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Comparison of clinical and ultrasonographic estimation of foetal weight at term and their correlation with birth weight

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Abstract

The study compares the accuracy of clinical and ultrasonographic estimation of foetal weight at term in predicting birth weight. It was a prospective comparative study conducted in a tertiary hospital in Abuja, Nigeria between May and August 2018. Three hundred pregnant women planned for delivery were recruited. In-utero clinical estimation of foetal weight was carried out using Dare's clinical method and sonographic estimation using Hadlock 3 formula. The newborn babies were weighed within 30 minutes of delivery. The difference in the accuracy of the clinical method (75.3%) and the ultrasonographic method (82.3%) was statistically significant (p-value=0.023). The accuracy of the clinical method among parturients whose BMI were <30kg/m^2 and ≥30.0kg/m^2 were 83.5% and 68.5% respectively while that of the ultrasonographic method were 85.2% and 80% respectively. We conclude that ultrasonographic estimation of foetal weight is more accurate than the clinical method. However clinical method may be used when an ultrasound scan is not accessible. *(Afr J Reprod Health 2021; 25[4]: 108-117).*

Keywords: Birth weight; estimated foetal weight; Dare's formulae, Hadlock formulae

Résumé

L'étude compare l'exactitude de l'estimation clinique et échographique du poids fœtal à terme dans la prédiction du poids à la naissance. Il s'agissait d'une étude comparative prospective menée dans un hôpital tertiaire à Abuja, au Nigeria, entre mai et août 2018. Trois cents femmes enceintes dont l'accouchement était prévu ont été recrutées. L'estimation clinique in utero du poids fœtal a été réalisée à l'aide de la méthode clinique de Dare et l'estimation échographique à l'aide de la formule Hadlock 3. Les nouveau-nés ont été pesés dans les 30 minutes suivant l'accouchement. La différence dans la précision de la méthode clinique (75,3 %) et de la méthode échographique (82,3 %) était statistiquement significative (valeur p = 0,023). La précision de la méthode clinique chez les parturientes dont l'IMC était <30kg/m2 et ≥30,0kg/m2 était respectivement de 83,5% et 68,5% tandis que celle de la méthode échographique était de 85,2% et 80% respectivement. Nous concluons que l'estimation échographique du poids fœtal est plus précise que la méthode clinique. Cependant, la méthode clinique peut être utilisée lorsque l'échographie n'est pas accessible. *(Afr J Reprod Health 2021; 25[4]: 108-117).*

Mots-clés: Poids à la naissance ; poids fœtal estimé ; les formules de Dare, les formules de Hadlock

Introduction

The usefulness of accurate estimation of foetal weight in pregnancy and labour has been well established. It enables obstetricians to take appropriate decisions about time, mode, and place of delivery thereby reducing the rates of adverse pregnancy outcomes[1].

Over time various methods have been assessed for their usefulness in predicting actual birth weight. None of the methods have proven to be perfect. Maternal self-estimation of foetal weight by multiparous women who are literate has been shown to be comparable to both clinical and ultrasound predictions in term pregnancies[2-4]. Different clinical methods used to predict foetal weight in-utero have been employed by researchers. Ojwang *et al.* used the product of symphysis-fundal height (SFH) and abdominal girth (AG) measurements at different levels in centimetres above the symphysis pubis in obtaining a fairly acceptable predictive value but with considerable variation from the mean[5]. Dare *et al* used the product of the symphysis-fundal height and abdominal girth at the level of the umbilicus measured in centimetres and result expressed in grams as estimated foetal weight (EFW) at term in-utero, and the estimate correlated well with birthweight[6]. Other clinical methods include the use of Johnson's formula, McDonald's equation, and Dawn's Formula[7]. There is no consensus on the best clinical method for foetal weight estimation. However, Dare's formula is used by some Authorities in clinical foetal weight estimation[3,8].

