Original Research Articles

A Comparison of Clinical and Ultrasound Estimation of Fetal Weigth at a Secondary Health Care Facility in Nigeria

*Patrick I.Okonta[1] * , Ayo Nwachi[2], Chukwuka Onyemesili [3]*

ABSTRACT

Background: Several methods have been used to estimate fetal birth weight; however two methods seem to be more widely accepted by obstetricians - ultrasound estimation and clinical estimation by palpation

Objective: This study sought to determine the accuracy and correlation of clinical and ultrasound estimation of fetal weight at the Central hospital, Warri, Delta state.

Methods: Sixty pregnant women in latent phase labour, very early first stage labour, or for induction of labour were selected for the study. Clinical estimation of fetal weight and an independent blinded ultrasound assessment of the fetal weight was done. Fetal weigth estimates obtained were compared with the actual weight at birth. Accuracy of estimates and correlation with actual birth weight was calculated.

Results: *The Clinical method had a greater mean absolute error (SD) of estimation of the actual birth weight when compared with the ultrasound scan method (391.08gm vs 63.00 gm). The mean difference between the methods was statistically significant (p = <0.001). The Clinical method also had a greater mean percentage error (SD) of estimation of actual birth weight of when compared to the ultrasound methods (12.50% vs 1.2%). The mean difference between the methods was statistically significant (p = <0.001).* Furthermore, the ultrasound method of birth weight estimation had a greater positive correlation (0.703) with the actual birth weight than the clinical method. This was statistically significant p = <0.001

Conclusion: Ultrasound estimation of fetal birth weight is better than clinical estimation done by residents at the Central hospital, Warri.

Key Words: *Fetal weight estimation, clinical, ultrasound, Nigeria*

[1] *Department of Obstetrics and Gynaecology, Faculty of Clinical Sciences, College of Health Sciences, Delta State University, Abraka, Delta State.*
[2].*Department of Obstetrics and Gynaecology, Central Hospital, Warri, Delta State.*
[3].*Department of Radiology, Central Hospital, Warri, Delta State.*

*** Correspondence:** *Patrick I. Okonta Department of Obstetrics and Gynaecology, Faculty of Clinical Sciences, College of Health Sciences, Delta State University, Abraka, Delta State. Email:* patrickokonta@yahoo.com

Introduction

Fetal weight at birth is an important obstetric factor that can significantly influence the mode and outcome of delivery. Adverse maternal and neonatal outcomes are closely associated with abnormal fetal birth weights. Normal fetal birth weight is between 2.5 – 4.0 kilogrammes(kg). Birth weights below 2.5kg are termed low birth weights and are associated with prematurity and its complications, respiratory distress, inability to regulate body temperature and metabolic derangements. On the other hand, birth weights

above 4 kg are associated with obstetric complications such as neonatal birth trauma, neonatal birth asphyxia, neonatal hypoglycaemia and electrolyte disorders. Other complications include increased caesarean section rates, shoulder dystocia, maternal genital tract trauma and primary postpartum haemorrhage. Correct estimation of fetal birth weights help in planning appropriate mode of delivery, place of delivery and proper immediate neonatal care.

Several methods have been used to estimate fetal birth weight, however two methods seem to be more widely accepted by obstetricians - ultrasound estimation and clinical estimation by palpation. Maternal estimation of fetal weight has been found to have some accuracy in predicting actual birth weight. These methods of fetal weight estimations have been evaluated mainly in studies conducted in western countries and north American countries. Some studies have been done to establish the correlation of these three methods and their ability to predict fetal weight correctly in developing countries. With the increasingly availability of ultrasound in urban hospitals, fetal weight estimation using the ultrasound is being performed. However, in many maternity centres especially in the rural and semi-urban areas access to ultrasound estimation cannot be guaranteed. Furthermore, in many hospitals with ultrasound scan services, it is not available in the obstetric units and so estimation of fetal weight by ultrasound scan may not be available when needed. Clinical estimation of fetal weight remain an important part of obstetric practice either as an alternative method of fetal weight assessment where ultrasound facilities are not readily available or as a collaborative method of assessing fetal weight even in centres where ultrasound scans are available. Fetal weight estimation by clinical method is an skill that is acquired through repeated performance and comparison against actual birth weight. It has been validated by several studies to be as comparable as ultrasound estimation of fetal weight, however there is a need for centres to continually assess how accurate these methods are in predicting fetal birth weight.

