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# CLINICAL ESTIMATION OF FOETAL BIRTH WEIGHT IN OBESE WOMEN WITH TERM PREGNANCIES AT OUR LADY OF APOSTLES HOSPITAL, JOS

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**Keywords:** Maternal obesity, foetal birthweight, clinical estimation, Body mass index, actual foetal weight

## ABSTRACT

**Background:** An accurate estimation of foetal birth weight is an integral part of the assessment of pregnant women in modern obstetric practice. Globally, there is a rise in the prevalence of maternal obesity, a condition that is associated with negative pregnancy outcomes. The estimation of foetal birth weight in obese pregnant women is an important consideration in improving delivery outcomes. The clinical method of foetal birthweight estimation is especially important in our environment where imaging techniques are not readily available at most health facilities where women deliver.
**Methods:** The study was a hospital based prospective observational study of term pregnant women who booked for antenatal care and delivered at Our Lady of Apostles Hospital, Jos. The body mass index at delivery was used to assess obesity in 79 participants who met the study criteria. The foetal birth weight was estimated clinically by multiplying the symphysio-fundal height by the abdominal circumference at the level of the umbilicus and this was compared with the actual foetal birth weight measured by weighing the babies within 30 minutes of birth. The mean of the clinically estimated foetal birth weight was compared with the mean of the actual foetal birth weight. The absolute error, the absolute percent error and the proportion of estimated foetal birth weight within ±10% of the actual birth weight were also used to assess accuracy of the clinical method of foetal birth weight estimation.
**Results:** The prevalence of maternal obesity in the study was 22.2%. The mean of the clinically estimated foetal birth weight (4396.14g) was significantly higher than the mean of the actual foetal birth weight (3664.68g) ($p < 0.0005$). The absolute error and the absolute percent error increased significantly with increasing BMI group, $p=0.038$ and 0.044 respectively. The proportion of the clinically estimated foetal birth weight within ±10% of actual birth weight significantly decreased with increasing BMI group ($p = 0.042$).
**Conclusion:** Maternal obesity significantly reduces the accuracy of the clinical method of foetal birth weight estimation. A reliance on this method to estimate foetal birth weight in obese pregnant women may result in unnecessary and costly obstetric interventions. It is recommended that as much as possible imaging techniques should be used to estimate foetal birth weight in obese pregnant women.

## INTRODUCTION

The accurate estimation of foetal birth weight is an integral part of the assessment of pregnant women in modern obstetrics practice.[1-4] The accurate prediction of foetal birth weight enables physicians and patients make decisions about appropriate interventions such as the timing of delivery, the optimum route of delivery and the cadre of health facility where delivery should be effected.[2-6] This makes the foetal birth weight an important variable that affects both maternal and peri-natal morbidity and mortality.[3-6]

Foetal birth weight cannot be measured directly before birth, it can only be estimated from maternal and foetal anatomic characteristics.[4] Techniques for estimating foetal birth weight are broadly classified into clinical and imaging methods. The clinical methods include (a) tactile foetal size assessment (b) clinical risk factors assessment (c) maternal self-estimation of foetal size and (d) birth weight prediction equations. The imaging methods involve the use of (a) obstetric ultrasonography and (b) magnetic resonance imaging.[4,7]

The development and validation of simple, effective and inexpensive tools for reproductive healthcare is important worldwide and especially in developing countries where high-cost equipment and trained technicians are scarce.[8] The clinical method of foetal birth weight estimation using birth weight prediction equations is still very relevant in obstetric care in the

developing world. This method is simple, inexpensive and readily available. It is easy to teach and it is reproducible. The inter- and intra-observer variability of uterine height measurement is small, ranging from 0.52cm to 1.72cm.[8] There is sufficient documented evidence that shows that both clinical and ultrasound estimated foetal birth weight have similar degree of accuracy in normal weight pregnant women.[3,8-10]

Maternal obesity which is defined as obesity in a woman while pregnant has been shown to be rising in prevalence in line with the global increase in the prevalence of obesity.[3] This has prompted the World Health Organization (WHO) to designate obesity as a major unmet health problem that requires urgent attention.[11],[12] A study in 2002 among adults in Jos, North central Nigeria reported a prevalence of 4.0% and 4.5% in adult men and women respectively.[13] Another study in 2014 among the obstetric population at Bingham University Teaching Hospital Jos reported the prevalence of maternal obesity as 33.1%.[14]

