# Comparative Study for Estimation of Fetal Weight by Various Clinical Methods and its Correlation with Actual Birth Weight

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## Abstract
**Introduction:** Fetal weight, in conjunction with gestational age, is an important indicator of pregnancy outcome. Accurate estimation of fetal weight is of paramount importance in the management of labor and delivery and it also help in avoidance of complications associated with fetal excessive or low-birth-weight babies, thereby decreasing perinatal morbidity and mortality. Various clinical formulae like Johnson's formula & Dare's formula are in use for fetal weight estimation. Aim of the study was to assess the fetal weight in term pregnancy by various clinical methods- Dare's formula & Johnson's formula and its comparison and correlation with actual birth weight. **Materials & Method**: It was a prospective observational study of 334 women at term pregnancy at GMERS medical college & Hospital, Vadnagar from April 2021 to July 2021. The formulas used in this study were: Johnson's formula and Dare's formula. The measurements were compared with actual birth weight after the birth of baby. **Results:** The mean actual birth weight was 2759.07±466.15 grams. The mean estimated birth weight by Dare's and Johnson's method was 2845.79±453.43 grams and grams 2990.81±413.68respectively. Dare's method was more accurate and had least maximum and minimum error than Johnson's method. **Conclusion:** Dare's formula is an inexpensive method for fetal birth weight estimation. It can be used on large scale because of its low cost, ease of use, and need for little training as the setup for ultra sonographic evaluation is not readily available in rural setups.

**Keywords:** Abdominal Girth, Actual birth weight, Dare's formula, Estimated birth weight, Johnson's formula, Symphysio-fundal height.

## Introduction
Fetal weight, in conjunction with gestational age, is an important indicator of pregnancy outcome.[1,2,3] Accurate estimation of fetal weight is of paramount importance for deciding the time, mode and place of delivery. Expected birth weight is an important parameter to evaluate for cephalopelvic disproportion when deciding the mode of delivery. It is especially important for the obstetrician to estimate the expected fetal birth weight while managing high risk pregnancies like breech presentation, IUGR, trial of labor after caesarean delivery, diabetic pregnancy, severe PIH etc.[4,5,6]

It has been suggested that accurate estimation of fetal weight would help in care of the new born in the neonatal period and help in avoidance of complications associated with fetal excessive or low-birth-weight babies, thereby decreasing perinatal morbidity and mortality.[7,8,9] Low birth weight (LBW) babies and macrosomic babies have higher perinatal morbidity and mortality. Macrosomia is associated with shoulder dystocia, birth asphyxia, birth trauma, metabolic complications and maternal, fetal trauma. Low birth weight babies are susceptible to birth asphyxia, hypothermia, hypoglycemia and other metabolic complications.[5,6,10,11,12,13] After birth, prognosis of these babies depends upon good neonatal care facilities. The NICU and paediatrician can be alerted whenever the birth of a low birth weight baby or

macrosomic baby is anticipated.
Estimation of birth weight prior to delivery is very important in the peripheral health centers.[14] In utero transfer to higher centers can be done timely if birth of a low birth weight or macrosomic baby is likely.
Presently, many methods are in practice to estimate the fetal birth weight. All currently available techniques are associated with significant degree of inaccuracy.[10,11,14] Several studies have compared the accuracy of fetal weight estimation by USG and clinical methods. Advantages of clinical methods over USG in low resource settings cannot be overlooked. Availability of USG, radiologists and high cost may be constraints in low resource settings. However, clinical methods are simple, can be performed quickly and require no cost. It can be taught easily, does not require expertise and can be done by trained midwives, staff nurses, junior doctors and health care providers in a rural or poor resource set up.[10,14] Among the many studied clinical methods, Johnson's method and Dare's method are simple and widely used. The Aim of the study is to assess the fetal weight in term pregnancy by various clinical methods- Dare's formula and Johnson's formula and its comparison and correlation with actual birth weight.

