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Antenatal fetal weight assessment by clinical and radiological method and to compare with actual fetal weight at birth in term patients

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ABSTRACT

Background- We conducted this study to estimate the fetal weight by clinical examination and Sonography and to compare the finding of Sonography and clinical examination with the actual weight.

Methodology- This study was conducted as an observational study on pregnant female at term gestation presenting in labour, attending Department of obstetrics and gynaecology, People's Hospital Bhopal, during the study period of Nov 2022 to May 2023. Fetal weight was assessed by clinical method (Leopold's maneuvers &Insler and Bernstein's formula) and ultrasound (Hadlock's formula) and was compared with actual weight.

Results- We documented near perfect correlation of weight through clinical assessment with actual weight ($p<0.05$) and substantial agreement between USG and actual birth weight ($k=0.78$; $p<0.05$). We observed very high positive significant corelation of weight assessment through clinical method with actual birth weight ($r=0.901$; $p<0.05$) whereas USG weight showed high positive corelation with that of actual birth weight ($r=0.859$; $p<0.05$).

Conclusions- Clinical methods of fetal weight estimation can be used as diagnostic tool to determine weight and managing the clinical situation and deciding the mode of delivery. When USG is available, further sonographic estimation may be mandated. However, in peripheral areas, where USG is not available, clinical methods can be relied on for deciding the further management. Moreover, the cost of USG must also be kept in mind as sonographic assessment may lead to financial burden on the patients.

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Keywords- ultrasound, Hadlock’s formula, fetal weight, accuracy, clinical methods,

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INTRODUCTION

Assessment of fetal weight during antenatal period is an essential component of antenatal care as fetal weight is an important determinant of outcome of pregnancy as well as well being of infant during first year of life.[1] Antenatal estimation of fetal weight is helpful in predicting not only intrauterine growth retardation but risk of preterm delivery also.[2] Since maternal and perinatal complications and risk have been associated with abnormal growth of the fetus, accurate assessment of fetal weight is essential.[3]

Both the extremes of birth weight, i.e. low birth weight and excessive birth weight have been associated with maternal and perinatal complications. Some researchers have hypothesized that accurate fetal weight prediction helps the obstetricians manage labor more effectively and reduce the risk of complications that are typically linked to microsomia, which lowers morbidity and mortality rates for both mothers and newborns.[4]

There are two main methods for assessing the fetal weight during antenatal period, namely, clinical methods and imaging method. Clinical methods are based upon palpation of fetal parts per abdominally (Leopold's maneuver) and assessment of fundal height and abdominal circumference of mother such as Johnson's method and Insler & Bernstein's formula whereas imaging methods include ultrasonography and magnetic resonance imaging.[3,5,6]

Ultrasound is a preferred method for estimating fetal weight due to its availability, objectivity, reliability and precision.[2] The advantage of sonographic assessment include its reliability on measurement of linear or planar fetal dimensions, which can be defined objectively.[5] Sonography predictions for fetal weight are based upon measurement of biometric parameters such as femur length (FL), head circumference (HC), abdominal circumference (AC) and biparietal diameter (BPD). One of the most common formula used for estimating fetal weight is Hadlock's formula, which take three biometric parameters into consideration viz. FL, AC and HC. However, ultrasound-derived fetal weight estimations exhibit measurement

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discrepancies of up to ± 6-11 percent at or near term, regardless of the regression equation applied.[7,8]

Though the sonographic measurement is reliable method for estimating fetal weight, many researchers have suggested this method as laborious and affected by certain maternal characteristics such as maternal weight, age, location of placenta, race and oligohydramnios.[9,10] Literature comparing the accuracy of estimated fetal weight using sonography with actual birth weight is ample in developed countries, however due to racial variations, the data of developed nations could not be used for our country.[11,12] With the above background, the present study was conducted at tertiary care centre to estimate the fetal weight by clinical examination and Sonography and to compare the finding of Sonography and clinical examination with the actual weight.

MATERIALS AND METHODS

The present study was conducted as an observational cross sectional study on all the pregnant female at term gestation presenting in labour, attending Department of obstetrics and gynaecology, People's College of Medical Sciences & research Centre and associated People's Hospital Bhopal, during the study period of 18 months i.e. from Nov 2022 to May 2023. All pregnant female with labour pain attending the study area were included whereas Pregnant women with twin pregnancy and patients not willing to participate were excluded from the study.

