Egyptian Journal of Hospital Medicine (October 2020) Vol. 81 (7), Page 2468-2475

Clinical and Ultrasound Estimation of Fetal Weight at Term and Its accuracy with Birth Weight

Magdi Ragab El-Sayed, Badeea Seliem Soliman, Mohamed Mustafa Zaitoun, Rehab Jamal Mohammed El Shorbaji*

Department of Obstetrics and Gynecology, Faculty of Medicine, Zagazig University, Egypt.

***Corresponding author**: Rehab Jamal Mohammed El Shorbaji, **Mobile**: +20 01204547416,

E-mail:dr.rehabjamal89@gmail.com

ABSTRACT

Background: Accurate estimation of fetal weight is of paramount importance in the management of labor and delivery. **Objective:** To evaluate fetal weight by clinical and ultrasound methods and its correlation to actual birth weight. **Patients and Methods:** This comparative cross sectional study was conducted at maternity hospital Zagazig University Hospitals and Zagazig General Hospital, in the period from September 2018 to March 2019. 84 women with singleton pregnancy, full term, no medical disorders with pregnancy were selected from Antenatal Clinics and Maternity Wards. They were prepared for elective caesarean section within 24 hours. Full history was taken then general and abdominal examination was done, followed by obstetric palpation (Leopold's manoeuver) to evaluate fundal level, fundal and umbilical grip and first pelvic grip by the right hand to grasp the presenting part (head). Local examination was done to evaluate cervical dilatation if present, degree of descent of the fetal head into pelvis and the fetal station.

Results: The Hadlocks formula is more accurate than Johnson's formula. The sensitivity of ultrasound was 82.0% higher than clinical (76.7%).

Conclusions: Antenatal fetal weight can be estimated with reasonable accuracy, by ultrasounography using Hadlocks formula and clinically using Johnson's formula.

Keywords: Foetal Birth-Weight, Pregnancy, Ultrasonography.

INTRODUCTION

Birth weight is a single most important factor that determines the neonatal outcome and survival **[(1)]**. Fetal and Neonatal life are affected by many factors including genetic, socio economic and environmental factor **[(2)]**. Both low birth weight and excessive fetal weight at time of delivery are associated with increased risk of newborn complications during labor and the puerperium **[(3)]**.

The perinatal complications associated with low birth weight are attributed to either preterm delivery or intrauterine growth restriction (IUGR). For excessively large fetuses, the potential complications associated with delivery include shoulder dystocia, brachial plexus injuries, intrapartum asphyxia, hypoglycemia, electrolyte imbalance and neonatal jaundice **[(4)]**.

In preterm deliveries and intrauterine growth restriction, perinatal counseling on the likelihood of survival, the intervention taken to postpone delivery, optimal route of delivery or the level of hospital where delivery should occur is completely based on the estimated fetal weight **[(5)]**.

It has been suggested that accurate estimation of fetal weight would help in successful management of labor and care of the newborn in the neonatal period and help in avoidance of complications associated with fetal macrosomia, thereby decreasing perinatal morbidity and mortality **[(6)]**. Two main methods for predicting birth-weight in current obstetrics were used: (a) Clinical techniques based on abdominal palpation of fetal parts and calculations based on fundal height and (b) Sonographic measures of skeletal fetal parts, which are then inserted into regression equations to derive estimated fetal weight **[(7)]**. Evaluation of uterine size externally with use of a physician's hands is characterized by being simple, easy and cheap. In addition, it is characterized by being standard clinical method as an alternative to ultrasonography (USG), which is expensive and not always easy to access, especially in countries with limited financial resources for health. However, the clinical method has many drawbacks such as it is the oldest method and there have been doubts about its use because it is not objective **[(8)]**. The aim of this study was to evaluate fetal weight by clinical and ultrasound methods and its correlation to actual birth weight.

PATIENTS AND METHODS

A cross-sectional study was carried out at Maternity Hospital, Zagazig University Hospitals and Zagazig General Hospital, in the period from September 2018 to march 2019. The study included 84 pregnant women, 40 of them were delivered in Maternity Hospital, Zagazig University Hospitals and 44 were delivered in Zagazig General Hospital. All were delivered by elective caesarean section. The mean maternal age was 28.2 years, with minimum age being 20 years and maximum being 37 years. The mean gestational age was 38.1, with a minimum gestational age being 37 weeks and maximum being 42 weeks.

Inclusion criteria: Full term 37-42 weeks of gestation, singleton pregnancy, cephalic presentation and women with reliable date.

