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ORIGINAL ARTICLE

Comparative Study of Various Methods of Fetal Weight Estimation in Term Pregnancy

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ABSTRACT

Objective: The goal of this study was to evaluate the various methods of estimating fetal weight in term pregnancy and to determine their relative accuracy in predicting the same in different weight categories.

Materials and methods: The study was conducted at Department of Obstetrics and Gynecology, Medical College and Hospital, Kolkata from 1st July 2009 to 30th June 2010. It was a prospective cohort type of study covering 500 pregnant women at term. Parameters studied (a) average error (gm) in different birth weight categories, (b) standard deviation of prediction error in each birth weight category.

Results: Ultrasonography was found to have least standard deviation closely followed by the two clinical methods proposed by Johnson and Dare. The average positive predictive value of different methods in our study was 42.2, 70.9, 80.5 and 76% for Dawn's, Johnson's, Dare's formulas and USG respectively.

Conclusion: Easily measurable obstetric parameters with simple instruments requiring minimal manpower training are equally accurate as USG in predicting fetal weight.

Keywords: Estimated fetal weight, Johnson's formula, Dare's formula.

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INTRODUCTION

Knowledge of the weight of the fetus *in utero* is important for the obstetrician to decide whether to deliver or not to deliver and also to decide on the mode and place of delivery in order to optimize the fetomaternal outcome. Extremes of birth weight are associated with an increased risk of newborn complications during labor and puerperium.[1]

Standard growth curves for different population groups have been devised in order to predict birth weight at different gestational ages. However, these do not prove useful in pregnancies with various unique complications where the knowledge is more needed to optimize the outcome. So different methods of estimating fetal weight have been tried in different parts of the world in search of the best method. Broadly they are classified as:

1. *Clinical methods*: Worldwide, this method is used extensively because it is both convenient and virtually costless, however it is subject to wide range of predictive errors.
2. *Risk factor assessment*: Quantitative assessment of clinical risk factors can be valuable in predicting deviations in fetal size.[2]
3. *Maternal self-estimation*: A third method of estimating fetal weight is maternal self-estimation. Perhaps a surprise in some studies maternal self-estimation of fetal weight in multiparous women were as accurate as clinical estimates in predicting fetal weight and abnormally large fetuses at term.[3]
4. *Obstetric ultrasonography*: This is the most modern method for assessing fetal weight *in utero*.

However, controversies abound as to which method is most useful and widely applicable for predicting fetal weight. Contrary to the widely held belief several studies have shown that ultrasonographic estimates of fetal weight are no better than clinical palpation in predicting fetal weight.[4] Associated with this is the question of its availability in resource poor settings. However, clinical methods have limitations of their own subject to interindividual variation depending on the experience of the observer in addition to errors inherent to the technique.

Therefore, there is a need to devise a method to accurately predict fetal weight which is widely available as well as reliable in order to achieve the best outcome. The goal of this study is to evaluate the various methods of estimating fetal weight in term pregnancy and to determine their relative accuracy in predicting the same in different weight categories.

MATERIALS AND METHODS

The study was conducted at Department of Obstetrics Gynecology, Medical College and Hospital, Kolkata from 1st July 2009 to 30th June 2010. The study was approved by the Institutional Ethical Committee. It was a prospective cohort type of study covering 500 pregnant women at term, (i.e. >37 weeks of gestation).

Inclusion criteria: Pregnant women admitted for confinement in antenatal ward at term.

Exclusion criteria:

1. Multiple gestation
2. Malpresentation
3. Poly- or oligohydramnios
4. IUGR (Intrauterine growth retardation)
5. Fibroids or adnexal mass
6. IUFD (Intrauterine fetal death)
7. Congenital anomalies.

All the eligible patients participated in the study after giving proper written informed consent.

Parameters studied:

a. Average error (gm) in different birth weight categories
b. Standard deviation of prediction error in each birth weight category.