After obtaining ethical clearance from institute's ethical committee, all the patients fulfilling the inclusion criteria were enrolled ad written consent was obtained from all of them. Their sociodemographic data was obtained and entered in proforma. History regarding their period of gestation along with detailed obstetric history was noted along with LMP. All the patients were then subjected to detailed clinical examination. Per Abdomen examination was done and uterine height was noted and comprehended in terms of period of gestation in weeks. The lie

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and presentation of fetus was assessed and Symphysio fundal height was calculated along with abdominal circumference. Amount of liquor was assessed and findings were noted in proforma.

Fetal weight by clinical method-

Leopold's maneuvers - estimated by abdominal palpation of fetal body parts. Symphysis-fundal height (SFH) measurement was done from the mid-point of the upper border of the maternal pubic symphysis to the highest point on the uterine fundus. Maternal abdominal circumference was measured at the level of the umbilicus. Measurements were taken using a flexible tape calibrated in cm.

Fetal weight was calculated using Insler and Bernstein's formula:

fetal weight (g) = SFH (cm) × AC (cm).

Further, ultrasound examination of all the study participants was done for growth monitoring.

Fetal weight estimation by ultrasound

After obtaining informed consent from the participants, patients were subjected to ultrasonography ultrasound machine. For assessing fetal weight, following parameters were assessed

a. Biparietal diameter

b. Head circumference

c. Femoral length

d. Abdominal circumference

These measurements were entered into the database (Viewpoint database) to calculate fetal weight using Hadlock's formula.

Weight of neonate at birth was recorded.

Statistical analysis :-

Data was compiled using MsExcel and analysis was done with the help of IBM SPSS software version 20. Categorical data was expressed as frequency and percentage whereas continuous

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data was expressed as mean and standard deviation. Comparison of difference in actual weight and estimated fetal weight by clinical and USG method was done using chi square test for categorical variables and t test for continuous variables. Kappa coefficient was assessed for assessing level of agreement between the methods of weight assessment. Correlation of weight assessment using clinical method and USG method with actual weight was done using Pearson correlation coefficient. P value of less than 0.05 was considered statistically significant.

RESULTS

This study was conducted on a total of 350 obstetric patients seeking care at our hospital.

Table 1- Distribution of subjects according to baseline variables

Baseline variables		Frequency (n=350)	Percentage
Age (years)	≤20	23	6.6
	21-30	281	80.3
	31-40	46	13.1
Education	Upto middle school	67	19.1
	Upto high school	87	24.9
	Intermediate or diploma	169	48.3
	Graduate	27	7.7
Occupation	Housewife	281	80.3
	Private job	38	10.9
	Teacher	31	8.9
Booking status	Booked	291	83.1
	Unbooked	59	16.9

Mean age of obstetric patients enrolled in our study was 26.49±4.215 years and majority i.e.80.3% of the cases belonged to 21 to 30 years of age. majority i.e. 48.3% of the cases were educated up to intermediate or diploma levels and 281 (80.3%) were housewives whereas

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10.9% were employed in private job and 8.9% were teachers. All the patients belonged to lower middle socioeconomic class. 83.1% cases were booked whereas 16.9% of the cases were unbooked (Table 1).

Table 2- Comparison of actual weight with weight through clinical method

Weight (kg)	Actual weight		Weight through clinical method		Weight through USG method	
	n	%	n	%	n	%
<2 kg	1	0.3	0	0	0	0
2-2.5 kg	45	12.9	41	11.7	32	9.1
2.6-2.9 kg	126	36.0	147	42.0	119	34.0
3-3.5 kg	139	39.7	125	35.7	153	43.7
>3.5 kg	39	11.1	37	10.6	46	13.1
Mean	2.99±0.403		2.91±0.39		3.11±0.375	

Actual weight was in the range of 3 to 3.5 kg in majority of the cases (39.7%) whereas majority of cases had weight in the range of 2.6 to 2.9 kg through clinical assessment (42.0%) and in the range of 3 to 3.5 kg (43.7%) through USG assessment. Mean actual weight was 2.99±0.403 kg whereas weight assessed with the clinical method and USG method was 2.91±0.39 kg and 3.11±0.375 kg with mean difference of 0.087 and 0.11 kg respectively. The observed difference in the weight assessment using clinical methods and USG method with actual weight was statistically insignificant ($p>0.05$) (Table 2).

