Original Research Article

Estimation of foetal birth weight clinically and sonographically and its correlation with its actual birth weight: a prospective and comparative study

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ABSTRACT

Background: Knowledge of fetal weight in utero is vital for the obstetrician in deciding whether to deliver the fetus as well as in fixing the mode of delivery. Both low birth weight and excessive fetal weight at delivery are associated with increased risk of newborn complications during labor and the puerperium. During the last decade, estimated fetal weight has been incorporated into the standard routine antepartum evaluation of high-risk pregnancies and deliveries. Objective of present study was to assess the fetal weight in term pregnancies by Clinical and Sonographic and to compare the methods after knowing the actual weight of the baby after birth.
Methods: It is a prospective and comparative study of 200 women at term pregnancy at Sir T. Hospital, Bhavnagar, India from 2015 to 2016. Patients within 7 days from their Expected Date of Delivery were included in the study. The formulas used in this study are: Johnson's formula, Dare's formula and Hadlock's formula using ultrasound.
Results: Results vary in terms of accuracy with various methods employed for estimating the fetal weight. This study showed that Dare's Formula was the best indicator among all other methods assessed followed by Hadlock's formula by ultrasonographic method.
Conclusions: SFH measurement continues to be used in many countries on large scale because of its low cost, ease of use and need for little training as the setup for ultrasonographic evaluation is not readily available in rural setups.

Keywords: Abdominal girth, Dare's formula, Hadlock's formula, Johnson's formula, Symphysio-fundal height

INTRODUCTION

Assessment of fetal weight is a vital and universal part of antenatal care, not only in the management of labor and delivery but often during the management of high risk pregnancies and growth monitoring.[1] Birth weight of an infant is the single most important determinant of newborn survival.[1,2] Both low and excessive fetal weights at delivery are associated with an increased risk of newborn complications during labor and puerperium. Limiting the potential complications associated with the birth of both small and excessively large foetuses requires that accurate estimation of fetal weight occurs before decision to deliver is made.[3]

On the other hand, fetal macrosomia is associated with more maternal and fetal complications at the time of birth than other neonatal weight groups.[4] Maternal complications include increased caesarean rate, higher risk of injury to the genital tract, uterine rupture, as well as postpartum hemorraghe.[5] The two main methods for predicting birth weight in current obstetrics are clinical

and ultrasonographic methods.[6,7] In developing countries, ultrasonography may be unavailable or may not be affordable by patients. That is why measurement of fundal height using inexpensive and easily available non-elastic tapes has been recommended as a means of assessing birth weight in low-resource countries.

The present study aimed at estimation of fetal birth weight clinically and sonographically and compare them with actual birth weight after delivery of fetus.

METHODS

The present study was a prospective comparative study done in between in the year 2015-2016 in Department of Obstetrics and Gynaecology, Sir Takhtsinhji Hospital, Bhavnagar. The study population consisted of 200 patients which were randomly selected, who were admitted in Gopnath Maternity Home at Sir T. Hospital, Bhavnagar

Inclusion criteria

- Term pregnancies 37-42 weeks
- Singelton pregnancy
- Vertex presentation
- Women should deliver within 3 days of estimation.

Exclusion criteria

- Oligohydramnios, polyhydramnios
- Multiple pregnancies
- Malpresentation
- Congenital abnormalities of foetus
- Intrauterine foetal death
- Premature rupture of membrane
- Pregnancy with uterine fibroid or any abdominal mass
- Placenta previa.

Patients admitted in the Gopnath Maternity Home for various reasons were taken in study after the satisfying the inclusion and exclusion criteria. A preliminary history taking, thorough general examination and obstetric examination was taken for study and informed consent for the study was taken.

Patients were asked to lie flat on their back with thighs slightly flexed after emptying bladder. Symphysio-fundal height and abdominal girth measurement were taken in between contractions with flexible elastic standard measuring tape. Estimated fetal weight was calculated according to Johnson's formula and Dare's formula.

