ORIGINAL RESEARCH PAPER

Volume - 12 | Issue - 07 | July - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ULTRASONOGRPAHIC ESTIMATION OF FOETAL WEIGHT USING FOETAL ABDOMINAL WALL, MID THIGH AND MID ARM SOFT TISSUE THICKNESS AT THIRD TRIMESTER

Radio-Diagnosis

Dr Hari Sankar S* Junior resident, Department of Radiodiagnosis, Government T.D medical college, Alappuzha *Corresponding Author

Dr Beenamol S Professor (CAP), Department of Radiodiagnosis, Government T.D medical college, Alappuzha

Dr Safi Salim Assistant professor, Department of Radiodiagnosis, Government T.D medical college, Alappuzha

Dr Renjini Assistant professor, Department of Radiodiagnosis, Government T.D medical college, Alappuzha

ABSTRACT

Background: Presently Hadlock's formula used, which includes BPD, AC, FL and HC for estimation of fetal weight. In late trimesters, greater variability in soft tissue thickness than other parameters. Hence, soft tissue parameters are assessed to find their correlation with fetal weight and derive a cut off from these parameters to predict small and large for gestational age babies. **Materials & methods:** A prospective observational study was done for 1 year involving singleton 60 uncomplicated pregnancies at more than or equal to 37 weeks gestation with an interval from the ultrasound scan to delivery of ≤7 days.**Results:** Fetal mid arm soft tissue thickness (FMASTT), fetal abdominal soft tissue thickness (FASTT) and fetal mid-thigh soft tissue thickness (FTSTT) and showed positive correlation with fetal birth weight. All variables showed better diagnostic accuracy in predicting large for gestational age babies than small for gestational babies. Among all the variables studied, FTSTT appears to be better predictor of both small for gestational age and large for gestational age babies. **Conclusion:** Inclusion of fetal mid arm, abdominal and thigh soft tissue thickness can help to predict large of gestational age babies in late trimester as an alternative method when the correct plane of standard measurements are not possible. The prospects of soft tissue measurement need to be revalidated in future

KEYWORDS

Estimated fetal weight, Fetal abdominal soft tissue thickness, Fetal mid-arm soft tissue thickness, Fetal mid-thigh soft tissue thickness, Birth weight.

INTRODUCTION

Ultrasonography (USG) is commonly used to assess fetal growth and further to estimate fetal weight. Estimated fetal weight (EFW) gives valuable information for planning and managing labor. This estimation is done using various formulae. Currently, Hadlock's formula is used widely for fetal weight estimation, which includes standardized fetal parameters such as biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal wall circumference (AC) Recently, soft tissue markers like fetal abdominal wall subcutaneous tissue thickness (FASTT) Fetal Mid Arm Soft Tissue (FMASTT) mm and Fetal Mid-Thigh Soft Tissue have been used to predict fetal weight in-utero. [1–3]

Although it is quite variable, AC is one of these markers that is frequently used to estimate foetal weight. However, because these criteria do not take into consideration the bulk of soft tissues, the foetal weight is underestimated. Additionally, these equations are proven to be less accurate at the weight extremes. Neonatal mortality and morbidity are also brought on by the aberrant foetal growths, coupled with intra- and postnatal problems. Macrosomia is linked to potentially deadly perinatal problems such postpartum haemorrhage, brachial plexus injury, shoulder dystocia, hypoxia, and injury to maternal soft tissues. Therefore, at term, identifying macrosomic infants is important since it influences the mode of delivery. [1,2,4]

Fetal weight is without a doubt one of the most important factors in determining newborn survival. It is an independent factor that determines the best chance of survival for the infant. Obstetric ultrasound's diagnostic capability aids in the accurate prediction of foetal weight. Soft tissue measurements can be used to predict macrosomia at term, because subcutaneous tissue contains 75% of the body's fat.

Macrosomia can be predicted using a variety of ultrasonographic parameters, including foetal abdominal 2 wall subcutaneous tissue thickness (FASTT), mid-thigh soft-tissue thickness (MTSTT), and mid arm soft-tissue thickness (FMASTT). Improved management of high-risk pregnancies results from measurement of fetal weight in gestation.[3]

MATERIAL AND METHODS

Study Design: A prospective observational study conducted for period of 1 year in government TD medical college, Alappuzha, Kerala.

Study Population: 60 antenatal women referred for ultrasound in the third trimester with an interval from ultra sound to delivery of ≤7 days.

