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## **A comparative study on estimation of fetal weight in term pregnancy by clinical methods and USG with actual birth weight in a tertiary care center**

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**Abstract---**Background: Primary goal in modern obstetrics is to deliver a healthy baby in a healthy mother. Birth weight is the most important factor in determining the neonatal outcome and survival.<sup>1</sup> So the accurate estimation of fetal weight is one of the important aspects in management of labour.<sup>2</sup> objectives: To compare the accuracy of estimated fetal weight by USG and clinical methods with actual birth weight. Material & Methods: Study Design: Prospective hospital based cross – sectional study. Study area: Department of Obstetrics & Gynaecology, Modern Government Maternity Hospital, Osmania Medical college, Petlaburj, Hyderabad, Telangana state. Study Period: Feb. 2021 - Jan 2022. Study population: Pregnant women attending Obstetrics and Gynaecology department, Modern Government Maternity Hospital, Osmania Medical college, Petlaburj, Hyderabad. Sample size: Study consisted a total of 200 cases. Results: There was no significant difference between actual birth weight and

USG, Johnson and Dare's formula estimated weight. It is inferred that all the methods are more or less accurately estimated the actual birth weight. But, when compared to the other two methods, USG estimate was more accurate as the mean difference between USG estimate and actual birth weight was found to be very less ie. 13.00 g. Conclusion: Among the two clinical methods, Johnsons method of fetal weight estimation was found to be more reliable. It is concluded that USG method more accurately estimated the birth weight followed by Johnson and Dare's formulae.

**Keywords**---fetal birth weight, ultrasound, Johnsons formula, Dares formula, Hadlocks formula.

## Introduction

Primary goal in modern obstetrics is to deliver a healthy baby in a healthy mother. Birth weight is the most important factor which determines the neonatal outcome and survival.<sup>1</sup> So the accurate estimation of fetal weight is one of the important aspects in management of labour.<sup>2</sup> Estimated fetal weight is incorporated into the routine antepartum evaluation of pregnancy.<sup>3</sup> For instance, in the management of diabetic pregnancy, vaginal birth after a caesarean section is influenced by estimated fetal weight.<sup>4</sup> In the high-risk conditions such as Intrauterine growth restriction (IUGR), previous lower segment cesarean section and macrosomia, fetal weight influences management of the labor and delivery.<sup>5</sup>

Low birth weight babies which include small for gestational age babies, intra uterine growth restricted babies or preterm babies are associated with increased perinatal morbidity and mortality. Large babies which include large for gestational age or macrosomic babies, may land up with complications like brachial plexus injuries, facial palsies, birth canal injuries, post-partum haemorrhage.<sup>6</sup> Factors influencing the fetal growth include environmental factors, maternal, fetal and placental factors. This includes race, maternal age, parity index, sex of the baby, socioeconomic status, maternal and congenital infections.

Abnormalities in fetal growth can be detected clinically or by ultrasound (USG). Simple methods like measurements of Symphysio-Fundal height (SFH) and Abdominal Girth (AG) can be used to predict expected fetal weight in low resource settings.<sup>4</sup> Ultrasound is also used for estimation of expected fetal weight and diagnosis of impaired growth. But, it is not easily available in all places offering obstetric care, especially in low resource settings. Fetal weight estimation using ultrasound needs training, expertise and an expensive equipment. In such circumstances clinical methods of estimating fetal weight can aid in obstetric decision making.<sup>7</sup> Various clinical formulae based on measurements of symphysio- fundal height and abdominal girth have been developed.

In a study, product of symphysio-fundal height(cms) and abdominal girth (cms) to obtain expected fetal weight with fairly acceptable predictive value but with considerable variation from the mean was used.<sup>8</sup> To simplify this formula, the product of symphysio-fundal height and abdominal girth at level of umbilicus to

give the expected fetal weight in grams which correlated well with the birth weight was introduced by Dare.<sup>9</sup> Hence the present study was undertaken on 200 full term pregnancies in early labour to compare the accuracy of the two clinical formulae viz, Johnson's and Dare's formulae, Ultrasound to assess fetal weight and compare with actual birth weight.

### **Objectives**

- i. To assess fetal weight by clinical methods using Johnson's formula and Dare's formula.
- ii. To assess fetal weight by ultrasound, using Hadlock's formula.
- iii. To compare the accuracy of estimated fetal weight by USG and clinical methods with actual birth weight.