Received:26 /6 /2020
Accepted:24 /8 /2020

Exclusion criteria: Congenital fetal anomalies, oligohydramnios, polyhydramnios, intrauterine gross restriction (IUGR), rupture membranes, medical disorders with pregnancy (diabetes, heart disease, and pregnancy-induced hypertension).

Ethical approval: Written informed consent was obtained from all participants. **The study was approved by the Research Ethical committee, Faculty of Medicine, Zagazig University.** The work was carried out for studies involving humans in accordance with the World Medical Association's Code of Ethics (Helsinki Declaration).

Gestational age was calculated according to Negle's rule (a standard way of calculating the due date for a pregnancy when assuming a gestational age of 280 days at childbirth). The rule estimates the expected date of delivery (EDD) by adding a year, subtracting three months, and adding seven days to the origin of gestational age.

All patients fulfilled the study inclusion criteria were registered on the monitoring chart including their name, age, height, weight, gravidity, parity and duration of pregnancy. Then clinical examination, ultrasonic evaluation of the fetus and estimated fetal weight by three methods (clinical, ultrasonic and actual birth weight) were reported in the monitoring chart. Full history was taken (personal, menstrual, obstetric, past and family history), then general and abdominal examination was done, followed by obstetric palpation (Leopold's manoeuver) to evaluate fundal level, fundal and umbilical grip and first pelvic grip by the right hand to grasp the presenting part (head). fetal heart sound (FHS) is heard in cephalic presentation below the level of the umbilicus as a tic-tac rhythm. Local examination was done to evaluate cervical dilatation if present, degree of descent of the fetal head into pelvis and the fetal station as follows:

- Station -1 (the presenting part lies 1cm above the ischial spines).
- Station 0 (the presenting part is even with the ischial spines).
- Station +1 (the presenting part lies 1cm blow the ischial spines).

After examination, measurement of symphyseal-fundal height (McDonald's measurement) and assessment level of engagement, fetal weight was calculated by **Johnson's Formula**; Emptying the bladder, patient placed in the supine position, McDonald's measurement of height of the fundus from middle point of the upper edge of the symphysis pubis following the curvature of the abdomen was taken with centimeter tape. The upper hand was placed firmly against the top of the fundus, with the measuring tape pressing between the index and middle finger then using this formula:

(McDonald's measurement: 13) × 155 When the presenting part at (-1) station.

(McDonald's measurement: 12) × 155 when presenting parts at (0) station.

(McDonald's measurement: 11) × 155 when presenting part at (+1) station.

To evaluate presentation, viability, placental location and amniotic fluid index, then using Hadlock's Formula to estimate fetal weight.

Hadlock's Formula:

Ultrasound machine used in Zagazig University Hospitals was Siemens, Acuson X300 with transabdominal convex probe (3.5-4.5MHZ) frequency. In Zagazig General Hospitals, ultrasound used machine was LOGIQ P7 with transabdominal convex probe (3.5-5 MHZ).

After clinical estimation of fetal weight, we used ultrasound for evaluation of the fetus by measuring biparietal diameter (BPD), abdominal circumference (AC) and femur length (FL) in centimeters. The sonographic machine calculated fetal weight automatically by the equipment according to hadlock's formula.

The biparietal diameter (BPD) was measured at right angles to the longitudinal axis of the elliptical skull at a level at which a clear midline echo and easily discernable lateral ventricle can be visualized. At this level, the transvers scan also should show cavum septum pellucidum and the thalamus. Biparietal diameter (BPD) was measured from the outer table of anterior skull to the inner table of the posterior skull. The measurement of the fetal abdominal circumference (AC) was made from a transverse axial image of the fetal abdomen at the level of the liver. The major landmark in this section is the umbilical portion of the left portal vein deep in the liver, with the fetal stomach representing a secondary landmark. Femur length (FL) measurement was obtained from the greater trochanter to the lateral condyle. The head of the femur and the distal femoral epiphysis, when present, was not included in the measurement. The measured ends of the bone were blunt and not pointed.

After elective C.S, the newborn babies were weighted within 30 minute of delivery by electronic children scale and their weights were recorded. Predicted estimated fetal weight by each method was compared with neonatal actual birth weight.