The selected patients were asked to empty their bladder and the symphysiofundal height (SFH) and abdominal girth

(AG) in relaxed uterus was measured using a flexible, nonelastic standard measuring tape and the measurements were rounded to nearest centimeters. The fundal height was measured from the midpoint of the upper border of symphysis pubis to the highest point of uterine fundus marked after centralizing the uterus. For AG measurement, the tape was repositioned to encircle the women, at the level of the umbilicus, without applying excessive pressure to tighten the tape around the abdomen. The measurements were performed with the patient lying flat on her back with her legs extended. The longitudinal and transverse diameters of the uterus were measured using a pelvimeter. A pelvic examination was performed to evaluate cervical dilatation and the degree of descent of the fetal head into the pelvis. The fetus was considered to be at minus station when the lowermost portion of the fetal head was above the ischial spines, at zero station when the vertex was at the level of spines, and at a plus station when below the level. All the measurements and information were recorded on individual datasheet and later on used to calculate the fetal weight according to the formula proposed by Johnson and Tosch, Dare et al, and Dawn et al.

Johnson and Tosch formula	Fetal weight (gm) = 155 × (fundal height-x) where x = 11 at plus station, = 12 at zero station = 13 at minus station
Dare's formula	Fetal weight (gm) = SFH × AG
Dawn's formula	Fetal weight (gm) = longitudinal diameter of the uterus × (transverse diameter of the uterus) 2 × 1.44/2

All the measurements were taken in centimeters and DAWT (Double abdominal wall thickness) was measured (Dawn's measurements were taken with pelvimeter). If DAWT was >3 cm the same was deducted from transverse diameter and half of the excess was deducted from the longitudinal diameter.

Ultrasonography

Fetal weight was estimated by Hadlock's formula[5] taking biparietal diameter (BPD), abdominal circumference (AC) and femur length (FL).

The measurements were tabulated in the datasheet and compared with the actual birth weight after delivery. The estimations repeated, if the delivery did not occur within 1 week.

The study population was divided into three groups: Group A—Birthweight <2,500 gm; group B—Birthweight 2,500 to 4,000 gm; group C—Birthweight >4,000 gm.

The average errors, standard deviation of prediction error and p-value were calculated with the help of statistician and results analyzed.

RESULTS

Majority of the babies in the study group belonged to the average birth weight category of 2,500 to 4,000 gm as shown in Table 1.

Table 1: Distribution of patients according to birth weight

	Birth weight (gm)		
	<2500	2501-4000	>4001
Number	132	365	3
Frequency	26.4%	73%	0.6%

Table 2: Average error in various categories by different methods according to birth weight

Methods	*Birth weight (gm)*		
	<2500	2501-4000	>4001
Dawn's	912.31	672.61	140
Johnson's	454.33	261.48	550
Dare's	342.18	236.6	339
Hadlock's	256.79	233.48	433.3

Table 3: Standard deviation of prediction error with respect to actual birth weight and formula used

Formula	*Actual birth weight (gm)*			*Average*
	<2500	*2501-4000*	*>4000*	*SD*
Dawn's	447.75	374.55	52.91	291.73
Johnson's	262.80	213.92	78.58	185.1
Dare's	317.19	192.055	83.51	197.58
USG	166.50	157.27	57.73	127.16

Table 4: Positive predictive value (in percentages) of each method with respect to weight

Formula	*Actual birth weight (gm)*		
	<2500	2501-4000	>4000
Dawn's	10.6	73.8	100
Johnson's	55.3	86.6	0
Dare's	69.7	90.4	0
Hadlock's	69.7	90.4	0

The average positive predictive value of different methods in our study was 42.2, 70.9, 80.5 and 76% for Dawn's, Johnson's, Dare's formulas and USG respectively

Table 2 clearly shows the average error in prediction of the weight was highest in Dawn's formula in up to 4 kg but the method was fairly accurate in predicting birth weights more than 4 kg. On the other hand USG and clinical method applying Dare's formula attained high level of accuracy in predicting birth weights <4 kg. There was no significant difference between the two methods.