This study sought to determine the accuracy and correlation of clinical and ultrasound estimation of fetal weight at the Central hospital, Warri, Delta state. The Central hospital , Warri is a state owned secondary health care facility that has been accredited for postgraduate training in obstetrics and gynaecology by National Postgraduate Medical College of Nigeria and also the West African Postgraduate Medical College.

Methods

Pregnant women who were receiving antenatal care at the Central hospital, Warri were invited to participate in the study. The study was conducted from September 2012 to January 2013. Only consenting pregnant women were recruited into the study. Pregnant women in latent phase labour, very early first stage labour, or for induction of labour were selected for the study. Other inclusion criteria were:

1. Singleton pregnancy
2. Cephalic presentation
3. Gestational age known either by LMP or early USS
4. Intact membranes.

Pregnant women with the following conditions were excluded from the study.

1. Multiple pregnancies
2. Abnormal lie
3. Presence of fibroids
4. Clinical diagnosis of oligohydramnios or polyhydramnios
5. Advanced first stage labour.

6. Ruptured membranes.

On arrival at the labour ward, a complete history and physical examination including obstetric examination was performed by the senior registrar under the supervision of the Consultant in labour ward. Clinical estimation of fetal weight was performed using the Dare's method.

Dare's formula for estimation of fetal weight

Fetal weight (g) = Symphysio-fundal (cm) x Abdominal girth at the level of the umbilicus (cm)

The estimated fetal weights were recorded in the data proforma and thereafter an ultrasound scan was performed to estimate the fetal weight.

Ultrasound estimation of fetal weight

The third author – a consultant radiologist – performed the ultrasound scan for fetal weight estimation and was blinded to the clinical estimation of fetal weight obtained by the resident. A trans abdominal ultrasound methods scan was performed using EDAN digital ultrasound diagnostic imaging system model DUS 3 shanghai international holding corp.QMB4 (Europe Effestrasse 80.D20557) Hamburg Germany with a 3.5 m Hz probe. Fetal measurement of the biparietal (BPD), abdominal circumference (A.C.), femur length (FL) and head circumference (HC) were obtained and the sonographic estimated fetal weight calculated using the formula by Hadlock *et al.*

Actual birth weight.

At delivery, the fetal birth weight was measured using a Salter's weighing scale.

All data were recorded in a data proforma sheet and inputted into a computer using the Epiinfo statistical software version 3.5.1.

Sample size calculation

The required sample for the study was estimated using the sample size estimation with correlation co-efficient.

$$n = \frac{(Z\alpha + Z_{1-}\beta)^2}{\frac{1}{4}\left[\log e\left(\frac{1+r}{1-r}\right)\right]} + 3$$

Where;

n = required sample size

Zα = standard normal deviate at 95% confidence level = 1.96

Z1-β = standard normal deviate at 80% power (20% type II error) = 0.842

r = correlation estimate between two variables of interest. This was taken from a correlation study done in Southwest Nigeria to estimate the relationship between clinical and sonographic methods and actual birth weight.

$$n = \frac{(1.96 + 0.842)^2}{\frac{1}{4}\left[\log e\left(\frac{1+0.78}{1-0.78}\right)\right]} + 3$$

n = 37.59

making-up for 10% attrition, n ≈ 41.

Minimum required sample size = 41 patients. However a total of 60 patients were recruited into the study.

Data Analysis

Data analysis was done using the Epiinfo statistical software version 3.5.1. The accuracy, mean percentage error, mean absolute error for each method of fetal birth weight estimation was calculated. Test for correlation was done using the Pearson's correlation coefficient. Test for statistical significant was done using the Chi square test, Fisher's exact test and ANOVA test

as appropriate. A p-value less than 0.05 was considered significant.