The use of ultrasound to estimate foetal weight gained popularity because of the perceived ability to standardize and reproduce measurements[7,9]. The advantage of this technique is that it relies on linear and/or planar measurement of in-utero foetal dimensions including biparietal diameter (BPD), abdominal circumference (AC), and femur length (FL) that are defined objectively and are reproducible. However, the technique can be challenging, depending on the mother's physique, uterine anomalies, placenta location, and amniotic fluid volume as well as the skill of the operator. The paucity of functional ultrasound and expertise in many health facilities in developing countries especially in the primary health centres where most deliveries occur is a major challenge in the application of this method. There are different sonographic equations based on foetal biometric measurements for estimating foetal weight. However, Hadlock regression formulae have been shown to have reasonable accuracy in foetal weight estimation[7,10].

The early expectation that ultrasonography might provide an objective standard for estimating foetal weight has not materialised as studies comparing the accuracy of ultrasonographic and clinical estimation of foetal weight did not show consistent results. While some studies indicated that ultrasonographic foetal weight estimation is superior especially with an increase in maternal BMI[4] others showed it to be similar in accuracy to clinical methods[13-15].

The effect of maternal body mass index (BMI) upon estimated foetal weight (EFW) accuracy is an important clinical consideration. Some studies have demonstrated that high BMI is associated with decreased clinical estimated foetal weight accuracy and that ultrasonographic estimation tends to have better accuracy at higher BMI[16-18] while others did not show these associations[13,15].

Another important clinical consideration is the influence of actual birth weight categories on the accuracies of clinical and ultrasonographic estimation of foetal weight. Studies on the influence of birth weight categories on the accuracy of both clinical and ultrasonographic estimation of foetal weight showed different results. Some studies indicate that the clinical method is best for estimating foetal weight in the normal reference range of 2500-4000g[3,19]. The accuracy of clinical palpation for estimating foetal weight less than 2500g is low, while ultrasonographic estimation show superiority over clinical methods[15,18,19].

As we strive to improve the quality of obstetrics care in our practice, the need to determine the most accurate methods of predicting the actual birth weight of newborns has become imperative. This study is aimed at determining and comparing the accuracies of clinical and ultrasonographic methods of foetal weight estimation. The influence of body mass index and actual birth weight categories on the accuracy of the methods were also investigated.

Methods

Setting

The study was conducted in the Obstetrics and Gynaecology Department of National Hospital, Abuja, Nigeria, which is a major referral tertiary centre for most hospitals in Federal Capital Territory, Nasarawa State, Niger State, and Kogi State of Nigeria. There are about 1,500 deliveries per year in this hospital.

Study population

Subjects were consented pregnant women at term admitted for delivery, who are either in the latent phase of labour, planned for induction of labour or elective caesarean delivery. A total of 346 parturients presented for the study but only 300 consented and eligible pregnant women participated in the study. All the 300 pregnant women completed the study. There was no loss to follow up as the study started on their admission and ended before they were discharged from the hospital.

The inclusion criteria include singleton pregnancy at term, in the latent phase of labour, live foetus in a longitudinal lie. The exclusion criteria include eclampsia, antepartum haemorrhage, the active phase of labour, ruptured membrane, fibroid in pregnancy, polyhydramnios/oligohydramnios, multiple pregnancy, abnormal lie, foetal congenital anomaly, and unbooked patient with an unsure date and no early scan.

Study design

This is a prospective comparative study that evaluated the accuracy of clinical and sonographic estimation of foetal weight at term. This study was carried out over four months period from May to August 2018. Patients' selection was based on a consecutive sampling method in which all eligible parturients on admission into the antenatal ward for delivery at term who consented for the study were selected. The women had their gestational age determined by the last menstrual period and/or ultrasound scanning done before 20 weeks. The data collection sheet was used to obtain information on socio-demographic characteristics, clinical parameters, and ultrasonographic parameters.