Maternal obesity has been unequivocally linked to increased incidence of miscarriages, gestational diabetes, pre-eclampsia, foetal macrosomia, shoulder dystocia, stillbirth and increased incidence of caesarean delivery.[5,15,16]

Obesity is traditionally assessed using the body mass index, also known as the Quetelet Index and it is objectively defined as an elevated body mass index (BMI) $\geqslant$ 30mg/kg$^2$. Some authors have defined obesity as an absolute body weight more than 90kg.[17-19]

In obstetric care, there is a lack of standardization in the calculation of body mass index (BMI) both in clinical practice and in research.[20] Often, maternal obesity is assessed during the preconception period. It can also be reliably assessed at the first antenatal visit which should ideally be before 14 weeks of gestation[21,22]. However, this is not often practical in Nigeria and in several developing countries because of late booking by pregnant women in these countries.[21,22] For practical purposes therefore, the Body Mass Index (BMI) is measured in labour during studies to determine the effect of maternal obesity on the accuracy of the clinical method of foetal birth weight estimation because its value at this time is more relevant at the point of clinically estimating foetal birth weight.[3,5,23]

The clinical method for foetal birth weight estimation using symphysio-fundal height and maternal abdominal girth measurement has been proven to have the same degree of accuracy as ultrasound estimated foetal birth weight in women with normal body mass index. The accuracy of this method in estimating foetal birth weight has not been extensively studied in the obese pregnant population.[3]

## OBJECTIVE

To determine the accuracy of clinical estimation of foetal birth weight in obese women with normal term pregnancies at Our Lady of Apostles Hospital, Jos to assist in predicting the optimal route of delivery.

## METHODS AND MATERIALS

The study was a hospital based prospective observational study carried out between August 2011 and December, 2011 at Our Lady of Apostles Hospital, a secondary-level faith based hospital in Jos, North Central Nigeria. Eligible participants included all pregnant women with normal term singleton pregnancies who booked in the facility and whose estimated gestational age was determined from the date of the last menstrual period and by an early ultrasound scan and who presented in the labour ward between 37 and 42 completed weeks of gestation during the study period.

All pregnant women with multiple gestation, co-morbidities such as hypertension, diabetes mellitus, tuberculosis or human immunodeficiency virus infection and pregnant women who smoked cigarettes or drank alcohol during pregnancy were excluded because these factors resulted in abnormal foetal weight gain.

All eligible pregnant women who presented to the labour ward for delivery during the five-month study period were recruited voluntarily into the study after they signed a written informed consent. The socio-demographic data of the participants were obtained and recorded into a data collection form. The gestational ages of the participants were determined from the date of the last menstrual period and from ultrasound estimation done within the first 20 weeks of pregnancy. While bare footed, the height of each participant was measured to the nearest 0.5 meters in the labour room using a stadiometer. The weight in kilograms to the nearest 0.5 kilogram was measured using a hospital balance weighing scale (ADE Mewa Gmbh/Schwerin. TYP M20313) while the participant stood bare footed and wearing light clothing.

The study parameters included the body mass index, estimated foetal birth weight and the actual birth weight. The body mass index (BMI) was calculated as weight in Kilograms divided by the square of the height in metres. The symphysio-fundal height was measured from the highest point on the uterine fundus to the midpoint of the upper border of the symphysis pubis to the nearest 0.5 centimetres. The abdominal circumference was measured in centimetres at the level of the umbilicus with the woman lying in the supine position. The measurements were done using a non-elastic tape with the reverse side up to forestall any bias. The

clinical estimation of the foetal birth weight in grams was calculated by multiplying the symphysio-fundal height by the abdominal circumference at the level of the umbilicus. After delivery, the babies were weighed within 30 minutes using the same standard analogue WAYMASTER (England) scale corrected for zero error.

Ethical approval for the study was obtained from the Research and Ethical Committee of Our Lady of Apostles Hospital, Jos.

