

## ESTIMATION OF FETAL BIRTH WEIGHT BY CLINICAL AND SONOGRAPHIC METHODS AND ITS CORRELATION WITH ACTUAL BIRTH WEIGHT

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### ABSTRACT

**Background:** Accurate estimation of fetal birth weight is crucial for optimal obstetric management, particularly in predicting complications associated with low birth weight and macrosomia. Various clinical and sonographic methods are used antenatally to estimate fetal weight. The objective is to compare the accuracy of clinical methods (Johnson's and Dare's formulae) and ultrasonography in estimating fetal birth weight and to correlate these estimates with actual birth weight. **Materials and Methods:** This hospital-based prospective descriptive study was conducted among 175 term pregnant women admitted to the Department of Obstetrics and Gynaecology, Government Medical College, Kottayam, over a period of ten months (August 2023 to May 2024). Fetal weight was estimated clinically using Johnson's and Dare's formulae and sonographically using Hadlock's formula. Actual birth weight was measured within one hour of delivery. Statistical analysis was performed using IBM SPSS version 22. **Result:** The mean actual birth weight was  $2985.93 \pm 373.07$  g. The mean estimated fetal weight was 3347.14 g by Johnson's method, 3185.37 g by Dare's method, and 3037.12 g by ultrasonography. The mean difference from actual birth weight was highest with Johnson's method (361.21 g), followed by Dare's method (199.44 g), and lowest with ultrasonography (51.19 g). The correlation coefficients with actual birth weight were 0.79, 0.84, and 0.87 for Johnson's, Dare's, and ultrasonography respectively. **Conclusion:** Ultrasonography is the most accurate method for antenatal estimation of fetal weight. Among clinical methods, Dare's formula is more reliable than Johnson's formula and may be recommended in resource-limited settings.

## INTRODUCTION

The weight of a newborn infant recorded right away after the delivery is known as birth weight.

Accurately estimating the baby's birth weight is a crucial procedure to be performed after birth. Gestational age at delivery, the mother's race, and other environmental, parental, and pregnancy-specific variables such as gestational diabetes, gestational hypertension, and preeclampsia are the major factors that determine birth weight. A newborn's normal birth weight falls between 2500 and 4000 grams. There is a higher chance of perinatal illness and death linked to birth weight outside of this range.<sup>[1]</sup> Shoulder dystocia, injuries of bone, brachial plexus injury, and intrapartum asphyxia are likely complications of vaginal delivery of a large fetus; pelvic floor and birth canal injuries, raised risk of vaginal and caesarean deliveries during surgery, and

postpartum haemorrhage are among the risks to the mother. In developing nations where many births take place at home or in birth centres without proper facilities, antenatal diagnosis of macrosomic and low birth weight fetuses can lead to the early referral of diagnosed cases to higher centers.<sup>[2]</sup>

The two techniques for estimating birth weight are clinical palpation and sonographic assessment. Based on algorithms of fetal measurements such as abdominal circumference, length of the femur, and biparietal diameter (Hadlock's formula), sonographic estimates of fetal weight are made. Most patients in underdeveloped nations cannot afford ultrasonography, and for the palpatory approach expertise of specialists is required. For this reason, measuring fundal height for determining birth weight using easily accessible and inexpensive measuring tapes can be of great use in nations with limited resources. It also helps us to determine if obtaining

an additional measurement, such as the abdominal girth (AG), enhances the accuracy of the birth weight assessment.<sup>[3]</sup> Two clinical formula accuracy namely; Dare's and Johnson's formula for EFW was tested by comparing it to ultrasound and ABW (Actual Birth Weight), by evaluating 175 full-term pregnancies.

### Objective

To ascertain the superiority of the clinical or sonological approach for estimating fetal weight when compared to the actual birth weight and the diagnosis of macrosomia.

