DOI - 10.21276/obgyn.20252024.11.1.18 *ISSN Print – 2454-2334; ISSN Online – 2454-2342*

RESEARCH ARTICLE

A study on estimation of fetal weight in term of pregnancy by clinical method and USG and comparison with actual birth weight

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ABSTRACT

Background: Fetal weight estimation is of key importance in the decision - making process for obstetric planning and management. It provides valuable information which aids the physician or midwife to take informed decisions concerning the timing and route of delivery. **Aim:** 1) To assess fetal weight by clinical methods using Johnson's formula and Dare's formula; 2) To access fetal weight by ultrasound, using Hadlock's formula; 3) To compare the accuracy of estimated fetal weight by USG and clinical methods with actual birth weight. **Materials and methods:** The study was conducted in 100 pregnant women attending Obstetrics and gynaecology department who came for routine antenatal check up in the period between 2018 - 2020 was collected and analysed. The data collection process includes obtaining a detailed history and doing a thorough general physical examination and systematic examination. Abdominal examination was then performed in supine position. **Results:** In our study multigravida (44%) had mean birth weight of 2955 grams than primigravidas (56%) who had a mean birth weight of 2907gms, which was statistically significant p=0.003. Among weight calculated using USG in 53% of cases 39% had overestimated and 55% had underestimated the fetal weight. Among weight calculated using Johnson method 53% were within ± 250 grams and 100% were within the range of ± 1000 grams. So 47% of cases had underestimated and 52% had overestimated fetal weight. Among weight calculated using Dares formula 52% were within ± 250 grams and 100% of cases were included only when the weight was >1kg hence by our study 72% of cases had overestimated and 27% of cases had underestimated fetal weight. As a result of our study Johnson's method of fetal weight estimation was found to be more reliable in terms of showing less mean error per kg of birth weight and less difference in mean estimated fetal weight from actual birth weight. USG estimated fetal weight was noted to be closer to actual birth weight. **Conclusion:** In this study, fetal weight estimated by clinical method of USG was compared with actual birth weight. It was found out that USG was found to be more accurate for estimating the fetal birth weight.

Keywords: Birth weight, USG, Hadlock's formula, Dare's formula.

In modern obstetrics, to deliver a healthy baby in a healthy mother is the primary goal. Birth weight is the single most important factor which determines the neonatal outcome and survival.[1] So estimated fetal weight is incorporated into the routine antepartum evaluation of pregnancy.[2] Importance is that, low birth weight babies which include small for gestational age babies, intra uterine growth restricted babies or preterm babies are associated with increased perinatal morbidity and mortality. Large babies which include large for gestational age or macrosomic babies of diabetic mothers, may land up with complications like brachial plexus injuries, facial palsies, birth canal injuries, post-partum haemorrhage.[3]

Factors influencing the fetal growth include environmental factors, maternal, fetal and placental factors. This includes race, maternal age, parity index, sex of the

Received: 9th January 2022, **Peer review completed**: **4th August 2022**, **Accepted: 21st April 2024**.

Nair RV, Sowbharnika CP, Farooq NH, Raagavi Sri S. A study on estimation of fetal weight in term of pregnancy by clinical method and USG and comparison with actual birth weight. The New Indian Journal of OBGYN. 2024; 11(1): 96-100.

baby, socioeconomic status, maternal and congenital infections. Regarding fetal factors, fetal infections,[4] chromosomal anamolies[5] and sex of baby [6] have an impact on fetal weight.