The data collected was analyzed using SPSS Windows based version 16.0, 2007, SPSS Inc., Chicago, IL. Means and standard deviations were used to describe and test statistically significant differences between relevant variables such as clinically estimated foetal birth weight and actual foetal birth weight. Where two groups (for example, estimated and actual birth weight) were compared, a t – test was used. One – way analysis of variance (ANOVA) was used for comparing more than two groups for example, BMI groups with estimated foetal birth weight and actual birth weight. Proportions were used for categorical data while the relationship between outcome variables with body mass index groups was assessed using Chi square ($x^2$) for trend analysis. Correlation between relevant variables (for example body mass index, estimated foetal birth weight and actual birth weight) was determined using the Pearson correlation, and the linear regression was used to test the relationship after adjustment. Estimated foetal birth weight (EFBW) accuracy was determined by comparing the mean of the clinically estimated foetal birth weight and the mean of the actual birth weight, the absolute error (absolute value of the clinically estimated birth weight minus actual birth weight), absolute percent error (absolute error divided by actual birth weight x 100) and the proportion of estimated birth weight within ±10% of actual birth weight. In all tests, $p < 0.05$ was considered as statistically significant.

## RESULTS

A total of 410 pregnant women delivered at the facility during the study period, out of which 91 were obese. The prevalence of maternal obesity in the study was 22.2%. The 79 participants recruited into the study were all married with a mean age of 29.22 years. A majority (53.3%) had tertiary level education. Thirty two (40.5%) of the participants were categorized as class 1 obesity while 27 (34.2%) were grouped as class 2 obesity and 20 (25.3%) were in the class 3 category.

**Table 1: Socio-demographic characteristics of the study participants**

| | Frequency | Percent | Cumulative percent | p-value |
|---|---|---|---|---|
| **Age (years)** | | | | 0.045 |
| 19-24 | 10 | 12.7 | 12.7 | |
| 25-30 | 42 | 53.2 | 65.9 | |
| 31-35 | 19 | 24.0 | 89.9 | |
| 36-40 | 8 | 10.1 | 100.0 | |
| **Marital status** | | | | 0.0005 |
| Married | 79 | 100 | 100.0 | |
| Not married | 0 | 0 | 0 | |
| **Educational level** | | | | 0.016 |
| None | 1 | 1.3 | 1.3 | |
| Primary | 8 | 10.1 | 11.4 | |
| Secondary | 28 | 35.4 | 46.8 | |
| Tertiary | 42 | 53.2 | 100.0 | |
| **Occupation** | | | | 0.031 |
| Civil/public | 26 | 32.9 | 32.9 | |
| Business/Trader | 31 | 39.2 | 72.1 | |
| Seamstress/Tailor | 7 | 8.9 | 81.0 | |
| Housewives | 8 | 10.1 | 91.1 | |
| Student | 7 | 8.9 | 100.0 | |
| **Religion** | | | | 0.617 |
| Christianity | 72 | 91.1 | 91.1 | |
| Islam | 7 | 8.9 | 100.0 | |
| **Parity** | | | | 0.276 |
| Primigravida | 20 | 25.3 | 25.3 | |
| Multigravida | 47 | 59.5 | 84.8 | |
| Grand Multigravida | 12 | 15.2 | 100.0 | |
| **Income (naira)** | | | | 0.039 |
| 0-40,000 | 69 | 87.3 | 87.3 | |
| 40,001-80,000 | 9 | 11.4 | 98.7 | |
| 80,001-100,000 | 1 | 1.3 | 100.0 | |

As shown in Table 2 below, 60 (75.9%) of the babies were clinically estimated to weigh more than 4000g. However, only 15 (19%) of the babies actually weighed more than 4000g. In Table 3, correlation analysis indicated that as the values of actual birth weight increased, there was a significant increase in the corresponding clinically estimated foetal birth weights, ($r = 0.459$, $df = 78$ $p = 0.0005$, $(p < .05)$ . There was a significant mean difference between the clinically estimated foetal birth weight and actual birth weight, ($t = 12.217$, $df = 78$, $p < 0.0005$); the mean of the clinically estimated birth weights (4396.14g) was significantly higher than the mean of the actual birth weight (3664.68g) as shown in Table 4.

**Table 2: Estimated foetal birth weight and actual birth weight**

| | Frequency | Percent | Cumulative |
|---|---|---|---|
| Clinically Estimated Foetal Birth Weight (g) | | | |
| ≤ 4000 | 19 | 24.1 | 24.1 |
| 4001-4500 | 28 | 35.4 | 59.5 |
| 4501-5000 | 23 | 29.1 | 88.6 |
| 5001-5500 | 6 | 7.6 | 96.2 |
| ≥ 5501 | 3 | 3.8 | 100.0 |
| Actual Birth Weight (g) | | | |
| ≤ 3000 | 7 | 8.9 | 8.9 |
| 3001-3500 | 25 | 31.6 | 40.5 |
| 3501-4000 | 32 | 40.5 | 81.0 |
| 4001-4500 | 13 | 16.5 | 97.5 |
| ≥ 4501 | 2 | 2.5 | 100.0 |