General physical examination and obstetric examination were carried out to validate some of the inclusion and exclusion criteria. The patients' height and weight were measured and the BMI was calculated. In-utero clinical estimation of foetal weight was done using a flexible tape measure calibrated in centimetre to measure the symphysio-fundal height and abdominal girth at the level of the umbilicus and the product of the two was calculated and used as foetal weight in grams [6]. The measurements were recorded on the data collection sheet.

Patients' selection, patients' recruitment, obtaining written informed consent, socio-demographic data collection, and general physical and obstetric examination to validate the inclusion and exclusion criteria were done by the researcher and research assistants. Measurements to determine the patient's body mass index and clinical foetal weight assessment were done by the researcher and/ or research assistants. The sonological foetal weight estimation was done by the researcher and/or sonologist recruited and trained for this study. The researcher had three months of training on obstetric ultrasound scanning before the commencement of this study.

Ultrasonographic estimation of foetal weight was performed with an ultrasound machine by Philips, a 3D, and 2016 model and, using an abdominal sector transducer of 3.5MHZ. Its formula for estimating foetal weight was that devised by Hadlock 3 on the basis of biparietal diameter (BPD), abdominal circumference (AC), and femur length (FL)[20].

After delivery, trained midwives weighed the newborn babies within 30 minutes of delivery employing a standard analogue Waymaster (England) scale corrected to zero error. These were cross-checked by the researcher or any of the resident doctors recruited for this study. The birth weight was recorded on the patients' partograph from where it was transferred to the data collection sheet. The interval between the clinical and sonographic estimation of foetal weight in-utero and delivery of babies was limited to 36 hours. Patients that were not delivered within 36 hours were re-evaluated and a repeat measurement was taken.

Performance biases were minimized by ensuring that the assessors of clinical foetal weight estimation, sonographic foetal weight estimation, and actual birth weight measurement adhered strictly to the standard procedures. To achieve this, two senior residents in the radiology department, two resident doctors in Obstetrics and Gynaecology department, and two midwives in labour ward were trained as research assistants and used for the study. Midwives were trained on the proper way of weighing and measuring height. The residents were trained on the process of obtaining informed consent, documentation, and weighing methods. The midwives were responsible for confirming that the consent form was signed, weighing the patient, measuring the height and the weight of babies after delivery.

The residents were responsible for counselling patients, documentation and obtaining written informed consent, and crosschecking the measured weight, height, and foetal weight. The clinical and sonographic foetal weight estimations were done by the principal researcher and senior resident doctors (radiologists) as well as the confirmation of the weight of the babies after delivery. Detection and measurement biases were minimized by doing the sonographic estimation first and ensuring that the parameters for calculating the clinical estimation were confirmed by a second person as well as that of the actual birth weight.

Clinical estimation of foetal weight

The participants emptied their bladder before the researcher measured their symphysis-fundal height

(SFH) and abdominal girth (AG) using a flexible, non-elastic simple metric tailors' tape and each measurement was rounded to the nearest centimetre. Both measurements were performed with the patient lying flat on her back, her head slightly raised on a comfortable pillow and her legs extended. Each measurement was taken twice to minimize intra-observer error.

Symphysis-fundal height was measured in the midline from the highest point on the uterine fundus to the upper border of the symphysis pubis using the thumb and index fingers to sustain tape while attempting to reach the upper border of the symphysis pubis. Measurement was made using the tape reverse-side up to forestall any bias and readings taken from the perpendicular intersection of the tape with the fingers.

Abdominal girth (AG) was measured with the same non-elastic tape repositioned to encircle the woman at the level of the umbilicus with minimal pressure to tighten the tape around the abdomen. Measurement was taken at the end of the normal expiration phase of respiration with the tape reverse-side up as previously done for SFH measurement.

The estimated foetal weight was calculated using Dare's formula in which the product of the symphysio-fundal height and abdominal girth in centimetre made is equivalent to the foetal weight in grams[6].

