Model for Estimation of Intrauterine Fetal Weight for Sudanese

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Abstract: *The aim of the present study was to estimate fetal weight antenatally at or near term by using ultrasound evaluation and measurement. The study was a descriptive study conducted on 232 pregnant women selected by simple random sampling who attended the Elribat national hospital and Khartoum diagnostic center in periods from January 2016-till January 2017. Ultrasound examination was performed and FL, BPD, AC and Fetal weight was estimated by using Hadlock's formula ultrasonogrphically. The mean value of calculated fetal weight was 1526.4±1007.7gm. Finally the correlation was done in order to predict models for estimation for future work.*

Keywords: GA-LMP, mensuration, ultrasound, pregnancy

1. Introduction

Present day obstetrics has in fact rightly been able to focus on the concept of fetal medicine as distinct and significant entity in view of rapid decline in maternal mortality and morbidity with simultaneous recognition of various forms of fetal handicaps affecting the overall perinatal mortality and morbidity. Growth is a basic fundamental of life. Assessment of fetal weight in utero leads to an improved prospective management of high risk pregnancies and considerable reduction in perinatal mortality and morbidity. It has become increasingly important especially for prevention of prematurity, evaluation of fetopelvic disproportion, induction of labor before term and detection of IUGR. Thus a quick, easy and accurate method for estimating the fetal weight in utero with optimum precision would be of obvious benefit to the clinical practicing modern obstetricians. Estimation of birth weight by Johnson's formula based on symphysiofundal height has advantages of speed, economy and general applicability. Obstetric ultrasound has in fact revolutionized the knowledge of fetal medicine in the present day and can predict fetal weight with a great degree of precision. Sowjanya and Lavanya (2015).

1.1. Obstetrical ultrasonography

Early expectations that this method might provide an objective standard for identifying fetus of abnormal size for gestation age was recently undermined by prospective studies that showed sonographic estimates of foetal weight to be no better than clinical palpation for predicting foetal weight (Sherman et al. 1998), Ratanasiri et al (2002), Bossak and Spellacy (1972), Banin et al. (2002), Titapant et al. (2001)). Susiki et al (1974), used ultrasound measurement of fetal heart volume to estimate fetal weight. Paulos et al. (1953) used fetal volume by ultrasound. Sonographic predictions based on algorithms using various combinations of fetal parameters ,such as abdominal circumference (AC), Femur Length(FL), Biparietal Diameter (BPD),and Head Circumference (HC) both singly and in combination have been used (Nzeb et al. (2002), Nahum (2002), Hadlock et al. (1985), Nzeb et al. (1992), Campbells and Wilkin (1975)).When other sonographic fetal measurements are used

for estimating fetal weight e.g. humorous soft tissue thickness, ratio of subcutaneous tissue to, femur length, cheek to cheek distance, these nonstandard measurements do not help to predict birth weight except in special subgroups e.g. Diabetic mothers (Abramowicz et al. (1991)). Multiple sonographic foetal biometery also do not improve prediction (Nzeb et al. (1992), Ratanasiri et al. (2002)). Foetal imaging is limited by maternal obesity, oligohydramnios and anterior placentation. Besides these formulas are obtained from populations which do not include pregnant women of all genetic background resulting in an inherent sampling error.

In some studies, ultrasound has been shown to determine the weight of the fetus to within 10% of the actual birth weight in as many as 75% of pregnancies and within 5% in as many as 40%. Watson et al. (1988).

1.2. Clinical risk Factor

This method involves quantitative assessment of clinical risk factors and has been shown to be valuable in predicting foetal weight. In case of foetal macrosomia ,the presence of risk factors ,such as maternal diabetes mellitus ,prolonged pregnancy, obesity ,pregnancy weight gain of >20 kg, maternal age >35 years, maternal height> 5 ft 3 inches, multiparity, male foetal sex and white race should be added. In low estimated birth weight socioeconomic status, constitutionally small mother, poor maternal weight gain, foetal infections, congenital malformations, chromosomal abnormality, teratogenic exposure, maternal anaemia, Anti phospholipid Antibody syndrome and other medical disorders complicating pregnancy should be mentioned.

1.3. Maternal Self estimation

In literate society maternal self-estimation of fetal birth weight in multiparous women show comparable accuracy to clinical palpation in some studies for predicting abnormally large fetus (Chauhan et al. (1992), Banin et al. (2002)).

