Actual Birth Weight Prediction at term using Clinical and Ultrasound methods at Federal Medical Centre, Keffi, Nasarawa State: A comparative Approach.

Abstract

Objective: The study sought to compare the predictive accuracy of clinical and ultrasound fetal weight estimation in predicting the actual birth weight of pregnant women at term at the FMC, Keffi, North central Nigeria.

Materials and Methods: This study was a cross-sectional study that enrolled 360 consecutive pregnant women at term (37 weeks + 0day - 41weeks +6days), who met the inclusion criteria between 10th December 2018 to 25th July 2019. Informed consent was obtained from participants and a proforma was interviewer-administered. The clinical estimate was done using the Dare's formula in the lying- in ward and labour ward. The ultrasound fetal weight estimation was done using an ultrasound scan machine imputed with the Hadlock formula mode (BPD, HC, AC, and FL) while the actual birth weight was measured in the labour room using the infant weighing scale. The data collected were analyzed using the Pearson's Chi- square or Fisher's exact test as appropriate, Pearson's correlation analysis and student's t test. Accuracy was determined using percentage error, absolute error, and proportion of estimates within 10% of actual birth weight; and compared using the Poisson's z-test for two proportions. All analyses were performed, using the IBM SPSS Statistics for Windows, version 20.0. (IBM Corp., Armonk, N.Y., USA) and Minitab, version 18.

Results: Analysis showed that the clinical fetal weight estimation within 10% of the actual birth weight was not significantly lower than that of ultrasound fetal weight estimation for babies of all birth weight (41.5% vs. 55.0%, P = 0.064). The actual birth weight had a strong correlation

with both clinical and ultrasound fetal weight estimation (r = 0.53, P <0.001 and r = 0.55, P < 0.001 respectively). The mean percentage error and mean absolute percentage error for normal weight babies (2.5- 3.99kg) was significantly higher in clinical method than ultrasound method (-13.29kg vs. 4.49 kg, P< 0.001) and (14.14kg vs. 9.47 kg, P< 0.001) respectively. Overall in most cases, the clinical method of fetal weight estimation overestimated the actual birth weight.

Conclusion: It was concluded that, ultrasound method of fetal weight estimation is a better predictor of actual birth weight than the clinical method. However, clinical weight estimation can still be used in a low-resource setting such as ours.

Key words: Actual birth weight, Clinical, Ultrasound, Prediction, Fetal Weight Estimation, Keffi.

Introduction

The role of Fetal weight assessment cannot be over emphasized during antenatal care, labour management and delivery.[1,2] Accurate pre-natal fetal weight estimation in late pregnancy and labour is vital to a successful outcome of labour and delivery.[1] It guides the obstetrician in deciding and preparing for preterm deliveries, instrumental vaginal delivery, trial of labour after caesarean section, assisted vaginal breech delivery and elective caesarean section for patients with suspected fetal macrosomia.[1,2,3] Peri-natal morbidity and mortality rates are very high in our environment and this problem is largely related to prematurity and low birth weights.[3,4] Basically, group of birth weights that are important to the clinicians are the low birth weight (1.5-2.49kg), the normal birth weight (2.5 -3.99kg) and the macrosomic babies ($\geq$4kg).[1]

Accurate estimation of fetal weight at different gestational ages is of important when considering the mode of delivery either vaginally or by caesarean section. This consideration is more important in our environment where high aversion for caesarean delivery is prevalent and good neonatal facilities are not readily available.[1]

Vaginal delivery of macrosomic fetuses is a major challenge as it will require considerable attention by an experienced Obstetrician and preparedness for operative delivery. Both low birth weight and excessive fetal weight are associated with an increased risk of newborn complication during labour, delivery and peuperium.[5,6] Peri-natal complications associated with low birth weight include either preterm delivery or intra-uterine growth restriction (IUGR) or both, while complications associated with delivery of macrosomic fetuses include prolonged labour, shoulder dystocia, brachial plexus injury, bony injuries and intrapartum asphyxia. [7,8] Maternal risks associated with delivery of a very large fetus include birth canal and pelvic floor injuries, as well as postpartum haemorrhage. [8]