Statistical Analysis

Data were analyzed using IBM SPSS 23.0 for windows (SPSS Inc., Chicago, IL, USA) and NCSS 11 for windows (NCSS LCC., Kaysville, UT, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Independent and Paired samples t-test of significance was used when comparing between two means. Analysis of variance (ANOVA) F test was used when comparing more than two means. Receiver operating characteristic (ROC) curve analysis was used to identify optimal cut-off values. P-value ≤ 0.05 was considered significant, P-value ≤ 0.001 was considered as highly significant and P-value > 0.05 was considered insignificant.

RESULTS

Table (1): Obstetric data of the studied group

Variables	N = 84	
Age (years)	**Range**	20 - 37
	Mean ± SD	28.2 ± 4.63
Weight (Kg)	**Range**	55 – 90
	Mean ± SD	74.9 ± 7.92
Height (m)	**Range**	1.5 - 1.85
	Mean ± SD	1.65 ± 0.08
BMI (Kg/m^2)	**Range**	20.8 - 31.2
	Mean ± SD	26.9 ± 2.61
Gestational age (days)	**Range**	259 – 280
	Mean ± SD	267.6 ± 5.89
Gestational age	**N**	%
37 weeks	**29**	34.5
38 weeks	**40**	47.6
39 weeks	**10**	11.9
40 weeks	**5**	5.9
BMI classification		
Normal	**20**	23.8
Over weight	**58**	69.1
Obese	**6**	7.2
	Range	0 – 4
	Mean ± SD	1.5 ± 0.9
Parity	**N**	%
0	**6**	7.1
1	**45**	53.6
2	**20**	23.8
3	**11**	13.1
4	**2**	2.4
	Range	1 – 7
	Mean ± SD	2.95 ± 1.3
	N	%

Table (1) showed that basic data of the women included in the study.

Table (2): Ultrasound and clinical parameters that were used to estimate fetal weights among the studied group

Ultrasound and clinical parameters		Studied group (n=84)	
		Range	**Mean ± SD**
Ultrasound parameters	Bi-parietal diameter (cm)	7.55 - 10.0	9.2 ± 0.48
	Bi-parietal diameter (days)	212 - 281	258.3 ± 12.9
	Abdominal circumference (cm)	6.4 - 43.1	32.8 ± 4.9
	Abdominal circumference (days)	225 - 287	260.7 ± 13.8
	Femur length (cm)	6.4 - 8.1	7.5 ± 0.38
	Femur length (days)	232 - 291	265.2 ± 13.4
Clinical parameters	SFH (cm)	28 – 40	33.9 ± 2.6

Table (2) showed the ranges of parameters used for ultrasonic FWT estimation.

Table (3): Comparison between clinically, sonographically estimated fetal weights and actual birth weight

		Clinical	Ultrasound	Actual	F test	P value
Fetal Weight (gm)	**Range**	**2325 – 4285**	**2070 – 4056**	**2125- 4025**	**3.38**	**0.04S**
	Mean ± SD	**3353.7 ± 424.8**	**3199.8 ± 418.4**	**3223.8 ± 394.5**		

S: P-value<0.05 is significant

Table (3) showed that statistical significant difference among clinical, ultrasound fetal weight estimates and the actual birth weight. In which the difference revealed that clinical estimates was the higher, while ultrasonographic was the lower in relation to the actual birth weight**.**

Table (4): Multiple comparisons between clinically estimated, sonographically estimated fetal weights and actual birth weight

Mean I	Mean II	Mean Difference (I-II)	P value
Actual weight	**US weight**	**23.95**	**0.707 (NS)**
	Clinical weight	**-129.98***	**0.04 (S)**
Ultrasound weight	**Clinical weight**	**-153.9***	**0.02 (S)**

NS:P-value > 0.05 is not significant. S: P-value < 0.05 is significant. Mean I: actual weight/ultrasound.
Mean II: comparison between them

Table (4) showed that on applying multiple comparisons between fetal weight estimates and the actual birth weight in which the comparison revealed that clinical estimate is significantly higher than both actual fetal weight and ultrasound estimate.

Table (5): Paired analysis between actual fetal weight and ultra-sonographic estimates

	Paired Differences				t	P value
	Mean	SD	S. error	95% CI		
Actual FWT – US FWT	**23.95**	**111.1**	**12.1**	**(-0.17 - 48.1)**	**1.975**	**0.05 NS**
Actual FWT – clinical FWT	**-129.9**	**218.4**	**23.8**	**(-177.4, -87.8)**	**5.45**	**<0.001 HS**
US FWT – clinical FWT	**-153.9**	**226.3**	**24.7**	**-203.1, -104.8)**	**6.23**	**<0.001 HS**

NS:P-value >0.05 is not significant HS: P-value <0.001 is high significant

Table (5) showed a high statistically significant mean error differences between clinical FWT with both US FWT estimates and actual FWT, while there was no statistical significant difference between US FWT estimates and actual FWT.

