Fetal Body Weight: How Far the Clinical and Sonographic Estimations Can Coincide and their Correlation with the Actual Birth Weight

Abdulrazak H. Alnakash, Deniz Rashad Mandan

Abstract

Objective: To evaluate how far clinical and sonographic fetal weight assessment done by obstetrician can coincide and outline their correlation with the actual birth weight of the newborn.

Study design and setting: This cross-sectional study was conducted at AL-Elwiya Maternity Teaching Hospital in Baghdad between Sept. 2009 to Sept. 2010.

Material and methods: The study sample consisted of 100 singleton term pregnant women (completed 38 weeks) with cephalic presentation and intact membranes; they were admitted for early labour or for induction of labour or cesarean section. Their gestational age determination depended on precise LMP and early pregnancy ultrasound (<20 weeks). Fetal weight estimation was done using Johnson's formula and sonographic weight estimation by Hadlock's formula. Immediately after delivery the newborns were weighed by using digital balance.

Results: Fetal weight estimation by clinical method is relatively accurate and comparable to ultrasound. The clinical fetal weight estimation is more accurate than ultrasound method when fetal weight is >3kg (p-value 0.907), while ultrasound is more accurate than clinical when fetal weight is <3kg (p-value 0.535).

Conclusion: Clinical fetal weight estimation is proved to be a relatively accurate and comparable to ultrasound. The study also proved that clinical estimation is better than ultrasound when actual fetal weight is more than 3 kg.

Key Words: Fetal weight, Johnson's formula, Hadlock's formula

Introduction:

Manual assessment of fetal size by the obstetrician is the oldest technique for estimating fetal weight and is also referred to as Leopold's maneuver. Worldwide, this method is used extensively because it is both convenient and virtually costless; however, it is a subjective method associated with notable predictive errors [1].

Findings from multiple studies have shown that ultrasonographic estimates of fetal weight are no better than clinical prediction, these observations have undermined early expectations that this method might provide an objective standard for identifying fetuses of abnormal size for gestational age [2,3].

Various calculations and formulas are based on clinical estimating fetal body weight including "*Johnson's formula*" for estimation of fetal weight in vertex presentation, it requires the height of the fundus in cm. and station level [**4]** .

Sonographic predictions of fetal weight are based on algorithms of fetal parameters, such as abdominal circumference, femur length and biparietal diameter i.e. Hadlock's Formula[5, 6].

Some formulas are based on measurement of the fetal head and abdomen (biparietal diameter & abdominal circumference), or using femur length instead of biparietal diameter for fetal weight estimation. While others added gestational age as a factor[6,7,8]. Most recent a three dimensional ultrasounds can be used to improve reliability of weight measurements[9].

Aim of study

To assess the accuracy of Johnson's formula (clinical formula) and Ultrasound method (Hadlock) in the estimation of fetal weight and their correlation to the actual birth weight.

Patients and methods:

This cross-sectional study was conducted at Al-Elwiya Maternity Teaching Hospital in Baghdad between Sept. 2009 and Sept. 2010.

The study protocol was approved by the Obstetrics and Gynecology committee of the Iraqi Board for Medical Specialization and the Hospital Administration.

The study sample consisted of 100 women with uncomplicated singleton term pregnancy (completed 38 weeks) and cephalic presentation and intact membranes. Their gestational age determination recalculated depending on their précised LMP and further confirmed by their early pregnancy ultrasound (<20 weeks). After initial assessment and performing clinical and sonographic fetal weight estimation, they were directed to the labour ward or to the operating theatre according to the mode of delivery planned. The exclusion criteria including, oligohydramnios or polyhydramnios, pregnancy with uterine fibroids or any abdominal mass and when there is fetal malformations.

Clinical weight estimation:

The patient is asked to empty her bladder then lie on her back with her legs extended to measure her symphyseal-fundal height using tape measure. Then pelvic examination is done to evaluat**e** degree of descent of the fetal head into pelvis. Both symphyseal-fundal height and fetal station are recorded on the individual data sheet to be used later for fetal weight calculation according to Johnson's formula. Fetal weight (gm) ={fundal height(cm)-n}*155.

N =13 when presenting part was not engaged.

N=12 when presenting part was at 0 station.

N=11 when presenting part was at +1 station.

Ultrasound fetal weight estimation:
Using the obstetric ultrasound scan that included measurement of biparietal diameter, abdominal circumference and femoral length. The ultrasound fetal weight can be calculated automatically by the equipment set, using Hadlock's reference table.
Immediately after delivery the infant were weighed using a digital balance.

Statistical Analysis
The fetal weights obtained by the three methods (clinical, ultrasound and the actual) were subjected to comparison and analysis using Minitab version 13 software. The following analyses were done: Descriptive statistics: mean, standard deviation, minimum and maximum. Inferential statistics: T-test was used P-value <0.05 considered to be statistically significant.