Fetal weight estimation can be predicted by two main methods which are: clinical and radiological methods. Radiological method of fetal weight estimation involves the use of magnetic resonance imaging and ultrasonography. In clinical obstetrics practice, there is a tendency to rely on available technology and ignore clinical judgment, which can lead to loss of the skill to estimate fetal weight clinically by clinicians.[9]

The study of an alternative method of fetal weight estimation is imperative in resource constraint settings such as the northern part of Nigeria, where sonographic method of fetal weight estimation is not readily available or where its availability is restricted due to high cost and proficiency of the sonologist.[10] Therefore, this study set to compare the predictive accuracy

of clinical method of fetal weight estimation and ultrasound method of fetal weight estimation in predicting the actual birth weight at the Federal Medical Centre, Keffi, Northern Central Nigeria.

Methods

Study area and period

The study was conducted at the Federal Medical Center, Keffi, North Central, Nigeria. The Centre is located in Keffi town in Keffi Local Government Area of Nasarawa State, North central Nigeria. The Department of O& G is a 40 bed capacity unit, which has an average of 1200 total deliveries every year; it is involved in the training of house officers, resident doctors (Junior/Senior) with consultants across specialties. Federal Medical Centre Keffi is a referral hospital serving Nasarawa State and other neighboring states like Kaduna, Kogi and the Federal Capital Territory Abuja. Keffi is a cosmopolitan city inhabited by about 92,664 people (as at the 2006 census National Population Commission). It has a total land mass of approximately 140km^2. The research study conducted from 10th December 2018 to 25th July 2019.

Study design

The study was a cross-sectional study which recruited a total of 360 pregnant women at term (37 weeks + 0day - 41weeks +6days), who met the inclusion criteria and consented were consecutively recruited until sample size was completed at the Federal Medical Center, Keffi, North Central, Nigeria. Informed consent was obtained from participants and a proforma was filled by the researchers. The clinical estimate was done using the Dare's formula (estimated foetal weight in kilogram= Symphisiofundal height x abdominal girth at the level of umbilicus/1000 ±0.05kg).[11] in the lying- in ward and labour ward. The ultrasound fetal weight estimation was done using an ultrasound scan machine imputed with the Hadlock Formula mode

(BPD, HC, AC, and FL).[12] The actual birth weight was measured in the labour room using the infant weighing scale which was corrected to zero to ensure reliability of measurement.

Sample size determination

The sample size was calculated, using the Cochrane's Formula[13] with a prevalence of 69.5% and an error margin of 5% at 95% confidence level. A total of 360 pregnant women at term were recruited for the study.

Inclusion/ Exclusion criteria

This included women with singleton term pregnancy, presenting in labour, planned for induction or caesarean section. While women with the following conditions were excluded -term pregnancy with maternal obesity (absolute weight > 90kg) ,Confirmed fetal congenital anomaly / IUFD, preterm labour, multiple gestation, abdominal girth > 108cm,polyhydramnious/ oligohydramnious, pregnant women presenting in second stage of labour with imminent delivery, patients in critical or emergency condition e.g. antepartum haemorrhage, severe cardiac disease, refusal to consent.

Data collection

The data collected was cleaned and analyzed using SPSS software version 25.0 and Minitab version 18. Accuracy was determined using percentage error, absolute error, and proportion of estimates within 10% of actual birth weight. This was compared using the Poisson's z-test for two proportions.

Result

Table 1A: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF MOTHERS n=360

Variables	Frequency	Percentage = 100
Age group (years)		
15-24	41	11.4
25-34	249	69.2
35-44	70	19.4
Highest Level of Education		
No formal education	18	5.0
Primary	20	5.5
Secondary	108	30.0
Tertiary	214	59.5
Occupational Status		
Artisan	31	8.5
Civil servant	99	27.5
Farming	11	3.0
Trading	31	8.5
Student	34	9.5
Unemployed	155	43.0
Religion		
Christianity	232	64.5
Islam	128	35.5
Traditional	0	0

