performed, noting vital signs, anthropometric measurements, and systemic examination findings.

Per-abdominal examination was performed in the supine position to assess lie, presentation, and engagement of the fetus.

Symphysio-Fundal Height (SFH):
Before measurement, the patient was asked to empty her bladder. In the supine position with thighs slightly flexed, the uterus was palpated, correcting for any dextro-rotation. The upper border of the pubic symphysis was identified, and SFH (in cm) was measured from the midpoint of the upper border of the pubic symphysis to the uterine fundus

using a flexible measuring tape placed in contact with the skin, with markings facing the examiner.

Abdominal Girth (AG):
Measured in centimetres at the level of the umbilicus using a flexible measuring tape.

Clinical Formulas for Fetal Weight Estimation:

Johnson's Formula [20]: If the presenting part was unengaged:
Fetal weight (g) = (McDonald's measurement − 12) × 155

If engaged: Fetal weight (g) = (McDonald's measurement − 11) × 155
If maternal weight > 91 kg, subtract 1 cm from SFH before calculation.

Dare's Formula [21]: Fetal weight (g) = SFH (cm) × AG (cm)

Ultrasonographic (USG) Estimation – Hadlock's Formula:
All participants underwent USG examination using a 2–5 MHz transducer (SIEMENS ACUSON X300). Fetal lie, presentation, placental position and maturity, and amniotic fluid volume were assessed. Standard biometric parameters were measured:

Biparietal Diameter (BPD) [22]: Measured in a transaxial view at the level of paired thalami and cavum septi pellucidi, from the outer edge of the near cranium to the inner edge of the far cranium.

Head Circumference (HC): Measured on the same transaxial image using an electronic ellipse, or calculated as:
HC = 1.57 × (outer-to-outer BPD + outer-to-outer occipitofrontal diameter [OFD]).

Abdominal Circumference (AC): Measured in a transverse view at the level of the stomach and intrahepatic umbilical vein, or calculated as:
AC = 1.57 × (anteroposterior diameter + transverse diameter).

Femur Length (FL): Measured from the greater trochanter to the lateral condyle, excluding the femoral head and distal epiphysis.

The Hadlock formula used was:
$\text{Log}_{10}(\text{BW}) = 0.3596 + (0.00061 \times \text{BPD} \times \text{AC}) + (0.0424 \times \text{AC}) + (0.174 \times \text{FL}) + (0.0064 \times \text{HC}) - (0.00386 \times \text{AC} \times \text{FL})$.

Actual Birth Weight:
All newborns, whether delivered vaginally or by cesarean section, were weighed within the first hour of birth using an electronic baby weighing machine. Estimated fetal weights from each method were compared with the actual birth weight.

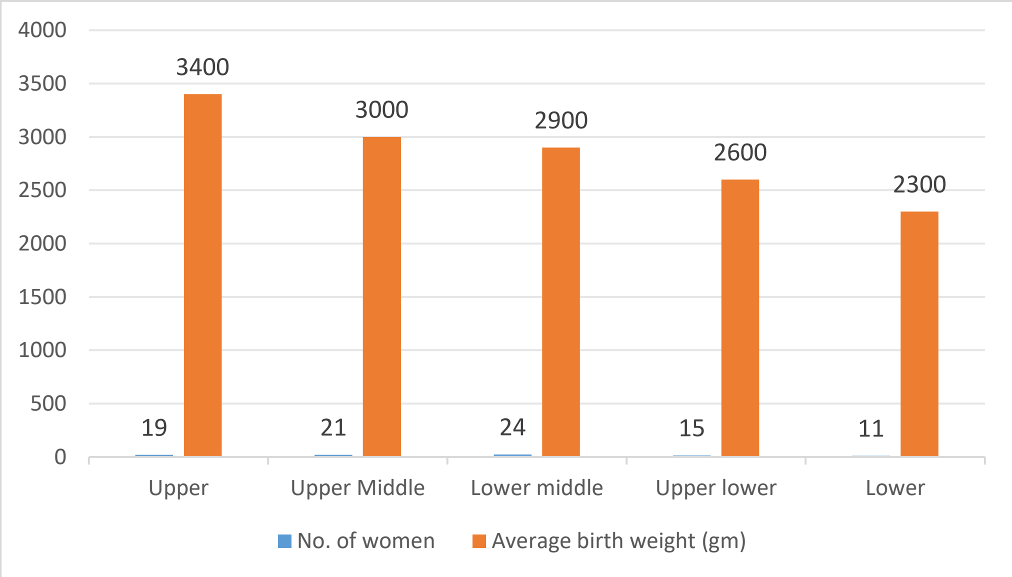
Results
This cross-sectional study was conducted on 90 pregnant women attending the Department of Obstetrics and Gynaecology, Sree Mookambika Institute of Medical Sciences, Kulasekharam. Participants were divided into five groups based on their

socioeconomic status. Analysis revealed that women from lower socioeconomic groups tended to have neonates with lower birth weights (Table 1).