### **Material & Methods**

Study Design: Prospective hospital based cross – sectional study.

Study area: Department of Obstetrics & Gynaecology, Modern Government Maternity Hospital, Osmania Medical college, Petlaburj, Hyderabad, Telangana state.

Study Period: Feb. 2021 - Jan 2022.

Study population: Pregnant women attending Obstetrics and Gynaecology department, Modern Government Maternity Hospital, Osmania Medical College, Petlaburj, Hyderabad.

Sample size: study consisted a total of 200 cases.

Sampling Technique: Purposive sampling

### **Inclusion Criteria**

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

### **Exclusion Criteria**

- Multiple gestation
- Anomalous fetus
- Non- cephalic presentation
- Intrauterine fetal death
- Presence of coexisting fibroids, ovarian cysts
- Already diagnosed liquor abnormalities

Ethical consideration: Institutional Ethical committee permission was taken prior to the commencement of the study.

### **Study tools and Data collection procedure**

After approval of the study protocol by our Institutional Research committee and Human Ethics committee, written informed consent was taken from pregnant women attending Obstetrics and Gynecology department, who fulfill the inclusion and exclusion criteria. Total 200 women were included in the study. A detailed history was taken which included the patient's education, occupation, socio-economic status, menstrual history, obstetric history, past medical and surgical history and personal history. A thorough general physical examination was done. Vitals signs and anthropometric measurements and systemic examination findings were recorded. Per abdominal examination was performed in supine position.

### **Formulas for clinical assessment of fetal weight**

Expected fetal weight was calculated using two clinical formulae, namely Johnson's formula and Dare's formula as follows:

#### **Johnson's formula <sup>10</sup>:**

Fetal weight= (McDonald's measurement-12) ×155 when presenting part is not engaged.

Fetal weight= (McDonald's measurement-11) ×155 when presenting part is engaged. If woman weighed more than 91 kg, 1 cm was subtracted from fundal height.

#### **Dare's formula:<sup>8</sup>**

Estimated Fetal Weight in grams = Symphio-fundal height (in cms) X Abdominal girth (in cms)

### **Fetal weights estimation by Hadlock's formula using Ultrasonography (USG)**

Sonographic examination using 2-5 MHz transducer (SIEMENS ACUSON X 300) USG machine was done in all patients. Patient was scanned in supine position. Transducer was placed over the abdomen, fetal parts were identified, cardiac pulsations noted and the lie and presentation of the fetus is determined. Position of placenta, its maturity and amount of liquor were noted.

Biparietal diameter(BPD) abdominal circumference(AC) and femur length (FL) and head circumference(HC) were measured in centimeters and the sonography machine calculated the fetal weight.

### **Actual birth weight**

All the babies delivered by vaginal or abdominal route were weighed using electronic baby weighing machine soon after birth. Predicted estimated fetal weight by each method was compared with respective actual birth weight.

## Statistical Analysis

The data was collected, compiled and compared statistically by frequency distribution and percentage proportion. Quantitative data variables were expressed by using Descriptive statistics (Mean  $\pm$  SD). Qualitative data variables were expressed by using frequency and Percentage (%). P values of  $<0.05$  were considered statistically significant. Data analysis was performed by using SPSS Version 20. Independent sample t-test/ ANOVA/ Paired t- test was used to assess statistical significance. Linear regression analysis was done. Regression coefficient, along with its 95% CI and p values are presented.

## Observations & Results

Table 1: Birth weight with Socio-Economic Status

SES	No. of Women	Average birth (gm)
Upper	38	3410
Upper Middle	52	3048
Lower Middle	50	2924
Upper Lower	34	2686
Lower	26	2310
ANOVA = 16.987	df=99	p=0.000

From the above table it is evident that difference in birth weight in five groups is statistically significant. Therefore, it is clear that birth weight differs according to the socio-economic status of the women. Those women belong to the Lower socio-economic status had fetus with lower birth weight.

## Actual Birth Weight: Descriptive statistics

Among 200 babies the mean actual birth weight was 2930 grams. The maximum actual birth weight was 4320 grams and minimum actual birth weight was 1480 grams.