## MATERIALS AND METHODS

The study was conducted in 175 full term antenatal women admitted in Department of Obstetrics and gynecology Government medical college Kottayam, a tertiary care center. The study was conducted for a period of ten months from august 2023 to may 2024. the study is a: Hospital based prospective descriptive study, ethical concerns were cleared from the institutional review board. Data was collected after informed consent with thorough history, clinical examination and ultrasonographic examination. Abdominal examination is done with the patients lying comfortably in semi recumbent position. The woman is asked to empty the bladder. Then symphysio-fundal height and abdominal girth measurement is taken.

SFH is measured with a metric tape made of non elastic material. The measurements are taken from the upper border of symphysis pubis to the highest

point of uterine fundus. The fundus is defined by gentle pressure exerted by ulnar border of left hand in a plane at right angle to the abdominal wall after centralized the uterus by right hand. Measurement is recorded to nearest 0.5cm. At the same time measurement of abdominal girth at the level of umbilicus taken with a non-elastic tape by cross over techniques at the end of a normal expiration. Dare's formula and Johnson's formula are calculated

- DARE'S FORMULA-Fetal weight in grams=Symphysiofundal height (SFH) X Abdominal girth(AG).<sup>[4]</sup>

- JOHNSON'S FORMULA-fetal weight in grams=(symphysiofundal height-X) \*155 where X is 12 if head is not engaged and X is 11 if head is engaged.<sup>[5]</sup>

- Ultrasound fetal weight estimation:

Using the obstetrics ultrasound scan that included measurement of biparietal diameter, head circumference, abdominal circumference and femoral length. The ultrasound fetal weight can be calculated automatically by the equipment set, using Hadlock's reference table.<sup>[6]</sup>

Actual birth weight measured using weighing scale within one hour of delivery

IBM SPSS software version 22 was used to correctly code, input, and analyse data after it has been entered into Microsoft Excel. The estimated fetal weight, which is the primary outcome variable, was computed as a mean or percentage. Paired t test was used to test for associations between quantitative variables.

## RESULTS

### Actual Birth Weight:

**Table 1: Mean actual birth weight**

<b>Total No. of pregnant women studied</b>	<b>175</b>
Total No. of live birth	175
Mean actual birth weight	2985.93 gm
Maximum birth weight	3938gm.
Minimum birth weight	2015gm.
Standard Deviation	373.07

Among 175 babies the mean actual birth weight was 2985.93 grams. The maximum actual birth weight was 3938 grams and minimum actual birth weight was 2015 grams in our study.

Weight assessed by clinical methods

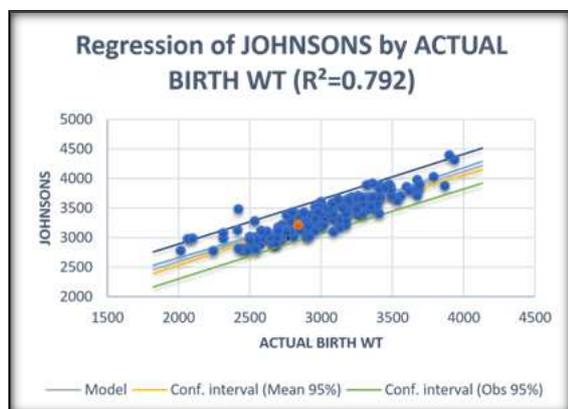
### Johnson Method

**Table 2: Comparison of mean actual birth weight with mean estimated birth weight by Johnson Method**

S. No	Estimates	Estimation by Johnson
1	Mean actual birth weight	2985.93
2	Mean estimated fetal weight by Johnson's method	3347.14
3	Difference between mean actual birth weight and mean estimated fetal weight by Johnson's method	361.21 gm.
4	The mean error of estimation of fetal weight	146.05 i.e. 48.9 gm/kg.
5	S. D – Standard deviation	319.09
6	S.E- Standard error of the mean	24.13
7	Pearson product moment Correlation Co-efficient	0.79

