

## A COMPARATIVE STUDY OF CLINICAL AND ULTRASOUND METHODS FOR ESTIMATION OF FETAL WEIGHT AT TERM PREGNANCY

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### Abstract

**Background:** Accurate prenatal estimation of fetal weight in pregnancy and labor is extremely useful in the management of labor and is an important indicator of pregnancy outcome. It permits obstetricians to make decisions about instrumental vaginal delivery, trial of labor after caesarian section and elective caesarian section for patients suspected of having a macrosomic fetus.

**Objectives:** To assess the fetal weight by four formulae e.g Johnson's formula, Insler's formula measured clinically while Hadlock's formula and Sephard's formula measured by ultrasound and comparison of that with actual birth weight of newborn following delivery. **Materials and Methods:** This is a hospital based prospective observational study which is conducted in MKCG Medical College, Berhampur, Odisha from May 2018 to 2021. Total 2000 cases were studied. **Results:** Out of all cases, 280 cases (14%) had diabetes mellitus while 235 cases (11.7%) and 140 cases (7%) had thyroid disorder and hypertension as associated disorder with pregnancy. The mean actual birth weight of cases was  $2891 \pm 579.13$  gms while the mean birth weight by Insler's formula, Johnson's formula, Hadlock's formula and Sephard's formula was  $2954 \pm 533.80$ gms,  $3280 \pm 501.73$  gms,  $3013 \pm 622.73$ gms and  $3175.15 \pm 501.63$  gms respectively. The mean birth weight by Johnson's formula was significantly more compared to the mean actual birth weight of babies ( $3280 \pm 501.73$ gms vs  $2891.14 \pm 579.13$  gms)( $p < 0.05$ ). The mean birth weight by Sephard's formula was significantly more as compared to mean actual birth weight of babies ( $3175.15 \pm 501.63$ gms vs  $2891.14 \pm 579.13$ gms) ( $p < 0.05$ ). Overestimation of fetal weight is more by Johnson's formula (68.6%) and Sephard's formula (63.3%) as compared to other while underestimation of fetal weight is more by Insler's formula (46.7%) followed by others. **Conclusion:** There is a significant difference between clinical estimation and ultrasound estimation of fetal weight in current study although clinical method of estimation of fetal weight is as accurate as routine ultrasound in day to day obstetric practice. Clinical formula can be of great help in developing countries like India where ultrasound is not widely available in many of health care facilities in rural areas. But in set up where ultrasound facilities are available combining the different methods will give us a more accurate fetal weight which will guide us in managing labour.

## INTRODUCTION

Accurate prenatal estimation of fetal weight in pregnancy and labor is extremely useful in the management of labor and is an important indicator of pregnancy outcome. It permits obstetricians to make decisions about instrumental vaginal delivery, trial of labor after caesarian section and elective caesarian section for patients suspected of having a macrosomic fetus.<sup>[1]</sup> Both low birth weight and excessive birth weight at delivery is associated with increased risk of newborn complications during

labor and postnatal period.<sup>[2]</sup> Different methods of estimating fetal weight have been used and broadly divided as clinical methods and ultrasound method. Various clinical formulas like Johnson formula and Insler's formula are commonly used. Several formulas have been developed by ultrasound for estimating fetal weight also like Hadlock's and Sephard's formula. The ultrasound estimation is based on measurement of various fetal dimensions like BPD, HC, AC and FL. A modern method of for assessing fetal weight involves use of fetal measurement by ultrasound. Obstetric ultrasound

assessment for the purpose of obtaining fetal biometric measurement to predict fetal weight has been integrated into the main stream of obstetric practice during past quarter century.<sup>[3]</sup> Increasing attention is being paid to the accuracy of using various ultrasound measurements in estimating fetal weight. Ultrasound estimation of fetal weight, while being accurate to a degree is associated with error ranging from  $\pm 6$  to 11 depending on parameters measured and equation used for estimation.<sup>[4]</sup> Current study is aiming at evaluating the accuracy of different methods of fetal weight estimation at term pregnancy.

Hence this study was conducted To assess the fetal weight by four formulae e.g Johnson's formula, Insler's formula measured clinically while Hadlock's formula and Sephard's formula measured by ultrasound and comparison of that with actual birth weight of newborn following delivery.

