International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979; Impact Factor: RJIF 5.72
Received: 08-11-2020; Accepted: 23-11-2020; Published: 09-12-2020
www.allsubjectjournal.com
Volume 7; Issue 12; 2020; Page No. 143-146

Fetal weight estimation by hadlock's formulae in third trimester and correlation of its accuracy for Indian fetuses

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Abstract
Objective: Several published formula Sexist forth e determination of estimated fetal weight (EFW), with limited data on their comparative accuracies. The aims of our study were to assess and compare the performance of different EFW formulas in predicting actual birth weight (BW) in subset of Indian population.
Methods: Live-birth singleton pregnancy with an EFW determined ultra sono graphically within 7 days of delivery and birth weight >500 g, gestational age >28 weeks were included in the study.
Six well known Hadlock's published formulas were used to calculate EFWs. The accuracy of the EFWs obtained from the different formulas were compared by mean percentage error methods.
Results: Hundered fetuses were included in the study. Formula IV of Hadlock *et al* had the best performance with least mean percentage error and good cornbach alpha correlation.
Conclusions: Six formulae show ed considerable variations. The choice of the appropriate formula for EFW in a given population should be based on objective and explicit criteria.

Keywords: fetal weight; formula; Indian babies

Introduction

The assessment of fetal growth is critical for prenatal care and for identification of at risk fetuses. Recognition of both fetal growth restriction (FGR) and large for gestation (LGA) is essential. Ultrasound plays a vital role in clinical decision making for many years despite its inaccuracies & considerable differences between the sonographic EFW and the actual birth weight (BW). There are several mathematical formulas that use different fetal structures to predict the fetal weight [1-15].Even under ideal sonographic conditions, may occur, with a mean error of 7% to 10% [16, 17] In the search to improve the ability to accurately predict BW from sonographic EFW, multiple EFW formulas have been published, but limited data exist on their comparative accuracies. Considerable variation in the EFW occurs with different formulas using the same fetal measurements. In fact, the large number of published weight formulas provides clear evidence that none of them are accepted universally. Improvement in the reliability of estimated fetal weight (EFW) may help improve clinical outcomes. There are several mathematical formulas that use different fetal structure linear measurements to predict the fetal weight.The accuracy and reliability of these formulas may differ and lowvalues can adversely affect physician's decisions. The accepted accuracy, or marginof error, between estimated and actual birth weight is $\pm$ 15 %. The H2adlock group developed at least seven regression models using different combinations of fetal parameters and found the mean deviation from actual birth weight to be a low 0.3 to 0.4% for all of their formulas but the accepted accuracy, or margin of error, between estimated and actual birth weight is ± 15%.The accuracy of any ultrasonic fetal weight formula is dependent on its 95% confidence limit.

The objective of this study was to compare the ability of different EFW formulas in predicting actual BW in an Indian subset of population by mean percentage error. The secondary objective was to compare cornbach alpha correlation for different Hadlock's formulas.

Materials and Methods

A bidirectional study design 100 pregnant singleton live term pregnancy with an EFW determined within 7 days of delivery and birth weight > 500g were considered eligible for the study and patients were enrolled retrospectively through our medical records in our obstetric and gynaecology unit during the time period of october 2019 to January 2020. Ethical committee approval taken. All eligible patients for this study were pooled into a single database. Actual BW, gestational age at delivery, and other clinical characteristics for this group had been collected prospectively and retrospectively. Cases with suspected fetal malformation or anomaly and women in active labour were excluded from the study. All the fetal biometric measurements were performed by single senior radiologist in the radiology unit of our hospital.The examinations were performed transabdominally using high-quality ultrasound systems (VolusonS8, GE Medical System).The biparietal diameter (BPD) was measured in a fetal head plane where the cavum septum pellucidum and falx cerebri could be seen. Cerebellum not included. The cursors were placed from leading edge to leading edge of the skull bones ('outer to inner'). The head circumference (HC) was measured at the outer perimeter of the calvarium, not including the fetal skin, in the same plane as the BPD.The AC measurement taken at the skin line on a true transverse view at the level of the junction of the umbilical vein, portal sinus, and fetal

stomach are visualized and the ribs are visualized symmetrically. Femur length (FL) was measured as the entire long axis of the diaphysis. Not including the cartilage at the ends of the femur in the measurement. Once we had the fetal biometric measurements (BPD, HC, AC, FL), we calculated the estimated fetal weight using different Hadlock formulae-Table 1.