## Estimated fetal weight studied in detail using 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	2930.00
2	Mean estimated fetal weight by Johnsons method	3020.00
3	Difference between mean actual birth weight and mean estimated fetal weight by Johnsons method	90.00 gm.
4	The mean error of estimation of fetal weight	255.47 ie. 84 gm/kg.
5	S. D – Standard deviation	431.10
6	S.E- Standard error of the mean	43.10

7	Pearson product moment Correlation Co-efficient	$r = 0.801$
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This shows strong positive correlation between the Johnson method of fetal weight estimation and actual birth weight.

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

Sl. No.	Range	No. of cases over estimated(%)	Equal	No. of cases under estimated(%)	Total no. of cases(%)
1	+50 gm	4	1	1	16
2	+100 gm	6	1	1	25
3	+150 gm	8	1	1	35
4	+200 gm	14	1	1	44
5	+250 gm	19	1	1	53
6	+300 gm	27	1	1	66
7	+500 gm	44	1	1	90
8	+1000 gm	52	1	1	100

This table shows in 16% cases fetal weight can be predicted within 50 g and about 66% of cases fetal weight prediction within 300 g.

#### 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	2930.00gm
2	Mean estimated fetal weight by Dare's Formula	3076.00 gm.
3	Difference between mean actual birth weight and mean estimated fetal weight by Dare's Formula is	146.00 gm.
4	The mean error of estimation of fetal weight	283.46 ie. 92 gm/kg.
5	S. D – Standard deviation	419.42
6	S.E- Standard error of the mean	41.94.
7	Pearson product moment correlation co-efficient <sup>3</sup>	$r = 0.782$

This shows positive correlation between the two ie. Estimated fetal weight through dare's formula and actual birth weight.

Table 5: Detailed study of the estimated fetal weight by Dare's method

Sl. No.	Range	No. of cases over estimated(%)	Equal	No. of cases under estimated(%)	Total no. of cases(%)
1	+50 gm.	6	1	2	9
2	+100 gm.	12	1	7	20
3	+150 gm.	18	1	8	27
4	+200 gm.	27	1	14	42

5	+250 gm.	35	1	16	52
6	+300 gm.	44	1	19	64
7	+500 gm.	64	1	23	88
8	+1000 gm.	71	1	27	99
9	> 1000 gm.	72	1	27	100

This table shows in 9% cases fetal weight can be predicted within 50 gms and about 64% of cases fetal weight prediction within 300 g.

Table 6: Comparison of mean actual birth weight with mean estimated birth weight by USG

S. No	Estimates	Estimation by USG
1	Mean actual birth weight	2930.00 gm
2	Mean estimated fetal weight by USG	2917.0 gm
3	Difference between mean actual birth weight and mean estimated fetal weight by USG is	13.00 gm.
4	The mean error of estimation of fetal weight	136.5gm. i.e. = 47 gm/kg of birth weight.
5	S. D - Standard deviation	485.80.
6	S.E- Standard error of the mean	48.58
7	Pearson product moment correlation co-efficient	r = 0.942.

This shows strong positive correlation between the Ultrasound method of fetal weight estimation and actual birth weight.

Table 7: Detailed study of the estimated fetal weight USG

Sl. No.	Range	No. of cases over estimated (%)	Equal	No. of cases underestimated (%)	Total(%)
1	+ 50 gm	6	6	7	19
2	+ 100 gm	15	6	32	53
3	+ 150 gm	22	6	37	65
4	+ 200 gm	31	6	43	80
5	+ 250 gm	34	6	46	86
6	+ 300 gm	36	6	54	96
7	+ 500 gm	39	6	55	100

Table showing percentage of cases predicted with accuracy in the above said range. It shows that 86 % of them are predicted with 250 g.

Table 8: Multiple Comparisons

Methods(A)	Methods(B)	Mean Difference (A-B)	Std. Error	Sig.
Actual Birth weight	USG	13.00000	65.47148	.997
	Johnson	-90.00000	65.47148	.542
	Dare's formula	-146.00000	65.47148	.117
	Actual Birth weight	-13.00000	65.47148	.997
	Johnson	-103.00000	65.47148	.420

USG	Dare's formula	-159.00000	65.47148	.074
	Actual Birth weight	90.00000	65.47148	.542
Johnson	USG	103.00000	65.47148	.420
	Dare's formula	-56.00000	65.47148	.807
Dare's formula	Actual Birth weight	146.00000	65.47148	.117
	USG	159.00000	65.47148	.074
	Johnson	56.00000	65.47148	.807

From the above table, it is clear that, there was no significant difference between actual birth weight and USG, Johnson and Dare's formulae estimated weight. It is inferred that all the methods are more or less accurately estimated the actual birth weight. But, when compared to the other two methods, USG estimate was more accurate as the mean difference between USG estimate and actual birth weight was found to be very less ie. 13.00 g.. Thus it is concluded that, USG method estimated the birth weight more accurately followed by Johnson and Dare's formulae.