Table 1: Birth weight with socioeconomic status

Socioeconomic status	No. of women	Average birth weight (gm)
Upper	19	3400
Upper Middle	21	3000
Lower middle	24	2900
Upper lower	15	2600
Lower	11	2300
ANOVA-5.36		P=0.0001

Graph 1: Birth weight with socioeconomic status



Birth weight was higher in foetuses born to mother with pre-pregnancy weight more than 45 kg, when compared to foetuses born to mother with pre-pregnancy weight less than 45 kg. More weight gain during pregnancy resulted in higher birth weight. The coefficient of correlation value shows a significant relationship between the maternal weight gained and birth weight. With p=0.0001 value which was statistically significant (table 2). The study also showed there is a significant relationship with a p value of (p=0.002) between mothers weight gain and birth weight of the baby (table 3)

Table 2: Relation of the birth weight with maternal pre-pregnancy weight (Kg)

Group	Body weight (Kg)	No. of women	Average birth weight (gm)
Group -1	<45	9	2712
Group-2	>45	81	2975
Anova= 14.51			P- 0.002

Table 3: Relation of the birth weight with maternal weight gain during pregnancy

Group	Weight gain (Kg)	No. of women	Average birth weight (gm)

Group -1	<7	10	2612
Group-2	>7	80	2995
Anova= 10.02			P-0.005

Table 4: Relation of the birth weight with parity

Group	**Parity**	**No. of women**	**Average birth weight (gm)**
Group -1	Primi	52	2902
Group-2	Multi	38	2970
Anova= 58.89			P-0.0001

The t value reveals that there is a significant difference found in birth weight among primi and multigravida. From the table – 4, it is seen that multiparous generally deliver baby of more birth weight compared to primipara. The study shows that there is a p value of 0.0001 statistically significant difference found in birth male and female babies. It is seen that male babies weighs more in comparison to female babies. Among 900 babies the mean actual birth weight was 2928 grams. The maximum actual birth weight was 4450 grams and minimum actual birth weight was 1550 grams. Table - 5 shows strong positive correlation between the Johnson method of fetal weight estimation and actual birth weight

Table 5: Comparison of mean actual birth weight with mean estimated birth weight by Johnson

Estimates	**Estimation by Johnson**
Mean actual birth weight	3120gm
Mean estimated fetal weight by Dare's method	3025gm
Difference between mean actual birth weight and mean estimated fetal weight by Dare's method	95gm

Table 6: Comparison of mean actual birth weight with mean estimated birth weight by Dare's formula

Estimates	**Estimation by Johnson**
Mean actual birth weight	3025gm
Mean estimated fetal weight by Dare's method	3074gm
Difference between mean actual birth weight and mean estimated fetal weight by Dare's method	49gm

Table - 6 shows positive correlation between the Dare's method of fetal weight estimation and actual birth weight. The study showed that USG estimation was more or less equal to the actual birth weight with a difference of 15 gm. Other methods deviate from the actual birth weight ie. Johnson (95 gm) and Dare (49gm). Hence, it is inferred USG method estimated the fetal weight more accurately than others methods. It is inferred that all the methods are more or less accurately estimated the actual birth weight. But, when compared to the three methods, USG estimate was more accurate than other two methods as the mean difference between USG estimate and actual birth weight was found to be very less ie. 14.1 g.

Discussion

Both fetal macrosomia and intrauterine growth restriction (IUGR) increase the risk of perinatal morbidity, mortality, and long-term neurological and developmental disorders.[23] Accurate prediction of fetal weight has long been an important goal in obstetrics. Since fetal weight cannot be measured directly, it is estimated using maternal and fetal anatomical parameters.

In ultrasonography-based methods, our findings are consistent with previous reports showing that the mean absolute percentage error in predicted birth weight typically ranges from 6% to 12% of the actual birth weight, and 40–75% of estimates fall within ±10% of the true value. The observed tendency of ultrasound to overestimate low birth weights and underestimate high birth weights has also been well documented.[23–24]

In the present study, women from lower socioeconomic status had significantly lower mean birth weights (2300 g) compared to women from higher socioeconomic groups (ANOVA = 5.36, $p < 0.001$), similar to the findings of Muhamed Rafiq et al.[25] Maternal pre-pregnancy weight also showed a significant influence on neonatal weight: women weighing > 45 kg had babies with higher mean birth weights than those ≤ 45 kg ($p = 0.002$).

Weight gain during pregnancy was another important determinant. Mothers gaining > 7 kg had babies with significantly higher birth weights than those gaining < 7 kg ($p = 0.005$), in agreement with Eastman and Jackson (1968).[26] Maternal height also played a role—women taller than 150 cm had neonates weighing on average 383 g more than those shorter than 150 cm, consistent with the results of Witter and Luke (1991).[27]

Parity influenced birth weight as well: multigravidas had babies with higher mean birth weights (2970 g) compared to primigravidas (2902 g), echoing the findings of Shah (2010).[28] In our study, male infants weighed, on average, 68 g more than females.

When comparing fetal weight estimation methods:

Johnson's formula: 53% of estimates were within ±250 g and 100% within ±1000 g; 47% underestimated and 52% overestimated fetal weight. The mean difference from actual birth weight was 95 g.

Dare's formula: 52% were within ±250 g (applicable for birth weights > 1 kg); 72% overestimated and 28% underestimated fetal weight. The mean difference from actual birth weight was 49 g.

Ultrasound (USG): Showed the smallest mean difference from actual birth weight (14.1 g), making it the most accurate method.

All three methods underestimated fetal weight when actual birth weight exceeded 3500 g, consistent with the findings of Uma Thombarapu.[29] Among clinical methods, Johnson's formula was more accurate than Dare's formula, although USG (Hadlock's formula) demonstrated superior overall accuracy, similar to the observations of Muralisree et al.[30]

Conclusion

In this study, fetal weight estimation by USG was the most accurate, with the smallest deviation from actual birth weight. Among clinical methods, Johnson's formula outperformed Dare's formula, producing estimates closer to those obtained via ultrasound. While USG remains the gold standard where available, Johnson's formula is a reliable alternative in resource-limited settings.

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