Ethical approval for the study was obtained from the ethics committee of the Central Hospital, Warri. Informed consent was obtained from the research participants.

Results

A total of 60 women participated in the study. Twenty five (41.7%) of which had tertiary education. The mean weight, height, and Body Mass Index were 86.47 ± 12.70kg, 1.59 ± 0.06 m, and 33.86 ± 4.89 kg/m^2 respectively. The mean parity was 1.28 ± 1.54 and the gestational age at delivery was 40.07 ± 1.69 weeks. Thirty – two female and twenty – eight male babies were delivered by the parturients.

The Clinical method of fetal weight estimation had a higher mean fetal weight estimation of 3985.25 ± 484.30 gm. The mean fetal weight estimation by ultrasound scan was 3531.17 ± 437.18 gm, and this was close to the mean actual fetal birth weight of 3594.17 ± 462.86 gm (Table 1).

The Clinical method had a greater mean absolute error (SD) of estimation of the actual birth weight when compared with the ultrasound scan method (391.08gm vs 63.00 gm). The mean difference between the methods was statistically significant (p = <0.001). The Clinical method also had a greater mean percentage error (SD) of estimation of actual birth weight of when compared to the ultrasound methods (12.50% vs 1.2%). The mean difference between the methods was statistically significant (p = <0.001). The Clinical method tended to overestimate the birth weight while ultrasound can tended to underestimate the birthweight. The ability of ultrasound method to accurately estimate within 10% of actual fetal birth weight was greater than the Clinical method (78.3% vs 53.3%). This difference in accuracy was statistically significant p = <0.001 (Table 2)

Furthermore, the ultrasound method of birth weight estimation had a greater positive correlation (0.703) with the actual birth weight than the Clinical method. This was statistically significant p = <0.001 (Table 3).

In terms of estimating normal birth weight (n=56 babies), the Clinical method had a higher mean absolute error (SD) and the mean percentage error (SD) of 464.15 (600.22) and 15.05 (20.92), which were statistically significantly different from the ultrasound method (p = <0.001;p = <0.001) respectively. The Ultrasound method had the higher accuracy of estimating normal birth weight (75.0%), compared to the Clinical method (52.1%). This findings were statistically significant p = 0.003 (Table 4).

In estimating macrosomia (n=4 babies), the ultrasound method had a higher mean absolute error (SD) and the mean percentage error (SD) of 188.33 (335.30) and 4.02 (7.42) respectively. These were not statistically significantly different from the Clinical methods (p = 0.189; p = 0.265) respectively. However, the Ultrasound method had higher accuracy in predicting macrosomia (91.7%), compared to the Clinical method (58.3%). However, this was not statistically significant p = 0.083 (Table 4).

Figures 1 and 2 show the scatter plot diagram between the fetal weights obtained from the two methods and the actual fetal weights.

TABLE 1: CLINICAL AND ULTRSOUND ESTIMATION OF FETAL WEIGHT WITH ACTUAL BIRTH WEIGH

Estimation methods	*Mean ± SD	Range	CV
Clinical method (g)**	3,985.25 ± 484.30	3,130 – 5,400	12.15
Ultrasound method (g)	3,531.17 ± 437.18	2,500 – 4,600	12.38
Actual Birth Weight (g)	3,594.17 ± 462.86	2,500 – 4,800	12.88

*F(ANOVA) = 17.023, df = 2, 177, p = <0.001, CV= coefficient of variation.
**Post Hoc test (LSD) = statistically significantly different from the other methods,

TABLE 2: CLINICAL AND ULTRASOUND ESTIMATION OF FETAL WEIGHT

Estimation methods	Mean absolute error	Mean percentage error	Estimate within ± 10% of birth
	± SD (g)	± SD (%)	(%)
Clinical method (g)	391.08 ± 582.26	12.50 ± 19.77	53.3
Ultrasound method (g)	-63.00 ± 347.51	-1.20 ± 10.38	78.3
p-value*	<0.001	<0.001	<0.001

Mean absolute error = estimate - actual birth weight. SD = Standard deviation
Mean percentage error = (value of absolute simple error/actual birth weight) x 100.
Estimate within ± 10% of birth (Accuracy).*t-test.