**Table 3: Correlation of estimated foetal birth weight with actual birth weight**

| | | Actual Birth Weight |
|---|---|---|
| **Estimated foetal birth weight** | Pearson's correlation (r) | 0.459** |
| | Sig. (2-tailed) | 0.0005 |
| | df | 1 |
| | N | 79 |

** Correlation significant at the 0.01 level (2-tailed)

**Table 4: Mean difference between clinically estimated birth weight and actual birth weight**

| | N | Mean | Std. Deviation | T | Df | p-value |
|---|---|---|---|---|---|---|
| Estimated birth weight (g) | 79 | 4396.14 | 547.80 | | | |
| Actual birth weight (g) | 79 | 3664.68 | 467.06 | 12.217 | 78 | 0.0005 |

## DISCUSSION

Maternal obesity increases both maternal and perinatal morbidity and mortality because of an increase in pregnancy complications. The body mass index categorization of obesity was used in this study – this definition is acknowledged by the 1990 Institute of Medicine guidelines, the Health Survey for England and by the World Health Organization's surveys as the most widely used for body fat estimation.[19] The body mass index (BMI) at delivery was used by Fox and colleagues while studying the influence of body mass index (BMI) on the clinical estimation of foetal birth weight. This is because the body mass index calculated from maternal weight at delivery is considered clinically more relevant at the time of calculating clinically estimated foetal weight.[3]

In this study, the prevalence of maternal obesity was 22.2%. The is similar to the prevalence of obesity among pregnant women of 22.6% – 33.1% reported by previous studies in Nigeria.[14,24]

The correct estimation of foetal birth weight and the accurate determination of gestational age along with the adequacy of the maternal pelvis are important considerations in the management of labour and delivery. In this study of obese pregnant women, 75.9% of the babies were clinically estimated to have birth weights greater than 4000g. The mean of the clinically estimated foetal birth weights was 4396.14g. There was a significant over estimation of foetal birth weight using the birth weight prediction equation – symphysio-fundal height multiplied by the abdominal girth at the level of the umbilicus. Although studies in normal weight women have shown a correlation between the actual birth weight and estimated foetal birth weight, [8] this was not so in this study on obese women. Correlation analysis showed that in the entire study, clinically estimated foetal birth weight was significantly higher than actual foetal birth weight. The proportion of clinically estimated birth within ±10% of the actual birth weight decreased significantly with increasing body mass index group. The absolute error and the absolute percent error also increased significantly for the increasing body mass index group.

Maternal obesity was responsible for the significant difference observed in the mean of clinically estimated foetal birth weight and the mean of the actual foetal birth weight. [4] The finding in this study is consistent with what was observed by Fox et al that maternal obesity was significantly associated with decreased clinically estimated foetal birth weight accuracy.[3] In another study by Farrell and colleagues, it was observed that the clinical method of foetal birth weight estimation over-estimated the actual foetal birth weight in women with high body mass index.[23] A study in Brazil showed that Dare's formula (symphysio-fundal height x abdominal circumference at the level of umbilicus) was less accurate than the Johnson's formula in estimating foetal birth weight because of the lack of a correction factor for obesity in Dare's formula. The absence of a correction factor for obesity in this simple and easy to apply formula by Dare and colleagues may have been the reason maternal obesity had a profound effect on the results obtained from clinical estimation of foetal birth weight in this study.[4.]

Like in this study, one multicentre study of foetal birth weight estimation involving 504 full term pregnant women reported that the mean estimated foetal birth weight among obese women was significantly different from the mean actual birth weight.[25] In this study, there was a linear relationship between maternal obesity and the values of clinically estimated foetal birth weight. The values of clinically estimated birth weight increased with increasing body mass index. However, these clinically estimated foetal birth weights were observed to be significantly higher than the corresponding actual foetal birth weights. The presence of significant abdominal fat in these women resulted in the high values of clinically estimated foetal birth weights.

This study indicates that reliance on clinical estimation of foetal birth weight alone in obese pregnant women was not accurate and would result in a high rate of unnecessary caesarean deliveries. This suggests that clinical estimation of foetal birth

weight in obese pregnant women is associated with a high level of inaccuracy.

**Conflict of interest:** The authors declare no conflict of interest in the conduct of the study or writing of the paper.

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