## Materials and Method:

**Ethical Approval:** Proposal of the study was approved by Ethical clearance committee of G.M.E.R.S. Medical College and Hospital, Vadnagar. Oral and written informed consent was obtained from every study participant by explaining about the study. All information collected from the study participants was handled confidentially and the data were used for the research purpose only.
**Study design:** Prospective observational comparative study
**Source population:** All Pregnant women admitted to the labor and maternity ward of Obstetrics and Gynaecology Department of G.M.E.R.S.Medicalcollege and Hospital were considered as source population for the study.
**Study population:** The study population was all selected women admitted to the labor and maternity ward of Obstetrics and Gynaecology Department of G.M.E.R.S.Medicalcollege and Hospital during the study period who fulfil the inclusion criteria and are not in the exclusion criteria.
**Inclusion criteria:** Singleton term pregnancy with longitudinal lie and vertex presentation having confirmed gestational age.
**Exclusion criteria:**

- Unreliable dates
- Malpresentations
- Multiple pregnancy
- Polyhydroamniosis, Oligohydroamniosis
- Congenital anomaly of fetus
- Fetal demise
- Fibroids or adnexal mass complicating pregnancy
- Anomaly of uterus

**Sample size:** The sample size was determined using the following single population estimation formula:
**$n= P (1-P)Z^2/d^2$**
The following assumptions were used in determining the sample size:

- P-Taking the accuracy of Dare's and Johnson's formula for estimation of fetal weight to be on average 68% [(5,6)]
- Z=1.96 which is the standard normal variable at 95% confidence level
- d -is the margin of sampling error tolerated=5%

**n= 0.68x0.32x1.96x1.96/0.05x0.05=334**
334 mothers was needed to give a precision of 5% around an observed percentage of estimated fetal weights correct to within 10% of the birth weight.
**Study duration:** 3 months

**Intended intervention:** All 334 pregnant women who fulfil the inclusion and not in the exclusion criteria were involved in this study. The participants were explained about the purpose and nature of the study and consent was obtained from them. A structured proforma was used to enter the information collected. A detailed history regarding age, parity, past pregnancy outcome and present pregnancy details were noted. Gestational age was confirmed by last menstrual period and dating scan. A thorough general and obstetric examination was carried out. Patient was asked to empty the bladder and lie in dorsal position. Abdominal examination was done noting the lie, presentation, amount of head palpable per abdomen (in fifths) and fetal heart sound was recorded. After correcting dextrorotation, symphysiofundal height (SFH) and abdominal girth (AG) was measured using a flexible, inelastic centimeter tape. Distance from the upper edge of pubic symphysis to the fundus was noted in centimeters and recorded as SFH. Station of the presenting part was assessed by abdominal examination and vaginal examination. AG in centimeters was recorded at the level of umbilicus. Clinical estimation of fetal weight was done by Johnson's method and Dare's method. After delivery, the actual birth weight was recorded. Birth weight was measured by correctly zeroed and calibrated weight scale.

**Dare's Formula:** Fetal weight (gm)= Abdominal girth (in cm) x Symphysio-fundal height (in cm) (AGXSFH)

**Johnson's Formula:** Fetal weight (gm) =SFH (cm)- n x 155.

Where SFH=Symphysio-fundal height

n=13 when presenting part not engaged

n= 12 when presenting part at station 0

n= 11 when presenting part at station +1

If a patient weighs more than 91 kg, 1 cm was subtracted from the fundal height.

**Statistical Analysis:** Data obtained was tabulated and analyzed using percentages, mean, averages to obtain the percentage errors, average errors of each clinical formula and the mean average error in all cases studied. Standard deviation was calculated using mean. Finally, the "p" values were calculated to know association between actual birth weight and the weights derived by the two clinical formulae and the significance was tested by paired T test.

## Results

Total 334 women participated in the study. The mean age of the women in the study was 24.70±3.45.30.53% women were primigravida and 70.05% were multigravida.58.98% women had normal vaginal delivery, 38.92% women underwent cesarean section, 2.09% women had instrumental delivery.