Inclusion Criteria:

Antenatal women referred for Ultrasound examinations in the third trimester and an interval from the ultrasound scan to delivery of ≤7days.Antenatal women who have given consent for this study

Exclusion Criteria:

Pregnancies with Intrauterine death, Major structural or chromosomal anomalies, multiple pregnancy, Oligohydramnios & Severe Polyhydramnios, Transverse lie and breech presentation are excluded from the study.

Study Variables:

Fetal Mid Arm Soft Tissue Thickness:

Distance between the outer surface of the arm and the outer surface of humerus measured perpendicular to the bone in its middle part.in a longitudinal humerus (arm)obtained by visualizing the condyle in its largest dimension. [5]

Figure 1. Fetal Mid Arm Soft Tissue Thickness.

Fetal Abdominal Wall Soft Tissue Thickness:

Measurement of subcutaneous tissue at the anterior abdominal wall at any point within one fourth of the abdominal circumference from the umbilical cord insertion in the midline between the outer and inner margin of echogenic subcutaneous tissue[5]

Figure 2. Fetal Abdominal Wall Soft Tissue Thickness

Fetal Mid Thigh Soft Tissue Thickness:
Measured by visualizing the femur in the longitudinal section in the coronal plane by visualizing the head and neck and freezing the image, and then measuring the distance between the outer surface of the thigh and the outer surface of the femur, perpendicular to the bone, in its middle part[5].

Figure 3. Fetal Mid Thigh Soft Tissue Thickness

Procedure:
All the patients was adequately counselled and their written informed consents were obtained before recruitment into the study. The procedure was explained to participants and were asked to evacuate the urinary bladder before the scanning. The accuracy of the weighing scale at the labor ward was validated prior to the study. Sonographic examination was obtained for all participants in supine position using ultrasound machine with curvilinear probe and transducer frequency of 3.5 Mhz. Fetal parametric measurements including FASTT, FTSTT and FMASTT was taken by a single observer at the point of scanning and the time of scanning noted. After delivery, the actual birth weight and the time of delivery was recorded.

STATISTICAL ANALYSIS AND RESULTS:
After collecting, the data were compiled and entered in Microsoft Excel Sheet (Microsoft Excel 2019 MSO - Version 2205 Build 16.0.15225.20278). Analysis was done using Statistical software SPSS version 16. Categorical and quantitative variables were expressed as frequency (percentage) and mean ± SD respectively. Karl Pearson Correlation Coefficient was used to find out relationship of quantitative parameters.

Receiver Operating Characteristic (ROC) graphs were plotted and the area under the curve was calculated to assess diagnostic accuracy of sonographic variables in detecting SGA and LGA and to assess the optimal cut-off scores. Sensitivity, Specificity, positive predictive value (PPV), and negative predictive value (NPV) and accuracy have been calculated for the diagnostic accuracy of sonographic variables in detecting SGA and LGA. For all statistical interpretations, $p<0.05$ was considered the threshold for statistical significance. Statistical analyses was performed by using a statistical software package SPSS, version 20.0

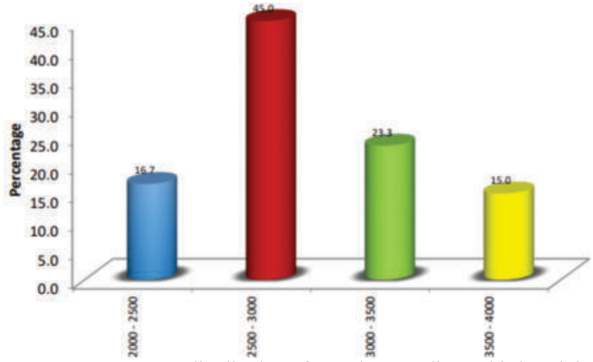

Figure 4. Percentage distribution of sample according to birth weight in grams.

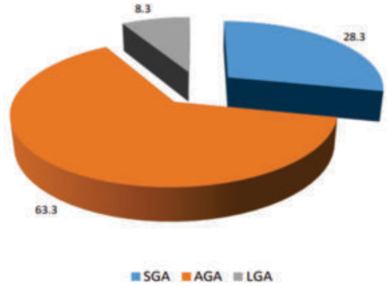

Figure 5. Percentage distribution of the sample according to small for gestational age, appropriate for gestational age and large for gestational age.

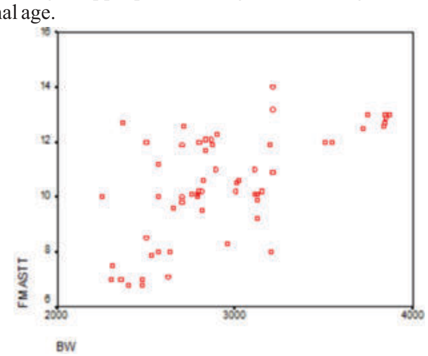

Figure 6. Scatter plot between FMASTT and birth weight in grams.