Ultrasonographic estimation of foetal weight

A 3.5MHz transducer was used for ultrasonographic assessment. The transducer is placed perpendicularly to the plane of the floor and aligned longitudinally with the patient in the supine position. During the ultrasonographic assessment, a general obstetric scanning was done to validate the inclusion criteria. These include the number of foetus(es), gestational age, foetal wellbeing, presentation, lie, placental localization, and amniotic fluid volume. The amniotic fluid volume was assessed using the amniotic fluid index which is obtained by measuring the vertical depth (mm) of the largest cord-free amniotic fluid pocket in the four quadrants of the uterus and the sum of the four measurements was the amniotic fluid index[20].

The foetal weight was obtained by measuring the biparietal diameter (BPD), abdominal circumference (AC), and femur length (FL). The biparietal diameter was taken from trans axial sonograms of the foetal head at the level of the paired thalami and cavum septum pellucidum. The biparietal diameter was measured from the outer edge of the cranium nearest the transducer to the inner edge of the cranium. The foetal abdominal circumference was the length of the outer perimeter of the foetal abdomen measured on a plane perpendicular to the foetal spine which intersects only a small portion of the umbilical vein; the stomach is also seen at this plane. The femur length was assessed by measuring the length of the diaphysis of the foetal femur. The ossified diaphysis was measured carefully in order to obtain an accurate estimate of the length. The portion of the femur measured was from the greater trochanter to the femoral condyles. The foetal weight estimate was computed by an in-built calculation based on Hadlock 3 formula[20].

Birth weight

After delivery, trained midwives weighed the newborn babies within 30 minutes of birth employing a standard analogue Waymaster (England) scale corrected to zero error. These were cross-checked by the researcher or any of the resident doctors involved in the study. The actual birth weight was recorded to the nearest 0.1gm. The interval between the clinical and ultrasonographic estimation of foetal weight in-utero and delivery of babies was limited to 36 hours. Patients that were not delivered within 36 hours were re-evaluated and repeat measurement was taken.

Sample size determination

The sample size was determined by the formula [21]

$$n = \left\{\frac{Z\alpha\sqrt{\pi0(1-\pi0)} - Z\beta\sqrt{\pi1(1-\pi1)}}{\pi0-\pi1}\right\}^2$$

n = minimum sample size of each arm of the study group.

α = probability of making Type 1 error

The value of α was set at 5% level (i.e. 0.05)

β = probability of making Type 2 error

The value of β was fixed at 20% (i.e. 0.2)

Zα is two-tailed value of Z related to α = $\pm$ 1.96

Zβ is one-tailed value of Z related to β = - 0.84

π_0 is the proportion associated with α (standard value) i.e. proportion of ultrasound estimation of foetal weight within 10% of ABW. 80% (Upper limit of the quoted range in literature)[22] was used for this study.

π_1 is the proportion anticipated i.e. proportion of clinical estimation of foetal weight within 10% of

ABW. 70% (value for the study done in OAUTH, Ile-Ife)[23] was used for this study.

$$n = \left\{\frac{1.96\sqrt{0.8(1-0.8)} - -0.84\sqrt{0.7(1-0.7)}}{0.8-0.7}\right\}^2$$

n = 136.66 subjects

Making provision for attrition of 10% i.e. approximately 13.666

Sample size = 136.66 + 13.666 = 150.326 i.e. approximately 150 subjects.

A total sample size of Three Hundred (300) participants was used for this study using the doubling effect in other to increase the power of this study

Data collection

The study data collection sheet was used to obtain information on socio-demographic characteristics, findings on examination, clinical and ultrasonographic parameters for foetal weight assessment. The socio-demographic data obtained includes age, parity, booking status, patient's occupation and educational status, gestational age as calculated from the last menstrual period or early ultrasound dating before 20 weeks gestational age.