Table (6): Comparison between clinical and ultrasound weight estimates at different gestational ages

	Ultrasound	Clinical	t-test	P
37 weeks (n=29) **Mean** ± **SD**	3205.8 ± 422.3	3413.4 ± 511.7	4.36	<0.001 (HS)
38 weeks (n=40) **Mean** ± **SD**	3164.8 ± 445.8	3292.6 ± 398.8	3.9	<0.001 (HS)
39 weeks (n=10) **Mean** ± **SD**	3328 ± 396.6	3391 ± 333.1	1.97	0.08 (NS)
40 weeks (n=5) **Mean** ± **SD**	3188.4 ± 196.6	3422 ± 192.2	1.62	0.128 (NS)

NS: P-value>0.05 is not significant HS: P-value<0.001 is high significant

Table (6) showed that on comparison between clinical and ultrasound methods at different gestational ages, the mean fetal weight was significantly higher in the clinical method at 37 and 38 weeks, while not reach significant level at 39 and 40 weeks.

Table (7): Difference between ultrasound and clinical methods as regards actual weight

Actual BW	US FWT	Clinical method	Z test	P value
Overall				
Mean absolute error (gm)	**298.2 301.3**	**469.6 310.5**	**4.6**	**<0.001**
Mean error percentage (%)	**9.2 10.3**	**15.6 10.5**	**4.9**	**<0.001**
Actual BW< 2500 gm (n = 4)				
Mean absolute error (gm)	**110.3 111.2**	**120 110.3**	**1.12**	**0.08**
Mean error percentage (%)	**5.3 10.5**	**9.3 11.3**	**0.934**	**0.61**
Actual BW 2500-4000 gm (n = 78)				
Mean absolute error (gm)	**107.6 100.5**	**320.3 210.3**	**5.7**	**<0.001**
Mean error percentage (%)	**6.2 5.5**	**17.2 11.6**	**3.5**	**0.001**
Actual BW >4000 gm (n = 2)				
Mean absolute error (gm)	**99.3 79.4**	**100.5 89.2**	**1.1**	**0.985**
Mean error percentage (%)	**8.2 5.3**	**9.3 12.1**	**1.22**	**0.654**

In < 2500 gm birth weight group, mean absolute error was higher in clinical method than ultrasound to estimate birth weight but difference was ***statistically not significant (p > 0.05). Mean error percentage was much*** lower in ultrasound method than clinical to estimate birth weight but the difference was ***statistically not significant (p > 0.05)***. In 2500-4000 gm birth weight group, comparing clinical and ultrasound methods showed significantly higher mean absolute error and mean error percentages in the clinical method (Table 7).

Figure (1) showed the cut-off value of clinical and ultrasound FWT estimates in predicting actual fetal weight > 3500gm, ultrasound FWT had higher AUC and better sensitivity.