Source: Author's Work

Table 1B: Descriptive Statistics of Mothers

Variables	Min.	Max.	Mean (SD)	Median
Age (yrs.)	19	43	29.48 (4.83)	29.00
Estimated gestational age (wks.)	37	42	39.17 (1.35)	39.00
Parity	0	9	1.51 (1.60)	1.00
Weight of mothers (kg)	52	90	71.33 (9.74)	70.00

Table 2: OBSTETRIC CHARACTERISTICS OF MOTHERS n=360

Variables	Frequency	Percentage = 100
Parity		
0	117	32.5
1	99	27.5
2	65	18.1
3	43	11.9
4	14	3.9
5 & above	22	6.1
Estimated gestational age at delivery		
37 wks. - 37 wks. 6days	45	12.5
38 wks. - 38 wks. 6days	68	18.9
39 wks. – 39 wks. 6days	102	28.3
40 wks. – 40 wks. 6days	83	23.1
41 wks. – 41 wks. 6days	49	13.6
42 wks. – 42 wks. 6 days	13	3.6
Mode of delivery		
SVD	225	62.5
CS	135	37.5
Baby's gender		
Male	193	53.6
Female	167	46.4

Sex ratio at birth = 1.16: 1

Source: Author's Work

Table 3: Percentage distribution of birth Weight of babies n=360

Variables	Frequency	Percentage = 100
CFWE (Dare's) (kg)		
2.5 – 2.99	7	2.0
3.0 – 3.49	95	26.5
3.5 – 3.99	211	58.5
4.0 – 4.49	40	11.0
4.5 – 4.99	7	2.0
Mean (SD)	**3.65 (0.34)**	
UFWE (kg)		
2.0 – 2.49	20	5.5
2.5 – 2.99	119	33.0
3.0 – 3.49	187	52.0
3.5 – 3.99	29	8.0
4.0 – 4.49	4	1.0
4.5 – 4.99	2	0.5
Mean (SD)	**3.07 (0.37)**	
ABW (kg)		
2.0 – 2.49	13	3.6
2.5 – 2.99	63	17.5
3.0 – 3.49	175	48.6
3.5 – 3.99	94	26.1
4.0 – 4.49	11	3.1
4.5 – 4.99	4	1.1
Mean (SD)	**3.24 (0.42)**	
Grouped ABW		
Low birth	13	3.6
Normal birth weight	333	92.5
Macrosomic birth	14	3.9

Source: Author's Work

Table 4: Assessment of accuracy of Clinical Fetal Weight estimation in predicting the Actual Birth Weight

Indices for accuracy	Values	p-value
Overall Actual Birth Weight		
Mean percentage error (SD)	-13.78 (12.33)	
Mean absolute percentage error (SD)	14.89 (12.54)	
Correlation co-efficient (r)	0.53	**<0.001**
Correct estimate within 10% of ABW	41.5%	**0.022**$^{\approx}$
Categories of birth Weight (kg)		
<2.5 kg		
Mean percentage error (SD)	-48.74 (17.01)	
Mean absolute percentage error (SD)	48.74 (17.01)	
Correlation co-efficient (r)	0.22	**0.487**
Correct estimate within 10% of ABW	0.0%	**------**
2.5 – 3.99 kg		
Mean percentage error	-13.29 (11.56)	
Mean percentage absolute error	14.14 (10.50)	
Correlation co-efficient (r)	0.62	**<0.001**
Correct estimate within 10% of ABW	71.5%	**<0.001**$^{\approx}$
>/=4.0 kg		
Mean percentage error	2.44 (8.61)	
Mean percentage absolute error	7.10 (5.08)	
Correlation co-efficient (r)	0.026	**0.934**
Correct estimate within 10% of ABW	52.9 %	**0.395**$^{\approx}$

Note: % absolute error was calculated as |{[(ABW- EBW)/ABW] X 100}|
Key: ≈ represents chi-square test

Table 5: Assessment of accuracy of Ultrasound Fetal Weight Estimations in predicting the Actual Birth Weight