Data analysis

The data obtained were recorded in a computer and analysed using the Statistical Package for Social Sciences (SPSS) software package (version 23; Chicago, Illinois, USA). Accuracy of foetal weight estimation was determined by calculating -

(i) the mean absolute estimated foetal weight error, defined as the mean absolute value of the estimated foetal weight minus the mean actual birth weight (EFW-ABW)

(ii) the mean absolute percent error, defined as the mean absolute estimated foetal weight error divided by the mean actual birth weight multiplied by 100 (EFW-ABW) x 100/ABW

(iii) the absolute percent error ±10% of ABW (i.e. proportion of foetal weight that is within ±10% of the actual birth weight)

Statistical significance was elicited using the chi-square test and student's *t*-test, where necessary. A p-value of < 0.05 was taken as statistically significant.

A subgroup analysis based on pre-set BMI categories defined using non-pregnant norms: underweight (BMI<18.5kg/m^2), normal weight (BMI=18.5-24.9kg/m^2), overweight (BMI=25.0-29.9kg/m^2), obesity (BMI=30.0-39.9kg/m^2) and morbid obesity (BMI≥40.0kg/m^2) was done. Another subgroup analysis based on pre-set ABW categories defined as low birth weight (ABW<2500g), normal birth weight (ABW=2500-3999g) and macrosomic baby (ABW≥4000g) was also undertaken.

Results

All the 346 consenting women who presented for delivery during the period of the study were screened. A total of three hundred parturient were recruited and all participated in the study. There was no loss to follow-up as the study was completed before they left the hospital. The mean maternal age was 28.9 ± 5.1 years, mean gestational age was 38.9 ± 1.1 weeks, median parity was 1, and mean maternal BMI was 30.9 ± 4.4 kg/m^2 (Table 1). About 38% of the subjects were multiparous, 32.0% were primiparous, 27.7% were nulliparous and grand multiparous were only 1.4%. The mean birth weight of the newborns was 3360 ± 387.4g (ranged 2450 - 4600). Among the neonates 94.0% (282/300) had normal weight, 5.7% (17/300) were macrosomic and 0.3% (1/300) of the babies had low birth weight.

As shown in Table 2, the two methods of foetal weight estimation, generally overestimated the birth weight except for macrosomic babies where the ultrasonographic method underestimated the birth weight. The over-estimation was significantly higher with the clinical method than the Ultrasonographic method. The clinical method has a significantly higher mean percentage error compared to the ultrasonographic method (8.8% vs 2.6%; P < 0.0001). Also, the proportion of estimates within 10% of actual birth weight in the clinical method were significantly lower than the ultrasound method (75.3% vs. 82.3%; P=0.023). The two methods of estimation of foetal birth weight positively correlated actual birth weight with an ultrasonographic method having a correlation coefficient, r = 0.806, and clinical method with r = 0.831. Table 3.

For babies with normal weights (2500-3999g), the two methods of estimation over-estimated the actual birth weight by varying degrees. The proportion of estimates within 10% of actual birth weight for the ultrasonographic method (82.3%) was significantly higher than the clinical method (74.1%) and P=0.012. Likewise, there was a strong positive correlation between birth weight and Ultrasonographic (r=0.781) and clinical method (r=0.806).

Table 1: Maternal demographic and clinical characteristics

Variable	Mean ± SD	Median	Range	P
Maternal age (years)	28.9± 5.1	30.0	16-43	
Maternal Age Group (years)				
<25 N (%)	70 (23.3)			
25 – 34 N (%)	194 (64.7)			
35 – 44 N (%)	36 (12.0)			<0.0001
Parity	1.3 ± 1.2	1.0	0-6	
Nulliparous N (%)	83 (27.7)			
Primiparous N (%)	96 (32.0)			
Multiparous N (%)	117 (38.9)			
Grand Multiparous N (%)	4 (1.4)			<0.0001
Gestational age (weeks)	38.9± 1.1	39.0	37-42	
Maternal Weight (kg)	85.0 ±16.2	86.0	52.0- 124	
Maternal Height (M^2)	1.7 ±0.1	0.1	1.5- 1.8	
Maternal BMI (Kg/M^2)	30.9 ± 4.7	30.8	20.8– 48.5	
Normal N (%)	24 (8.0)			
Overweight N (%)	111 (37.0)			
Obese class I N (%)	107 (35.7)			
Obese class II N (%)	50 (16.7)			<0.0001
Obese class III N (%)	8 (2.7)			

