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PROSPECTIVE OBSERVATIONAL COMPARATIVE STUDY OF VARIOUS METHODS OF FETAL WEIGHT ESTIMATION IN TERM PREGNANCY

Obstetrics & Gynaecology

Shraddha M Department of Obstetrics and Gynaecology, Ballari Institute of Medical Sciences and Research Centre, Ballari, Karnataka, India

Vijayalakshmi B* Department of Obstetrics and Gynaecology, Ballari Institute of Medical Sciences and Research Centre, Ballari, Karnataka, India*Corresponding Author

ABSTRACT

Background: Accurate fetal weight estimation at term is essential for obstetric decision making, particularly for identifying fetuses at risk of low birth weight or macrosomia and for planning mode of delivery. This study compared Johnson's formula, Dare's formula and ultrasound estimated fetal weight with actual birth weight in term pregnancy. **Methods:** This prospective observational comparative study included 40 term singleton cephalic pregnancies admitted to the Department of Obstetrics and Gynaecology, BMCRC, Ballari. Estimated fetal weight was calculated using Johnson's formula and Dare's formula and was compared with ultrasound estimated fetal weight. Actual birth weight after delivery was used as the reference standard. Mean error, mean absolute error, mean absolute percentage error, estimates within ±10% of actual birth weight and Pearson correlation were calculated. **Results:** The mean age of participants was 24.88 ± 3.64 years and mean gestational age was 39.60 ± 1.19 weeks. Mean actual birth weight was 3073.25 ± 325.22 g. Johnson's formula showed a significant positive bias of 137.70 ± 231.42 g ($p<0.001$). Dare's formula showed a small negative bias of -19.02 ± 204.13 g ($p=0.559$), while ultrasound showed minimal bias of 0.50 ± 148.98 g ($p=0.983$). Mean absolute error was lowest for ultrasound (119.00 g), followed by Dare's formula (158.97 g) and Johnson's formula (208.95 g). Estimates within ±10% of actual birth weight were 72.5% for Johnson's formula, 87.5% for Dare's formula and 95.0% for ultrasound. **Conclusion:** Ultrasound estimation showed the best overall accuracy in this cohort. Among clinical methods, Dare's formula performed better than Johnson's formula and may be useful where ultrasound is unavailable or delayed.

KEYWORDS

Fetal Weight Estimation; Johnson Formula; Dare Formula; Ultrasound; Term Pregnancy; Actual Birth Weight

INTRODUCTION

Accurate estimation of fetal weight is an important component of intrapartum management. It helps the obstetrician anticipate small-for-gestational-age and large-for-gestational-age fetuses and supports decisions regarding induction, trial of labour, operative delivery and neonatal preparedness (1,2). Birth weight is also one of the strongest determinants of neonatal survival and early neonatal morbidity.

Although ultrasonography is widely used for fetal weight estimation, clinical methods remain relevant in resource-limited settings because they are inexpensive, rapid and do not require specialized equipment. Clinical formulas are also useful when labour room decisions must be made immediately and ultrasound access is limited.

Johnson's formula and Dare's formula are commonly used bedside clinical methods. Johnson's formula uses symphysiofundal height with correction for engagement of the presenting part, whereas Dare's formula uses the product of symphysiofundal height and abdominal girth. Previous studies have reported variable accuracy for clinical methods compared with sonographic estimation and actual birth weight (1-4). Therefore, the present study was undertaken to compare Johnson's formula, Dare's formula and ultrasound estimated fetal weight with actual birth weight among term pregnancies.

Materials and methods

Study design and setting:

This was a prospective observational comparative study conducted in the Department of Obstetrics and Gynaecology, Ballari Institute of Medical Sciences and Research Centre, Ballari. The study period was from June 2025 to November 2025 as per the approved synopsis.

Study population:

The study included 40 pregnant women admitted to the antenatal ward and labour room after applying the inclusion and exclusion criteria. Eligible participants were women aged more than 18 years with singleton live fetus, cephalic presentation and gestational age between 37 and 42 completed weeks. Women with multiple gestation, noncephalic presentation, anomalous fetus, intrauterine fetal death, polyhydramnios, oligohydramnios, intrauterine growth restriction, fibroid uterus, adnexal mass or congenital anomalies were excluded.