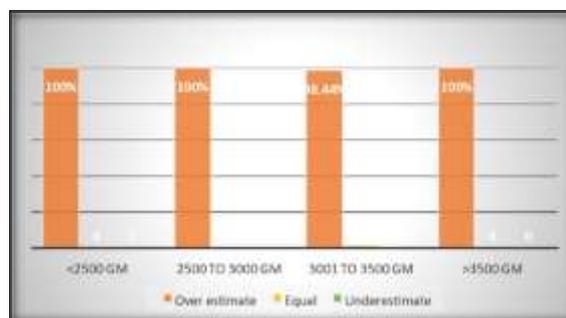
**Table 3: Detailed study of the estimated fetal weight by Johnson's method**

Range	No. of cases over estimated	Equal	No. of cases under estimated	Total no. of cases
<2500 gm	12 (100%)	0	0	12 (100%)
2500 to 3000 gm	85(100%)	0	0	85(100%)
3001 to 3500 gm	63 (98.44%)	1(1.56%)	0	64 (100%)
>3500 gm	14 (100%)	0	0	14 (100%)



**Graph 1: Regression analysis of Actual birth weight and birth weight by Johnsons method**

In our study the mean birth weight estimated using Johnson's formula was 3347.14. There was 361.21 gm difference between mean actual birth weight and mean estimated fetal weight by Johnson's method. The mean standard error was 24.13 with Pearson's coefficient of 0.79. This shows positive correlation between the Johnson method of fetal weight estimation and actual birth weight.



**Graph 2: Estimated fetal weight by Johnson's method**

**Observation:**

- Total no. of cases over estimated = 174
- Total no. of cases equal value = 1
- Total no. of cases under estimated = 0

In our study, using Johnson's method for estimation of birth weight, 12 (100%) babies of less than 2500gm, 85 (100%) babies of 2500 to 3000gms, 63 (98.44%) babies of 3001 to 3500gms and 14 (100%) babies of more than 3500gms was overestimated. 1(1.56%) baby of 3001 to 3500gms was estimated equally in our study.

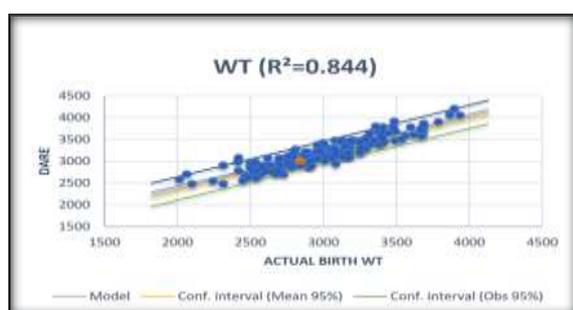
**Dare's Formula:**

**Table 4: Comparison of mean actual birth weight with mean estimated birth weight by Dare's formula**

S. No	Estimates	Estimation by AG & SFH
1	Mean actual birth weight	2985.93 gm
2	Mean estimated fetal weight by Dare's Formula	3185.37 gm.
3	Difference between mean actual birth weight and mean estimated fetal weight by Dare's Formula is	199.44 gm.
4	The mean error of estimation of fetal weight	132.55 i.e. 44 gm/kg.
5	S. D – Standard deviation	334.26
6	S.E- Standard error of the mean	25.28
7	Pearson product moment correlation co-efficient	0.84

**Table 5: Estimated fetal weight by Dare's method**

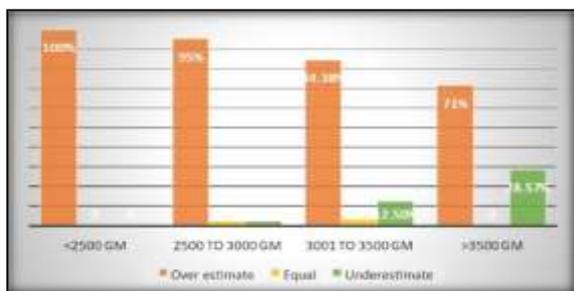
Range	No. of cases over estimated	Equal	No. of cases under estimated	Total no. of cases
<2500 gm	12 (100%)	0	0	12 (100%)
2500 to 3000 gm	81 (95.29%)	2 (2.35%)	2 (2.35%)	85 (100%)
3001 to 3500 gm	54 (84.38%)	2 (3.13%)	8 (12.5%)	64 (100%)
>3500 gm	10 (71.43%)	0	4 (28.57%)	14 (100%)