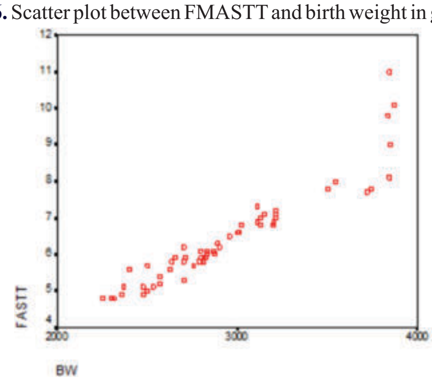

Figure 7. Scatter plot between FASTT and Birth weight in grams.

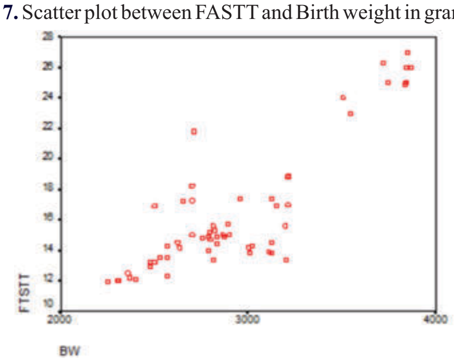

Figure 8. Scatter plot between FTSTT and Birth weight in grams.

Table 1. Correlation between fetal weight at term and sonographic measurements of fetal abdominal wall, mid-thigh and mid-arm soft tissue thickness using Pearson correlation.

Variables for correlation with actual birth weight (in grams)	r	P - value
FMASTT	0.631	p<0.01
FASTT	0.943	p<0.01
FTSTT	0.848	p<0.01

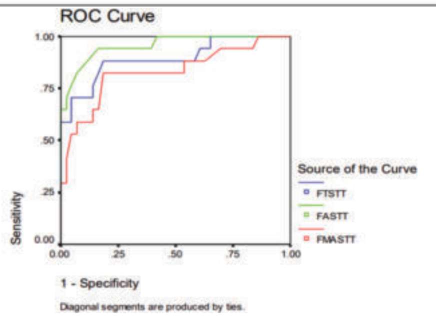

Figure 9. ROC Curve for sonographic measurements of fetal soft tissue markers in predicting SGA

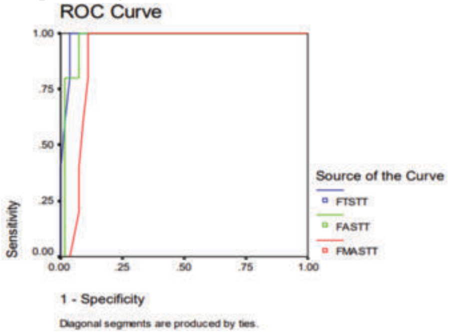

Figure 10. ROC Curve for sonographic measurements of fetal soft tissue markers in predicting LGA.

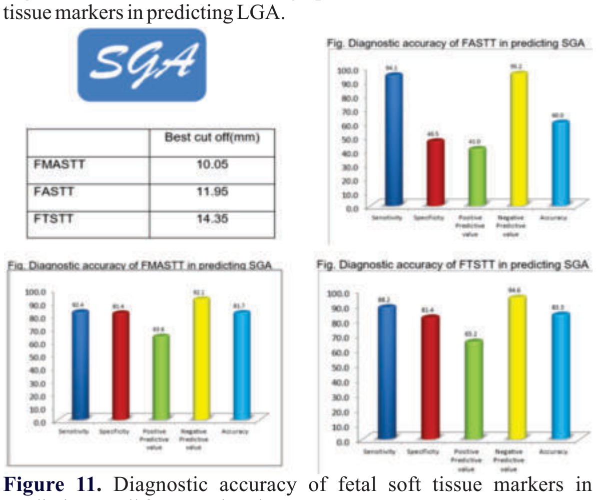

Figure 11. Diagnostic accuracy of fetal soft tissue markers in predicting small for gestational age.