Abnormalities in fetal growth can be detected clinically or by ultrasound (USG). Simple methods like measurements of symphysio - fundal height (SFH) and abdominal girth (AG) can be used to predict expected fetal weight in low resource settings.[7] Ultrasound is also used for estimation of expected fetal weight and diagnosis of impaired growth. But, it is not easily available in all places offering obstetric care, especially in low resource settings. Fetal weight estimation using ultrasound needs training, expertise and expensive equipment. In such circumstances clinical methods of estimating fetal weight can aid in obstetric decision making.[8] Various clinical formulae based on measurements of symphysio - fundal height and abdominal girth have been developed. Johnson's formula for estimating fetal weight in vertex presentations was developed. In a study, product of symphysio-fundal height (cms) and abdominal girth (cms) to obtain expected fetal weight with fairly acceptable predictive value but with considerable variation from the mean was used. [9] To simplify this formula, the product of symphysio-fundal height and abdominal girth at level of umbilicus to give the expected fetal weight in grams which correlated well with the birth weight was introduced by Dare.[10]

Hence this study was done on 100 full term pregnancies in early labour to compare the accuracy of the two clinical formulae viz, Johnson's and Dare's formula to assess fetal weight and compare with ultrasound estimated fetal weight and actual birth weight.

Materials and methods

This study was a cross sectional study which was conducted in Sree Mookambika Insttitute of Medical Sciences hospital, Kulasekaram, for a duration of 18 months from 2018-2020. For this, a total of 100 pregnant women fulfilling the section criteria were included.

Inclusion criteria:

- Singleton pregnancy
- Cephalic presentation
- Live fetus
- Known last menstrual period or ultrasound scan with confirmed expected date of delivery
- Gestational age 37-42 weeks

Exclusion criteria:

- Multiple gestation
- Anomalous fetus
- Non- cephalic presentation
- Intrauterine fetal death
- Presence of coexisting fibroids, ovarian cysts
- Already diagnosed liquor abnormalities

Procedure: After approval of the study protocol by our institutional research committee and human ethics committee, written informed consent was taken from pregnant women attending Obstetrics and Gynaecology department, in Sree Mookambika Institute of Medical Science Kulasekharam, who fulfil the inclusion and exclusion criteria. Total 100 women were included in the study. A detailed history was taken which included the patient's education, occupation, socio-economic status, menstrual history, obstetric history, past medical and surgical history and personal history. A thorough general physical examination was done. Vitals signs and anthropometric measurements and systemic examination findings were recorded. After a brief general physical examination, per abdominal examination was performed in supine position.

Symphysio-fundal height: Patient was requested to empty the bladder before examination. The patient was asked to lie in supine position with thigh lightly flexed on the examination bed. Whole abdomen was exposed and per abdominal examination was done for lie, presentation, and engagement. The uterine height was palpated from xiphisternum after correction of dextro-rotation of the uterus. Upper border of pubic symphysis was palpated and the symphysio-fundal height in centimetres was measured from symphysis pubis to the uterine fundus using flexible standard measuring tape with the markings of centimetres towards the patient and keeping the measuring tape in skin contact.

Abdominal circumference: This was followed by measurement of abdominal girth in centimetres at the level of umbilicus.

Formulas for clinical assessment of fetal weight: Expected fetal weight was calculated using two clinical formulae, namely Johnson's formula and Dare's formula as follows -

Johnson's formula[11] - Fetal weight = (McDonald's measurement - 12) ×155 when presenting part is unengaged.

Fetal weight = (McDonald's measurement-11) × 155 when presenting part is engaged. If woman weighed more than 91 kg, 1 cm was subtracted from fundal height.

Dare's formula[12]: EFW in grams = Symphysio-fundal height (in cms) × Abdominal girth (in cms).

Fetal weights estimation by Hadlock's formula using ultrasonography (USG): Sonographic examination using 2-5 MHz transducer (SIEMENS ACUSON X 300) USG machine was done in all patients. Patient was scanned in supine position. Transducer was placed over the abdomen and fetal parts were identified, cardiac pulsations noted and the lie and presentation of the fetus is determined. Position of placenta and its maturity was noted. The amount of liquor was also noted. Biparietal diameter (BPD) abdominal circumference (AC) and femur length (FL) and head circumference (HC) were measured in centimetres and the sonography machine calculated the fetal weight.