Table 3- Association of actual weight with weight through clinical assessment

Weight	Actual weight	Correct estimation			
		Clinical assessment method		USG method	
	n	n	%	n	%

ISSN: 0975-3583,0976-2833 VOL16, ISSUE 1, 2025

<2 kg	1	0	0	0	0
2-2.5 kg	45	40	88.9	31	68.9
2.6-2.9 kg	126	116	92.1	102	81
3-3.5 kg	139	113	81.3	129	92.8
>3.5 kg	39	37	94.9	36	92.3
k		0.82		0.78	
P value		**0.001**		**0.001**	

Out of 45 cases with birth weight of 2 to 2.5 kg, clinical method correctly estimated weight in 88.9% cases. Similarly, clinical methods correctly estimated weight in 92.1% neonates with actual weight of 2.6 to 2.9 kg, 81.3% in neonates of 3 to 3.5 kg and 94.9% cases with actual weight of more than 3.5 kg. We documented near perfect correlation of weight through clinical assessment with actual weight ($p<0.05$). Estimated fetal weight through USG correlated with actual weight in 68.9% cases with birth weight of 2 to 2.5 kg, 81% cases with birth weight of 2.6 to 2.9 kg, 92.8% neonates with birth weight of 3 to 3.5 kg and 92.3% cases with birth weight of more than 3.5 kg. We observed substantial agreement between USG and actual birth weight ($k=0.78$; $p<0.05$) (Table 3).

Table 4- Correlation of actual weight with Weight through clinical and USG assessment

Actual weight with	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig.
Weight through clinical assessment	0.901	0.811	0.810	0.174	**0.0001**
Weight through USG assessment	0.859	0.737	0.736	0.192	**0.0001**

ISSN: 0975-3583,0976-2833 VOL16, ISSUE 1, 2025

We observed very high positive significant corelation of weight assessment through clinical method with actual birth weight (r=0.901; p<0.05) whereas USG weight showed high positive corelation with that of actual birth weight (r=0.859; p<0.05) (Table 4, figure 1 and 2).

Figure 1- Correlation of actual weight with Weight through clinical assessment

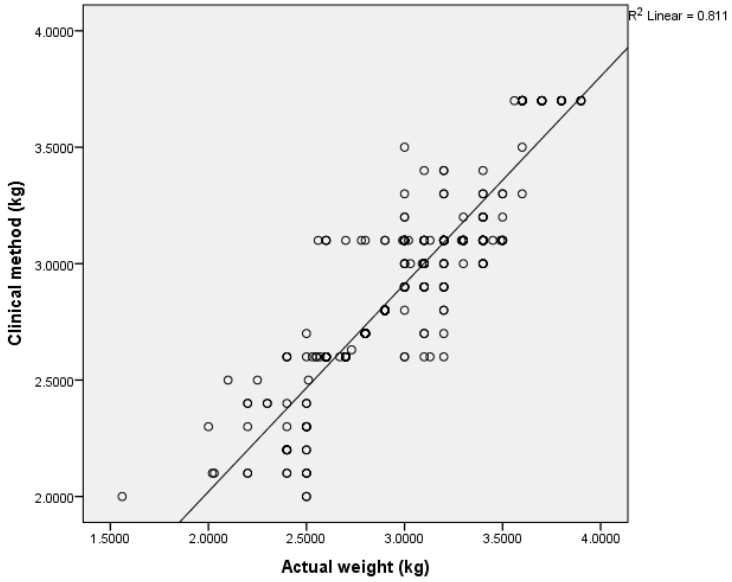
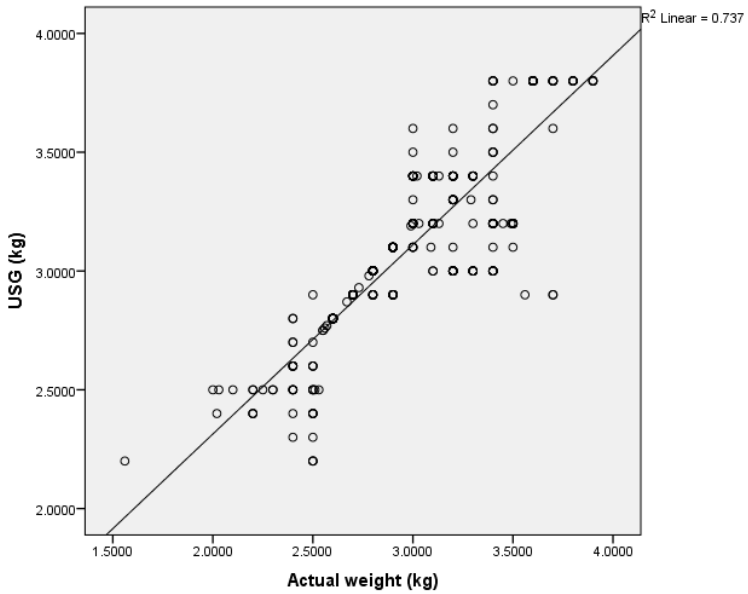