1.4. Birth weight Prediction equations:

Various calculations and formulae based on measuring

uterine fundal height above symphysis pubis have been developed. Ojwang et al used the product of symphysiofundal height and abdominal girth measurement at various levels in centimetres above symphysis pubis in obtaining a fairly acceptable predictive value but with considerable variation from the mean. Dare et al simplified and used the product of symphysiofundal height (Mc Donald's measurement) and abdominal girth at the level of umbilicus measured in centimetres and result expressed in grams to estimate foetal weight in uteru at term, and the estimation correlated well with birth weight (Dare et al. (1990)).

Johnson's formula for estimation of foetal weight in vertex presentation is as follows:

Foetal weight (grams) = (Mc Donald's measurement of symphysiofundal height in cm –X) x 155 where X = 13, when presenting part was not engaged, X = 12 when presenting part is at 0 station and X = 11 when presenting part was at +1 station. If a patient weighs more than 91 kg, 1cm is subtracted from the fundal height.

Dawn's formula states that weight (grams) = longitudinal diameter of the uterus x transverse diameter of the uterus x 1.44/2.
Measurements are made with pelvimeter. Double abdominal wall thickness was also measured pelvimeter. If Double abdominal wall thickness was more than 3 cm, the excess was deducted from the longitudinal diameter.

2. Material and Methods

The data from 232 pregnant Sudanese women were evaluated retrospectively during this study in period from January 2016-Till January 2017. Ultrasonography evaluation was conducted by Dr. Elsir Ali Saeed and prof. Dr. Mohamed Elfadil. Women with multiple gestations, diabetes, or growth disorders such as intrauterine growth retardation were excluded. Cross-sectional measurements of each case were used for estimation of fetal weight using ultrasonographic measurement. Biparietal diameter (BPD) was measured in axial plane at the level where the continuous midline echo is broken by the septum pellucidum cavum. Measurements were made from the outer to inner margin of the fetal skull. The abdominal circumference (AC) was measured directly by a plot on transfers section through the fetus abdomen at the level where the umbilical vein and stomach bubble were seen. The femur was measured from the origin to the distal end of the shaft. Then the correlation was developed to develop a linear and logarithmic equation to estimate the fetal weight as follow:
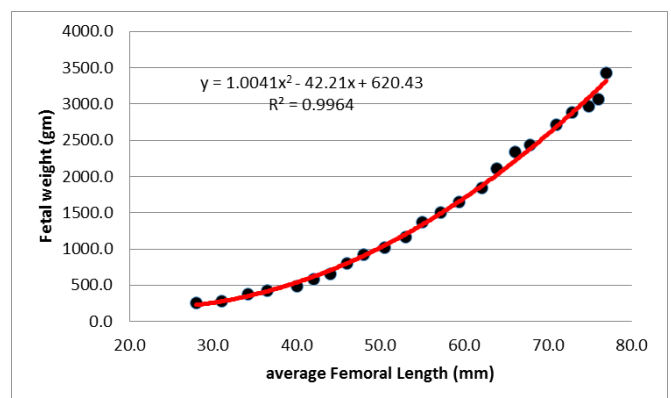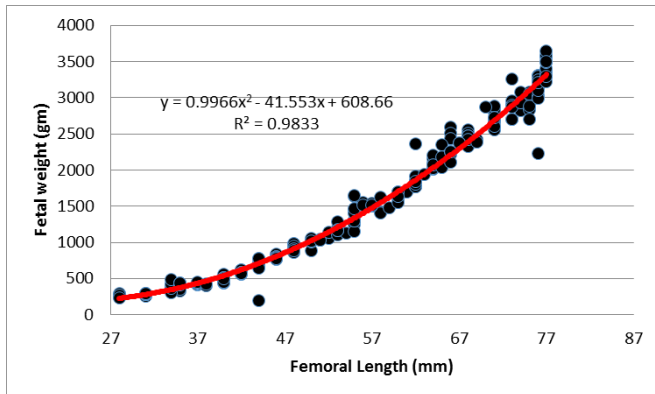
3. Result Presentation
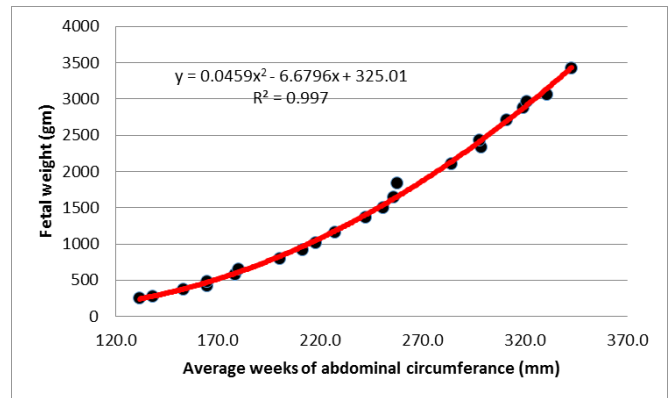
Figure 1: scatter diagram showed the relation between average value of abdominal circumference (AC) (mm) (x) and FW (y)
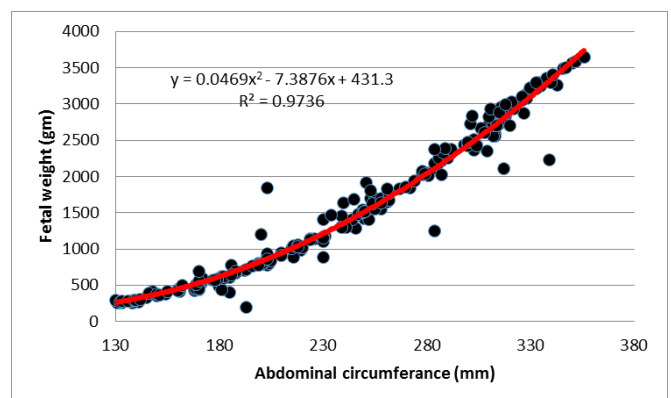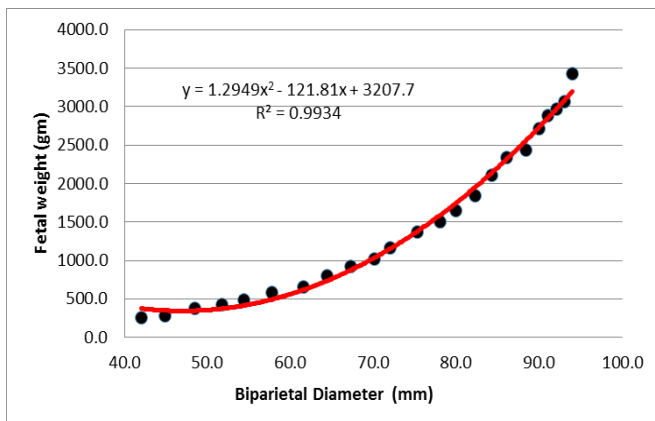

