VOLUME - 9, ISSUE - 12, DECEMBER - 2020 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Obstetrics & Gynaecology

FETAL WEIGHT ESTIMATION USING CLINICAL METHODS AND ULTRASONOLOGY AND TO COMPARE THEIR ACCURACY WITH ACTUAL BIRTH WEIGHT

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ABSTRACT A prospective study comparing the accuracy of clinical and ultrasonographic methods of estimation of fetal weight in 350 term Singleton pregnant women with gestational age ≥ 37 wks and ≤40weeks, cephalic presentation, admitted in labour room, fulfilling inclusion/exclusion criteria with informed consent was conducted. Clinical estimation of foetal weight by Johnson's and Dare's formula and by USG using Hadlock 's Formula was done. Actual birth weight after delivery was recorded & compared. Mean actual birth weight was 3311.97±229.85. The average error in foetal weight estimation using Dare's formula was 90.82± 106.02 grams, by ultrasound using Hadlock's formula (118.04± 115.46 gms), and by using Johnson's formula found to be highest (352.81 ± 213.41 gms). Therefore, clinical methods for estimation of fetal weight especially Dare's formula and by ultrasound using Hadlock's formula was almost closer to actual birth weight thus establishing the usefulness, and reliability of clinical method of fetal weight estimation.

KEYWORDS : Estimated Foetal Weight, Dare's Formula, Hadlock Formula

INTRODUCTION

Estimating foetal weight during pregnancy is an important aspect of prenatal and intrapartum care[1]. The correct estimation of foetal weight [EFW] in relation to gestational age is the key issue in the management of the labor and delivery.[2] Accurate fetal weight estimation leads to, improved prospective management of high-risk pregnancies and considerable reduction in perinatal mortality and morbidity beside prevention of prematurity, evaluation of fetopelvic disproportion, induction of labor before term and detection of FGR [3]

Foetal weight, in conjunction with gestational age, is an important indicator of pregnancy outcome[4]. Accurate prenatal estimation of foetal weight in late pregnancy and labor permits obstetricians to make decisions about instrumental vaginal delivery, trial of labor after previous caesarean delivery (TOLAC) and elective caesarean section for patients suspected of having a macrocosmic foetus[1,5,6,]. Both low birth weight and excessive birth weight at delivery have increased risk of newborn complications during labor and puerperium[4,7].

Ultrasound, as an imaging modality for fetal weight estimation is an expensive method. Accessibility, availability and need of costly equipments and expertise, limits its universal use in rural setup[2] and even in some part of urban areas especially in the developing countries like India. Contrastingly, clinical methods for foetal weight estimation are inexpensive, easily reproducible and simple objective methods, utilizing non-elastic tapes as the recommended tools for this purpose.[8]

Easy access to accurate and low-cost clinical methods for EFW are effective primary screening technique which can help to detect fetal weight gain during antenatal care management. Considering the global importance in development of simple, effective and affordable reproductive health techniques and due to high cost of ultrasound and lack of easy access to it at some medical centers, clinical methods for EFW are considerable, affordable as well as valuable options[2].

This study was planned to estimate foetal weight in utero at term clinically using Dare's formula & Johnson's formula with simultaneously estimation of birth weight using sonographic parameters at term and correlate them with actual birth weight measured after the delivery with the aim to establish the accuracy, efficiency and relative usefulness of clinical methods for estimation of birth weight

METHODOLOGY

This prospective, single centered, comparative study was conducted in the Department of Obstetrics and Gynecology, Kasturba Hospital, Delhi from January 2019 to December 2019. After taking written informed consent a total of 350 pregnant women admitted in labor room were taken up randomly according to inclusion criteria.

Inclusion criteria

Primi or multiparae women, aged between 18-40 years, Confirmed viable singleton intrauterine pregnancy with Cephalic presentation at Gestational age ≥ 37 weeks and <40 weeks

Clinical estimation of foetal weight was done by Johnson's and Dare's formula as follows:

1) Symphysiofundal height was taken, after correcting the dextrorotation, from the upper border of the pubic symphysis to the highest point of the uterus using measuring tape.
2) Abdominal girth was measured at the level of the umbilicus by standard measuring tape without excess pressure to tighten the tape to women's abdomen.