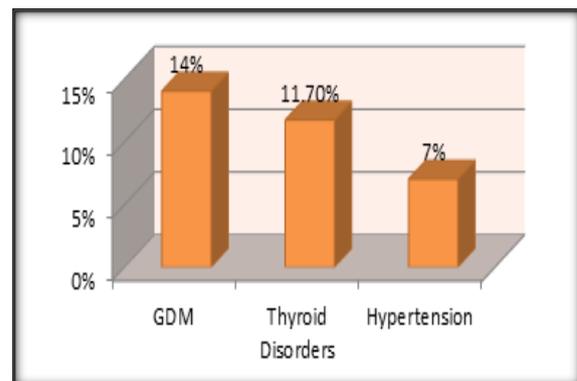
## MATERIALS AND METHODS

This is a hospital based prospective observational study which is conducted in MKCG Medical College, Berhampur, Odisha from May 2020 to 2022. Total 2000 cases were studied. Sample size (n) was calculated by formula  $n = [z^2 p (1-p)]/d^2$  where z: standard normal variate =1.96, p: power=75% and d: absolute error or precision =2% i.e  $n = [1.96 \times 1.96 \times 7.5 (0.25)]/0.02 \times 0.02 = 1800.75$  which was rounded to 2000. The cases were selected in respect to inclusion and exclusion criteria as follows; inclusion criteria (a) cases in which delivery anticipated in one week (b) cases with singleton term pregnancy (c) Ultrasound showing effective fetal weight (EFW) within one week before delivery (d) cases admitted for planned delivery/booked (e) cases with cephalic presentation and intact membrane. Cases who do not deliver within a week of fetal weight estimation were excluded from current study. After selection of cases, fetal weight was estimated by clinical and ultrasound method by using the following formulas e.g Johnson's formula: Fetal weight (gms) = [SFH (cm) X 12 X 155] if PP at minus station, [SFH (cm) X 11 X 155] if PP at plus station. (SFH: Symphysio fundal height and PP: presenting part). Insler's formula: Fetal weight (gms) = Abdominal Girth (AG) (cms) X SFH (cms). Hadlock's formula: EFW (gms) =  $10 \cdot 1.326 + 0.0107 \cdot HC + 0.03438 \cdot AC + 0.0158 \cdot AC \cdot X \cdot FL$ . Sephard's formula: EFW (gms) =  $10 \cdot 1.3598 + 0.051(AC) + 0.1844(FL) - 0.0037(AC \cdot X \cdot FL)$ . Appropriate statistical software of MS Excel SPSS version 2.0 was used for tabulation. Both the clinical and ultrasound fetal weight are compared with the actual birth weight after delivery. The chi square statistics was used for testing relationship on categorical variable. Association was tested by 'p' value (<0.05 as significant). Student 't' test was used to compare the means of a normally distributed

interval dependent variable for two independent groups.

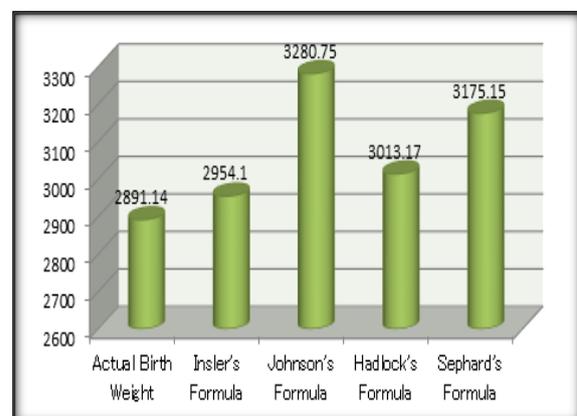
## RESULTS

Among 2000 cases, 1450 cases (72.5%) had BMI within normal range followed by 400 cases (20%) of overweight and 150 cases (7.5%) of obese. The mean BMI was  $23.93 \pm 2.88$  kg/m<sup>2</sup>. Out of all cases, 280 cases (14%) had Gestational diabetes mellitus (GDM) followed by 235 cases (11.7%) of thyroid disorder and 140 cases (7%) of hypertension as associated disorder with pregnancy (Figure-1).



**Figure 1: Associated Medical Disorders during pregnancy at term for study groups**

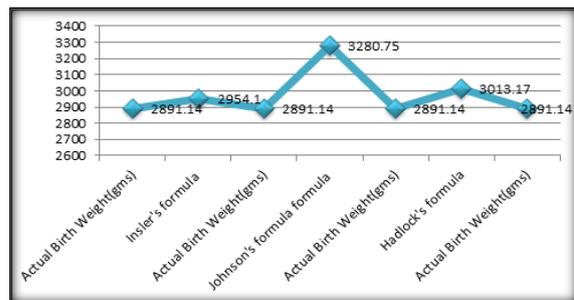
Among all cases, 882 cases (44.1%) were of primigravida and 1118 cases (55.9%) were of multigravida. The mean actual birth weight of newborns was  $2891.14 \pm 579.13$  gms while the mean birth weight by Insler's formula, Johnson's formula, Hadlock's formula and Sephard's formula was  $2954.1 \pm 533.80$ gms,  $3280.75 \pm 501.73$  gms,  $3013.17 \pm 622.73$ gms and  $3175.15 \pm 501.63$  gms respectively (Figure-II).