Table No.1 shows that the birth weight was ranged from 1500gm to 4100gm. 46.10% of babies had birth weight between 2500gm to 2999gm. Table No.2 shows the mean actual Birth weight of the babies was found to be 2759.07±466.15 gms. The mean birth weight by Dare's method was 2845.79±453.43gm and by Johnson's Method was 2990.81±413.68 gm. It was also found that actual birth weight was significantly different from clinically estimated birth weight. (t- test= 10.91, p value <0.0001 and t-test=22.38, p value <0.0001 for Dare's method and Johnson's method respectively). Table No.3 shows underestimated and overestimated EBW with Dare's and Johnson's method. Both clinical methods had tendency to overestimate. Number of overestimated cases was lesser with Dare's formula as compared to Johnson's method (74.25% and 88.62% for Dare's and Johnson's formula respectively). Number of underestimated cases was less with Johnson's formula (14.07%). Number of correct estimation was more with Dare's method (1.19%). Table No. 4 shows minimum weight estimation by Dare's and Johnson's method was 1800gm and 2000gm respectively and maximum weight estimation was 3900gm and 4100gm respectively. Maximum error with Dare's method was 500gm and with Johnson's was 950gms. Table No. 5 shows the errors in Birth weight estimation by various methods compared to actual Birth weight. Mean error for Dare's formula and Johnson's formula were -86.71±145.14gm and -231±189.33gm respectively (Difference was statistically significant as P value <0.0001). Mean absolute

error for Dare's formula and Johnson's formula were 149.72±78.98gm and 266.76±135.16gm respectively (Difference was statistically significant as P value <0.0001). The mean percentage error for Dare's formula and Johnson's formula were -3.14% and -8.39% respectively (Difference was statistically significant as P value <0.0001). ). Mean absolute percentage error for Dare's formula and Johnson's formula were 5.42% and 9.66% respectively (Difference was statistically significant as P value <0.0001). Statistical analysis with T tests was carried out. Both the clinical methods correlated well with the birth weight, Dare's having a slightly closer correlation (r) value of 0.9505 versus (r)= 0.9143 for Johnson's method. The p value < 0.001 was also found to be statistically significant.

**Table 1: Distribution of cases according Actual Birth weight and EBW by Dare's and Johnson's formula**

| Birth weight in gm | No. of cases (ABW) | EBW by Dare's | EBW by Johnson |
|---|---|---|---|
| 1500-1999 | 22(6.58%) | 16 | 0 |
| 2000-2499 | 57(17.06%) | 36 | 31 |
| 2500-2999 | 154(46.10%) | 164 | 174 |
| 3000-3499 | 81(24.25%) | 96 | 101 |
| 3500-3999 | 20(5.98%) | 22 | 26 |
| ≥4000 | 0 | 0 | 2 |

**Table 2 : Mean actual birth weight in relation to Mean estimated birth weight by Dare's method and Johnson's method**

| Method of Estimation | Birth Weight in gm (Mean ± S.D.) | Standard error of mean | Paired t- Test Value | p value |
|---|---|---|---|---|
| Actual Birth weight | 2759.07±466.15 | | | |
| Dare's Method | 2845.79±453.43 | 24.81 | 10.91 | <0.0001 |
| Johnson's Method | 2990.81±413.68 | 22.64 | 22.38 | <0.0001 |

**Table 3: Underestimated and Overestimated birth weight by various methods**

| Methods | Overestimated | Underestimated | Correctly estimated | Total |
|---|---|---|---|---|
| Dare's Method | 248(74.25%) | 82(24.55%) | 04(1.19%) | 334(100%) |
| Johnson's Method | 296(88.62%) | 37(14.07%) | 01(0.29%) | 334(100%) |

**Table 4: Maximum and Minimum Birth weight and maximum error by Various Methods**

| Methods | Minimum Weight (gm) | Maximum weight(gm) | Maximum Error(gm) |
|---|---|---|---|
| Dare's Method | 1800 | 3900 | 500 |
| Johnson's Method | 2000 | 4100 | 950 |

**Table 5: Errors in birth weight estimation by various clinical methods compared to actual birth weight**

| | Dare's Method | Johnson's Method | p value |
|---|---|---|---|
| Mean Error | -86.71±145.14 | -231±189.33 | <0.0001 |
| Mean Absolute Error | 149.72±78.98 | 266.76±135.16 | <0.0001 |
| Mean Percentage Error | -3.14 | -8.39 | <0.0001 |
| Mean Absolute Percentage Error | 5.42 | 9.66 | <0.0001 |