Table 2- Correlation of actual weight with Weight through USG assessment



DISCUSSIONS

ISSN: 0975-3583,0976-2833 VOL16, ISSUE 1, 2025

The weight of neonate at birth is an important predictor of fetomaternal morbidityDuring the routine antenatal checkup, fetal weight can be estimated using clinical assessment (by Leopold's maneuver or by Insler & Bernstein's formula) or by assessing fetal biometric parameters using ultrasound (Hadlock's formula).[3,5,6] However, ultrasound examination may not always be possible, especially in periphery and thus the decision of mode of delivery may be based upon clinical assessment. The present study was conducted on a total of 350 obstetric patients seeking care at our hospital to estimate the fetal weight by clinical examination and Sonography and to compare the finding of Sonography and clinical examination with the actual weight. In our study, mean actual birth weight of neonates was 2.99±0.403 kg whereas using clinical assessment, estimated fetal weight was 2.91±0.39 kg. We found clinical assessment to be as accurate as birth weight in 306 (87.43%) cases overall. Based upon stratification of neonates in various weight bands, highest correlation was noted for neonates of more than 3.5 kg (94.9%), followed by neonates belonging to 2,6 to 2.9 kg (92.1%). One neonate with actual weight of less than 2 kg could not be identified by clinical assessment, rather we overestimated weight in this neonate. Overall, clinical assessment underestimated the weight of neonate as compared to actual weight in majority of neonates with incorrect estimations. Based upon kappa statistics, level of agreement between clinical method and actual birth weight was 0.82, suggesting a near perfect agreement between actual weight and weight estimated through clinical assessment ($p<0.05$). We found a very high positive correlation of weight estimated by clinical assessment with that of actual weight ($r=0.901$; $p<0.05$).

Pavithra et al used Dare's formula for assessment of fetal weight by clinical methods and documented mean weight of 3.06 kg as compared to 3.02 kg actual birth weight suggesting estimated fetal weight y clinical methods to be higher as compared to actual weight, with mean error of -2.09% and mean error of -60 gm. Actual birth weight was in normal range in 71% neonates (2.5 to 4 kg), whereas according to clinical assessment, 89% neonates had normal

ISSN: 0975-3583,0976-2833 VOL16, ISSUE 1, 2025

weight. The authors reported that clinical method overestimated fetal weight. The authors also documented a good correlation of estimated fetal weight by clinical method with that of actual birth weight.[13] The actual birth weight of neonates in a study of Durgaprasad et al was 2.9 kg, whereas the estimated birth weight using Johnson's formula and Symphysio-fundal height * AG were 3.296 and 2.96 respectively. The authors observed weak positive correlation of clinical method with actual birth weight suggesting clinical methods to be less accurate.[14]

In a study of Ingale et al, the mean actual birth weight was 2.83±0.497 kg and 70% neonates had birth weight in the range of 2.5 to 4 kg whereas 25% had low birth weight and 5% were macrosomic neonates. The mean estimated weight by clinical methods was 2.92±0.39 kg and estimated fetal weight was in the range of low and normal weight in 13% and 87% cases respectively. The corelation between the weight assessment using clinical method and actual weight was strong ($r=0.87$; $p<0.05$).[15] Azeez et al documented mean birth weight of 3136±478 gram and 86.1% neonates had normal birth weight (2500–3999 g). The authors found that the clinical method overestimated the birth weight by 241 gm and 46.7% of the birth weight were within 10% of the actual birth weight.[16]