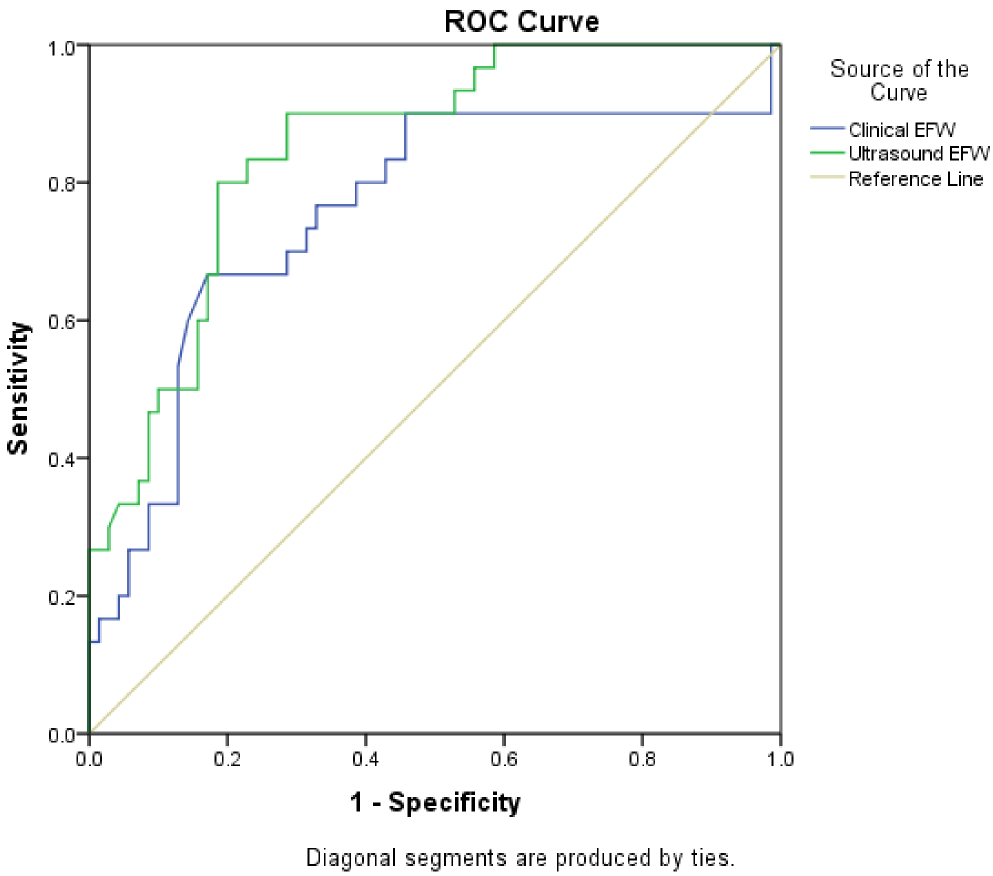

Figure (4) ROC analysis for predicting actual fetal weight > 3500 gm by clinical and ultrasound methods

DISCUSSION

In the present study, the mean maternal age was 28.2, with minimum age being 20 years and maximum being 37 years. The mean gestational age was 38.1, with a minimum gestational age being 37 weeks and maximum being 42 weeks. There were some studies that were in agreement with our study, for example a study carried out by **Joshi *et al.***[5] in which they compared between clinical versus ultrasound in estimation of fetal weight and they found that the mean maternal age was 24.78, with minimum age being 16 years and maximum being 40 years. The mean gestational age was 39.59, with a minimum gestational age being 37 weeks and maximum being 42 weeks. Furthermore **Ingale *et al.*** [9] reported that mean gestational age was 37.5 ± 1.52 weeks in which estimation of fetal weight was done by clinical method and ultrasonography. Then the birth weight after delivery was recorded in grams by electronic weighing machine. Additionally, our results are in agreement with the results reported by a study of **Basumatary *et al.*** [10] in which they calculated fetal weight by using Johnson's formula and was compared to the expected US fetal weight. Accuracy was determined by comparing both with the actual birth weight. They found that the mean age of pregnant women was 28.08 years. The minimum age was 21years, and maximum age was 40 years.

In the present study, the mean height of the study population was 165 cm and, the range was 150-185 cm. Our results are in agreement with results reported by a study carried out by **Basumatary *et al.*** [10], in which they found that the mean height of the study population was 149.59 cm and, the range was140-162 cm.

In the present study, the weight of the study population was between 55 kg - 90 kg with a mean of 74.9 kg. In addition, a study carried by **Njoku *et al.*** [11] found that the weight of the study population used to determine accuracy of fetal weight using ultrasound and clinical fetal weight estimations was between 53-109 kg with a mean of 72.48 kg.

The result of our study was 6 women (7.1%) nulliparous and 78 (92.9 %) were multiparous women. It is similar to a study reported by Basumatary ***et al.*** [10] in which there were 7 primigravida and 93 multigravida patients. Different results were reported by a study carried out by **Ingale *et al.*** [9] in which they estimated fetal weight by clinical method and ultrasonography and found that out of 100 women 59% were multigravida and 41% were primigravida. In addition, **Bajaj *et al.*** [12] in their study found that out of 200 women 34.5% were primigravida and 65.5% were multigravida in which they compared the accuracy of clinical and ultrasonographic estimation of fetal weight at term with actual birth weight.