Table 2: Comparison of mean actual birth weight and estimated birth weights

Birth Weight (g) Category	Clinical EFW (Mean ± SD)	Ultrasound EFW (Mean ± SD)	Actual Birth Weight (Mean ± SD)	P-value
Low birth weight (<2500g) [N=1]	2886.0±0.0	2650±0.0	2450.0±0.0	-
Normal birth weight (2500-3999g) [N=282]	3601.5±396.5	3401.6±445.0	3310.3±324.1	<0.0001
Macrosomia (≥4000g) [N=17]	4427.7±241.8	4190.6±328.1	4238.5±210.5	0.027
Overall [N=300]	3646.0±435.2	3443.8±476.8	3360.0±387.4	<0.0001

ABW-Actual Birth Weight; EFW – Estimated Foetal Weight
**Statistically significant at P <0.05

Table 3: Comparison of accuracy of the measured outcomes between ultrasound and clinical methods of estimation of foetal weights

Birth Weight Category	Ultrasound EFW	Clinical EFW	*P* -Value
Overall %			
Mean Absolute error (Mean ± SD	238.3 (186.0)	290.8 (265.4)	0.006
Mean % error (Mean ± SD)	2.6 (9.0)	8.8 (9.0)	<0.0001
Mean Absolute % error (Mean ± SD	7.2 (6.0)	8.9 (8.9)	0.099
Estimates within ABW ±10%	247 (82.3%)	226 (75.3%)	0.023
Correlation coefficient	0.806 *** c	0.831*** c	
Normal (2500 – 3999g)			
Mean Absolute error (Mean ± SD)	236.9 (181.4)	295.9 (270.7)	0.003
Mean % error (Mean ± SD)	2.8 (9.1)	9.0 (9.2)	0.0001
Mean Absolute % error (Mean ± S	7.3 (6.0)	9.2 (9.1)	0.004
Estimates within ABW ±10%	232 (82.3%)	209 (74.1%)	0.012
Correlation coefficient	0.781*** c	0.806*** c	
Macrosomic (≥4000g)			
Mean Absolute error (Mean ± SD)	264.4 (259.6)	197.7 (132.5)	0.352
Mean % error (Mean ± SD)	- 0.942 (8.5)	4.5 (3.2)	0.393
Mean Absolute % error (Mean ± SD	6.1 (5.8)	4.7 (3.1)	0.062
Estimates within ABW ±10%	14 (82.4%)	17 (100.0%)	0.114
Correlation coefficient	0.043*c	0.824*** c	

t test; ƚ-Mann Whitney U; c – Spearman's Rank Correlation; b- Chi square; ABW – Actual Birth Weight.
EFW – Estimated foetal weight;

Statistically significant (P<0.05)

Table 4: Percentage of estimated foetal weight within 10% of the actual birth weight with respect to maternal BMI

Method of foetal Wt estimation	Estimates within ABW ±10% BMI <30 Kg/m^2 (n=135)	Estimates within ABW ±10% BMI ≥30Kg/m^2 (n=165)	Estimates within ABW±10% Overall (n=300)	X^2 P Value
Clinical	113/135= 83.5%	113/165=68.5%	226/300= 75.3%	0.002
Ultrasound	115/135= 85.2%	132/165= 80.0%	247/300=82.3%	0.154

*** Statistically significant at P<0.01; ** Statistically significant at *p* <0.05
Wt – Weight;
BMI – Body mass index

For macrosomic babies (≥4000g), the clinical method gave a better estimation as a proportion within 10% of actual birth weight was 100.0% as compared to 82.4% for the ultrasonographic method. However, the difference was not statistically significant (p=0.114). The small number of low birth weight babies did not allow for meaningful analysis.