**Graph 3: Regression analysis of Actual birth weight and birth weight by Dare's method**

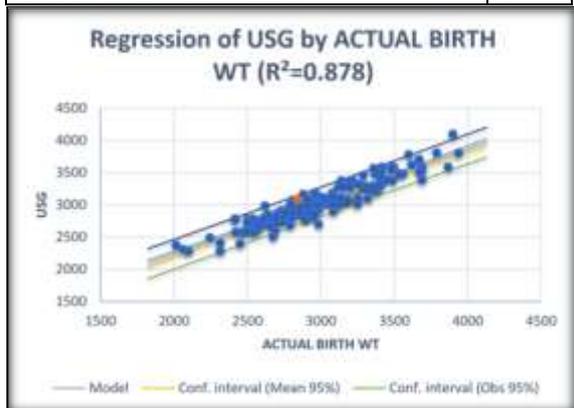
**Regression of DARE by ACTUAL BIRTH**

In our study the mean birth weight estimated using Dare's method was 3185.37 gms. There was 199.44 gms difference between mean actual birth weight and mean estimated fetal weight by Dare's method. The mean standard error was 25.28 with Pearson's coefficient of 0.84. This shows positive correlation between the Dare's method of fetal weight estimation and actual birth weight.



**Graph 4: Estimated fetal weight by Dare's method**

Observation	
Total no. of cases over estimated	157
Total no. of cases having equal value	4
Total no. of cases underestimated	14



**Graph 5: Regression analysis of Actual birth weight and birth weight by USG method**

In our study, using Dare's method for estimation of birth weight, 12 (100%) babies of less than 2500gm, 81 (95.29%) babies of 2500 to 3000gms, 54 (84.38%) babies of 3001 to 3500gms and 10 (71.43%) babies of more than 3500gms was overestimated. 2 (2.35%) babies of 2500 to 3000gms, 2 (3.13%) babies of 3001 to 3500gms was estimated equally in our study. 2 (2.35%) babies of 2500 to 3000gms, 8 (12.5%) babies of 3001 to 3500gms and 4 (28.57%) babies of more than 3500gms were underestimated.

**Ultrasonography:**

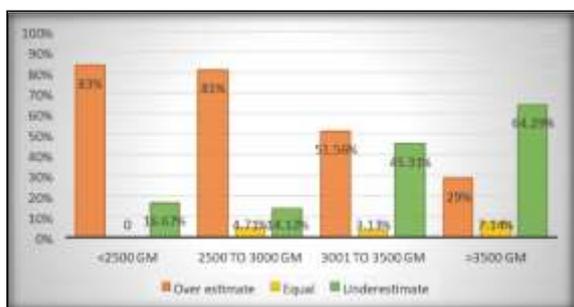
In our study the mean birth weight estimated using USG method was 3037.12 gms. There was 51.19 gms difference between mean actual birth weight and mean estimated fetal weight by USG method. The mean standard error was 24.61 with Pearson's coefficient of 0.87. This shows positive correlation between the USG method of fetal weight estimation and actual birth weight.

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

S. No	Estimates	Estimation by USG
1	Mean actual birth weight	2985.93 gm
2	Mean estimated fetal weight by USG	3037.12 gm
3	Difference between mean actual birth weight and mean estimated fetal weight by USG is	51.19 gm.
4	The mean error of estimation of fetal weight	114.05 i.e. = 38 gm/kg
5	S. D – Standard deviation	325.35
6	S.E- Standard error of the mean	24.61
7	Pearson product moment correlation co-efficient	0.87