JOHNSON'S FORMULA

Foetal weight(g) = [symphysiofundal height(cm)-n] x 155

n=13, when vertex is above the level of ischial spine
n=12, if vertex is at the ischial spines
n=11, if vertex is below ischial spines

If women's weight is more than 200 pounds(90 kg), 1 is subtracted from the fundal height.

DARE'S FORMULA

Foetal weight(g) = Abdominal girth (cm) x symphysis fundal height (cm)

Estimation of fetal weight using USG by Hadlock 's Formula

Sonographic examination was done in all patients using 3.5 MHz convex array and linear array transducer. Biparietal diameter (BPD) abdominal circumference (AC) and femur length (FL) was measured in centimeters.

HADLOCK'S FORMULA

Log10 (EFW)= 1.4787 - 0.003343 AC × FL + 0.001837 BPD2 + 0.0458 AC + 0.158 FL

AC: abdominal circumference measured in the transverse axis at the level of umbilical portion of the left portal vein deep in the liver and feal stomach.

BPD: Biparietal diameter measured in the transverse axis of skull at the level at which both thalami, lateral ventricles and cavum septum pellucidum from outer edge to inner edge of calvarial wall

FL: Femur length measured from greater trochanter to the lateral condyle excluding the epiphysis

Actual birth weight after delivery was recorded. Thus, obtained estimated fetal weight by clinical method and USG is compared in terms of their accuracy with the actual birth weight of the baby post-delivery.

OBSERVATIONS AND RESULTS

In this study majority (55.7%) of women belonged to age group of 26-30yrs with mean age being 27.05 ±3.48 yrs. Around 68.9 % of women had an average height ranging from 161-170 cm with mean height of 162.8cm. 71.7% of women had their weight ranging from 56-65 kg at term whereas only 20% and 8.3% of women in study group were under and overweight respectively.

Out of total 350 women in study group 215 were multipara, of which 45.1% women had conceived with inter-pregnancy interval of less than 2 yrs. 21.1% of women were in early term (37-37+6d) whereas 24.3% and 54.6% of women in mid-term and late term (39-39+6d) respectively. 195 women had male baby and 155 women had delivered a female baby. Majority of babies (68.9%) had their weight ranging from 3001-3500gms while only 10.3% of babies were < 3kg and remaining weighed over 3.5kg. Only 12 out of 350 patients experienced Postpartum hemorrhage which was managed conservatively.

Actual birth weight in the studied women ranged from 2600.0 - 3790.0 grams. Ultrasound using Hadlock's formula for foetal weight estimation ranged from 2780.0 - 4210.0 grams. Clinical method using Dare's formula for foetal weight estimation ranged from 2816.0 - 4185 grams and from Johnson's method showed range of 3022.5 - 4340.0 grams. In mothers with age less than 20 years all the newborns weighed less than 3500 grams.

Table 1 : Average error in different foetal weight groups by various methods

	2500-3000 gms		3001-3500 gms		3501-4000 gms		p value
	Mean	SD	Mean	SD	Mean	SD	
Weight by Johnson's formula	516.95	191.12	361.15	207.93	244.61	182.43	<0.001
USG weight using Hadlock's formula	175.55	108.19	107.03	112.30	125.86	121.49	0.01
Weight by Dare's formula	184.09	93.48	79.53	104.11	82.59	96.12	<0.001

Table 2 : Error in birth weight by various methods in terms of grams

	Johnson's formula		USG using Hadlock's formula		Dare's formula	
Error in grams	Number	%	Number	%	Number	%
Upto ±100 gms	42	12	145	41.42	176	50.28
Upto ±200 gms	94	26.85	275	78.57	305	87.14
Upto ±300 gms	150	42.85	326	93.14	343	98
Upto ±400 gms	203	58	346	98.85	348	99.42

Fig 1 2 and 3 shows Scatter plot showing correlation between weight by different methods

