

The accuracy of ultrasound in the estimation of the actual birth weight at term pregnancies in a sample from Erbil city

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Abstract

Background and objectives: Estimation of fetal weight is an important component of maternity health care, especially in the management and planning of the delivery mode, and this will play a big role in newborn and maternal safety. This study has been carried out for providing more knowledge about the accuracy of fetal weight estimation by ultrasound and its correlation with actual weight after birth.

Methods: This study was performed in the Radiology Department of the Maternity Teaching Hospital in Erbil city on 407 pregnant women with singleton and in term pregnancies from May 4th, 2015 to April 10th, 2016. The ultrasound examination typically involved estimating fetal weight by using both Hadlock's and Shepard's formula, and the actual birth weight of each participant's neonate was measured immediately after delivery by using a standardized neonatal weighing scale. This study was approved by the Research Ethics Committee of Hawler Medical University.

Results: Statistical analysis by t-test indicated that there was a significant difference between the actual birth weight and sonographic estimation of fetal weight using both formulas. The correlation between actual birth weight and sonographic estimation by Hadlock's formula was (R=0.869) while it slightly declined when Shepard's formula was used (R=0.805). Hadlock's formula showed a better relation with actual fetal weight. This study was showed higher correlation when the time of estimation was within seven days of delivery time, and it was about (R=0.921), and when the time of estimation became more than seven days from delivery, it was showed less correlation (R=0.811).

Conclusion: Hadlock's formula for estimation of fetal weight by ultrasound showed more accurate results, particularly within a time less than seven days from delivery date.

Keywords: Sonography; Pregnancy; Fetal parameters; Fetal weight.

Introduction

Estimation of fetal weight has an important role in maternity care especially in counseling, differential diagnosis, and management of labor and delivery mode,¹⁻³ and it has a great influence on fetal and neonatal morbidity,⁴⁻⁶ especially in the low birth weight, and macrosomic newborn. Since counseling on survival rate, route of delivery, and level of hospital care needed for each case based mainly or in part on the sonographic estimation of the birth weight.^{7,8} A variety of methods has been proposed for estimation of fetal weight, and the two main methods are clinical

and ultrasonography.^{1,2,7,8} Many studies indicated that ultrasonographic estimation of fetal weight gives a better result for prediction of fetal weight than other methods.^{1,2} A variety of formulas and parameters have been correlated with sonographic estimation of fetal weight,^{1,9,10,11} ultrasound examination involves measurement of different biometric parameters that are involved in a formula for calculating fetal weight. Most commonly, a combination of biparietal diameter, head circumference, abdominal circumference, femur length and other parameters are used in different formulas

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for fetal weight estimation. Shepard's and Hadlock's formulas are commonly used for fetal weight estimation; these formulas are included in most ultrasound equipment's.⁹⁻¹² Estimation of fetal weight from the Shepard and the Hadlock's formulas appear to have some variation from actual neonate weight as shown in many studies.^{2,10,12-14} In a study by Hadlock's et al found that combining of three parameters formula produced a more accurate result than the use of only two parameters formula.⁹ Conversely, other studies found no improvement in predictive accuracy over that of formulas using two parameters.^{13,14} There are many formulas and methods for fetal weight estimation by ultrasound, and there were still a percentage of errors in these formulas as shown in many studies^{1,10-12} which may affect the planning and management of delivery mode and maternal health. Therefore, this study was designed to determine the most accurate formula between Shepard's and Hadlock's for the estimation of fetal weight and its correlation with actual weight after birth in these methods in -term pregnancies.

Methods

This study was a prospective study conducted in the Radiology Department of Maternity Teaching Hospital in Erbil city on 407 pregnant women, from May 4th, 2015 till April 10th, 2016. The examination had been performed by a single radiologist, using PHILIPS ultrasound machine, 2-5 MHz convex transducer. Ultrasound examination typically involved measurement of different biometric structures that are incorporated into a formula for calculating estimated fetal weight (EFW). Most commonly, a combination of biparietal diameter (BPD), abdominal circumference (AC) were used in Shepard's formula and a combination of biparietal diameter (BPD), abdominal circumference (AC), and femoral length (FL) were used in Hadlock's formula,^{1,9,10} and all the data for fetal weight estimation