Biparietal diameter measurement (BPD)[13]: The BPD was measured from transaxial sonogram of the fetal head at the level of paired thalami and cavum septipellucidi. The biparietal diameter was measured from the outer edge of the cranium near the transducer to the inner edge of the cranium farthest from the transducer.

Head circumference (HC): The head circumference is the length of the outer perimeter of the cranium made on the same transaxial image of the fetal head. It was measured by using an electronic ellipse available on the ultrasound scanner. Alternatively it can be calculated from the outer edge to inner edge analogs of the biparietal diameter (BPD) and occipitofrontal diameter. Occipito frontal diameter (OFD) is measured from mid skull to mid skull along the long axis of the fetal head.

HC =1.57× (Outer to outer BPD + outer to outer OFD)

Abdominal circumference (AC) measurement**:** The measurement of the fetal AC was made from a transverse axial image of the fetal abdomen at the level of the stomach and intrahepatic portion of umbilical vein. Alternatively the abdominal circumference may be calculated with equivalent results from to orthogonal abdominal diameters (AD1, AD2), one anteroposterior and second transverse measured in the same image as follows - AC =1.57× (AD1+AD2).

Femoral length (FL) measurement: The shaft of the femur is the easiest fetal long bone to visualize and measure. FL measurement was obtained from the greater trochanter to the lateral condyle. The head of the femur and the distal femoral epiphysis, when present, was not included in the measurement.

The fetal weight was calculated using the formula: Log 10 BW=0.3596+ (0.00061 XBPD× AC) + (0.0424×AC) + (0.174×FL) + (0.0064×HC) - (0.00386×AC×FL).

Actual birth weight: All the babies delivered by vaginal or abdominal route were weighed using electronic baby weighing machine soon after birth. Predicted estimated fetal weight by each method was compared with respective neonatal actual birth weight.

Results

This is a cross section study conducted in 100 pregnant women attending the department of Obstetrics and Gynaecology, in Sree Mookambika Institute of Medical Science Kulasekharam. When the total 100 women were divided into 5 groups based in their socioeconomic status, it became evident that women belonging to lower socioeconomic status had foetuses with lower birth weight (table 1).

Table 1: Birth weight with socioeconomic status

Socioeconomic status	No. of women	Average birth weight (gm)
Upper	19	3408
Upper Middle	26	3050
Lower Middle	25	2922
Upper Lower	17	2684
Lower	13	2312
ANOVA=16.987	df= 99	P=0.000

Table 2: Relation of the birth weight with maternal pre-pregnancy weight (Kg)

Group	Body weight (Kg)	No. of women	Average birth weight (gm)
Group -1	<45	10	2734
Group - 2	>45	90	2950
Coefficient of correlation = 0.272			p=0.006

Table 3: Relation of the birth weight with maternal weight gain during pregnancy

Group	Weight gain (Kg)	No. of women	Average weight of baby (gm)
Group - 1	<7	11	2553
Group - 2	>7	89	2974
Coefficient of correlation = 0.260			p=0.009

Table 4: Relation of the birth weight with parity

Group	Parity	No. of women	Average birth weight (gm)
Group - 1	Primi	56	2907
Group - 2	Multi	44	2955
t = 3.034; df=98; p=0.003			

Birth weight was higher in foetuses born to mother with pre-pregnancy weight more than 45 kg, when compared to foetuses born to mother with pre-pregnancy weight less than 45 kg. More weight gain during pregnancy resulted in higher birth weight. The coefficient of correlation value shows a significant relationship between the maternal weight gained and birth weight. With p=0.006 value which was statistically significant (table 2). The study also showed there is a significant relationship with a p value of (p=0.009) between mothers weight gain and birth weight of the baby (table 3).