Indices for accuracy	Values	p-value
Overall Weight (kg)		
Mean percentage error	4.38 (11.42)	
Mean absolute percentage error	9.81 (7.29)	
Correlation co-efficient (r)	0.55	**<0.001**
Correct estimate within 10% of ABW	55.0%	**0.155**$^{\approx}$
<2.5 kg		
Mean percentage error	-12.58 (4.86)	
Mean absolute percentage error	12.58 (4.86)	
Correlation co-efficient (r)	0.26	**0.394**
Correct estimate within 10% of ABW	34.4%	**<0.001**$^{\approx}$
2.5 – 3.99 kg		
Mean percentage error	4.49 (11.02)	
Mean percentage absolute error	9.47 (7.20)	
Correlation co-efficient (r)	0.21	**0.298**
Correct estimate within 10% of ABW	74.2%	**<0.001**$^{\approx}$
>/=4.0 kg (Macrosomic)		
Mean percentage error	18.24 (5.78)	
Mean percentage absolute error	18.24 (5.78)	
Correlation co-efficient(r)	0.03	**0.934**
Correct estimate within 10% of ABW	57.1%	**0.046**$^{\approx}$

Note: % absolute error was calculated as |{[(ABW- EBW)/ABW] X 100}|
Key: ≈ represents chi-square test

Table 6: Comparison between Clinical Fetal Weight and Ultrasound Fetal Weight Estimations in predicting the Actual Birth Weight

	CFWE	UFWE	Test statistic	p-value
Overall Weight (kg)				
Mean percentage error	-13.78 (12.33)	4.38 (11.42)	**-20.50****	**<0.001**
Mean absolute percentage error	14.89 (12.54)	9.81 (7.29)	**6.65****	**0.001**
Correct estimate within 10% of ABW	**41.5%**	**55.0%**	**-1.86**$^{\perp\perp}$	**0.064**
<2.5 kg				
Mean percentage error	-48.74 (17.01)	-12.58 (4.86)	**-38.78****	**<0.001**
Mean absolute percentage error	48.74 (17.01)	12.58 (4.86)	**38.78****	**<0.001**
Correct estimate within 10% of ABW	**0.0%**	**34.4%**	**-7.18**$^{\perp\perp}$	**<0.001**
2.5 – 3.99 kg				
Mean percentage error	-13.29 (11.56)	4.49 (11.02)	**-21.12****	**<0.001**
Mean percentage absolute error	14.14 (10.50)	9.47 (7.20)	**6.96****	**<0.001**
Correct estimate within 10% of ABW	**71.5%**	**74.2%**	**-0.32**$^{\perp\perp}$	**0.750**
>/=4.0 kg (Macrosomic)				
Mean percentage error	2.44 (8.61)	18.24 (5.78)	**-28.91****	**<0.001**
Mean percentage absolute error	7.10 (5.08)	18.24 (5.78)	**-27.47****	**<0.001**
Correct estimate within 10% of ABW	**52.9 %**	**57.1%**	**-0.57**$^{\perp\perp}$	**0.569**

Note: % absolute error was calculated as |{[(ABW- EBW)/ABW] X 100}|
Key: $^{\perp\perp}$ represents Poisson z-test while ** represents Independent samples t-test
CFWE: Clinical Fetal Weight Estimation; UFWE: Ultrasound Fetal Weight Estimation

Discussion

The mean actual birth weight in this study was 3.24 ± 0.42kg. This is in tandem with what was reported by Shittu et al in Ife, Nigeria [5] and Njoku et al in Calabar, Nigeria.[2] and slightly higher than 3.08 ± 0.61kg reported by Swende in Makurdi, Nigeria.[14] This is however significantly lower than value of 3.57 ± 0.60kg documented in the United Kingdom. This finding is in consonance with the report in literature which stated that birth weight of Caucasian babies is higher than that of Africans.[15] The reason for this difference was not investigated in this study, but it may be due to several factors such as observer error, regional and socioeconomic factors.[16]

In the same vein, the mean clinical fetal weight estimation for this study was 3.65 ± 0.34kg; when this was compared with the actual birth weight, the difference was found to be statistically significant ($p < 0.001$). While the mean for the ultrasound fetal weight estimation in this study was 3.07 ± 0.37kg, which when compared with the actual birth weight after delivery, the difference was found to be statistically significant ($p < 0.001$). It is clear that ultrasound estimation is better than clinical estimation (Dare) in predicting fetal weight. This finding is similar to that of Ugwu et al., [1] who reported that ultrasound method of fetal weight estimation was significantly more accurate than the clinical method. However this is in contrast with findings of 3.54 ± 633g and 3.14 ± 441g for clinical and ultrasound methods respectively by Njoku et al and some other studies.[2,5] where they reported no significant difference. This may be due to the accuracy of ultrasound method in estimating birth at term in the studied population.