The percentage of deliveries with estimated foetal weight within 10% of the actual birth weight with respect to BMI is documented in table 4. Overall, 75.3% of clinical estimates and 82.3% of ultrasonographic estimates were within 10% of the actual birth weight. In those women with a BMI <30 kg/m^2, 83.5% of clinical and 85.2% of ultrasonographic estimates of foetal weight were within 10% of the actual birth weight. For those women with BMI ≥30kg/m^2, 68.5% clinical and 80.0% ultrasonographic estimates of foetal weight were within 10% of the actual birth weight. The differences in the distribution in women with BMI <30 kg/m^2 and BMI ≥30kg/m^2 using the clinical method were statistically significant (*P*=0.002) while the differences in the distribution were not statistically significant (*P*=0.154) using the ultrasonographic method.

Discussion

This study is a contribution to the ongoing efforts to determine the best predictor of actual birth weight in pregnant women. In the current prospective study, we compared the accuracy of clinical (Dare's formulae) and ultrasonographic (Hadlock's formulae) methods in estimating foetal weight. We found the accuracy of ultrasonographic estimation of foetal weight better than clinical estimation. All the three parameters of mean absolute error, mean percentage error, and proportion of estimates within 10% of actual birth weight, used in the assessment of the accuracy of EFW showed significant differences in favour of ultrasonographic estimations as the more accurate method. Similar findings were reported from studies in Enugu, Nigeria[24,] and Kathmandu, Nepal[28]. Despite the differences in the accuracy of the two methods, this study recorded higher accuracy in both methods compared to previous studies cited. This is most likely due to the proper training of the people that participated in the use of both methods for this study. Good training has been found to be essential for proper use of any method and improves accuracy[16].

In this study, although the two methods of foetal weight estimation correlated positively with the actual birth weight (ABW), overall, both methods overestimated the birth weight. The recorded mean ABW was 3360g compared with the clinical mean EFW of 3646g and ultrasonographic mean EFW of 3443g. While this was the case with normal birth weight range, in macrosomic range clinical method overestimates and ultrasonographic method underestimate the ABW. This finding is similar to the report in some studies[17,28,29] but contrary to other studies in which both methods underestimated foetal weight[30]. The increase in abdominal fat contributes to the overestimation of the clinical method as it increases the abdominal girth which is employed in the foetal weight estimation.

The study showed that ultrasonographic estimation of foetal weight was generally more accurate than clinical estimation. However, no significant difference exists between clinical estimation and sonographic estimation in predicting birth weight in the macrosomic foetus. This is similar to the study by Ugwu et al in Enugu[24]. In their study involving 200 women, among the 2.5-3.99 kg group, there was no significant difference between the mean absolute percentage errors for the two methods. However, in the low-birth weight group, the clinical method overestimated birth weight, while in the macrosomic group, the ultrasonographic method underestimated the birth weight. Generally, underestimation of foetal weight by ultrasound at higher birthweight can be explained by technical problems in the estimation of the abdominal circumference (AC). With this weight category, the cross-section of the abdomen may not be properly displayed on the monitor. This can result in estimations of the abdominal circumference that would tend to favour the bias of the examiner. With newer models of ultrasound machines, such technical problems can be resolved.

In the current study, all (100%) of clinically estimated foetal weight in the macrosomic group were within a 10% accepted error margin of actual birth weight. This finding is the same with reports from another study where clinical estimation of foetal weight was more accurate than ultrasound in macrosomic foetuses[24]. It was not possible to conduct any meaningful analysis of the accuracy of ultrasonographic and clinical estimation in the underweight category as only one baby was less than 2,500g (underweight).

The mean absolute error and mean percentage error in this study were significantly higher in the clinical estimation than ultrasonographic estimation. Similar results with higher mean absolute error in clinical estimation compared to ultrasonographic estimations have been reported in some previous studies[4,15]. Some other studies however reported the reverse[14,31]. The timing of the fetal weight estimation and the expertise of the people play important role in the accuracy of any of these methods[16].