Results:
Table1: shows the different data obtained from the study which includes:
Mean fetal weight, standard deviation, minimum and maximum fetal weight.
Table 2: shows comparison between mean clinical fetal weight and mean of ultrasound weight. There was significant difference between the 2 weight estimation (P-value 0.00), which mean that clinical fetal weight estimation is superior to ultrasound estimation.
Table 3: compares between ultrasound fetal weight and actual fetal weight, there was significant difference between the two groups (P-value 0.00), which mean that ultrasound estimation of fetal weight is accurate when compared with the actual weight.
Table 4: compare between clinical fetal body weight and actual fetal weight. There was no significant difference between the two groups (p-value 0.276), which mean that clinical fetal weight estimation is relatively accurate method for fetal weight estimation.
Table 5 A and B: show the estimated fetal weight by the three methods when the actual weight is more or less than three kilograms. The ultrasound fetal weight estimation using Hadlock's formula is more accurate (closer to the actual weight) when the fetal weight is less than three kilograms (P value 0.535). While the clinical fetal weight estimation using Johnson's formula is more accurate when the actual weight is more than 3 kilograms (P value 0.907).

Table 1: Fetal weight estimation by the three methods (ultrasound, clinical and actual fetal weight)**.**

	Clinical Weight (gram)	Ultrasound Weight	Actual Weight
Mean	3457	3109	3376
SD	$^{+}$ 559.8	375.5	486.9
Minimum	1700	2100	2200
Maximum	4400	4200	5000

Table 2: Comparison between clinical and ultrasound fetal weight assessment

	clinical weight	Ultrasound weight
Mean	3457	3109
SD	$^{+}$ 560	376
p-value	0.0001	
C.I	215-481	

Table 3: Comparison between ultrasound and actual fetal weight

	Ultrasound weight	Actual weight
Mean	3109	3376
SD	$^{+}$ 376	487
P-value	0.0001	
C.I	-388_-145.7	

Table 4: Comparison between clinical and actual fetal weight

	Clinical weight	Actual weight
Mean	3457	3376
SD	560	487
P-value	0.276	
C.I	65.3_227.3	

Table 5. A: Difference between ultrasound and actual fetal weight more or less than 3 kg.

Body weight < 3 kg		
	Ultrasound weight	**Actual Weight**
Mean	**2888**	**2843**
SD	**310**	**252**
P value	**0.535**	
Body weight > 3kg		
Mean	**3213**	**3627**
SD	**360**	**349**
P value	**0.0001**	

Table 5. B: Difference between clinical and actual fetal weight with body weight more or less than 3 kg.

Body weight < 3 kg		
	Clinical weight	**Actual weight**
Mean	**3000**	**2843**
SD	**484**	**252**
P value	**0.010**	
Body weight >3 kg		
Mean	**3635**	**3627**
SD	**504**	**349**
P value	**0.907**	

Discussion:

Birth weight is the principal variable affecting fetal and neonatal morbidity, especially in the preterm and small-for-date fetus. It is also of value in the management of breech presentation, diabetes, trial of labour, twins [1].

In our study we used two methods for estimation of fetal body weight, first depends on clinical measurement of fundal height by Johnson's formula and the other by ultrasound using Hadlock's formula. In their original publication in1954, Johnson and Toshach reported that fetal weight was within 353g of the actual birth weight in 68% of their 200 cases [10].

We report that fetal weight was within about 300-500g of actual birth weight in 70% of 100 cases. Similarly, Mhaskar, et al. found the estimated weight by using Johnson's formula of an average 310g higher than actual weight [4].

In this study a comparison was done between the estimated clinical and ultrasound fetal body weight, the predictive value was 0.0001 which means that there was a significant difference between the two weights, the clinical fetal body weight is more comparative than ultrasound body weight with the actual weight, and this goes with the study of Sauceda Gonzales et.al [11], who reported in a multicenter study involving 504 full-term patients, and it is in agreement with other studies confirmed that Johnson's formula correctly predicts actual birth weight. Cury and Garria[12] reported that using Johnson's formula was as accurate as ultrasound estimation.

We observe that Johnson's formula is not very accurate if estimated fetal weight is <3kg as shown in table 5, (p-value (0.010)) this means that there is a significant difference between clinical fetal weight estimation obtained by Johnson's formula and the actual birth weight, and this goes with Watchree Numpraset [4], who mentioned that fetal weight estimation using Johnson's formula is not sufficiently accurate in small for gestational age babies (weight <2500g).

We observed that ultrasound estimation is more accurate than Johnson's formula when fetal weight is <3kg as shown in table 6, (p-value 0.535) this means that there is no much difference between ultrasound and actual fetal weight, this is more explained by the study done by Juozas Kurmanavicius [13] who proved that in low birth weight groups, Hadlock's formula had systemic errors under 5%, which is nearly zero in this birth weight group. Moreover Hadlock's formula underestimates fetal weight in birth weight groups over 3 kg. Generally underestimation of fetal weight can be explained by technical problems in estimation of abdominal circumference. At this weight category the entire abdomen not always fit on the display [13].

Conclusion:

Clinical fetal weight estimation is proved to be relatively accurate and comparably to ultrasound in measuring fetal weight when compared with the actual weight after delivery. The study also proved that clinical estimation is better than ultrasound when actual fetal weight is more than 3 kg.

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** Professor MBChB, FICOG, CABOG*
Consultant Obstetrician and Gynecologist
Department of Obstetrics and Gynecology
Alkindy Medical College/ Baghdad University
Al-Elwiya Maternity Teaching Hospital
Email: razaknakash@yahoo.com
Tel: 07901311564
*** MBChB Candidate of Iraqi Board*
Senior Registrar at Al- Elwiya Maternity Teaching Hospital