Figure 2: scatter diagram showed the relation between abdominal circumference (AC) (x) and FW (y)
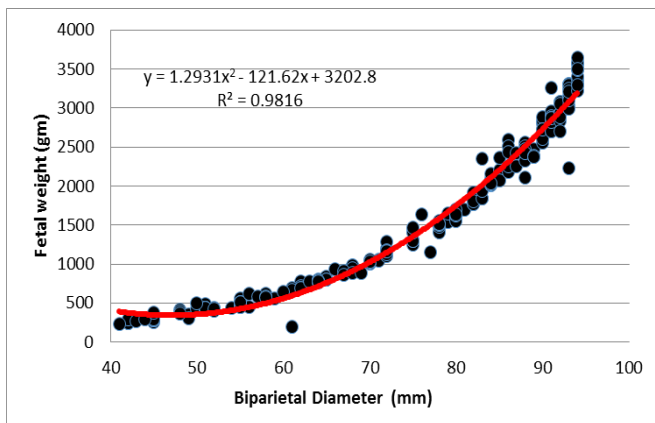

Figure 3: scatter diagram showed the relation between average value of femur length (FL) (x) and FW (y)

Figure 4: scatter diagram showed the relation between of femur length (FL) (x) and FW (y)

Figure 5: scatter diagram showed the relation between average value of BPD (x) and FW (y)

Figure 6: scatter diagram showed the relation between BPD (x) and FW (y)

Table 1: statistical measure for study variables

Variables	Mean	Std. Deviation
BPD	72.4	16.5
FL	54.5	15
AC	237.6	66.2
FW	1526.4	1007.7

4. Discussion

The purpose of this study was to develop a model for estimation of fetal weight using ultrasound measurement, in normal Sudanese pregnant women using ultrasound measurement. The research includes 232 pregnant women. The variables used to establish this study was FA, BPD, fetal FL, and AC, which having mean± SD of (1526.4 ± 1007.7gm), (72.4 ± 16.5mm), and (54.5 ± 15mm), (237.6 ± 66.2mm) respectively. As in table (1).