In our study, mean birth weight of neonate was 2.99±0.403 kg and mean estimated fetal weight by USG was 3.11±0.375 kg. Overall, we observed USG weight to be as accurate as birth weight in 298 (85.1%) cases and higher the weight higher was the correlation of estimated weight by USG with that of actual weight with more than 90% correlation in neonates weighing above 3kg, 81% correlation in neonates with birth weight of 2.6 to 2.9 kg and 68.9% correlation in neonates weighing 2 to 2.5 kg. We observed that USG overestimated the weight of neonate. We documented a high positive and statistically significant correlation of estimated weight through USG with of actual birth weight ($r=0.859$; $p<0.05$). Similarly, in a study of Pavithra et al, the mean estimated fetal weight estimated by USG was 2.92 kg, as compared to 3.02 kg (actual birth weight) and the mean error and mean difference was 3.06% and -110 g

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respectively. Actual birth weight was in the range of 2.5 to 4 kg in 71% cases whereas USG estimated normal birth weight in 75% cases and the author reported USG fetal assessment to be slightly higher as compared to actual weight. A good correlation of USG weight with actual birth weight was reported by authors.[13] On the other hand, in a study of Durgaprasad et al, the mean birth weight was 2.9 kg whereas based upon Hadlock's formula in USG, estimated fetal weight was 3.003 kg, with mean difference of 0.1 kg. The authors documented high positive corelation of estimated fetal weight by USG with that of actual birth weight ($r=0.701$; $p<0.05$).[14] In a study of Ingale et al, mean actual birth weight was 2.83±0.497 kg whereas that by USG was 3.2±0.49 kg, the authors observed a strong correlation of weight assessment using USG with actual weight was strong ($r=0.76$; $p<0.05$).[15] Azeez et al documented underestimation of birth weight using USG method for weight estimation by 50 g.[16]

In our study, mean difference of estimated fetal weight using clinical assessment and USG method from that of actual weight was 0.087 and 0.11, with overall correlation of clinical assessment and USG with actual birth weight was 87.43 and 85.1% respectively. Clinical method showed better correlation with actual weight ($r=0.901$- very high positive) as compared to ultrasonography ($r=0.859$ high positive). Our study findings were supported by the findings of Pavithra et al, in which though both USG as well as clinical method of fetal weight estimation had good correlation with actual weight, the mean difference was less with clinical method as compared to USG (-60 vs -110 gm).[13] Our study findings were also consistent with the findings of Ingale et al in which the authors found slightly better correlation of clinical method with actual weight as compared to USG ($r=0.87$ vs. 0.76).[15]

Durgaprasad et al reported weight estimation by USG to be more reliable as compared to clinical methods of fetal weight estimation. USG correlated well with actual birth weight ($r=0.701$) whereas clinical methods showed weak positive correlation with birth weight and mean difference from actual birth weight was also higher in clinical methods.[14] Azeez et al

ISSN: 0975-3583,0976-2833 VOL16, ISSUE 1, 2025

reported that clinical methods overestimated the weight whereas USG underestimated the weight and the mean absolute percentage error using clinical and USG method were 11.06% and 8.85% respectively.[16] Shittu et al observed clinical method to be slightly better as compared to USG in estimation of fetal weight, except in neonates with low birth weight, where clinical examination was found to be of low utility.[5]

Njoku et al reported accuracy of clinical method in estimation of fetal weight to be comparable to that of ultrasound.[17] Ratwani et al documented clinical methods for estimating fetal weight too be simple and reliable and comparable with USG.[18] Prajapati et al found ultrasound to be best method for predicting fetal weight as compared to clinical methods but the Dare's formula is inexpensive and can be utilized when USG is not available [19] Ramesh et al observed Hadlock formula to be better than clinical methods in estimation of fetal weight with sensitivity of 96.55% whereas that of Johnson's formula and Insler's formula was 79.31% and 65.52% respectively.[20]

Our study had certain limitations, first, the ultrasound examination was performed by multiple observers and as the ultrasound examination is observed dependent, inter observer variations may be present, which were not addressed in our study. As the proportions of low birth weight and macrosomic neonates was less, the diagnostic values of both the methods could not be assessed. All the cases belonged to lower middle socioeconomic class and thus, the sample was not representative of general population.

CONCLUSIONS

Both clinical methods and Ultrasonography helps in estimating fetal with good accuracy, clinical methods of fetal weight estimation can be used as diagnostic tool to determine weight and managing the clinical situation and deciding the mode of delivery. When USG is available, further sonographic estimation may be mandated. However, in peripheral areas, where USG is not available, clinical methods can be relied on for deciding the further management.

ISSN: 0975-3583,0976-2833 VOL16, ISSUE 1, 2025

Moreover, the cost of USG must also be kept in mind as sonographic assessment may lead to financial burden on the patients.

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