### Discussion

In our study, 200 antenatal term women coming to the department of Obstetrics and Gynaecology 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. Soon after birth, the actual birth weight of the fetus was measured. It was found that women belonging to low socioeconomic status had low birth weight babies with average birth weight of 2310 grams. The average birth weight gradually increased with increase in socio economic class. This is proved by the significant weight difference among upper and lower class with ANOVA value of 16.987. This is similar to study made by Muhamed Rafiq et al.<sup>11</sup> In our study actual birth weight ranged between 1480 to 4320 grams.

In our study, when weight was calculated using USG 53% of cases were within the range of  $\pm 100$  grams. Nearly 39% of cases had overestimated and 55% had underestimated the fetal weight. The difference between mean estimated fetal weight and mean actual birth weight was 13.00 grams. By Johnson method 53% were within  $\pm 250$  grams and 100% were within the range of  $\pm 1000$  grams. 47% of cases had underestimated and 52% had overestimated fetal weight. The difference between mean estimated fetal weight and mean actual birth weight was 90.00 grams. By Dares formula 52% were within  $\pm 250$  grams and 100% of cases were included only when the weight was  $>1$ kg. The difference between mean estimated fetal weight and mean actual birth weight was 146.00 grams. 72% of cases had overestimated and 27% of cases had underestimated fetal weight.

In our study all methods had over estimation of fetal weight when birth weight was less than 2500grams. This is similar to study made by Akinolo S Shittu where clinical methods were less accurate when birth weight was less than 2500 grams <sup>4</sup> and study made by Niziurski Piase <sup>12</sup> In our study all methods underestimated the fetal weight when birth weight was greater than 3500 grams. This is comparable to the study made by Uma Thombarapu<sup>6</sup>. The above findings are backed up by the study of Colman A, Maharaj D in 2006<sup>13</sup> where there was



underestimation when fetal weight was >4 kg and overestimated when fetal weight is < 2.5kg. Among all the three methods USG was found to be more accurate in estimating the fetal weight. This is similar to the study by Muralisree et al<sup>1</sup>. Among the clinical methods Johnsons formula had more accuracy than Dare's formula in estimating the fetal weight.

It was found out that women with pre pregnancy weight of >45kg (90%) had increased birth weight of fetus, with difference of 218 gms from average birth weight of babies born to women with pre pregnancy weight of ≤45kg (10%). This difference was statistically significant (p=0.006). In our study, it was found that women with >7kg (89%) of weight gain during pregnancy had increased weight of babies compared to mothers with weight gain less than 7 kg. The difference between the mean birth weight between the 2 groups was 422 grams. This difference was statistically significant p=0.0 which is comparable to the study made by Eastman and Jackson (1968).<sup>14</sup> According to which women with low pre pregnancy weight and low weight gain had low birth weight babies.

In our study, it was found that women with <150 cm height (12%) had babies with mean birth weight of 2755 grams and for women >150 cm (88%) it was 2953 grams and difference in weight was 199 grams. The difference was statistically significant p=0.023. This finding is similar to the study made by Witter and Luke in 1991<sup>15</sup> where shorter women had smaller newborn babies than the taller women. Ghosh et al<sup>16</sup> had reported that low birth weight of less than 2.5kg was 42.87% in mothers with height less than 140cm.

In our study multigravida (44%) had Babies with higher birth weight with the mean birth weight of 2960 grams than primigravidas (56%) who had a mean birth weight of 2900 gms. This difference was statistically significant p=0.003. This is comparable to study done by Shah<sup>17</sup> in 2010 in which lowest birth weight was observed in infants born to primi mothers. In our study there was a statistically significant difference in birth weight of male and female babies (p=0.001). The mean birth weight was 64 grams more in males compared to females.

## **Conclusion**

Among the two clinical methods, Johnsons method of fetal weight estimation was found to be more reliable. Ultrasonogram method of fetal weight estimation was found to be more accurate when compared to the other two clinical methods. Thus USG is more reliable in prediction of fetal weight than clinical methods and Johnsons formula can be used in resource limited settings.

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