**Figure 2: Mean birth weight by different formulas**

The mean birth weight by Insler's formula was comparable to the mean actual birth weight of babies ( $2954.1 \pm 533.80$  gms vs  $2891.14 \pm 579.13$  gms) ( $p > 0.05$ ). The mean birth weight by Johnson's formula was significantly more compared to the

mean actual birth weight of babies ( $3280.75 \pm 501.73$ gms vs  $2891.14 \pm 579.13$  gms)(Figure-III). The difference was statistically significant as per Student 't' test ( $p < 0.05$ ). The mean birth weight by Hadlock's formula ( $3013.17 \pm 622.73$  gms) was significantly more as compared to mean actual birth weight of newborns (Table-I). The difference was statistically significant as per Student 't' test( $p < 0.05$ ).The mean birth weight by Sephard's formula was significantly more as compared to mean actual birth weight of babies ( $3175.15 \pm 501.63$ gms vs  $2891.14 \pm 579.13$ gms). The difference was statistically significant ( $p < 0.05$ ) (Figure-III).



**Figure 3: Comparison of Different formulas with actual birth weight of newborn**

The mean error by Insler's formula and Johnson's formula was  $6.51 \pm 2.48\%$  and  $18.42 \pm 3.13\%$  respectively while the mean error by Hadlock's and Sephard's formula was  $8.76 \pm 3.24\%$  and  $14.65 \pm 3.06\%$  respectively and there is significant difference between these two groups as per Student's 't' test ( $p < 0.05$ ) (Table-I).

**Table 1: Percentage of Error in Different formulas**

% Error	Insler's formula		Johnson's formula		Hadlock's formula		Sephard's formula		'p' value
	n	%	n	%	n	%	n	%	
<10%	524	26.2	599	29.9	549	27.4	563	28.2	< 0.05
10-20%	514	25.6	433	21.6	434	21.7	426	21.3	
>20%	964	48.2	968	48.5	1017	50.9	1011	50.5	
Total	2000	100	2000	100	2000	100	2000	100	
Mean SD	6.51±2.48		18.42±3.13		8.76±3.24		14.65±3.08		

Overestimation of fetal weight is more by Johnson's formula (68.60%) and Sephard's formula (63.30%) as compared to Insler's formula (53.30%) and Hadlock's formula (55.90%) while underestimation of fetal weight is more by Insler's formula (46.70%) followed by Johnson's formula (31.40%), Sephard's formula (36.70%) and Hadlock's formula (44.10%). There was significant difference between clinical estimation and ultrasound estimation ( $p < 0.05$ ) (Table-II).

**Table 2: Overestimation and Underestimation by different formulas**

Method	Over estimation of Fetal Weight		Under estimation of Fetal Weight		'p' value
	Number(=n)	Percentage (%)	Number(=n)	Percentage (%)	
Insler's Formula	1065	53.30%	935	46.70%	< 0.05
Johnson's Formula	1371	68.60%	629	31.40%	
Hadlock's Formula	1118	55.90%	882	44.10%	
Sephard's Formula	1266	63.30%	734	36.70%	

## DISCUSSION

Birth weight is the principal variable affecting fetal and neonatal morbidity, especially in preterm and small for date fetuses. Both fetal macrosomia and fetal growth restriction increase the risk of prenatal morbidity and long term neurological disorders. Identification of FGR after 37 weeks is an indication for delivery to reduce the chance of fetal morbidity and mortality. Similarly diagnosis of fetal macrosomia leads to caesarian section frequently which reduces failed vaginal delivery and shoulder dystocia. Current study shows, 72.5% of cases had BMI in normal range followed by 20% cases of overweight and 7.5% cases of obese women. The mean BMI was  $23.93\% \pm 2.88$  kg/m<sup>2</sup> which is similar to Raghuvanshi et al.<sup>[5]</sup> Out of all cases, 14% cases had GDM while 11.7% cases had thyroid disorder and 7% cases had hypertension as

associated disorder. Among all, 44.1% cases were primigravida while 55.9% cases were multigravida comparable to Nayak L et al having 40.5% cases of primigravida and 59.5% cases of multigravida.<sup>[6]</sup> Among all cases, 60.5% cases underwent vaginal delivery whereas 39.5% cases undergone caesarian section in current study. The mean of actual birth weight of newborn was  $2891.14 \pm 579.13$  gms while the mean birth weight by Insler's formula, Johnson's formula, Hadlock's formula and Sephard's formula was  $2954.10 \pm 533.80$  gms,  $3280.75 \pm 501.73$  grms,  $3013.17 \pm 622.73$  gms and  $3175.15 \pm 501.63$  gms respectively which is concurrent to Eze Cl et al who found the actual birth weight had mean of  $3332 \pm 513$  gm.<sup>[7]</sup> The mean birth weight by Insler's formula was comparable to mean actual birth weight of newborn [ $(2954.10 \pm 533.80)$  gms vs  $2891.14 \pm 579.13$  gms)] ( $p > 0.05$ ) which is similar to Dare et al who observed that Insler's