The t value reveals that there is a significant difference found in birth weight among primi and multigravida. From the table – 4, it is seen that multiparous generally deliver

Table 5: Comparison of mean actual birth weight with mean estimated birth weight by Johnson method

Estimates	Estimation by Johnson
Mean actual birth weight	3015.3 gms
Mean estimated fetal weight by Johnsons method	2928.10 gms
Difference between mean actual birth weight and mean estimated fetal weight by Johnsons method	87.27gms
The mean error of estimated of fetal weight	254.47 ie, 84 gm/kg
S.D - Standard deviation	431.10
S.E- Standard error of the mean	43.10
Pearson product moment correlation co-efficient	= 0.801

baby of more birth weight compared to primipara. The study shows that there is a p value of 0.003 statistically significant difference found in birth male and female babies. It is seen that male babies weighs more in comparison to female babies. Among 100 babies the mean actual birth weight was 2928 grams. The maximum actual birth weight was 4300 grams and minimum actual birth weight was 1500 grams. Table - 5 shows strong positive correlation between the Johnson method of fetal weight estimation and actual birth weight.

Table - 6 shows positive correlation between the Dare's method of fetal weight estimation and actual birth weight. The study showed that USG estimation was more or less equal to the actual birth weight with a difference of 13 gm. Other methods deviate from the actual birth weight ie. Johnson (87.27 gm) and Dare (145.42). Hence, it is inferred USG method estimated the fetal weight more accurately than others methods. It is inferred that all the methods are more or less accurately estimated the actual birth weight. But, when compared to the three methods, USG estimate was more accurate than other two methods as the mean difference between USG estimate and actual birth weight was found to be very less ie. 12.90 g.

Table 6: Comparison of mean actual birth weight with mean estimated birth weight by Dare's formula

Estimates	Estimation By AG & SFH
Mean actual birth weight	2928.1 gms
Mean estimated fetal weight by Dare's method	3074.02 gms
Difference between mean actual birth weight and mean estimated fetal weight by Dare's method	145.9 gms
The mean error of estimated of fetal weight	283.46 ie, 92 gm/kg
S.D - Standard deviation	419.42
S.E - Standard error of the mean	41.94
Pearson product moment correlation co-efficient	= 0.782

Discussion

In this study, it was found that women belonging to low socioeconomic status had low birth weight babies with average birth weight of 2312 grams. This is proved by the significant weight difference among upper and lower class with ANOVA value of 16.987. This is similar to study made by Muhamed Rafiq et al.[14] It was found out that women with pre-pregnancy weight of >45kg (90%) had increased birth weight of fetus compared to the weight of the babies born to women born to women with pre-pregnancy weight of ≤45kg (10%). In our study, it was found that women with >7 kg (89%) of weight gain during pregnancy had increased weight of babies compared to mothers with weigh gain less than 7 kg. The difference between the mean birth weight between the 2 groups was statistically significant p=0.009 which is comparable to the study made by Eastman and Jackson (1968).[15]

In our study, it was found that women with <150 cm height (12%) had babies with mean birth weight of 2753 grams and for women >150 cm (88%) it was 2952 grams and difference in weight was 199 grams. The difference was statistically significant p=0.023. This finding is similar to the study made by Witter and Luke in 1991.[16]

In this study multigravida (44%) had babies with higher birth weight with the mean birth weight of 2955 grams than primigravidas (56%). This is comparable to study done by Shah[17] in 2010 in which lowest birth weight was observed in infants born to primi mothers. In our study, the mean birth weight was 64 grams more in males compared to females.

By Johnson method 53% were within ± 250 grams and 100% were within the range of ± 1000 grams. 47% of cases had underestimated and 52% had overestimated fetal weight. The difference between mean estimated fetal weight and mean actual birth weight was 87.27 grams. By Dares formula 52% were within ± 250 grams and 100% of cases were included only when the weight was >1kg. The difference between mean estimated fetal weight and mean actual birth weight was 145.9 grams. 72% of cases had overestimated and 27% of cases had underestimated fetal weight. In our study all methods underestimated the fetal weight when birth weight was greater than 3500 grams. This is comparable to the study made by Uma Thombarapu.[3] Among all the three methods USG was found to be more accurate in estimating the fetal weight. This is similar to the study by Muralisree et

al [1]. Among the clinical methods Johnsons formula had more accuracy than Dare's formula in estimating the fetal weight.