Gestational age was calculated by the last menstrual period (LMP).The gestational ageat the delivery and the actual birth weights were obtained from the hospital's medical records. The newborn were weighed on an electronic weighing machineafter the delivery bynurses working in the delivery ward.

The results given by the electronic weighing machine were recorded to the patient's files. Calculation of Mean percentage error for each and calculation of Cronbach's alpha value to know the power of association. The errors in predicting fetal weight were expressed as a percentage of actual birth weight.The percentage error (PE) was calculated using the formula

$$PE(\%) = \frac{\text{Actual birth weight (ABW) - Estimated fetal weight}}{\text{Actualbirth weight}} \text{ X } 100$$

Table 1: Six Various Hadlock's formulae

Author	Parameters	Formulae
Hadlock I	BPD, HC, AC, FL	10^(1.3596 + 0.0064 * HC + 0.0424 * AC + 0.174 * FL + 0.00061* BPD * AC – 0.00386 * AC * FL) [g, cm]
Hadlock II	AC, FL	
		10^(1.304 + 0.05281 * AC + 0.1938 * FL – 0.004 *
Hadlock III	BPD, AC, FL	
		10^(1.335 – 0.0034 * AC * FL + 0.0316 * BPD +
Hadlock IV	HC, AC, FL	
		10^(1.326 – 0.00326 * AC * FL + 0.0107 * HC +
Hadlock V	BPD, AC	10^(1.1134 + 0.05845 * AC – 0.000604 * AC^2 – 0.007365 * BPD^2 + 0.000595 * BPD * AC + 0.1694 * BPD) [g, cm]
Hadlock VI	AC	10^(0.1 * AC^) [g, cm]

Table 1 showing six most commonly used Hadlock's formulae and the parameters used in each formula.

Table 2 showing the mean birth weight and standard deviation in each of the formulae.

Results

Hundred fetus meeting the inclusion criteria (sonography within 7 days of delivery) were evaluated for this study. The median gestational age was 38.2 ± 3.2 weeks. The median BW was 3011± 541 g and Median time duration from the last scan to the delivery was 4.3 ± 1.8 days.

Table 2: Mean Birth weight and standard deviation of various formulae

SL. NO	Birth Weight	Mean (Gm)	S.D
1	Actual birth weight	3011	541.92
2	AC/BPD/FL/HC (Hadlock I)	3006.35	550.8
3	AC/FL (Hadlock II)	2669.91	1433
4	AC/BPD/FL (Hadlock III)	3049.02	550.234
5	AC/FL/HC (Hadlock IV)	3000.78	548.229
6	AC (Hadlock VI)	3057.323	508.004
7	AC/BPD (Hadlock V)	3040.57	554.662

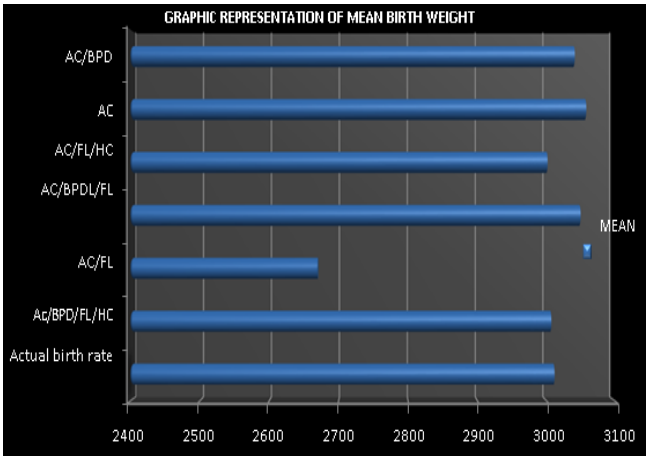

Fig 1: Bar diagram showing comparision of actual birth weight with mean estimated fetal weight by various models.