Johnson's formula

Foetal weight in gm =155 * (fundal height in cm – K)

K= 11 (foetal head at plus station), K=12 (foetal head at zero station), K=13 (foetal head at minus station).

Dare's formula

Foetal weight in gm = fundal height in cm * abdominal girth in cm.

For sonographic method: They were analyzed for estimated fetal weight by Hadlock's formula (inbuilt) on ultrasonography machine.

Patients were followed up till delivery and actual birth weight measured. Their data was taken as per performa.

Statistical analysis

Data obtained was tabulated and analysed using percentages, mean, averages to obtain the percentage errors, average errors of each clinical formula and sonography, after that the mean average error in all cases studied. Standard deviation was calculated using mean. Finally, the correlation coefficient "r" were calculated to know association between actual birth weight and weight decided by clinically and sonographically.

RESULTS

In this study, maximum group of the patients were observed in the 20-25year age group (60.5%).

Table 1: Maternal age distribution (N=200).

Age (years)	No. of patients	%
18-20	5	2.5
20-25	121	60.5
26-30	49	24.5
>30	17	8.5

In this study, out of 200 women 34.5% were primigravida and 65.5% multigravidas. Parity distribution is comparable to the Bhandary et al.

Table 2: Maternal parity distribution (N=200).

Parity	Primigravida	Multigravida
Anupurna K	50%	50%
Bhandary A et al	45 %	55 %
Present study	69 (34.5%)	131 (65.5%)

In this study, 70% of patients delivered vaginally where as 30 % patients had undergone LSCS for various indications.

The cases were distributed as per the birth weight of babies into five groups. In India, average birth weight 2500 – 3000gm. In this study, 2501- 3000gm group had maximum distribution (46.5%) of cases compared to other groups. So, birth weight according to weight in gm

in present study is comparable to Bandhary et al and Anupurna K et al.

Table 3: Mode of delivery (N=200).

Type of delivery	Normal delivery	Instrumental	LSCS
Present study	85% (170)	-	15% (30)
Bhandary A et al	70%	19.5%	10.5%
Anupurna K et al.	86%	-	14%

The proportion of Low Birth weight (<2500) was found to be high with maternal weight group ranging from 40-55kg (66%) compared to women with increased weight in the range of 56-70kg (25%).

It can be observed that the birth weight increases along with the maternal weight. So, results of present study are comparable to study by Anupurna K.

Table 4: Distribution of cases according to birth weight (N=200).

Birth weight in GM	<2000	2000-2500	2501-3000	3001-3500	>3500
Bhandary A et al	7%	22.5%	54%	15%	1.5%
Anupurna K et al.		15%	46%	35%	4%
Present study	3% (6)	21% (42)	46.5% (93)	24.5% (49)	5% (10)

Table 5: Birth weight in relation to maternal weight.

Maternal weight in kg	Birth weight in gm					Present study	Anupurna K et al.
	<2000	2000-2500	2501-3000	3001-3500	>3500		
40-55	4	28	26	12	2	72 (36%)	40%
56-70	1	11	50	27	5	94 (47%)	60%
>70	1	03	17	10	3	34 (17%)	-
Total	6	42	93	49	10	200	

Table 6: Birth weight in relation to gravida.

Gravida	Birth weight in gm					Present study	Anupurna K et al.
	<2000	2000-2500	2501-3000	3001-3500	>3500		
1	2 (33.3%)	12 (28.5%)	33 (35.5%)	18 (36.7%)	4 (0.4%)	69	50
2	2 (33.3%)	15 (35.7%)	30 (32.2%)	15 (30.6%)	4 (0.4%)	66	30
3	2 (33.3%)	12 (28.6%)	21 (22.6%)	11 (22.4%)	0	46	15
4	0	3 (7.1%)	6 (6.4%)	4 (8.2%)	2 (0.2%)	15	5
>4	0	0	3 (3.2%)	1 (2.0%)	0	04	-
Total	6	42	93	49	10	200	100

Table 7: Average error in various fetal weight groups by various methods.