This study documented that 75.3% of clinical estimated foetal weight at term was within 10% of actual birth weight. This finding is close to that reported in the study done in Ile-Ife, Nigeria which reported 70% accuracy of clinical estimation of foetal weight within 10% of actual birth weight[14]. This is, however, lower than that of sonographic estimation which has 82.3% accuracy of foetal weight within 10% of actual birth weight. Despite the fact that the mean BMI of the study group was high, it still recorded such high accuracy. This still supports the fact that expertise increases the accuracy of any of the methods[16]. In the study done at IIe-Ife, the mean BMI was much lower compared to this study but still, the accuracy in this study was higher for both methods.

A meta-analysis to determine whether maternal, clinical, or ultrasound estimation provides the best predictor of birth weight concluded that although the rate of ultrasound estimations within 10% of actual birth weight was significantly higher than that of clinical estimations, there was no significant difference in the correlation of actual birth weight with ultrasound estimation compared with clinical estimation[32]. From this meta-analysis, it was found out that the significant differences between the different methods increase with an increase in the estimation-delivery interval. Also, most publications done after the year 2000, showed that ultrasound has a better prediction of foetal weight. This is mainly due to an increase in the quality of ultrasound estimation. The estimation-delivery interval for this study was 36hours thus reducing the influence of long estimation-delivery interval on the accuracy of the methods used.

Accuracy of clinical and sonographic estimation of foetal weight at term was 83.5% and 85.2% respectively in women with a BMI less than 30 kg/m^2 in this study. For women with a BMI of 30kg/m^2 or more, the accuracy of clinical and ultrasonographic estimation of foetal weight at term was 68.5% and 80.0% respectively. Although the accuracy of EFW decreases with an increase in maternal BMI, the effect on the clinical method is significantly higher than in the ultrasonographic method. This is in keeping with findings from other studies that ultrasound is more accurate than the clinical estimation of foetal weight in women with high BMI[13,17]. This pattern has been attributed partly to the increased thickness of the anterior abdominal wall in obese persons which affects symphysio-fundal height and abdominal girth measurements.

The lower accuracy of clinical estimation of foetal weight in this study might be related to the higher proportion of participants who are obese. The average BMI of the participant in this study is 30.9 ± 4.7kg/m^2 and 55.1% of the participant had BMI ≥of 30.0kg/m^2.

The variation in error observed in both ultrasonographic and clinical estimations of foetal weight seen in this study is partly due to intra- and inter-observer variability[33]. There is a need to reduce this variation in an effort to improve the accuracy of foetal weight estimations. This can be achieved through refinement of measurement methods, equipment calibration, and upgrade, improvement of image quality, averaging of multiple repetitive measurements, and improvement in skills of practitioners.

Ethical consideration

Approval for the study was obtained from the institution's ethics committee (NHA/EC/085/2017), and written informed consent was obtained from the parturients. The subjects were made to understand that their participation was voluntary and that they had the freedom to withdraw from participating at any stage of the study and their decision would not in any way influence their subsequent care from the medical personnel. There was no additional cost for all the parturient that participated in the study. All the cost was borne by the researcher.

Conclusion

This study shows that both methods of foetal weight estimation at term can reasonably predict the birth weight. Ultrasonographic estimation of foetal weight is however more accurate than clinical estimation. The accuracy of both methods of foetal weight estimation decreases with increasing BMI but the effect is more on the clinical method. To further validate this finding, and provide information on low-birth weight babies, we recommend more studies with larger sample size on this subject.

Clinical estimation is still a useful tool in clinical practice especially in low resource setting where ultrasound machines and skilled personnel are not readily available. Its accuracy is also reasonably high though lower than sonographic method. However, in a situation where there is a biological variable such as maternal obesity that can affect the accuracy of clinically estimated foetal weight, ultrasound scan become essential. This should be done by health workers trained to proficiency in obstetric ultrasonography.

Conflict of interest

No conflict of interest declared.

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