Original Research Article **DOI: 10.56412/gmcp.2023.6.01.140**

Comparison of Various Methods of Fetal Weight Estimation At Term Pregnancy

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Introduction: Various factors have been noted which can affect fetal and neonatal morbidity and survival. However, it has been seen that amongst them the birth weight is the most important variable that affects it. Therefore estimation of fetal weight is very crucial in management of labor and delivery. The most commonly used methods for estimating fetal weight are clinical and ultrasonographic methods, with each one having its limitations. Our aim of this study was to compare the fetal weight estimation with both these methods at term pregnancy and to compare them to the actual birth weight of the baby.

Materials and methods A prospective comparative study covering 100 women at term pregnancy with a single fetus in cephalic presentation was conducted in Department of Obstetrics and Gynaecology, Government Medical College, Patiala. Fetal weight was estimated by Johnson's, Dare's and Hadlock's methods. Fetal weight taken by each method was compared to actual birth weight of the newborn. Results were compiled and analyzed statistically.

Results: The estimated fetal weight calculated by Hadlock's formula and actual birth weight ($p=0.83$) had no significant difference as compared to the Dare's formula ($p=0.008$) and Johnson's formula ($p<0.001$). The average error<10% shown was 65% cases with Dare's formula, 35 % cases with Johnson's formula and 77% cases with Hadlock's formula. The least average error was with Hadlock's.

Conclusion: Hadlock's formula was found to show superior results and had better predictable results in fetal weight estimation, compared to other two formulae, but when facilities for ultrasound are not available readily, like in developing countries, clinical estimation by Dare's formula is a better option than Johnson's formula.

Keywords : Estimated fetal weight, Actual birth weight, Hadlock's formula

Introduction

The most important aspect of prenatal and intrapartum treatment is the accurate evaluation of foetal weight throughout pregnancy.1 It is important because an accurate prediction of the foetal weight at term will influence the mode of delivery and the timing of labour induction. The need for this arises from the fact that accurate estimation of the foetal weight reduces the possibility of damage to birth canal and pelvic floor of mother. As a result, the likelihood of PPH is reduced.2 Cephalopelvic disproportion, which increases with foetal weight, causes macrosomic fetuses to have a higher frequency of surgical vaginal and caesarean deliveries than do foetuses of normal weight.3

As the foetal weight cannot be measured directly, we must estimate it based on anatomical characteristics of the mother and the foetus. Clinical methods and ultrasonography are the two techniques that are most commonly used for measuring foetal weight. The Johnson's formula and the Dare's formula are just two examples of the numerous formulas utilized in clinical practice.

Ultrasonography is the most modern method for estimating foetal weight during pregnancy. 4

It is challenging to determine foetal birth weight in rural and distant areas because ultrasonography is not usually available there. Hence clinical methods, which are crucial for assessing birth weight, are used by health experts in these areas. This is because they

are inexpensive, easy to use and have immediate results.5 Consequently, it is necessary to create a system that is precise, easy to use, trustworthy and accurate. Therefore, the aim of study was to evaluate alternative methods for determining the weight of the foetus during term pregnancy and compare them to the child's actual birth weight.

MATERIALS AND METHODS

The study was conducted in the Department of Obstetrics and Gynaecology at Government Medical College, a tertiary care centre in Patiala, Punjab including 100 pregnant women having a single foetus with cephalic presentation at term from January 2021 to December 2021. The approval from Institutional Ethics Committee was taken wide BFUHS/2K21p- TH/5147. It was a prospective comparison research.

Inclusion criteria:

1. A singleton pregnancy
2. Gestation ≥37 weeks
3. Cephalic presentation

Exclusion criteria:

1. Women with gestation <37 weeks
2. Multiple gestation
3. Malpresentation
4. Poly or oligo-hydraminos
5. Pregnancy with fibroid
6. Intrauterine death (IUD)
7. Congenital anomalies
8. BMI>30 subjects
9. Major degree placenta previa

A flexible, non-elastic standard measuring tape was used to measure the symphysio-fundal height (SFH) and abdominal girth (AG) in a relaxed uterus following bladder evacuation. The measurements were made in centimeters with the patient lying supine with both legs extended and hands by her side. The distal point of the SFH was designated as the highest point of the uterine fundus after the uterus had been centralised, starting from the middle of the upper limit of the symphysis pubis. For the AG, the woman's abdomen was measured by gently encircling it at the lower border of the umbilicus.