In the current study, mean birth weight by clinical examination was 3353.7 ± 424.8 gm. While, mean sonographically estimated fetal weight was 3199.8 ± 418.4 gm and the mean actual birth weight was 3223.8 ± 394.5 gm. The estimated mean birth weight by clinical method was significantly different from actual birth weight (p = 0.04) while the estimated mean birth weight by ultrasonographic method was not statistically different from actual birth weight (p = 0.7). In addition, when applying multiple comparisons between fetal weight estimates and the actual birth weight, it revealed that clinical estimate is significantly higher than actual fetal weight while ultrasound assessment was significantly lower than actual weight. In agreement with our study, **Njoku *et al.*** [11] found that the mean actual birth weight was 3242 ± 508 g, while the mean estimated fetal weights by clinical and ultrasound methods were 3541 ± 633 g and 3141 ± 441 g respectively. In addition, when they compared the accuracy of clinical and sonographic methods of predicting fetal weights at term, they found that the clinical fetal weight estimation was significantly higher than actual weight while ultrasound assessment was significantly lower than actual weight. Also, there is a study similar to ours study reported by **Joshi *et al.*** [5] in which the mean ultrasound estimated fetal weight was 3230.02 ± 407.22 gm, the mean clinical estimated fetal weight was 3492.75 ± 393.16 gm and the mean actual birth weight was 3236.32 ± 472.87 gm. They found that the mean ultrasound estimated fetal weight was lower than the mean actual birth weight while clinical fetal weight estimation was significantly higher than actual weight. The estimated mean birth weight by clinical method was significantly different from actual birth weight (p < 0.001) while the estimated mean birth weight by ultrasonographic method was not statistically different from actual birth weight (p = 0.872). Thus demonstrating that ultrasound estimate to be more reliable than clinical method.

In the present study clinical estimates was higher than the actual birth weight, while ultra-sonographic was lower than actual birth weight. This comes in agreement with **Ugwu *et al.*** [13] who found that the clinical method significantly overestimated actual birth weight, while the ultrasonic method underestimated it. Different results were reported by **Ingale *et al.*** [9] in which they found that mean birth weight by clinical examination was 2916.6 ± 399.15, mean sonographically estimated fetal weight was 3203.66 ± 497.05 and the mean actual birth weight was 2831.79 ± 515.79 gm. Moreover, there was statistically significant difference between mean birth weight estimated by clinical examination, ultrasonography and mean actual birth weight (p < 0.05), which revealed that clinical and ultra-sonographic estimates were higher than the actual birth weight. In addition, a study carried by **Yadav *et al.*** [14] reported results against our study, they found that the mean actual birth weight was 3100 ± 455.8 grams. The mean estimated birth weight by US was 3240 ± 389.7 grams while the mean estimated birth weight by Johnson's formula was 2911 ± 364 grams (P value < 0.01). The reason for the discrepancy between different studies may be due to several factors affecting birth weight such as regional and socioeconomic factors. Additionally, it may be attributed to different body mass indices of the studied women. The study of **Aksoy *et al.*** [15] highlighted the value of BMI in modulating the sonographically assessed fetal weight where increased BMI was associated with increased estimates of ultrasound fetal weight assessment.

In the present study, the mean absolute error in estimating birth weight by ultrasonography was 23.95 ± 111.1 gm at 95% confidence interval with no significant difference while mean absolute error in estimating birth weight by clinical method was 129.9 ± 218.4 gm. at 95% confidence interval with highly significant difference. In agreement with our study, **Ugwu *et al.*** [13] compared the accuracy of clinical and ultrasound methods of fetal weight estimation in 200 consecutive term pregnancies. They noted that ultrasound assessment had significantly lower absolute errors and error percentages as compared to clinical methods. While different results were reported by **Joshi *et al.*** [5] in which they performed a cross sectional study over a period of 6 months. All singleton term mothers with cephalic presentation and intact membranes with ultrasound examination done within a week were included in the study. The study found that the net mean error in clinical weight estimation was 415.65 ± 283.54 gm while, by ultrasonograhic method it was 312.40 ± 252.15gm. The mean clinical weight estimation showed significantly higher error than ultrasonograhic weight estimation. In addition, **Njoku *et al.*** [11] found that the mean absolute error in estimating birth weight by ultrasonography and clinical method was 293 ± 313 g and 362 ± 307 g respectively. The clinical method significantly overestimated actual birth weight, while the ultrasonic method underestimated it. The difference in mean absolute error between the three studies was due to a difference of sample size and inclusion criteria. Nevertheless, all similar in the mean clinical weight estimation showed significantly higher error than ultrasonograhic weight estimation.