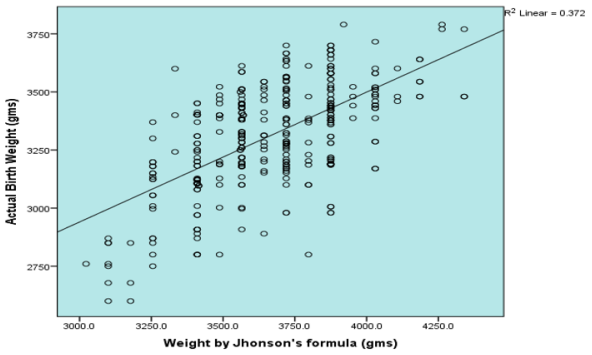

FIG 1

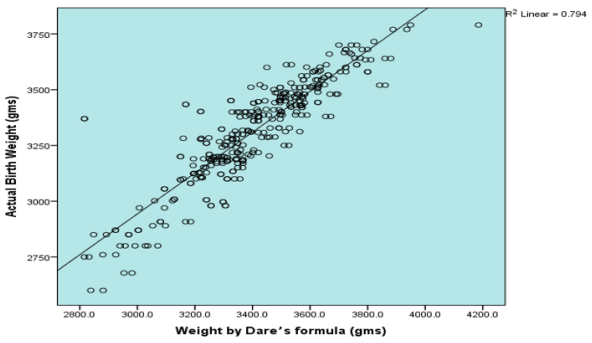

FIG 2

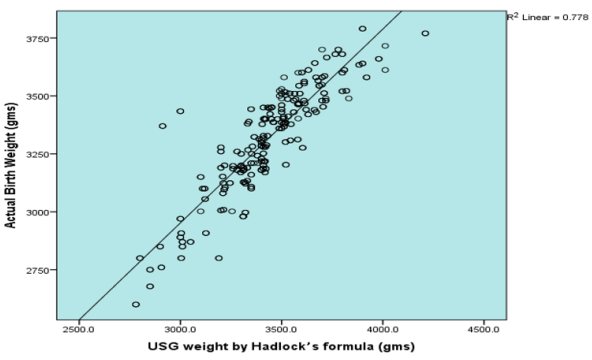

FIG 3

DISCUSSION

More than half the number of cases (55.7 %) belonged to 26-30 years. In this age group, 142 out of 195 cases had babies with weight range of 3001-3500 grams. In mothers with age less than 20 years all newborns weighed less than 3000 grams. In mothers with age above 20 years, out of 335, 307 had foetal weight more than 3000 grams. This result was consistent with that given by *Doughberty and Jones* [9] (1982) in their study which also showed that younger mothers had a tendency to have babies with lesser birthweight.

In the present study, mean actual birth weight was

3311.97±229.85. Mean birth weight was closest to actual birth weight by Dare's formula (3402.79±223.75 grams) followed by ultrasound using Hadlock's formula (3430.07±242.44 grams). Johnson's formula (3664.786±250.77 grams) had maximum deviation from actual birth weight thus showing Dare's formula is clinically better than Johnson's formula.

Raghuvanshi et al (2014) [10] reported the mean of actual birth weight (2593gm), mean estimated foetal weight by Dare's (2696 gm), Hadlock's (2574 gm) and Johnson's (2893 gm) showing clinical estimation especially by Dare's method was found to be as accurate as routine USG estimated average birth weight. Durgaprasad et al.[11] (2019) also concluded the same results. Comparative table for the same has been shown in table3. Correlation between actual birth weight with other methods was done using Karl Pearson's Correlation Coefficient Method. Results of the correlation analysis showed that there is a significant relationship between estimated and actual birth weight for all the methods.