by both formulas were tabulated to be analyzed statistically. A term pregnancy is defined as the period of gestation from 37 completed weeks up to 41 completed weeks and six days.¹⁵ All estimates were based on the sonographic determination (0-7 days) before suspected delivery time^{10,12} and the time was extended in this study according to real delivery time and patient visit time for new sonographic examination. After delivery, the weight of each participant's neonate was measured within 30 minutes by trained assistants (nurses) using a standardized neonatal weighing scale. The estimated fetal weight was adjusted by adding 25g for each day between the ultrasound fetal weight estimation and delivery date.¹⁰ The sampling method is a nonprobability; convenient sampling involving 407 women with an uncomplicated singleton at term pregnancies (completed 37 weeks) with cephalic presentation and intact membranes. Their gestational age determination was calculated depending on their precise last menstrual period (LMP) and further confirmed by their early pregnancy ultrasound before 20 weeks. The pregnant lady was asked to empty her bladder, then lie down in the supine position. Pregnant women with obesity (BMI ≥ 30 kg/m²) or greater,^{16,17} premature rupture of membranes, antepartum hemorrhage, and congenital fetal anomalies were excluded as well as ladies with preeclampsia, oligohydramnios or polyhydramnios and uterine fibroids.^{2,6} The data were recorded and saved onto a computer and analyzed with the statistical package for the social sciences computer software (version 19.0). Paired Student's t-test was used for comparing the accuracy of sonographic fetal weight versus the actual birth weight. A *P* value <0.05 was regarded as significant and correlation coefficient were used to assess the relation between the two variables estimated and actual fetal weight.

Results

This study was performed on 407 adult pregnant ladies, their ages range were between 18 to 41 years, and their mean age was 28.5±4.1years. The gestational age of the newborn baby was between 37.2 and 41.4 weeks at the time of delivery. From Table 1 the following results can be concluded that the mean of the actual birth weight was (3231g) and their weight at

birth was between (2000-4500g), their estimated weight by ultrasound Hadlock's formula was between (2119-4175g) Their mean was 3268g, while the estimated weight by ultrasound Shepard's formula was between 2156g and 4180g and their mean was 3296g. The results from the Table 2 indicated that there were significant differences between the actual birth weights and the sonographic estimation in both formulas of the study,

Table1: The analysis of the main data in this study.

	Mean	Minimum-Maximum	Range	SD	C.V %
Gestational age (week)	39.1	41.4-37.2	4.2	1.018	2.6%
Actual birth weight (g)	3231	2000-4500	2500	479.080	14.8%
Estimated fetal birth weight (g) by Hadlock's formula	3268	2119-4175	2056	422.361	13%
Estimated fetal birth weight (g) by Shepard's formula	3296	4180-2156	2024	437.389	13.3%

Table 2: Statistical analysis by t-test for comparing fetal weight estimation in both Hadlock's and Shepard's formulas with actual birth weight.

	Mean	SD	Std. Error	Correlation	t-value	P value
Actual birth weight with / Estimated fetal weight by Hadlock's	3231 3268	237.469	11.771	0.869	3.071	0.002
Actual birth weight with / Estimated fetal weight by Shepard's	3231 3296	288.871	14.319	0.805	4.478	0.001
Estimated fetal weight by Hadlock's / Estimated fetal weight by Shepard's	3268 3296	159.912	7.927	0.931	3.528	0.001

and it showed high correlation ($r=0.869$) between actual birth weight and sonographic estimation by Hadlock's formula (Figure 1) while the correlation declined in Shepard's formula ($r=0.805$) with actual birth weight as shown in Table 2

and Figure 2. This result indicated that weight estimation by Hadlock's formula showed a better correlation with actual fetal weight, and the correlation between the two formulas was about 93.1%.