Method of fetal weight estimation:

After obtaining relevant clinical details, symphysiofundal height and abdominal girth were measured using a nonstretchable measuring tape. Johnson's estimated fetal weight was calculated as:

Estimated fetal weight (g) = (symphysiofundal height in cm - n) x 155, where n = 12 when the presenting part was engaged and n = 13 when it was not engaged.

Dare's estimated fetal weight was calculated as:
Estimated fetal weight (g) = symphysiofundal height (cm) x abdominal girth (cm).

Ultrasound estimated fetal weight recorded near term was also noted. Actual birth weight measured after delivery was considered the reference standard.

Outcome measures:

The primary outcome was accuracy of Johnson's formula, Dare's formula and ultrasound estimated fetal weight compared with actual birth weight. Secondary outcome measures included mean signed error, mean absolute error, mean absolute percentage error, proportion of estimates within ±10% of actual birth weight and correlation with actual birth weight.

Statistical analysis:

Data were summarized as mean ± standard deviation for continuous variables and frequency with percentage for categorical variables. Paired t-test was used to compare estimated fetal weight with actual birth weight. Pearson correlation was used to assess correlation between each method and actual birth weight. A p value <0.05 was considered statistically significant.

RESULTS

Baseline and obstetric characteristics:

A total of 40 term pregnant women were included in the analysis. Mean age was 24.88 ± 3.64 years, ranging from 19 to 35 years. Mean gestational age was 39.60 ± 1.19 weeks. Most participants were booked cases (34/40, 85.0%). The mean BMI was 23.80 ± 3.02 kg/m2. There were 20 male and 20 female neonates. Vaginal delivery occurred in 22 participants, LSCS in 15 and instrumental delivery in 3. Mean actual birth weight was 3073.25 ± 325.22 g, and all babies were in the normal birth weight category in the generated master sheet.

Comparison of estimated fetal weight with actual birth weight:

The mean estimated fetal weight by Johnson's formula was 3210.95 ± 396.38 g, by Dare's formula was 3054.22 ± 352.00 g, and by ultrasound was 3073.75 ± 302.78 g. Johnson's formula significantly overestimated actual birth weight, with mean signed error of 137.70 g ($p<0.001$). Dare's formula and ultrasound did not show statistically significant bias against actual birth weight.

Accuracy analysis:
Ultrasound showed the lowest mean absolute error (119.00 ± 87.58 g) and the lowest mean absolute percentage error (3.94%). Dare's formula had lower mean absolute error than Johnson's formula (158.97 g vs 208.95 g). Estimates within ±10% of actual birth weight were highest with ultrasound (95.0%), followed by Dare's formula (87.5%) and Johnson's formula (72.5%). Ultrasound was the most accurate method in 17 cases (42.5%), followed by Dare's formula in 13 cases (32.5%) and Johnson's formula in 10 cases (25.0%).

Correlation with actual birth weight:
All three methods showed strong positive correlation with actual birth weight. The correlation coefficient was highest for ultrasound ($r=0.890$, $p<0.001$), followed by Dare's formula ($r=0.821$, $p<0.001$), and Johnson's formula ($r=0.812$, $p<0.001$).

DISCUSSION

The present study compared two bedside clinical methods and ultrasound estimation of fetal weight with actual birth weight among term pregnancies. The main finding was that ultrasound had the best overall accuracy, with the lowest mean absolute error, lowest mean absolute percentage error and the highest proportion of estimates within ±10% of actual birth weight. Among the clinical methods, Dare's formula performed better than Johnson's formula.

Johnson's formula showed significant overestimation in this dataset. This may be due to reliance on symphysiofundal height alone and the effect of engagement correction. Fundal height is influenced by maternal habitus, fetal lie, liquor volume and observer variation. Even after correction for station, these factors can lead to wider error margins.

Dare's formula incorporates both symphysiofundal height and abdominal girth, which may explain its better performance compared with Johnson's formula. The mean absolute error of Dare's formula was lower and a higher proportion of estimates were within ±10% of actual birth weight. This supports the value of Dare's formula as a practical clinical method in settings where ultrasonography is not immediately available.

Ultrasonography showed the highest correlation with actual birth weight and the best descriptive accuracy. This is consistent with studies reporting lower percentage error for sonographic estimation compared with clinical methods (2). However, the availability of ultrasound and the timing of the scan can influence its usefulness in real-time labour room decision making.