Table 3: comparative table showing estimated fetal weight using different methods

	Actual birth weight		Dare's Formula		Johnson's Formula		Hadlock's Formula	
	Mean birth weight	SD	Mean birth weight	SD	Mean birth weight	SD	Mean birth weight	SD
Present study	3311.97	229.85	3402.79	223.75	3664.78	250.77	3430.07	242.44
Siddiqua et al (12) (2014)	3083.78	447.03	3028.63	399.80	3009.95	383.62	3079.94	383.62
Raghuvanshi et al (10)(2014)	2593.00	427.00	2696.00	394.20	2893.00	503.20	2574.00	357.10
Durgaprasad et al (11)(2019)	2902.89	412.27	2959.01	331.49	3003.14	384.897	3296.15	404.25

The correlation of EFW by using Dare's formula showed maximum positive correlation (r= 0.89; p<0.001) with actual birth weight. This was followed by ultrasound using Hadlock's formula which showed comparable significant positive correlation (r= 0.88; p<0.001). The Johnson's method showed least significant positive correlation (r= 0.61; p<0.001) with actual birth weight. Thus, suggested correlation between actual birth weight is strongest with Dare's formula followed by ultrasound using Hadlock's method and least by Johnson's method. In a study by Siddiquae (2014) [12] the calculations of foetal weight using Dare's method are parallel to those of Hadlock's formula to a higher degree than Johnson's formula in concordance with our study. Similar results were also inferred in a study by Prajapati et al (2018).[13]

The mean average error represents the sum of the positive (over estimation) and the negative (under-estimation) from actual birth weight. The average error in EFW using Dare's formula was 90.82± 106.02 grams, by Hadlock's formula was 118.04± 115.46 grams, and by Johnson's formula was 352.81 ± 213.41 grams. The average error in EFW using Johnson's formula showed highest error followed by ultrasound using Hadlock's formula while it was least in Dare's formula.

Raghuvanshi [10] et al (2014) found that the average percentage error was 6%, 12% and 17.5% by Hadlock's, Dare's, and Johnson's methods respectively. Clinical estimation especially by Dare's method is as accurate as routine USG estimated in average birth weight. Similar findings were seen with average error in percentage in EFW using Dare's formula 2.83±3.30 %, by ultrasound using Hadlock's formula 3.62±3.51%, and by using Johnson's formula to be10.87±6.84%. Dare's clinical formula can be of great value in developing countries like ours, where ultrasound is not available at many health care centers especially in a rural area.

Average error in weight group of 2500-3000 gms was least with Hadlock's formula (175.55 ±108.19) followed by Dare's formula (184.09±93.48). It was maximum with Johnson`s formula (516.95±191.12). Similar results were seen in weight groups of 3001-3500 gms and 3501-4000 gms. Overall, including all foetal weight groups, average error was least with Dare's formula followed by ultrasound using Hadlock's formula with exceptions being foetal weight group of 2500-3000 gms where average error by Hadlock's formula was less compared to Dare's formula. Average error was maximum for Johnson's method.

As it is evident by table 2, accurate birth weight could be estimated by Dare's formula with an error of 200 gms in 87.1 % of cases and in 78.6 % cases by Hadlock's formula but only in 26.9 % of cases by Johnson's formula. With an error of ±300 gms, correct weight could be estimated in 98 % cases by Dare's formula. The results of Hadlock's formula were comparable (93.1 %) while those of Johnson's formula (42.9 %) were inferior to the other two.

Therefore, the results of Dare's formula and ultrasound using Hadlock's formula were comparable, except those of Johnson's formula were inferior to the other two methods. Clinical methods of fetal weight estimation are easy, quick and as accurate as USG and thus a safer alternative especially in rural areas where ultrasound and expertise are lacking.

CONCLUSIONS

We conclude that Foetal weight estimation by clinical method using Dare's formula was closest to actual birth weight out of all the three methods. It also showed maximum positive corrélation with actual birth weight with least average error which was followed by Headlocks formula. Johnson's formula showed highest average and maximum error.

The mean of estimated foetal weight by Dare's formula and Hadlock's formula was almost closer to mean of actual birth weight, thus establishing the usefulness of clinical method of fetal weight estimation in low resource settings. Assessment of foetal weight at term leads to an improved prospective management of high-risk pregnancies and considerable reduction in perinatal mortality and morbidity. Ultrasound for estimating fetal weight is expensive and quick access may not always be available in low resource settings. Clinical estimation of foetal weight is one of the many important skills that should be practiced as it is convenient, easy, quick, and does not require expensive instruments.

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