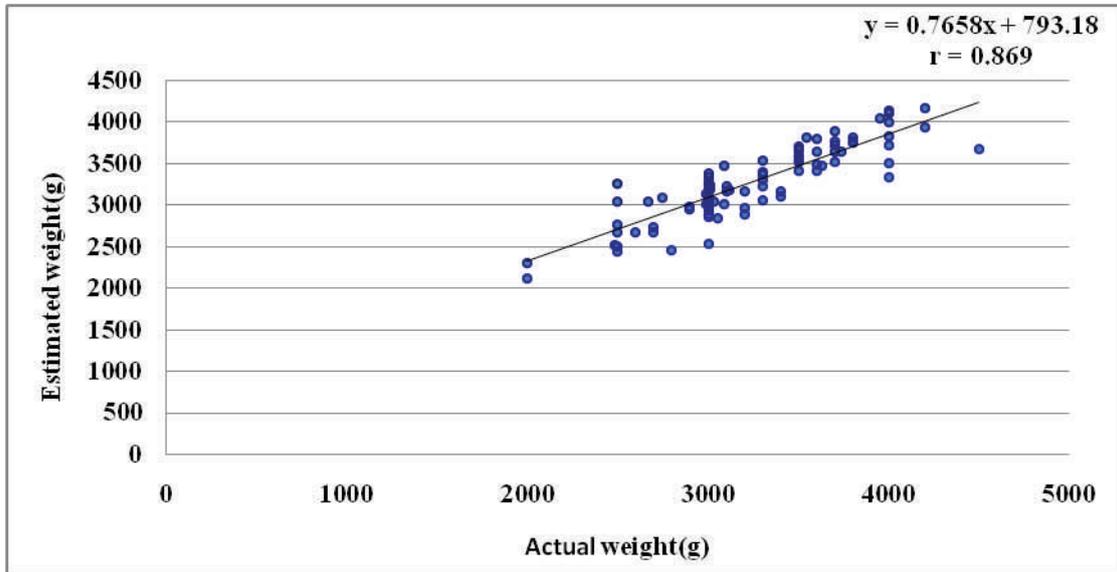


Figure 1: The correlation between actual birth weight and estimated weight by Hadlock's formula.

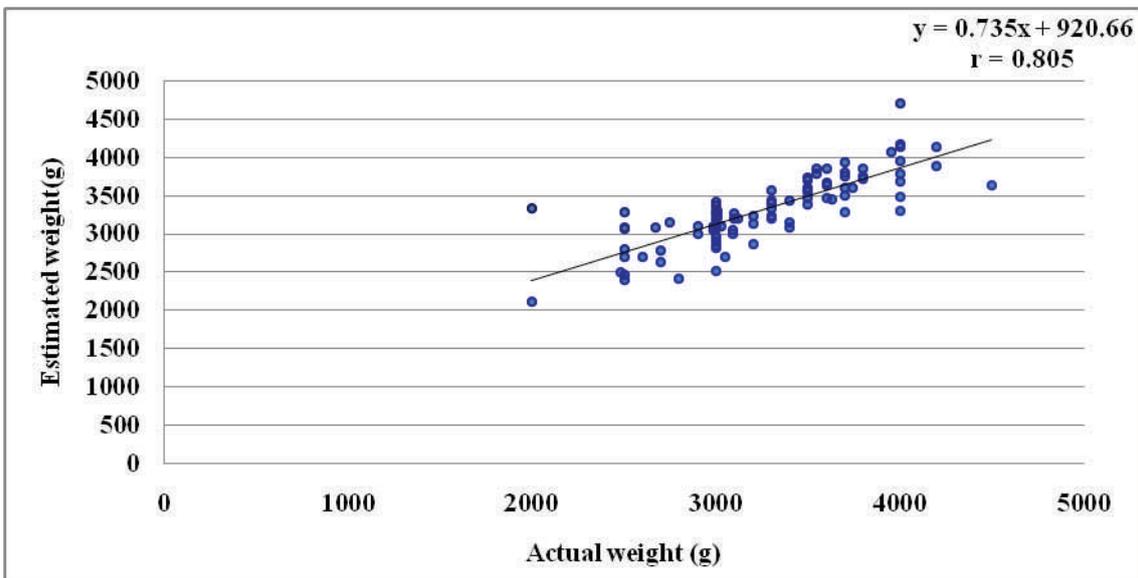


Figure 2: The correlation between actual birth weight and estimated weight by Shepard's formula.

The results in Table 3 indicates that there was a significant difference between the estimated weight and actual weight in both periods of time, and the correlation was higher ($r=0.921$) when the time of estimation was less than seven days from the delivery time, and it was decreased to ($r=0.811$) when the time of estimation become more than seven days. The results from Table 4 showed that there was a significant difference in actual birth weights between genders and the mean weight of male newborn babies was 3303g which was greater than female in this study while in female was 3160g.