**Table 6: Detailed study of the estimated fetal weight USG**

Range	No. of cases over estimated	Equal	No. of cases under estimated	Total no. of cases
<2500 gm	10 (83.33%)	0	2 (16.67%)	12 (100%)
2500 to 3000 gm	69 (81.18%)	4 (4.71%)	12 (14.12%)	85 (100%)
3001 to 3500 gm	33 (51.56%)	2 (3.13%)	29 (45.31%)	64 (100%)
>3500 gm	4 (28.57%)	1 (7.14%)	9 (64.29%)	14 (100%)



**Graph 6: Detailed study of the estimated fetal weight USG**

**Observation**

Total no. of case over estimated = 116.  
 Total no. of case having exactly equal fetal weight estimation with birth weight = 7. Total no. of cases underestimated = 52.  
 In our study, using USG method for estimation of birth weight, 10 (83.33%) babies of less than 2500gm, 69 (81.18%) babies of 2500 to 3000gms, 33 (51.56%) babies of 3001 to 3500gms and 4 (28.57%) babies of more than 3500gms was overestimated. 4 (4.71%) babies of 2500 to 3000gms, 2 (3.13%) babies of 3001 to 3500gms and 1 (7.14%) baby of more than 3500gms was estimated equally in our study. 2 (16.67%) babies of less than 2500gm, 12 (14.12%)

babies of 2500 to 3000gms, 29 (45.31%) babies of 3001 to 3500gms and 9 (64.29%) babies of more than 3500gms were underestimated.

**Table 7: Comparison of clinical methods with actual birth weight**

Sl. No.	Variables	Actual birth weight	Johnson's	Dare's	USG
1	Average of mean	2985.93	3347.14	3185.37	3037.12
2	Difference of mean actual birth wt. with mean estimated fetal weight	-	361.21	199.44	51.19
3	Standard deviation	-	319.09	334.26	325.35
4	Mean error of estimation	-	24.13	25.28	24.61
5	Mean error per kg	-	48.9 gm/Kg	44 gm/kg	38 gm/ kg
6	Co-efficient of correlation	-	0.79	0.84	0.87

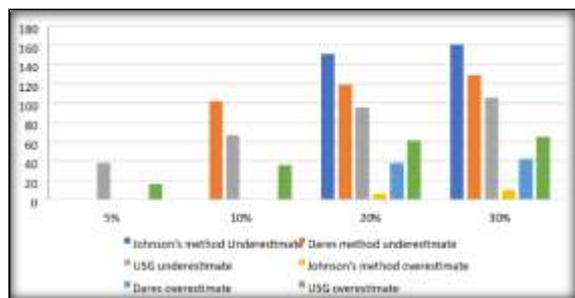
Analysis of data shows that USG estimation was more or less equal to the actual birth weight with a difference of 51.19 gm. Other methods deviate from the actual birth weight i.e. Johnson (361.21 gm) and Dare (199.44). Hence, it is inferred USG method estimated the fetal weight more accurately than others methods. Dares and Johnson's methods seems

to be least correlated and this correlation is statistically significant.

Hence antenatal assessment of the birth weight of the babies is more accurate with USG method followed by clinical estimation of the birth weight by Dare's formula.

**Table 8: Number of cases displaying, by percentage, overestimates, and underestimates using various techniques.**

Percentage of estimate	No. of cases with underestimation			No. of cases with overestimation		
	Johnsons methos	Dares method	USG	Johnsons methos	Dares method	USG
5% (150g)	0	0	38	0	0	16
10% (300g)	0	102	67	0	1	36
20% (600g)	151	119	96	6	38	61
30% (900g)	161	129	106	10	42	65



Number of cases displaying, by percentage, overestimates and underestimates using various techniques.

The fraction of cases accurately predicted by Johnson's method within 10% of the ABW, or 300 grams, is almost negligible, but within 20% of the ABW, it is 89.7%. Compared to Johnson's method, the proportion of cases correctly predicted using Dare's formula and USG within 10% of ABW, or 300gms, is 58.8%, and within 20% of ABW, it is 89.7%.