Method	Birth weight in gm					Present study	Bhandary A et al	Anupurna K et al.
	<2000	2000-2500	2501-3000	3001-3500	>3500			
N	6	42	93	49	10	200	200	100
Johnson's formula	488.33	337.52	284.54	215.24	359.20	336.96	292.51	121.2
Dare's formula	340.33	198.88	170.65	193.63	204.20	221.53	224.37	-
Hadlock's formula	252.66	257.92	195.61	203.24	218.80	225.64	299.11	42.91

The cases within the birth weight (2000-2500gm) were observed more in second gravida (35%) followed by third gravida (28.6%). Birth weight according to Gravida status in this study is almost comparable to the study by Anupurna K et al.

Average error in fetal weight group is given in Table 7.

Average error =1/n ∑{actual birth weight-estimated birth weight}

Where, n=no of cases, Average error in all groups except <2000gm was least with Dare's formula, closely followed by Hadlock's formula. Average error in <2000gm weight group was least with Hadlock's formula. Present study is comparable to study by Bhandary et al.

Table 8: Maximum error in various fetal weight groups by various methods.

Method	Birth weight in gm					Present study	Bandhary A et al	Anupurna K et al
	<2000	2000-2500	2501-3000	3001-3500	>3500			
N	6	42	93	49	10	200	200	100
Johnson's formula	790	840	901	732	737	800	534.2	600
Dare's formula	450	550	566	480	507	510.6	714	-
Hadlock's formula	400	590	517	450	407	472.8	647.4	563

Table 9: Ranges of percentage error in the various methods.

Percentage error		Johnson's formula	Dare's formula	Hadlock's formula
Up to 5%	Present study	35.5	50	34
	Bandhary A et al	17	33.5	27.5
	Anupurna K et al	22		65
Up to 10%	Present study	55.5	68	67
	Bandhary A et al	41	67	62
	Anupurna K et al	54		88
Up to 15%	Present study	73	86	87
	Bandhary A et al	63.5	85.5	85.5
	Anupurna K et al	87		97
Up to 20%	Present study	80.5	94.5	94
	Bandhary A et al	79.5	94	96.5
	Anupurna K et al	98		99
Up to 25%	Present study	91.5	98	98
	Bandhary A et al	89.5	96.5	96.5
	Anupurna K et al	100		100

Maximum error was most marked with Johnson's formula and least with Hadlock's formula.

Maximum error with fetal weight 200-2500g was least with Dare's formula. Present study is comparable to Bhandary et al. Percentage error of method was calculated by using the formula

Percentage error= x/y*100

Where x=error in gm, y=actual birth weight in gm,

As seen in Table 8, 86% of the cases fell within 15 percentile error of birthweight by both Dare's formula and Hadlock's formula. As compared to that only 73% of cases fell within 15 percentile error of birthweight by Johnson's formula.

So, this study is more comparable to the study by Bhandary et al than the study by Anupurna K et al.

Table 9: Standard deviation of prediction error.

Method	Present study	Bandhary A et al
Johnson's formula	405.04	309.98
Dare's formula	404.68	272.66
Hadlock's formula	400.71	258.48

Standard deviation= $\sqrt{\sum(x-y)^2/n}$,

Where, x= actual birth weight, y = estimated birth weight.

Standard deviation of the prediction error by different method: 400.71 gm by Hadlock's formula closely followed by Dare's formula followed by Johnson's formula.

Results of this study by standard deviation of prediction error is comparable to the study by Bhandary et al.

Table 10: Comparison of different methods.