Table 3: Mean percentage error obtained with each of the formula.

SL. No	Model	Mean Perencentage Error	S.D
1	AC/BPD/FL/HC (Hadlock I)	0.556	13.234
2	AC/FL (Hadlock II)	2.489	14.085
3	AC/BPD/FL (Hadlock III)	1.567	13.51
4	AC/FL/HC (Hadlock IV)	0.379	13.177
5	AC/BPD (Hadlock V)	1.765	13.82
6	AC (Hadlock VI)	2.673	14.29

Table 3 showing the mean percentage error obtained with each formula. The lowest three MPE values were associated With Hadlock IV (AC/FL/HC) (0.37± 13.17), Hadlock I(HC/BPD/AC/FL)(0.55 ±13.23)

Table 4: Cornbach's alpha value for each of the formulae

Cronbach's alpha value	correlation
AC/BPD/FL/HC	0.869 (GOOD CORRELATION)
AC/FL	0.859(GOOD CORRELATION)
AC/BPDL/FL	0.867(GOOD CORRELATION)
AC/FL/HC	0.870(GOOD CORRELATION)
AC	0.841(GOOD CORRELATION)
AC/BPD	0.866(GOOD CORRELATION)

Table 4 showing Cronbach's alpha values showing the degree of correlation was highest in Hadlock IV (AC/FL/HC) (0.870) followed by Hadlock I (0.869). The Cronbach's alpha value shows the degree or the power of the correlation between correlation ($0.7 \leq \alpha < 0.9$ good correlation)

Discussion

Its observed that average baby weight show variation from one geographical region to region, from race to race and ethnicity playes a role an average Indian baby weighs 2.8-3 kg by 38-40 weeks. It is observed that up to 32 weeks the biometry - BPD, FL, AC, HC parameters do not differ much between other population and Indian standards. From 32 weeks onward the Indian babies weighs less than the western babies. In our study, Hadlock I (Cronbach's alpha = 0.869) and Hadlock IV (Cronbach's alpha = 0.87) and Hadlock III (0.867) formulas were associated with the perfect performance in predicting the fetal birth weight in all patients. A study done by Warrior [18] to compare the western formulae for Indian standard support the use of Indian based formula, they used a formula by Rajan R [19] and found a good correltion. Our study agrees with the suggestion by Altman, *et al* [20] for choosing an EFW formula.

Considering the possible problems of head moulding and BPD measuring this study suggests the use of: Hadlock FP, Harrist RB, Deter RL, Park SK (1982) – Formula incorporating HC/AC/FL Burd *et al* [21] compared the performance of 14 different formulas for prediction of fetal birth weight. They reported that Hadlock III showed the best performance according to the bias and precision method.Our study had some limitations. The main limitation was that it comprised of small group of population and it was a single institution study. However, we were able to adequately investigate the performance of various formulas in our population with a normal BW distribution.

On the basis of our findings, ultrasound centers should be encouraged to evaluate the performance of their chosen formulas in their populations. There is a evolving need to develop formula based on Indian population for Indian babies.

Conclusions

Six formulae show ed considerable variations. The choice of the appropriate formula for EFW in a given population should be based on objective and explicit criteria.