This study showed that the overall mean % error for both clinical and ultrasound methods were -13.78± 12.33 and 4.38 ± 11.42, while the mean absolute % errors were 14.89 ± 12.54 and 9.81± 7.29 respectively. This means that clinical methods overestimated actual birth weights while ultrasound underestimated actual birth weight. The overall mean % error and mean absolute % error for clinical method was higher than that for ultrasound method and the difference was

statistically significant. This result also applies to the normal birth weight category. This finding is similar to low values of mean % error of -6.6 ±381g and means absolute % error of 104 ± 89g/kg for ultrasound reported by Chaun et al.[17] Thus suggesting that ultrasound is more accurate than clinical method of fetal estimation.

The accuracy within 10% of actual birth weight in this study was 41.5% and 55.0% for both clinical fetal weight estimation and ultrasound fetal weight estimation respectively for all birth weight categories. This was comparatively similar to the findings of 35.0% and 67.5% for clinical and ultrasound fetal weight estimations reported by Ugwu et al in Enugu, Nigeria and 75% for ultrasound fetal weight estimation reported by Tawe et al in Jos, Nigeria.[1,18] However this result was at variance with the findings of 70% and 68% for clinical and ultrasound fetal estimations reported by Shittu et al in Ife, Nigeria and other reporters in Calabar,[2] Nigeria and in Kenyatta, Kenya.[19] The finding may be attributed to improvement in skills and knowledge of scanning in recent time.

In this study both methods of fetal weight estimation, underestimated the actual birth weight for macrosomic babies (> 4kg), this difference were statistically significant ($p < 0.001$) but the estimate within 10% of actual birth weight was not significant ($p = 0.140$). This finding was similar to the finding of Shittu et al[5], where no significant difference was found in the estimate within 10% of actual birth weight ($p= 0.76$), but contradict the finding of Ugwu et al[1] who reported a significant difference ($p = 0.009$). A correlation analysis was done in this study between actual birth weight and estimated fetal weight using clinical and ultrasound methods. The findings showed that the correlation between actual birth weight and ultrasound method of fetal weight estimation was stronger ($r = 0.55$, $P < 0.001$), as compared to the correlation between actual birth weight and clinical fetal weight estimation ($r = 0.53$, $P < 0.001$). This finding was

consistent with correlation coefficient of r = 0.740 and r = 0.847 ($p < 0.001$) for clinical and ultrasound fetal weight estimations respectively as reported by Njoku et al [2] but slightly different from correlation coefficients of r = 0.71 and r = 0.69 reported for clinical and ultrasound method by Ugwu et al[1] and other researcher like Shittu et al.[5] Overestimation in this study may be due to confounders like placenta size.

Recommendation for clinical practices

This study recommends that ultrasound method should be used in estimating the actual birth weight whenever accessible by trained individuals. However clinical method of fetal weight estimation should not be jettisoned but remain a valuable alternative where the ultrasound is unavailable (it has a moderate level of accuracy in predicting the actual birth weight).

Future research

In view of the discrepancies in results from different researchers on this subject, it is proposed that there should be further researches conducted using larger sample drawn from various centres for the purpose of comparison.

Conclusion

The study clearly showed that ultrasound method of fetal weight estimation has higher predictive accuracy than clinical (Dare) method of fetal weight estimation and it correlated strongly with actual birth weight.

Ethical approval

The ethical approval for the conduct of this research was obtained from the ethical committee of Federal Medical Centre Keffi (FMC/KF/HREC/236/18). All participants consented to the study.