TABLE 3: CORRELATION BETWEEN THE ESTIMATION METHODS AND ACTUAL BIRTH WEIGHT

Estimation methods	Test statistics	Estimation methods		Actual Birth Weight
		Clinical	Ultrasound	
Clinical method	Pearson correlation	1	0.162	0.243
Ultrasound method	Pearson correlation	0.162	1	0.703
	p-value*	0.216		<0.001

**Statistical test of significance for correlation coefficient.*

TABLE 4: MEAN ABSOLUTE ERROR, MEAN PERCENTAGE ERROR, AND ACCURACY BY FETAL WEIGHT GROUPS

Parameters	Clinical	Ultrasound	p-value*
2,500 - <4,000 (g) (56 babies)			
Mean absolute error (g)	464.15 ± 600.22	32.92 ± 347.36	<0.001
Mean percentage error (g)	15.05 ± 20.92	0.49 ± 10.95	<0.001[a]
Estimates within ± 10% of ABW	52.1	75.0	0.003**
≥4,000 (g) (4 babies)			
Mean absolute error (g)	98.83 ± 403.28	188.33 ± 335.30	0.189[a]
Mean percentage error (g)	2.31 ± 9.22	4.02 ± 7.42	0.265[a]
Estimates within ± 10% of ABW	58.3	91.7	0.083***

***t-test, **Chi-squared test, ***Fisher's exact test**

FIGURE 1: SCATTERPLOT (WITH REGRESSION EQUATION) BETWEEN THE CLINICAL METHOD AND ACTUAL BIRTH WEIGHT

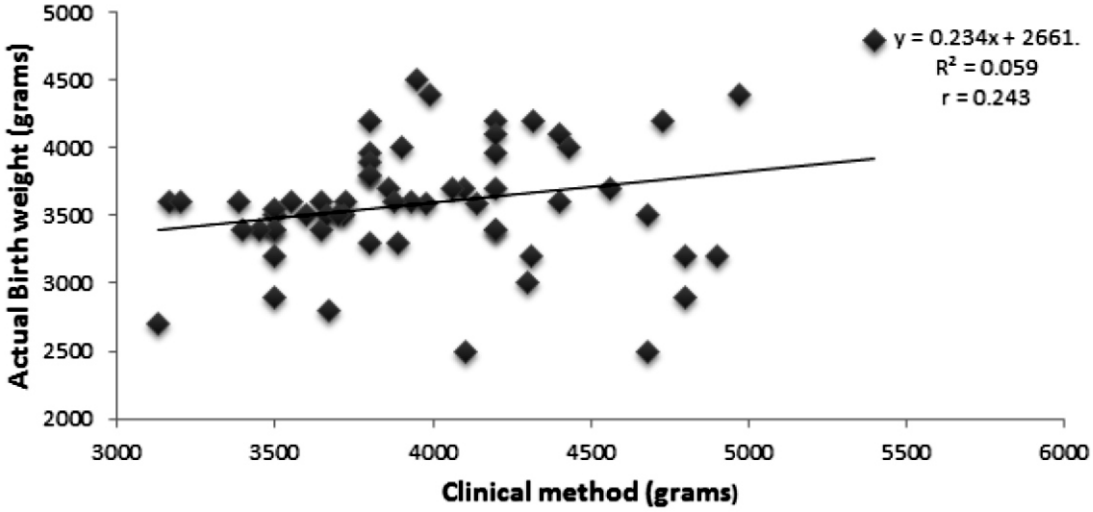
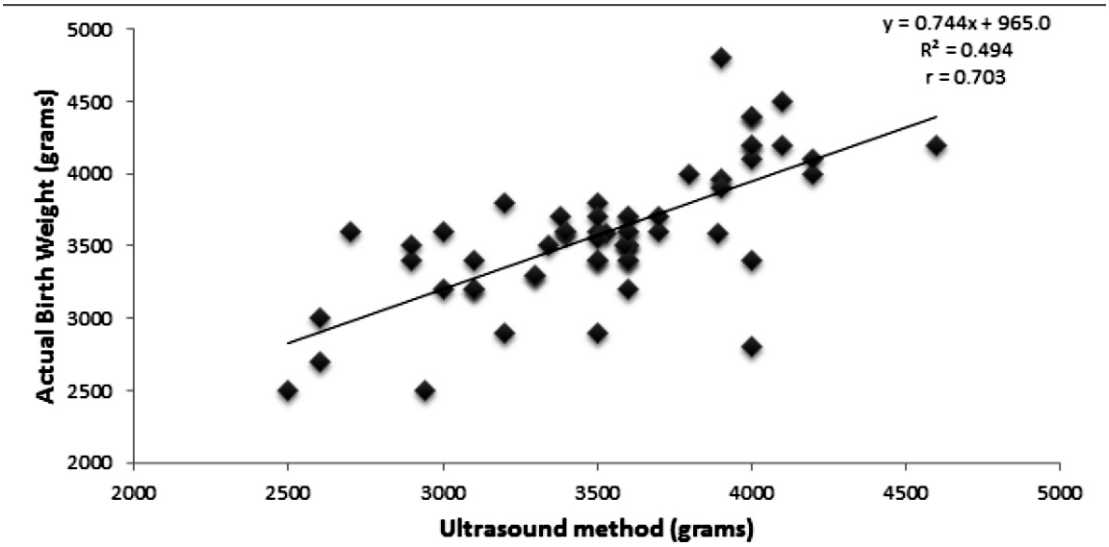