Fetal weight estimation has become increasingly important especially for the prevention of prematurity, evaluation of fetopelvic disproportion, decision for mode of delivery in breech presentation, induction of labor before term, in complications of pregnancy and in detection of intrauterine growth retardation. A lot of work has been done to find out the accurate methods for estimation of fetal size and weight in utero. The different works include clinical, biochemical, radiographic and ultrasonographic methods. Clinical methods were criticized on the basis of being less accurate and subject to considerable observer variation. Biochemical methods were not found to be satisfactory. Radiography was abandoned because of its hazards to both fetus and mother. Ultrasonography has gained popularity for determination of fetal parameters and wellbeing and also found to be useful for estimation of fetal weight. ($P < 0.05$).

Predanic et al. (2002) reported a significant improvement in EFWs with more training of residents. Ben-Aroya et al. (2002) reported that residents' fatigue affected the accuracy of clinical, but not sonographic EFWs. This study demonstrated that O&G residents and MFM subspecialists achieved accuracies of 65% and 79%, respectively, for EFWs to within 10% of the actual birth weight for all births.

Average weeks of abdominal circumference (mm) strongly related to the fetal Weight in (Gm) where logarithmic correlation was investigate this relationship reveals that (fetal weight = $(0.0459 \ast \text{Average AC})2 - (6.6796 \ast \text{Average AC}) + 325.01$). This equation further can be used for estimation of fetal weight without any ultrasonographic formula correlation co-efficient equal to ($R2 = 0.997$).

Also abdominal circumference (mm) strongly related to the fetal Weight in (Gm) where logarithmic correlation was investigate this relationship reveals that (fetal weight = $(0.0469 \ast AC \ (mm))^2 - (7.3876 \ast AC(mm)) + 431.3$). This equation further can be used for estimation of fetal weight without any ultrasonographic formula correlation co-efficient equal to ($R2 = 0.9736$). We used the average in state of normal measurement because of some sort of variation that noted in scatter plot and the average date of GA using AC can be used for fetal weight estimation. As in figure (1) and (2).

Linear correlation was intended to assess the relationship between the fetal weight and average values of femur length after grouping the femur length data, so as in figure (3) strong logarithmic correlation was noted at $R2 = 0.9964$ and the fetal weight$=((1.0041 \ast \text{Average FL} \ (mm))2 - (42.21 \ast \text{Average FL} \ (mm)) + 620.43$). Also when we use the measurement without average values the correlation co-efficient equal to $R^2 = 0.9833$, indeed these values crospond the strong relationship between these variables. Where the equations stated that (y = $0.9966x2 - 41.553x + 608.66$)

Where Y= fetal weight and X= FL (mm). As in figure (4 and 3)

Indeed as we already show in other articles the BPD is one of the methods that can be used in assessing the value of ultrasound examination in 2nd and strongly in 3rd trimester in case of fetal weight and GA estimation using ultrasound formulas here was a strong relationship between the Fetal weight and BPD in which direct (logarithmic) relation was reveals that (y = 1.2931x2 - 121.62x + 3202.8) at R² = 0.9816, for BPD in (mm). And (y = 1.2949x2 - 121.81x + 3207.7), at R² = 0.9934. For average value in (mm). As in figure (5) and (6).

5. Conclusion

The model can be summarized as:

$FW\ (gm.) = 0.0459*(average\ AC\ (mm))^2 - 6.6796* average\ AC\ (mm) + 325.01.$
$FW\ (gm.) = 0.0469* AC\ (mm)^2 - 7.3876* AC\ (mm) + 431.3.$
$FW\ (gm.) = 1.0041*(Average\ FL\ (mm))^2 - (42.21*Average\ FL\ (mm)) + 620.43.$
$FW\ (gm.) = 0.9966*(FL\ (mm))^2 - 41.553* FL\ (mm) + 608.66$
$FW\ (gm.) = 1.2949*(average\ BPD\ (mm))^2 - 121.81* average\ BPD\ (mm) + 3207.7$
$FW\ (gm.) = 1.2931*(BPD\ (mm))^2 - 121.62* BPD\ (mm) + 3202.8.$

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