In the present study, there was no significant correlation between gestational age and estimated fetal weight by clinical method and by ultrasonographic method. Our result was against to results reported by **Joshi *et al.*** [5] that found the error of estimation of weight by clinical method showed significant negative correlation (r = -0.24; p = 0.01) with gestational age. Thus, making the clinical method to be better as the gestational age advanced. However, ultrasonographic method did not show significant correlation (r = +0.045; p = 0.64) demonstrating reliability of ultrasound in wide range gestational ages. In contrary of our results a study carried out by **Ugwu *et al.*** [13] in which they showed significantly direct correlation between clinical EFW and gestational age, ultrasound EFW and actual BW likewise. The variation in error in ultrasound and clinical estimation of birth weight is a factor of large intra- and inter-observer variability. This variability must be minimized if estimated birth weight is to be made clinically useful. Averaging of multiple repetitive measurements, equipment calibration, improvement of image quality and careful design and refinement of measurement method can help reduce the variability to certain extent.

In the present study, at the cut-off value of clinical and ultrasound FWT estimates in predicting actual fetal weight > 3500 gm, the sensitivity was 76.7 % and 82.0% respectively and the specificity was 82.9% and 81.4% respectively. Ultrasound FWT had higher AUC and better sensitivity. In agreement with results of the present study, the reliable sensitivity of ultrasound fetal weight estimation was also reported by the study of **Ashrafganjooei *et al.*** [16] who compared the accuracy of ultrasound, clinical estimates of fetal weight in 246 parous women with singleton, term pregnancies. The cut-off value of clinical and ultrasound FWT estimates in predicting actual fetal weight > 3500 gm, the sensitivity was 76.1 % and 81.7% respectively and the specificity was 75.0% and 62.5% respectively. Ultrasound FWT had higher AUC and better sensitivity. In disagreement with our study, **Joshi *et al.*** [5] found that the sensitivity and specificity of clinical method and ultrasonographic method for identifying fetal birth weight above 3500 gm was 69.23; 65.67% and 46.15; 80.60% respectively. Larger babies were slightly better identified by clinical method (AUC- 0.732 CI- 0.64-0.84) than ultrasonograhic method (0.712 CI-0.61-0.81) as determined by area under the ROC curve method. This represents the fact that clinical method may be more useful to use as a screening tool to identify patient at risk of labour dystocia. Moreover, the study carried by **Lanowski *et al.*** [17] in which they compared the accuracy of abdominal palpation with that of ultrasound performed by different examiners to estimate fetal weight. The authors showed that ultrasound notably dominated the clinical methods in the accurate assessment of fetal weight. Other studies have also identified the superiority of ultrasound over clinical method for estimation of fetal weight especially in low birth weight babies, with no added advantage over clinical method in normal or macrosomic babies [6]**.** In our study, < 2500 g birth weight group, mean absolute error was higher in clinical method than ultrasound to estimate birth weight but difference was statistically not significant (p > 0.05). Mean error percentage was *much* lower in ultrasound method than in clinical to estimate birth weight but the difference was statistically not significant (p > 0.05). In 2500-4000 gm birth weight group, comparing clinical and ultrasound methods showed significantly higher mean absolute error and mean error percentages in the clinical method.

In our study ultrasound estimation was more accurate than clinical method in estimation of fetal weight. This result is similar to results of a study carried by **Ugwu *et al.*** [13] in which they found that the ultrasound estimation was significantly more accurate than clinical prediction. Different result was reported by **Bajaj *et al.*** [12] in which they found that clinical estimation of fetal weight is as accurate as the ultrasonographic method of estimation within the normal birth weight range. Although, while the clinical method overestimated fetal weight, the ultrasonic method underestimated it.

The relationship between birth weight and the direction of the estimation error was not due to a bias in the time interval between ultrasound and delivery as there was no significant relationship between infant birth weight and the time interval between ultrasound and delivery here. In this study, the ultrasound estimations were performed at most within 24 hours prior to delivery. In another study, **Akinola *et al.*** [18] studying reliability of ultrasound estimation of fetal weight performed up to 14 days prior to delivery. Others have restricted their data to estimations performed within 7 days for example **Nzeh *et al.*** [19].

CONCLUSIONS

Accurate estimation of fetal weight would help in care of the newborn in the neonatal period, successful management of labor and prevent complications. Antenatal fetal weight can be estimated with reasonable accuracy, by ultrasounography using Hadlocks formula and clinically using Johnson's formula. Hadlocks formula is more accurate, reliable and showed better sensitivity and specificity in detecting fetal weight than Johnson’s formula. Ultrasound assessment of fetal weight is a reliable method in assessment of fetal weight and should be incorporated within the maternal weight program. We recommend the use of clinical method (Johnson’s formula) as diagnostic tool in estimation of fetal weight, as well as routine ultrasonography even when done by trained medical person.