References

1. Ugwu EO, Udealor PC, Dim CC, Obi SN, Ozumba BC, Okeke DO, et al. Accuracy of clinical and ultrasound estimation of fetal weight in predicting actual birth weight in Enugu, Southeastern Nigeria. NJCP 2014; 17(3): 270- 275.
2. Njoku C, Emechebe C, Odusolu P, Abeshi S, Chukwu C, Ekabua J. Determination of accuracy of fetal weight estimation using ultrasound and clinical fetal weight estimations in Calabar South, South Nigeria. International Scholarly Research Notices volume 2014: 1-6. http://dx.doi.org/10.1155/2014/970973way
3. Adimora GN, Odetunde IO. Perinatal morality in University of Nigeria Teaching Hospital (UNTH) Enugu at the end of the last millennium. Niger J Clin Pract 2007; 10:19-23.
4. Olamijulo JA, Olaleye O. Perinatal mortality in Lagos University Teaching Hospital: A five year review. Nig Q J Hosp Med 2011; 98:208-11.
5. Shittu AS, Kuti O, Orji EO, Makinde NO, Ogunniyi SO, Ayoola OO, et al. Clinical versus sonographic estimation of fetal weight in southwestern Nigeria. J Health Popul Nut 2007; 25:14-23.
6. Coutinho PR, Cecatti J, Surita FG, Costa ML, Morais SS. Perinatal outcomes associated with low birth weight in a historical cohort. Reprod Health 2011; 8:18.
7. MacGregor S, Sabbagha R. Assessment of gestational age by ultrasound. Glob.libr.women's med., (ISSN: 1756-2228) 2008.PubMed DOI: 10.3843/GLOWM.10206.
8. Henriksen T. The macroscopic fetus: a challenge in current obstetrics. Acta Obst Gynecol Scand. 2008; 87(2): 134-145.

9. Peregrine E, O'Brien P, Jauniaux E. Clinical and ultrasound estimation of birth weight prior to induction of labour at term. Ultrasound Obstet Gynecol 2007; 29:304-309.
10. Idris Muhammad Yakubu, Srikanta Banerjee, Nwi-Ue Letam. Determinats of Access to Low-Cost Ultrasound Services among Pregnant Women in Rural Areas of Keffi, Nigeria. Indian J Community Med.2021; 46(3): 570-571.
11. Dare FO, Ademowore AS, Ifaturiti OO. The value of symphysio- fundal height /abdominal girth measurement in predicting fetal weight. Int J Obst/ Gyne 1990; 31(3): 243-8.
12. Chudleigh P, Pearce JM, Obstetrics ultrasound: how, why, and when. Edinburgh; UK: Churchill Livingstone (Medical division of Longman Group UK LTD); 1986; 49-60.
13. Barlett JE, Kotrlik JW, Higgins CC. Organizational research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning and Performance Jour 2001; 19(1):43-50.
14. Swende TZ. Termbirth weight and sex ratio of offspring of a Nigerian population. International Jour of Biological and Medical research 2011; 2(2):531-2.
15. Glenn E (ed). Mass of newborn baby. The physics factbook. Available at http:// hypertextbook.com/facts2002/leahOppenheimI.shtml. Accessed August 25, 2019.
16. Kehinde OA, Njokanma F, Olanrewaju D. Parental socioeconomic status and birth weight distribution of Nigerian term babies. Nigerian Jour of Paediatrics 2013; 40(3): 299-302.
17. Chauhan SP, Hendrix NW, Magann EF, Morrison JC, Kenney SP, Devoe LD, Limitation of clinical and sonographic estimates of birth weight: Experience with 1034 patients. Obstet Gynecol 1998; 91:72-77.

18. Tawe GS, Igoh EO, Pam SD, Mutihir JT, Ani CC. Correlation between ultrasound estimated fetal weight in term pregnancy and actual birth weight amongst pregnant women in Jos. Jos Journal of Medicine 2018; 12(1): 22-31.
19. Wanjaria DK, Kamau K. Accuracy of ultrasound versus clinical fetal weight estimation at term with actual birth in Kenyatta National Hospital. European Jour of Health Sciences 2017; 1(1): 22-24.