formula fairly correlates with actual birth weight.<sup>[8]</sup> The Insler's formula being more accurate followed by Hadlock's formula. They also observed that clinical estimation by Insler's formula and ultrasound method (Hadlock's & Sephard's method) are equally good for estimation of birth weight within 10 % as 6.35% and 8.1% errors respectively. The mean birth weight by Johnson's formula was significantly more compared to mean actual birth weight of newborn [(3280.75 ± 501.73 gms vs 2891 ± 579.13 gms)] which is statistically significant (p < 0.05) and this is concordance to Raghuvanshi et al who observed actual birth weight of 2593 ± 427.00 gms while estimated fetal weight by Johnson's method as 2893 ± 503.2 gms.<sup>[5]</sup> The mean birth weight by Hadlock's formula was significantly more compared to mean actual birth weight of newborn [(3013.17 ± 622.73 gms vs 2891.14 ± 579.13 gms)] and the difference was significant (p < 0.05). Present study shows that mean birth weight by Sephard's formula was significantly more compared to mean actual birth weight of patients [(3175.15 ± 501.63 gms vs 2891.14 ± 579.13 gms)]. The difference was statistically significant as per Student's t test (p < 0.05). The mean percentage of error by Insler's and Johnson's formula was 6.51 ± 2.48% and 18.42 ± 3.13% respectively while the mean percentage of error by Hadlock's and Sephard's formula was 8.76 ± 3.24% and 14.65 ± 3.08% respectively and the difference between two groups i.e clinical and ultrasound is significant (p < 0.05). These findings were consistent with studies by Tiwari R et al<sup>[9]</sup> Similar observations were also seen in Raghuvanshi et al having maximum percentage of error in Johnson's formula. Njoku C et al showed by comparing accuracy of clinical and ultrasound method for estimating fetal weight at term and found mean absolute percentage of error of both clinical and ultrasound methods were 11.16% ± 9.48 and 9.03% ± 7.61 respectively and the difference was not significant which is not concurring to current study.<sup>[10]</sup> Bhandary Amrita et al studied average error in estimation fetal weight by different formul and found that Insler's formula has average error of 224.3gms which is least when compared to Hadlock's formula (299.1 gm).<sup>[11]</sup> Tiwari et al observed that Johnson formula was with average error of 224.8 gms.<sup>[8]</sup> Nayak et al found that least variation was found in Insler's formula (±348.52gm) followed by Hadlock's method (391.33 gm) and highest variation in Johnson's method (±422.48gm) which is similar to present study. Siddique et al showed that least variation in Insler's formula (±379.65gm) followed by Hadlock's formula (±389.33gm) and highest variation in Johnson's formula (±430.04gm).<sup>[12]</sup> Current study shows overestimation of fetal weight is more by Johnson's formula (68.6%) and Sephard's formula (63.3%) as compared to Insler's (53.3%) and Hadlock's formula (55.9%). But underestimation of fetal weight is more by Insler's formula (46.7%) and Hadlock's formula (44.1%) as

compared to Sephard's formula (36.7%) and Johnson's formula (31.4%). There was significant difference between these groups (p < 0.05). Similar observations were noted by Shittu AS et al and Dare FO et al.<sup>[13,14]</sup> They found that clinical method of estimation of fetal weight is as accurate as routine ultrasonic estimation except in low birth weight babies. Current study shows significant relationship between actual and estimated fetal weight for all the method as per Pearson's correlation coefficient (p < 0.05) (Table-I). This is similar to Raman S et al and Chouhan S et al.<sup>[15,16]</sup> Hendrix N et al showed that clinical estimation was significantly more accurate than ultrasound prediction.<sup>[17]</sup> Similarly Titapant V et al observed that ultrasound estimation was more accurate only when there is low birth weight.<sup>[18]</sup> Prajapati D et al found that Hadlock's formula was the best indicator among all methods for assessing fetal weight at term concurring to current study.<sup>[19]</sup>

## CONCLUSION

There is a significant difference between clinical estimation and ultrasound estimation of fetal weight in current study although clinical method of estimation of fetal weight is as accurate as routine ultrasound in day to day obstetric practice. Overestimation of fetal weight is more by Johnson's formula and Sephard's formula whereas underestimation is more by Insler's formula. Also is significant relationship between actual and estimated birth weight for all the methods. Clinical formula can be of great help in developing countries like India where ultrasound is not widely available in many of health care facilities in rural areas. But in set up where ultrasound facilities are available combining the different methods will give us a more accurate fetal weight which will guide us in managing labour.

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