	Average error	Standard deviation	Confidence interval
Johnson's formula	336.96	405.04	280.4819 to 393.43
Dare's formula	221.53	404.68	165.0519 to 278.008
Hadlock's formula	225.64	400.71	169.7256 to 281.4744

Confidence interval = mean±2 SE,

Where, SE = s/√n, s= standard deviation, n=no of cases

Based on average error in weight, Dare's formula showing near average of actual weight as compared to other formulas. So, Dare's formula is more reliable than other formula. Considering the Degree of variation based on average error, standard deviation and their Confidence interval, Dare's formula and Hadlock's formula are almost comparable. No significant variation has been observed in both the formulas.

DISCUSSION

Both fetal macrosomia and intrauterine growth restriction increase the risk of perinatal morbidity and mortality and of long term neurologic and developmental disorders.[8]

Accurate prediction of fetal weight has been of great interest in obstetrics. As fetal weight cannot be measured directly, it must be estimated from fetal and maternal anatomical characteristics.

For the ultrasonographic method, our results are also consistent with what have been previously observed that the mean absolute percentage error of predicted birthweight varies from 6% to 12% of actual birthweight, and 40–75% of the estimates are within 10% of actual birthweight.[8-10] The observation that, compared to actual birthweight, ultrasound overestimated low birthweight and underestimated high birthweight, has also been previously reported.[8,11]

The major finding from this prospective study is that clinical estimation of foetal weight is as accurate as the ultrasonographic method of estimation within the normal birthweight range. Although, while the clinical method overestimated foetal weight, our ultrasonic method underestimated it. However, when there is the case of intrauterine growth restriction (birthweight <2,500 g), both the methods overestimated birthweight, but the ultrasonic method was statistically more accurate with smaller mean errors and more estimates within ±10% of actual birthweight.

Despite the differences in study design, present findings are in consonance with those reported by others that the accuracy of clinical estimation of birthweight is similar if not better than that of ultrasonic estimation. The studies by Hendrix et al. and Raman et al. showed that clinical estimation was significantly more accurate than sonographic prediction.[12,13] Similar results as obtained by Sharman et al. and Titapant et al. who observed that ultrasonic estimation was more accurate only when there is low birthweight but in their own studies, both the methods underestimated birthweight by more than 400 g.[11,14] Watson et al. found no significant difference between the two methods even at extremes of birthweight at term.[15]

Present observation implies that there is clearly a role for clinical estimation of birthweight as a diagnostic tool, suggesting that clinical estimation is sufficient to manage labour and delivery in a term pregnancy. Even in estimating weight of macrosomic foetus for making decision regarding trials of labour, there appears to be no benefit in obtaining a routine sonographic birthweight. The role for ultrasonographic estimation appears that, when clinically estimated weight suggests weight less than <2,500 g, subsequent sonographic estimation would yield a better prediction and would be further necessary to assess such foetuses for congenital malformation and to do the biophysical profile to determine the well-being of the foetus.

The potential limitations of the study include: (a) the subjectivity of clinical estimation, (b) use of only one sonographic model to derive estimates of foetal weight, (c) no confirmation that the formula used (Hadlocks 3) is universally applicable.

We regard the overestimation of foetal weight by the clinical method as a positive factor since it will enhance the sensitivity of health workers at peripheral centres if properly taught to them for earlier referral of mothers with macrosomic foetuses, thus contributing to reduction of obstructed labour and its sequelae.[16]

CONCLUSION

Antenatal fetal weight can be estimated clinically by using Johnson's formula and Dawn's formula and sonographically by Hadlock's formula. Despite the superiority of ultrasonography, the simple clinical method of estimation of fetal weight is of great value especially in a developing country. Thereafter for the confirmation and to rule out complications they can refer to higher centre for ultra-sonographic examination and for better management specially when they are high-risk patients. The present study indicates that among full term singleton cephalic presentation, foetal weight estimation using measuring tape is just as accurate as ultrasound estimates for prediction of actual birth weight. This simple clinical method for FEW is easy to perform. It is very useful, inexpensive, and practical tools for predicting birth weight, especially for less experienced examiner and with limited resources.

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