**Table 6 : Correlation coefficient**

| Clinical method | Correlation coefficient(r) | p value |
|---|---|---|
| Actual birth weight and Dare's Method | 0.9505 | <0.001 |
| Actual birth weight and Johnson's Method | 0.9143 | <0.001 |

## Discussion

Estimation of fetal weight is an important prerequisite for decision making in obstetrics and labor management.[10,14,15] Currently, ultrasound and several clinical methods are available to estimate fetal weight. Ultrasound is costly, requires a skilled radiologist and may not be available in all settings.[4,10,14] Clinical methods for estimation of fetal weight are simple, easily available, involves no cost, are non-invasive, reproducible and easily acceptable to patients. They are especially useful in situations where ultrasound is not possible.[16] However, clinical methods have variable degrees of error and are influenced by intra observer and inter observer variations.[4,14] Maternal obesity and liquor amount can also influence the measurements.[4,17,18] However, currently, methods which can estimate birth weights within 10% accuracy of actual birth weight are considered acceptable.[10] Several studies have shown that clinical methods are as accurate or superior to ultrasound in estimating fetal weight. In a study conducted by SP Chauhan et al concluded that a term parous woman in labor can estimate birth weight of fetus as accurate as clinical estimation or ultrasonography estimation of fetal weight.[17]

In this study, we aim at analysing the accuracy of Dare's method and Johnson's method in estimating fetal weight. In present study, mean birth calculated by Dare's method and Johnson's method was 2845.79±453.43grams and 2990.81±413.68 grams respectively in comparison with mean actual birth weight of 2759.07±466.15grams. This shows that fetal weight estimation by Dare's method is closer to actual birth weight when compared to Johnson's method and the difference was statistically significant. Yadav et al and Raghuvanshi et al have reported that the EBW by Dare's formula is closer to ABW.[11,19] However, Malik et al and Esmaeilou et al found that the mean difference in birth weight was least with Johnson's method than Dare's method.[5,10] In concordance to the present study, Raghuvanshi et al, Kathiriya et al, Bhandary et al found higher mean absolute error with Johnson's formula than Dare's method.[19,20,21]

In the present study, both Dare's method and Johnson's method had tendency to overestimate birth weight. Between the two methods, Dare's method was more accurate. Similar to our study, Thombarapu et al and Raghuvanshi et al found that Dare's method and Johnson's method overestimated birth weight but Dare's method was better than Johnson's method.[6,19] In contrast, Malik et al found Johnson's method more sensitive than Dare's method to predict IUGR babies.[5] Malik et al found that Dare's method was more sensitive but Johnson's method was more specific in predicting macrosomia.[5] Shittu et al and Emechebe et al found that clinical methods over estimated birth weight in all birth weight groups.[4.10] Johnson's method overestimated all birth weight groups according to the studies by Numprasert[13], Annapurna et al[16] and Sowjanya et al.[23]

To sum up, when the accuracy of the two methods were compared, Dare's method of estimation of birth weight was closer to actual birth weight and had lesser mean absolute error than Johnson's method. In accordance with our studies,Yadav et al,Raghuvanshi et al and Bhandary et al found Dare's method is more accurate than Johnson's method in estimating fetal birth weight.[11,19,21] In contrast, Malik et al, Esmaeilou et aland Torlani et al found Johnson's method is better than Dare's method.[5,12,22] Thombarapu et al found that both methods correlated well with actual birth weight.[6]

## Conclusion

Among the clinical methods, Dare's formula is more accurate than Johnson's formula. Average error in estimated birth weight compared to ABW is least with Dare's formula. Dare's formula is more accurate in estimating birth weight within 10% of ABW as compared to Johnson's formula. Both methods of birth weight estimations in our study have positive linear correlation with ABW. As the actual birth weight increases the estimation of birth weight by clinical methods also increases. In all term pregnant women, birth weight should be estimated before delivery as it helps us to predict maternal and perinatal outcome. In low resource settings, the Dare's formula should be used as against the Johnson's formula for estimating birth weight.

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