Discussion

Accurate estimation of fetal weight by sonography is considered as one of the most significant findings, which provide a significant role in growth assessment and help for determination of the mode of delivery which has a great effect on

maternal and neonatal safety.^{1,2,12} The mean of actual birth in this study was 3.231 kg which was nearly similar to the mean showed by many studies^{2,11,12}, and it was in agreement with normal range of birth weight of child standard by World Health Organization (WHO)^{18,19}, and this reflects conventional condition of maternal health, environment, and diet, and it was slightly less than mean of birth weight (2.482 ± 354.1 kg) of a study done in Erbil by Shahla at 2010 and some of other studies^{1,9,20} and this variation may be due to several factors which affect the birth weight such as demographic changes due to popular migration from other cities as a result of crisis in this region, socioeconomic changes at the period of study, also variation in sample size and regional change with other studies with environmental factors may play a role in this variation in birth weight. The estimated birth weight mean by Hadlock's formula

Table 3: The statistical analysis by t-test for actual birth weight and sonographic estimated of fetal weight by Hadlock's formula when the time of delivery less than one week or more than one week from sonographic estimation time.

	Mean (kg)	Correlation	St. Error	SD	t- value	P value
Actual birth weight fewer 7days	3231		31.56	454.17		
Estimated fetal weight by sonography less than seven days from delivery	3187	0.921	31.39	451.66	3.59	0.004
Actual birth weight more than seven days	3312		27.27	382.2		
Estimated fetal weight more than seven days from delivery	3109	0.811	35.51	498.53	3.89	0.027

Table 4: Statistical analysis by ANOVA test for actual birth weight in male and female.

	Mean	SD	SE	F- value	P value
Actual birth weight for male	3305	484.02	34.14		
Actual birth weight for female	3160	464.25	32.34	9.53	0.002

was 3.268 ± 422 , and by Shepard's formula was 3.296 ± 437 and when compared statistically with the actual birth weight it was found that there was a significant difference and this result agrees with many studies,^{1,9,10,12-14} which may be due to the following factors, the amount of differences which still present between actual birth weight and estimated weight by both formulas, *P* value of t-test is function of both the sample size and the difference between the two groups, so its significance may be attributed to the sample size in this study, and the percentage of errors that may have occurred when three-dimensional structures measured by a radiologist for determining these parameters AC, BPD and FL from two-dimensional images of ultrasound. In contrast to the study done in Nigeria by Charles et al. 2014 which showed no significant differences between the actual birth weight and the estimated fetal weight,²¹ this study showed the reversed, this may be due to the variation in the sample size and the time of sonographic estimation, in that study was within 72 hours from the date of their delivery. Furthermore considering the significant correlation between Hadlock's formula and actual birth weight in this study ($R=0.869$, $P < 0.05$) which support and agree with results of these studies^{1,2,13} as they showed a high correlation between estimated weight and actual weight, while the estimation of fetal weight by Shepard's formula yield lower correlation ($R=0.805$, $P < 0.05$) with actual birth weight and this result indicated that Hadlock's formula is more reliable in sonographic estimation of fetal weight, and this finding may be due to more measurement errors when we depend on fewer structures assessment, as there was anatomic and growth rate variation for different body structures which may affect the weight assessment by both formulas. This study concluded better sonographic assessment of weight when the assessment had been done in a time less than seven days as it was showed

higher correlation ($R=0.921$) and the correlation decline when this assessment was done in more than seven days ($R=0.811$), and this may be due to variation in growth rate of body structure which may be affected by many factors such as maternal diet, environmental factors, genetic causes and the way of assessment of birth weight by ultrasonic device according to these formulas, and this result agree with most study which advocated sonographic assessment of weight in time less than week from delivery time.^{1,2,10,11,13,20-22} This study found that the newborn male gender have greater weight than female newborn, and this result agrees with many studies^{18,23} that they found the same results which might be due to variation in growth rate, hormonal factor.

Conclusion

This study indicates that there was a significant difference between the actual birth weight and sonographic estimation of fetal weight using both formulas, so further modification for these formulas or finding a new way for the accurate assessment of birth weight still is in need. Estimation of fetal weight by Hadlock's formula showed a better correlation with actual birth weight than Shepard's formula. The results indicate greater correlation when the time of estimation of fetal weight was less than seven days of delivery time.

Competing interests

The authors declare that they have no competing interests.

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