References

1. Campbell S, Wilkin D: Ultrasonic measurement of fetal abdomen circumference in the estimation of fetal weight. Br J Obstet Gynaecol. 1975; 82:689-697.
2. Combs CA, Jaekle RK, Rosenn B, Pope M, Miodovnik M, Siddiqi TA, *et al*. Sonographic estimation of fetal weight based on a model of fetal volume. Obstet Gynecol. 1993; 82:365-370.
3. Hadlock FP, Harrist RB, Carpenter RJ, Deter RL, Park SK. Sonographic estimation of fetal weight. The value of femur length in addition to head and abdomen measurements. Radiology. 1984; 150:535–540.
4. Hadlock FP, Harrist RB, Sharman RS, Deter RL, Park SK. Estimation of fetal weight with the use of head, body, and femur measurements– a prospective study. Am J Obstet Gynecol. 1985; 151:333-337.
5. Higginbottom J. Estimation of fetal weight. Ultrasound Med Biol. 1977; 3:59.
6. Merz E, Lieser H, Schicketanz KH, Harle J. [Intrauterine fetal weight assessment usingultrasound. A comparison of several weightassessment methods and development of a new formula for the determination of fetalweight]. Ultraschall Med. 1988; 9:15-24.
7. Ott WJ, Doyle S, Flamm S, Wittman J: Accurate ultrasonic estimation of fetal weight. Prospective analysis of new ultrasonic formulas. Am J Perinatol. 1986; 3:307-310.
8. Rose BI, McCallum WD: A simplified method for estimating fetal weight using ultrasound measurements. Obstet Gynecol 1987; 69: 671-675.
9. Shepard MJ, Richards VA, Berkowitz RL, Warsof SL, Hobbins JC: An evaluation of two equations for predicting fetal weight by ultrasound. Am J Obstet Gynecol. 1982; 142:47-54.
10. Thurnau GR, Tamura RK, Sabbagha R, Depp OR 3rd, Dyer A, Larkin R, *et al*. A simple estimated fetal weight equation based on real-time ultrasound measurements of fetuses less than thirty-four weeks' gestation. Am J Obstet Gynecol 1983; 145:557-561.
11. Vintzileos AM, Campbell WA, Rodis JF, Bors-Koefoed R, Nochimson DJ: Fetal weight estimation formulas with head, abdominal, femur, and thigh circumference measurements. Am J Obstet Gynecol. 1987; 157:410-414.
12. Warsof SL, Gohari P, Berkowitz RL, Hobbins JC. The estimation of fetal weight by computer- assisted analysis. Am J Obstet Gynecol. 1977; 128:881-892.
13. Warsof SL, Wolf P, Coulehan J, Queenan JT: Comparison of fetal weight estimation formulaswith and without head measurements.Obstet gynecol. 1986; 67:569-573.
14. Weiner CP, Sabbagha RE, Vaisrub N, Socol ML. Ultrasonic fetal weight prediction: role ofhead circumference and femur length. Obstet Gynecol. 1985; 65:812-817.
15. Woo JS, Wan MC. An evaluation of fetal weight prediction using a simple equation containing the fetal femur length. J Ultrasound Med. 1986; 5:453-457.
16. Colman A, Maharaj D, Hutton J, Tuohy J. Reliability of ultrasound estimation of fetal weight in term singleton pregnancies.NZ Med J. 2006; 119:U2146.
17. Scioscia M, Vimercati A, Ceci O, Vicino M, Selvaggi LE. Estimation of birth weight by two- dimensional ultrasonography a critical appraisal of its accuracy. Obstet Gynecol. 2008; 111:57-65.
18. Warrier HG, Ashokan KM. Fetal Biometry in Late 3rd Trimester for Gestational Age Indian Standards. International Journal of Scientific Study. 2016; 3(12):291-4.
19. Rajan R, Girija B, Vasantha R. Ultrasound fetal growth

parameters. J Obstet Gynecol India. 1991; 41(1):139-14.
20. Altman DG, Chitty L. Charts of fetal size: Methodology. Br J ObstetGynaecol. 1994; 101: 29-34.
21. Burd I, Srinivas S, Pare E, Dharan V, Wang E. Is sonographic assessment of fetal weight influenced by formula selection? J Ultrasound Med. 2009; 28:1019-1024.