As a result, the USG and Dare's method of prenatal weight assessment is more accurate than the Johnson's method in predicting fetal birth weight within 10% of ABW.

## DISCUSSION

In our study, 175 antenatal term women coming to the department of Obstetrics and Gynecology were included. They were subjected to fetal weight measurement using clinical methods Johnson's formula and Dare's formula. Then ultrasonogram

was taken to find out the estimated fetal weight. After delivery the actual birth weight of the fetus was measured soon after birth. We found that among 175 babies the mean actual birth weight was 2985.93 grams. The maximum actual birth weight was 3938 grams and minimum actual birth weight was 2015 grams. While estimating the mean birth weight using Johnsons formula it was 3347.14 with 361.21 gm from mean actual birth weight. The mean standard error was 24.13 and Pearsons coefficient was 0.79. our results showed positive correlation between the Johnson method of fetal weight estimation and actual birth weight.

But majority of the infants weights were overestimated and only one birthweight was estimated equally using johnsons method.

Whereas the birth mean weight estimated using Dare's method was 3185.37 gms. There was 199.44 gms difference between mean actual birth weight, which was less compared to the weight difference using johnsons formula. The mean standard error was 25.28 with Pearsons coefficient of 0.84. There was a positive correlation between the Dare's method of fetal weight estimation and actual birth weight.

But even using Dares formula also resulted in over estimation of birth weight like Johnson formula.

The mean birth weight estimated using USG method was 3037.12 gms. There was 51.19 gms difference from mean actual birth weight. This was the lowest difference observed in our study. The mean standard error was 24.61 with Pearsons coefficient of 0.87. There was positive correlation between the USG

method of fetal weight estimation and actual birth weight also.

Analysis of our data showed that USG estimation was more or less equal to the actual birth weight with a difference of 51.19 gm. Other methods deviate from the actual birth weight more compared to USG. i.e. Johnson (361.21 gm) and Dare (199.44). Hence, it is inferred USG method estimated the fetal weight more accurately than others methods. Dare's and Johnson's methods seems to be least correlated and this correlation is statistically significant.

Hence antenatal assessment of the birth weight of the babies is more accurate with USG method followed by clinical estimation of the birth weight by Dare's formula.

While comparing with other studies we found lot of similarities in the results. In a prospective comparison study of 200 parturients carried out at the University of Calabar Teaching Hospital, Calabar, also found USG as a better method for estimating the birthweight.<sup>[7]</sup> Ultrasound is the best approach for determining birth weight when it is available, according to a prospective observational study at GMERS Medical College and Hospital Sola, Ahmedabad. But they suggested that Dares formula is a low-cost technique for checking for fetal growth as the equipment for ultrasonographic assessment is not easily accessible in rural areas.<sup>[8]</sup>

Similarly In a research comparing several methods of estimating fetal weight in a tertiary hospital in Kanchipuram showed that the Dare formula accurately predict 69% of the instances, while the Johnson technique could accurately predict 61% of the cases. USG accurately anticipated 67% of instances which was similar to our findings.<sup>[9]</sup>

## CONCLUSION

Johnson and Dare's Formula were comparable in estimating Fetal Weight. Among the two, Dares methods of fetal weight estimation was found to be more reliable in terms of showing less mean error /

kg of birth weight and less difference in mean estimated fetal weight from actual birth weight.

On comparison with USG estimation of Fetal weight with the above clinical methods, USG estimate was found to be more accurate than the other two methods as the mean difference between USG estimate and actual birth weight was found to be very less. When clinical methods were compared with ultrasound, Dare's formula estimated weight was much closer to USG estimated Fetal Weight.

This study reveals that USG is more reliable in prediction of fetal weight accurately than the two clinical methods, Johnson and Dare's Formula.

USG estimated fetal weight was noted to be more closer to actual birth weight. But this requires appropriate equipment and expertise.

Among the clinical methods both Dare's formula is recommended over Johnsons formula especially in resource limited settings for estimation of fetal weight.

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