The strengths of this study include direct comparison of three commonly used methods in the same participants and use of actual birth weight as the reference standard. The study also assessed multiple accuracy indices rather than relying only on mean estimated weight. The limitations include small sample size, single-centre design and generated dataset restricted to normal birth weight neonates; therefore, accuracy in low birth weight, macrosomic, IUGR, oligohydramnios and polyhydramnios cases cannot be inferred from the present master sheet.

CONCLUSION

Ultrasound estimated fetal weight showed the best overall accuracy for predicting actual birth weight in term pregnancy. Dare's formula was more accurate than Johnson's formula among the clinical methods and may be a useful bedside alternative when ultrasound is unavailable or delayed. Larger studies including low birth weight and macrosomic fetuses are required to validate these findings.

Conflict of Interest:
The authors declare no conflict of interest.

Tables

Table I: Baseline demographic, obstetric and neonatal characteristics of study participants.

Variable	Value
Sample size	40
Age (years), mean ± SD; range	24.88 ± 3.64; 19-35
Gestational age (weeks), mean ± SD; range	39.60 ± 1.19; 37.0-41.9
BMI (kg/m2), mean ± SD; range	23.80 ± 3.02; 19.0-29.0
Booked / Unbooked	34 (85.0%) / 6 (15.0%)
Primigravida / Multigravida	15 (37.5%) / 25 (62.5%)
Presenting part engaged: Yes / No	17 (42.5%) / 23 (57.5%)
Symphysiofundal height (cm), mean ± SD	33.29 ± 2.69
Abdominal girth (cm), mean ± SD	91.77 ± 7.91
Mode of delivery: Vaginal / LSCS / Instrumental	22 (55.0%) / 15 (37.5%) / 3 (7.5%)
Baby sex: Male / Female	20 (50.0%) / 20 (50.0%)
Actual birth weight (g), mean ± SD; range	3073.25 ± 325.22; 2500-3810
NICU admission: Yes / No	7 (17.5%) / 33 (82.5%)

Table II: Comparison of estimated fetal weight with actual birth weight.

Parameter	Actual BW	Johnson's formula	Dare's formula	Ultrasound EFW
Mean ± SD (g)	3073.25 ± 325.22	3210.95 ± 396.38	3054.22 ± 352.00	3073.75 ± 302.78
Range (g)	2500-3810	2682-4139	2460-3731	2540-3970
Paired p value vs actual BW	-	<0.001	0.559	0.983

Table III: Accuracy analysis of fetal weight estimation methods.

Method	Mean signed error (g)	Mean absolute error (g)	MAPE (%)	Within ±10%	Correlation with actual BW
Johnson	137.70 ± 231.42	208.95 ± 168.00	6.94 ± 5.88	29/40 (72.5%)	r=0.812; p<0.001
Dare	-19.02 ± 204.13	158.97 ± 126.96	5.11 ± 3.97	35/40 (87.5%)	r=0.821; p<0.001
USG	0.50 ± 148.98	119.00 ± 87.58	3.94 ± 3.02	38/40 (95.0%)	r=0.890; p<0.001

Table IV: Method with least absolute error in individual participants.

Most accurate method	Frequency	Percentage
Johnson	10	25.0%
Dare	13	32.5%
USG	17	42.5%

Figures

Figure 1: Mean absolute error by fetal weight estimation method.

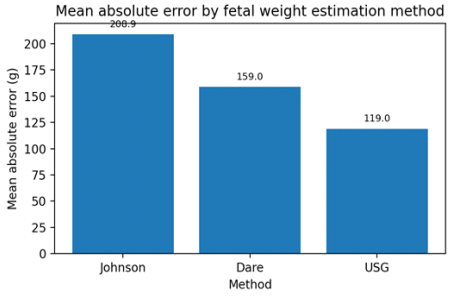

Figure 2: Proportion of estimates within ±10% of actual birth weight by method.

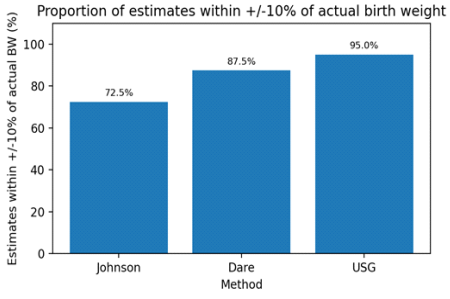

Figure legends: Figure 1 shows the mean absolute error in grams for Johnson's formula, Dare's formula and ultrasound estimated fetal weight. Figure 2 shows the percentage of estimates falling within ±10% of actual birth weight for each method.

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