REFERENCES

1. **Bener A, Saleh N, Salameh K *et al.* (2012):** The impact of the interpregnancy interval on birth weight and other pregnancy outcomes. Revista Brasileira de Saúde Materno Infantil., 12 (3): 233-241.
2. **Lunde A, Melve K, Gjessing H *et al.* (2007):** Genetic and environmental influences on birth weight, birth length, head circumference, and gestational age by use of population-based parent-offspring data. American Journal of Epidemiology, 165 (7): 734-741.
3. **Eze C, Abonyi L, Njoku J *et al.* (2015):** Correlation of ultrasonographic estimated fetal weight with actual birth weight in a tertiary hospital in Lagos, Nigeria. African Health Sciences, 15 (4): 1112–1122.
4. **Roy A, Kathaley M (2018):** Comparison of Estimation of Fetal Weight by Clinical Method, Ultrasonography and its Correlation with Actual Birth Weight in Term Pregnancy. MVP Journal of Medical Sciences, 5: 1.
5. **Joshi A, Panta O, Sharma B (2017):** Estimated Fetal Weight: Comparison of Clinical Versus Ultrasound Estimate. Journal of Nepal Health Research Council, 15 (1): 51-55.
6. **Shittu A, Kuti O, Orji E *et al.* (2007):** Clinical versus sonographic estimation of fetal weight in southwest Nigeria. Journal of Health, Population, and Nutrition, 25 (1): 14.
7. **Khani S, Ahmad-Shirvani M, Mohseni-Bandpei M *et al.* (2011):** Comparison of abdominal palpation, Johnson’s technique and ultrasound in the estimation of fetal weight in Northern Iran. Midwifery, 27 (1): 99-103.
8. **Zahran M, Tohma Y, Erkaya S *et al.* (2015):** Analysis of the effectiveness of ultrasound and clinical examination methods in fetal weight estimation for term pregnancies. Turkish Journal of Obstetrics and Gynecology, 12 (4): 220-5.
9. **Ingale A, Khade S, Shirodkar S (2019):** Clinical versus ultrasonographic fetal weight estimation and its correlation with actual birth weight. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 8 (2): 503-512.
10. **Basumatary J, Bhattacharjee A, Borah S (2015):** Estimation of Fetal Weight by Johnson’s Formula and Its Correlation with Actual Birth Weight. Sch J App Med Sci., 3 (7B): 2552-2557.
11. **Njoku C, Emechebe C, Odusolu P *et al.* (2014):** Determination of accuracy of fetal weight using ultrasound and clinical fetal weight estimations in Calabar South, South Nigeria. Int Sch Res Notices, 15: 970-973.
12. **Bajaj P, Kadikar G, Kannani M *et al.* (2017):** Estimation of foetal birth weight clinically and sonographically and its correlation with its actual birth weight: a prospective and comparative study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 6 (7): 3103-3108.
13. **Ugwu E, Udealor P, Dim C *et al.* (2014).** Accuracy of clinical and ultrasound estimation of fetal weight in predicting actual birth weight in Enugu, Southeastern Nigeria. Nigerian Journal of Clinical Practice, 17 (3): 270-275.
14. **Yadav R, Sharma B, Deokota R *et al.* (2016):** Assessment of clinical methods and ultrasound in predicting fetal birth weight in term pregnant women. Int J Reprod Contracept Obstet Gynecol., 5: 2775-9.
15. **Aksoy H, Aksoy Ü, Karadağ Ö *et al.* (2015):** Influence of maternal body mass index on sonographic fetal weight estimation prior to scheduled delivery. J Obstet Gynaecol Res., 41 (10): 1556-61.
16. **Ashrafganjooei T, Naderi T, Eshrati B *et al.* (2010):** Accuracy of ultrasound, clinical and maternal estimates of birth weight in term women. East Mediterr Health J., 16 (3): 313-7.
17. **Lanowski J, Lanowski G, Schippert C *et al.* (2017):** Ultrasound versus Clinical Examination to Estimate Fetal Weight at Term. Geburtshilfe Frauenheilkd., 77 (3): 276-283.
18. **Akinola S, Oluwafemi K, Ernest O *et al.* (2007):** Clinical versus Sonographic Estimation of Fetal Weight in Southwest Nigeria. J Health Populnutri., 25 (1): 14-23.
19. **Nzeh D, Rimmer S, Moore W *et al.* (1992):** Prediction of birth weight by fetal ultrasound biometry. Br J Radiol., 13: 6687-89.