The placement of the foetal head was then determined by performing a pelvic examination. The vertex, the lowest portion of the foetal head, was classified as being in the minus station when it was higher than the ischial spines, the zero station when it was at the ischial spines, and the plus station when it was lower than the ischial spines.

All the measurements were used to calculate fetal weight by the following formulas:

JOHNSON'S FORMULA :

Fetal weight (grams) = 155 x (symphysiofundal height - X)

X= 12 at zero station X=11 at plus station X=13 at minus station

DARE'S FORMULA:

Fetal weight (grams) = Symphysiofundal height (SFH) x Abdominal Girth (AG)

HADLOCK'S FORMULA:

Log10BW= 0.3596 + (0.00061 × BPD × AC) + (0.0424 × AC) + (0.174 × FL) + (0.0064 × HC) - (0.00386 × AC × FL) HC = head circumference BPD = biparietal diameter FL = femur length AC = abdominal circumference The maximum distance between the back parietal bone's inner corner and the outside corner of the front parietal bone was assessed for BPD using electronic markers on the frozen image. The thalami were observed symmetrically on both sides, the cavum septum pellucidum was seen at a distance of 1/3 from the frontal occipital, and the falx cerebri echo was visible at the midline.

In femur, measurement was taken from greater trochanter and lateral condyle for FL, without accounting for the head of the femur and the distal epiphysis.

For measuring AC, the direction of the fetus's longitudinal axis was first established using its spine or aorta. On the platform where the umbilical vein was monitored at the front third, the stomach was monitored without monitoring the heart or the bladder, and measurements were recorded while also producing a chamber around the skin and an echo from one outer corner to the other.

In an axial plane that crossed the thalami and cavum septum pellucidum, at the same level as the BPD, the circumference of the head was measured around the outside of the calvarium. The transducer and the head's centre axis should be perpendicular to

each other. The cerebellar hemispheres shouldn't be on the image's plane.

In the event that the delivery did not occur within 7 days, additional measurements were obtained. Each case was followed through to birth, and as soon as the baby was delivered, the actual birth weight was recorded in grams. Each of the three formulas' estimated foetal weights was tabulated in a datasheet and compared to the newborn's actual birth weight. The estimated foetal weight (EFW) calculated using each of the three formulas was compared to the actual birth weight by using the independent t test. The one- way ANOVA and the Chi-Square tests were used to compare the average error in grams and % for each of the three formulations. A p- value of 0.05 was considered significant.

OBSERVATIONS

The mean age of study was 26.48 ± 4.52 years (Minimum 19 years; Maximum 45 years). Majority of patients were in between 20-30 years of age (71%), 20-25 years (37%) and 25-30 years (34%) as shown in Table 1.

Most of the women were at gestation age of 39-40 weeks (32%), followed by 38-39 weeks (29%); 37-38 weeks (22%) and >=40 weeks (17%).

Table No. 1 : Showing distribution of study population according to age, gestation in weeks, gravida and actual weight of newborn

Age (In Years)	**No. of Subjects**	**Percentage**
<20	3	3.0
20-25	37	37.0
25-30	34	34.0
30-35	22	22.0
35-40	3	3.0
40-45	1	1.0
Total	100	100.0
Mean Age: 26.48 ± 4.52 Years		
Period of gestation (In weeks)	**No. of Subjects**	**Percentage**
37-38	22	22.0
38-39	29	29.0
39-40	32	32.0
≥40	17	17.0
Total	100	100.0
Gravidity	**No. of Subjects**	**Percentage**
G1	31	31.0
G2	37	37.0
G3	17	17.0
≥G4	15	15.0
Total	100	100.0
Actual Birth weight in Grams	**Counts**	**Percentage**
<2500	7	7.0
2500-3000	53	53.0
3000-3500	33	33.0
3500-4000	6	6.0
>4000	1	1.0
Mean weight : 2958 ± 356.7 grams		