FIGURE 2: SCATTERPLOT (WITH REGRESSION EQUATION) BETWEEN THE ULTRASOUND'S METHOD AND ACTUAL BIRTH WEIGHT



Discussion

In this study, there was a statistically significant difference in the accuracy of fetal weight estimation by clinical method and by ultrasound method. While ultrasound was able to estimate 78.3% of the birth weights within 10% of actually birth weight, clinical method was only able to estimate 53% of the birthweights within 10% of actual birthweigth. Furthermore, the margin of error both in absolute mean error and in percentage error were greater for clinical method than ultrasound method. This is in sharp contrast to findings from other studies, for example the study by Shittu et al did not reveal any significant statistical difference in the accuracy of clinical estimation of fetal weight and the ultrasound estimation of fetal weight. In their study clinical estimation correctly predicted 70% of birthweights within 10% of actual fetal birth weight, while the ultrasound prediction was accurate in 68%. Also in another study, the accuracy of the clinical method to predict within 10% of actual birth weight was 72% while that of ultrasound was 74% , the difference was not statistically significant.

The possible explanation of why there is a significant difference in our study could be seen in the rather poor ability of the clinical method to accurately estimate the fetal weight in our study. Only in 53% of our study sample was there an accurate estimation clinically of fetal weight within 10% of actual birth weight. This is in sharp contrast to findings of other studies where accurate estimation within 10% of actual birthweight was at least 70%. However, some other studies have reported a clinical estimation of fetal weight accuracy of between 55% and 70% within 10% of actual birthweigths. Several factors can affect the accuracy of clinical method of fetal weight estimation. Such factors include, experience of the clinician, maternal BMI, amount of liquor and engagement of fetal head amongst others. In this study clinical fetal weight estimation was done by residents who were at atleast three years into their residency training. Perhaps a better accuracy may have been obtained if it was done by consultants. Baum *et al* found that senior residents could clinically estimate fetal weight better that junior residents. Furthermore Ben-Aroya *et al* documented that accuracy of clinical estimation of fetal weight was not only affected by level of training but also affected by residents' fatigue. The delivery rate at this study hospital is about 4500 per annum which is relatively high especially compared with the few numbers of residents available.