Conclusion

When clinical methods were compared with ultrasound, Johnson formula estimated weight was much closer to USG estimated fetal weight.

Conflict of interest: None. **Disclaimer:** Nil.

References

1. Muralisree M, Mirunalini S. Comparative study of fetal weight estimation by clinical and ultrasound methods and its correlation with actual birth weight. Int J Modn Res Revs. 2015; 3 (10): 948-54.
2. Sharma N, Srinivasan JK, Sagayaraj BS, Lal DV. Foetal weight estimation methods – Clinical, Sonographic and MRI imaging. Inter J Sci Res Publications. 2014; 4(1).
3. Thombarapu U, Agrawal P. Comparative Evaluation between Two Clinical Methods of Fetal Weight Estimation with Actual Birth weight – A Prospective Study. Inter J Sci Res. 2015; 4(6): 1491.
4. Waldorf KM, McAdams RM. Influence of infection during pregnancy on fetal development. Reproduction. 2013 Nov 1; 146(5): R151-62.
5. Boghossian NS, Horbar JD, Carpenter JH, Murray JC, Bell EF, Vermont Oxford Network. Major chromosomal anomalies a mong very low birth weight infants in the Vermont Oxford Network. The Journal of pediatrics. 2012 May 1; 160(5): 774-80.
6. Brown ZA, Baan E, Schalekamp-Timmermans S, Verburg BO, Jaddoe VW, Steegers EA. Sex specific differences in fetal and infant growth patterns: a prospective population-Broere based cohort study. Biology of sex differences. 2016 Dec; 7(1): 65.
7. Shittu AS, Kuti O, Orji EO, Makinde NO, Ogunniyi SO, et al. Clinical versus Sonographic Estimation of Foetal Weight in Southwest Nigeria. J Health Popul Nutr. 2007; 25(1):14-23.
8. Torloni MR, Sass N, Sato JL, Renzi AC. Clinical Formulas, mother's opinion and ultrasound in predicting birth weight. Sao Paulo Med J 2008;126(3): 145-9.
9. Dare FO, Ademowore AS, Ifaturoti OO, Nganwuchu A. The value of symphysio-fundal height/abdominal girth measurements in predicting fetalweight. Int J GynaecolObstet. 1990; 31 (3):243-8.
10. Ojwang S, Ouko BC. Prediction of Fetal Weight in Utero by Fundal Height/Girth Measurements. J ObstetGynecol East Central Afr 1984; 3:111.
11. Johnson RW, Toshach CE. Estimation of fetal weight using longitudinal measurementation. American journal of obstet and gynaecol. 1954; 68(3): 891-6.
12. Dare FO, Ademowore AS, Ifaturoti OO, Nganwuchu A. The value of symphysio -fundal height/abdominal girth measurements in predicting fetalweight. Int J Gynaecol Obstet. 1990; 31 (3): 243-8.
13. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal biparietal diameter: rational choice of plane of section for sonographic measurement. AJR Am J Roentgenol 1982; 138: 871-74.
14. Rafique M, Zia S, Ubaidullah SM, Sultan MA. Impact of socioeconomic status on birth weight and length of Newborns delivered at Services Hospital Lahore. Pak Paed J. 2008; 32(2): 94-100.
15. Eastman NJ, Jackson E. Weight relationships in pregnancy. I. The bearing of maternal weight gain and pre-pregnancy weight on birth weight in full term pregnancies. Obstet, Gynaecol, Survey 1003; 1968.
16. Witter FR, Luke B. The effect of maternal height on birth weight and birth length. Early Hum Dev. 1991; 25: 181-6.
17. Shah PS. Parity and low birth weight and preterm birth: a systematic review and meta-analyses. Acta obstetrician et gynecologica Scandinavica. 2010 Jul 1; 89(7): 862-75.

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