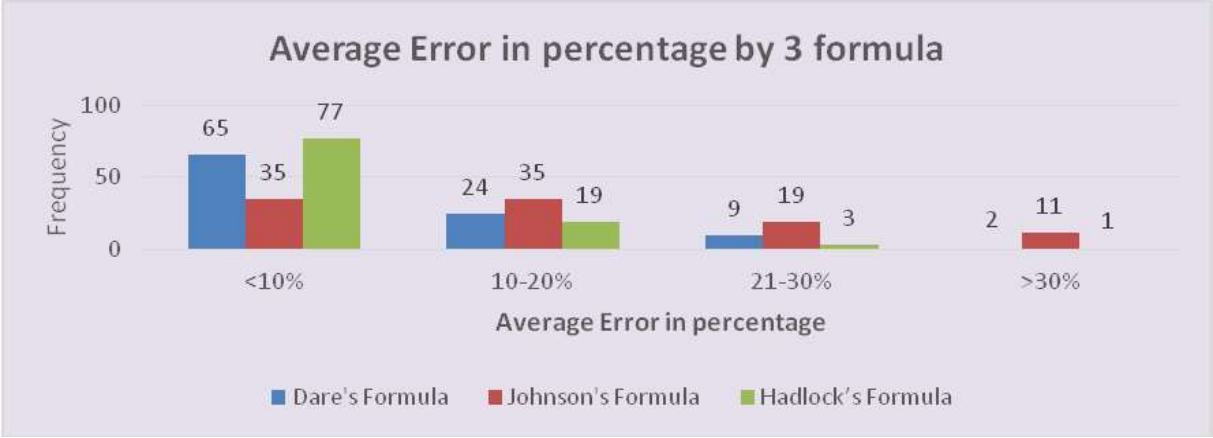
Table No. 1 shows that most of the women were second gravida (37%) and primigravida (31%) followed by third (17%) and fourth and more (15%). The majority of newborn belonged to 2500-3000 grams (53%) followed by 3000-3500 grams (33%). The mean actual birth weight (in grams) was 2958 ± 356.7 grams (Minimum 2300 grams; Maximum 4210 grams).

Table No. 2 : Showing estimation of fetal weight by Dare's, Johnson's and Hadlock's formula and comparison with actual birth weight

	Actual birth weight	Dare's Formula	Johnson's Formula	Hadlock's Formula
Mean fetal weight (in grams)	2958.8	3086.4	3363.2	2992.5
Standard deviation	356.7	244.71	168.97	314.54
Minimum	2300	2220	2945	2276
Maximum	4210	3672	3797.5	3785
Range	1910	1452	852.5	1509
Mean difference		127.59	404.42	33.72
Independent, t-test		p=0.008	p<0.001	p=0.83

Table No. 3: Average Error in Fetal Weight Groups by various methods

Actual birth weight (grams)	Average error by Dare's formula		Average error by Johnson's formula		Average error by Hadlock's formula	
	Grams	Percentage	Grams	Percentage	Grams	Percentage
<2500	**-426.86**	**-17.84**	**-830.29**	**-34.44**	**-80.43**	**-3.39**
2500-3000	**-265.94**	**-9.85**	**-546.7**	**-20**	**-126.53**	**-4.72**
3000-3500	**56.08**	**1.66**	**-217.03**	**-6.87**	**58.12**	**1.73**
3500-4000	**318.83**	**8.64**	**156.42**	**4.24**	**256.17**	**6.9**
>4000	**560**	**13.3**	**568**	**13.49**	**442**	**10.5**
One way ANOVA; p< 0.001						



DISCUSSION

The mothers in our study were 26.48 ± 4.52 years old on average. 2958±356.7 grams was the usual range for birth weight. Similar results were observed by various authors as shown in Table No. 4.

Table No. 4: Comparison of mean age of mother and mean birth weight of baby

Various authors and year of study	Sample size	Mean age of mother in years	Mean birth weight of baby in grams
Siddiqua et al [6] 2014	100	28.52± 2.60	3083.78 ± 447.03
Njoku C et al [7] 2014	200	28.86 ± 6.355	3242 ± 508
Aruna S et al [1] 2017	200	21.84 ± 2.298	2902 ± 412.275
Parvathavarthini K et al [8] 2018	100		2984.2 ± 490.3
Yadav SS et al [9] 2018	100	25	2780.6
Bano et al [10] 2019	50		2965
Our study	100	26.48 ± 4.52	2958.8 ± 356.7

In this study, we found that ultrasonographic procedures outperform clinical approaches for assessing foetal weight at term gestation. No discernible differences were seen in the Siddiqua SA et al.6 study for estimated foetal weights using various methods. A research by Baum et al.11 found that ultrasound was not substantially superior to clinical assessment of foetal weight at term. Titapant12 and colleagues claimed to have reached similar conclusions. Hendrix et al.13 found that clinical estimate was clearly more accurate than USG. Dare et al.14 obtained similar results.