The accuracy of sonographic estimation of fetal weight obtained in this study was quite comparable to other studies. Of note, is that the sonographic estimation of fetal weight in our study was done by a consultant sonologist. The ability to accurately predict fetal weight sonologically is influenced by the competence of the sonologist. Other factors that could influence accuracy include time between scans, fetal age and birth age.

Our study showed that sonographic estimation of fetal weight for macrosomic babies had a greater margin of error compared to clinical estimation although it did not reach statistically significant level. Although this findings collaborates previous studies that showed ultrasound estimation of fetal weight had a larger margin of error , we recognise our limitation of a very small number (four) of macrosomic babies in this subgroup. This may also explains the inconsistency of a 90% prediction within 10% of actual birth weight despite a larger mean absolute error and mean percentage error.

The better performance of ultrasound in estimating fetal weigth compared with clinical estimation was also reflected in the significant difference in the correlation coefficient between ultrasound estimated fetal weigth and actual birth weigth on one hand and the correlation

coefficient between clinically estimated fetal weigth and actual birth weigth on the other hand (0.703 vs 0.243; p value < 0.001). This is also shown in the scatter plot with ultrasound showing a better linear pattern than clinical estimation.

This result of this study is limited in the generalizability as the study was conducted under the usual situation of routine care obtainable in the hospital. The findings may be different in other situations. Furthermore, our sample size was not calculated for fetal weight subgroup analysis and so we did not have adequate numbers for each fetal weight subgroups. Infact, our analysis did not have any birth weights below 2500gms.

Conclusion

Ultrasound estimation of fetal birth weight is better than clinical estimation done by residents at the Central hospital, Warri. Efforts should be made in the training of residents to increase the accuracy of clinical estimation of fetal weight. Furthermore, ultrasound estimation of fetal weight should be the preferred method of fetal weight estimation and obstetricians including residents should develop this competence.

Acknowledgement

The authors are grateful to all pregnant women that participated in this study and also the residents that assisted with data generation.

References

1. Salle B, Picaud JC, Lopilloune A, Claris O. Mortality and morbidity of low-birth-weight infants. Current prognosis and future perspectives. *Bull Acad Natl Med* 2004; **188**(7): 1127-39; discussion 39-41.
2. Teng RJ, Tsou Yau KI, Lu CP, Lee CY. The neonatal morbidity and mortality of low birth weight neonates. *Zhonghua Min Guo Xiao Er Ke Yi Xue Hui Za Zhi* 1992; **33**(3): 167-75.
3. Karim SA, Mastoor M, Ahmed AJ, et al. Macrosomia: maternal and fetal outcome. *Asia Oceania J Obstet Gynaecol* 1994; **20**(1): 73-6.
4. Abudu OO, Awonuga AO. Fetal macrosomia and pregnancy outcome in Lagos. *Int J Gynaecol Obstet* 1989; **28**(3): 257-62.
5. Ezegwui HU, Ikeako LC, Egbuji C. Fetal macrosomia: obstetric outcome of 311 cases in UNTH, Enugu, Nigeria. *Niger J Clin Pract* 2011; **14**(3): 322-6.
6. Jordaan HV. Estimation of fetal weight by ultrasound. *J Clin Ultrasound* 1983; **11**(2): 59-66.
7. Khani S, Ahmad-Shirvani M, Mohseni-Bandpei MA, Mohammadpour-Tahmtan RA. Comparison of abdominal palpation, Johnson's technique and ultrasound in the estimation of fetal weight in Northern Iran. *Midwifery* 2011; **27**(1): 99-103.
8. Levin I, Gamzu R, Buchman V, et al. Clinical estimation of fetal weight: is accuracy acquired with professional experience? *Fetal Diagn Ther* 2011; **29**(4): 321-4.
9. Baum JD, Gussman D, Wirth JC, 3rd. Clinical and patient estimation of fetal weight vs. ultrasound estimation. *J Reprod Med* 2002; **47**(3): 194-8.
10. Harlev A, Walfisch A, Bar-David J, Hershkovitz R, Friger M, Hallak M. Maternal estimation of fetal weight as a complementary method of fetal weight assessment: a prospective clinical trial. *J Reprod Med* 2006; **51**(7): 515-20.
11. Chien PF, Owen P, Khan KS. Validity of ultrasound estimation of fetal weight. *Obstet Gynecol* 2000; **95**(6 Pt 1): 856-60.
12. Colman A, Maharaj D, Hutton J, Tuohy J. Reliability of ultrasound estimation of fetal weight in term singleton pregnancies. *N Z Med J* 2006; **119**(1241): U2146.
13. Finikiotis G, MacLennan AH, Verco PW, Ogden SE. An evaluation of two methods of antenatal ultrasonic fetal weight estimation. *Aust N Z J Obstet Gynaecol* 1980; **20**(3): 135-8.
14. Dare FO, Ademowore AS, Ifaturoti OO,