The Table 3 reflects standard deviation of prediction error in the different categories and average standard deviation by all methods. Ultrasonography was found to have least standard deviation closely followed by the two clinical methods proposed by Johnson and Dare. Break-up analysis of the data shows USG was more accurate in predicting low birth weight while clinical methods as well as USG were equally accurate in predicting average birth weight.

The average positive predictive value of different methods in our study was 42.2, 70.9, 80.5 and 76% for Dawn's, Johnson's, Dare's formula and USG respectively as is evident from Table 4.

DISCUSSION

The commonest birth weight category was 2.5 to 4 kg in our study group as reiterated by other studies. The prevalence of low birth weight was 26.4% and the prevalence of macrosomia was found to be 0.6%. The average error in estimating fetal weight was very high in all weight categories by Dawn's formula and thus it was found to be not useful in predicting birth weight in different categories except for in the group weighing >4 kg where it was found to be exceptionally accurate detecting all the cases. However, the sample size was very small (n = 3) to draw any useful conclusions. In the low to average birth weight groups USG and Dare's formula were found to be equally accurate in our study similar to the conclusions reached by Amritha et al.[6] The p-value between these two methods applying paired t-test in weight categories <2.5 kg and 2.5 to 4 kg was found to be 0.28 and 0.35 respectively which was not significant emphasizing that both the methods are comparable and hence can be used interchangeably thus, conferring a clear cut advantage to the clinical method in terms of its cost effectiveness and wider applicability. Contrary to the findings by Dawn et al and even Amritha et al. Dawn's formula[7] was highly inaccurate in predicting birth weights. However, the p-value for Dawn's formula when compared to USG was found to be 0.001 which was highly significant and this area needs to be investigated further whether this method is really so accurate in predicting macrosomia.

Similar trends were noted in standard deviation of prediction error in different methods. The SD was least with USG closely followed by Dare's formula.[8] Johnson's formula[9] was found to be a bit more accurate in <2.5 kg category. Overall both USG and Dare's method were the most accurate in our study similar to the conclusions reached by Amritha et al.

The positive predictive value of different methods in our study was 42.2, 70.9, 80.5 and 76% for Dawn's, Johnson's, Dare's formulas and USG respectively. The same in different studies is compared in the following:

Amritha et al	Dawn's	50%
	Johnson's	63.5%
	Dare's	85.5%
	USG	85.5%
Tiwari et al	Dawn's	68%
	Johnson's	78%
	Dare's	74%
	USG	92%
Torloni et al	Dawn's	NA
	Johnson's	57%
	Dare's	61%
	USG	65%
Our study	Dawn's	42.2%
	Johnson's	70.9%
	Dare's	80.5%
	USG	76%

From the above studies we can safely conclude that though USG continues to be the most accurate method clinical methods are no less accurate and thus have more clinical applicability in low resource settings.

USG as well as Dare's formula were equally useful in predicting birth weight in categories up to 4l kg however, their accuracy dipped steeply in predicting higher birth weight whereas Dawn's formula in general highly inaccurate was found to be useful in >4 kg group.

CONCLUSION

Contrary to the widely held notion that more sophisticated techniques are more accurate at predicting birth weight; we in our study found that the accuracy does not improve with technology. Ultrasonography has shortcomings of its own with the method requiring greater financial investment and more skilled manpower which is a stumbling block in resource poor setting of the developing nations. On the other hand simpler method using easily measurable obstetric parameters with simple instruments requiring minimal manpower training are equally accurate as USG in predicting fetal weight. We in our study found that the p-value of the two most accurate methods, i.e. USG and Dare's formula in birth weight categories <2.5 kg and 2.5 to 4 kg was 0.28 and 0.35 respectively which was not significant. Thus, USG provided no extra advantage over clinical methods of prediction of fetal weight. It is hoped that the conclusions of this study will add up to the evidence provided by earlier investigators that clinical methods are equally reliable, cheap and easier to teach and can go a long way in aiding decision-making process in resource poor developing nations without compromising on the results in terms of fetal and maternal well being.

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