The AG X SFH methodology and Hadlock's method had the lowest average error in calculating foetal weight in the vast majority of cases, according to Bhandari AA et al.15 The researchers came to the conclusion that ultrasound is the most trustworthy assessment method when they discovered that USG had the lowest standard deviation of prediction inaccuracy. Nonetheless, our research led us to the conclusion that Hadlock's method had the lowest average error, followed by Dare's formula and Johnson's formula. Similar results were found by Zahran M et al.16, which showed that ultrasonographic estimates were superior to clinical ones in the range of normal birth weights (2500-3999 grams). Ultrasonography performed noticeably better in determining foetal weight,as per a study by Lanowski JS et al.2 Additionally, it demonstrated that foetal weight estimates are more accurate when made by ultrasound professionals.

According to a study by Parvathavarthini K et al.8, Johnson's approach had the greatest percentage inaccuracy, followed by Dare's method and then USG method. The percentage error with USG was 6.4%, with Dare's approach 12.5%, and it was 16% with Johnson's method. In present study, average error in percentage was larger than 30% in 1% cases with Hadlock's computation, 2% with Dare's formula, and 11% with Johnson's formula.

According to Nayak et al.,17 USG had the lowest average error and its values were closest to those attained by Dare's method. The data showed that the results from Dare and USG were closer to actual baby weight. So, in areas where USG is not available, Dare's method can be considered the best alternative. As has been demonstrated in prior investigations, the current study also discovered that USG had the lowest percentage error and that an ultrasonographic estimate is more accurate than clinical estimates.

When compared to clinical procedures, USG had the lowest mean absolute percentage error (3.374 ± 3.245%), and this conclusion by Prajapati DG et al.5 was statistically significant (P value <0.0001). With an inaccuracy of 10% of the actual birth weight, the USG formula had the greatest estimations (95.59%), followed by Dare's formula (90.31%), and Johnson's formula had the lowest estimates (48.90%). This distinction was statistically significant as well. The Chi square test has a P value of 0.0000. In our investigation, the average error was less than 10% in 65% of the cases using Dare's

formula, 35% of the cases using Johnson's formula, and 77% of the cases using Hadlock's formula, as shown in Table No. 5.

These instances were 35.68% and 12.77% using Dare's and Johnson's formulas, respectively. Using Dare's formula in 22% of cases, Johnson's formula in 10% of cases, and Hadlock's formula in 34% of cases, the average error in the current investigation was <100 grams.

The study by Raghuvanshi T et al.18 shows that when evaluating EBW, USG had the lowest average error of all the formulas used. Njoku C et al.7 reported similar findings with USG estimating that EBW had the lowest average inaccuracy (293 grams). The average discrepancy between the EFW computed using Dare's and Hadlock's formula and the EFW computed using Johnson's formula was substantially higher in the current investigation as well.

According to Tiwari and Sood's study19, the average error for the AG SFH, Johnson's, and Hadlock's ultrasonography methods, respectively,

Table No. 5: Comparison of average error in percentage (<10%)

Various authors and year of study	Dare's	Hadlock's	Johnson's	Dawn's
Sherman et al [20] 1998	72%	69%		
Bhandari AA et al[15] 2004	67%	62%	41%	32.50%
Shittu AS et al [4] 2007	70%	68%		
Siddiqua et al [6] 2014	73%	73%	56%	
Aruna S et al [1] 2017	97.3%	91.3%	100%	
Parvathavarthini K et al [8] 2018	39%	45%	37%	
Prajapati et al [5] 2018	90.31%	48.90%	95.59%	
Bano et al [10] 2019	68%	46%	58%	34%
Our study	65%	77%	35%	

The findings of this study are not noteworthy for rich countries because they have sophisticated ultrasound technology that can accomplish complex tasks like measuring foetal weight, but they are very helpful for developing countries because they lack this technology. Nonetheless, there are qualified doctors who could do this function utilising clinical methods just as successfully. Therefore, domiciliary midwives can easily, affordably, and access clinical methods for assessing foetal weight.

Limitations of our study

The present study was also having few limitations like (i) Small sample size and (ii) Ultrasonography related issues like maternal obesity, oligohydramnios and anterior placentation. Also USG based fetal weight estimation requires costly and high quality equipment and trained personnel.

CONCLUSION

- All patients who are at term and when they are in labour, An EFW should be measured for their assessment with full awareness of the limitations of the methods for making such estimates.
- For management of labour and delivery in a term pregnancy, the birth weight estimation has acrucialrole.
- Of the three methods studied, USG (Hadlock's formula) has better predictable results in fetal weight estimation, compared to other two formulae, but when facilities for ultrasound are not readily available like in developing countries, clinical fetal weight estimation by Dare's formula is a better option than Johnson's formula.

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