Nganwuchu A. The value of symphysio-fundal height/abdominal girth measurements in predicting fetal weight. *Int J Gynaecol Obstet* 1990; **31**(3): 243-8.
15. Shittu AS, Kuti O, Orji EO. Comparison of clinical and ultrasonographic estimation of fetal weight. *Int J Gynaecol Obstet* 2005; **90**(2): 140-1.
16. Shittu AS, Kuti O, Orji EO, et al. Clinical versus sonographic estimation of foetal weight in southwest Nigeria. *J Health Popul Nutr* 2007; **25**(1): 14-23.
17. Banerjee K, Mittal S, Kumar S. Clinical vs. ultrasound evaluation of fetal weight. *Int J Gynaecol Obstet* 2004; **86**(1): 41-3.
18. 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**(3): 333-7.
19. Suresh K, Chandrashekara S. Sample size estimation and power analysis for clinical research studies. *Journal of human reproductive sciences* 2012; **5**(1): 7-13.
20. Noumi G, Collado-Khoury F, Bombard A, Julliard K, Weiner Z. Clinical and sonographic estimation of fetal weight performed during labor by residents. *Am J Obstet Gynecol* 2005; **192**(5): 1407-9.
21. Peregrine E, O'Brien P, Jauniaux E. Clinical and ultrasound estimation of birth weight prior to induction of labor at term. *Ultrasound Obstet Gynecol* 2007; **29**(3): 304-9.
22. Chauhan SP, Hendrix NW, Magann EF, Morrison JC, Kenney SP, Devoe LD. Limitations of clinical and sonographic estimates of birth weight: experience with 1034 parturients. *Obstet Gynecol* 1998; **91**(1): 72-7.
23. Farrell T, Holmes R, Stone P. The effect of body mass index on three methods of fetal weight estimation. *BJOG* 2002; **109**(6): 651-7.
24. Ben-Aroya Z, Segal D, Hadar A, et al. Effect of OB/GYN residents' fatigue and training level on the accuracy of fetal weight estimation. *Fetal Diagn Ther* 2002; **17**(3): 177-81.
25. Blann DW, Prien SD. Estimation of fetal weight before and after amniotomy in the laboring gravid woman. *Am J Obstet Gynecol* 2000; **182**(5): 1117-20.
26. Chauhan SP, Grobman WA, Gherman RA, et al. Suspicion and treatment of the macrosomic fetus: a review. *Am J Obstet Gynecol* 2005; **193**(2): 332-46.
27. Wong SF, Chan FY, Cincotta RB, Oats JJ, McIntyre HD. Sonographic estimation of fetal weight in macrosomic fetuses: diabetic versus non-diabetic pregnancies. *Aust N Z J Obstet Gynaecol* 2001; **41**(4): 429-32.

Citation

This article should be cited as: "*Patrick I. Okonta, Ayo Nwachi , Chukwuka Onyemesili,* A Comparison of Clinical and Ultrasound Estimation of Fetal Weigth at a Secondary Health Care Facility in Nigeria. Afr. J. Trop. Med. & Biomed. Res 2013; 2 (2): 10-19".