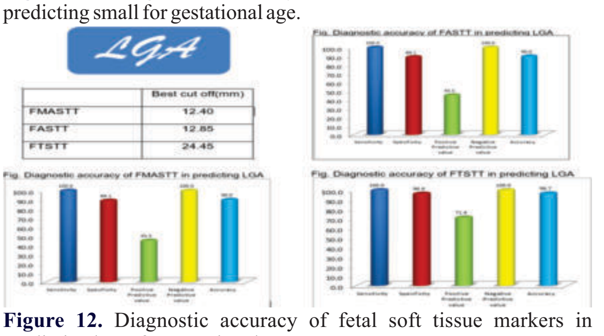

Figure 12. Diagnostic accuracy of fetal soft tissue markers in predicting large for gestational age.

Out of the three soft tissue thickness measurements FTSTT showed greatest accuracy in predicting large for gestational age babies. All FMASTT, FASTT, FTSTT showed high negative predictive value (NPV) of 100%. Indicating that if the soft tissue thickness is less more than cut off values, the baby is less likely to be large for gestational age. Diagnostic accuracy of FMASTT, FASTT, FTSTT in predicting SGA 81.7, 86.7 and 83.3 respectively. Diagnostic accuracy of FMASTT, FASTT, FTSTT in predicting LGA 90.0, 93.3 and 96.7 respectively.

DISCUSSION:

The present study was a prospective observational study done among 60 pregnant women to determine the role of soft tissue measurements - fetal mid arm soft tissue thickness (FMASTT), fetal abdominal soft tissue thickness (FASTT) and fetal mid-thigh soft tissue thickness (FTSTT) of fetus with actual birth weight and to derive cut off values to each variable in order to predict small for gestational age and large for gestational age babies.

Pearson's correlation showed a high statistically significant positive linear relationship between FMASTT, FASTT and FTSTT and fetal birth weight with r values of 0.631, 0.943 and 0.848 respectively and all of the soft tissues showing p value <0.01. FASTT and FTSTT showed greater positive correlation with fetal birth weight than FMASTT.

Diagnostic accuracy of FMASTT, FASTT, FTSTT in predicting SGA 81.7, 86.7 and 83.3 respectively.

Diagnostic accuracy of FMASTT, FASTT, FTSTT in predicting LGA 90.0, 93.3 and 96.7 respectively.

In the current study, the sensitivity, specificity, negative predictive value and accuracy was high in predicting large for gestational age babies than small for gestational age babies.

Positive predictive value was less for all variables. All variables showed slightly more positive predictive value to predict small for gestational age babies than large for gestational age babies, except FTSTT

All variable shows better diagnostic accuracy in predicting large of gestational age babies than small for gestational babies.

For predicting small for gestational age FASTT appears to be a best among the variables studied. And for predicting large for gestational age FTSTT appears to be a best among the variables studied.

This is similar to the findings in several studies have been conducted to find the correlation between sub cutaneous tissue thickness and birth weight.

Forouzmehr et al .[6] showed a positive correlation between FASTT and a wide range of fetal weights. The study was done in 300 fetuses, FASTT evaluated within 11 days of delivery was correlated with immediate birth weight following delivery. The mean FASTT was significantly higher in macrosomic than normal fetuses. The mean soft tissue thickness differed significantly between normal and macrosomic fetuses (6.6±1.6 mm versus 12.0±1.4 mm, respectively; $P < 0.001$). There was a significant positive correlation between the abdominal subcutaneous tissue thickness and the birth weight ($r = 0.86$, $P < 0.001$).

In this present study, the cut off value of FASTT for small and large for gestational age babies derived from receiver operative characteristics (ROC) curve were 5.8mm and 7.5mm respectively. For SGA, FASTT showed negative predictive value of 97.3% and with a diagnostic accuracy was only 86.7%. For LGA, FASTT showed negative predictive value of 100% and a diagnostic accuracy of 93.3%.

Rajeshwari G Bhat et al [5] conducted study a similar study to correlate fetal abdominal subcutaneous tissue thickness and to obtain a cut off value to predict large and small for gestational age babies . Conducted among 350 antenatal women. The mean FASTT was 6mm ± 0.94 , the mean birth weight of the babies were 2986 ± 392.8. Cut off of FASTT for large babies obtained was > 6.25mm. Large for gestational age newborns have a sensitivity for FASTT >6.25mm of 79%, a specificity of 70%, a positive predictive value (PPV) of 24.4%, and a negative predictive value (NPV) of 96.4%. Negative Predictive Value is high, indicating that if the FASTT is less than the cut-off value (6.25 mm in our study), baby is less likely to be large for gestational age (LGA). These results obtained by Rajeshwari G Bhat et al is similar to present study results of FASTT for LGA. However, cut off small babies was not obtained in Rajeshwari G Bhat et al study since area under ROC curve was not significant when drawn for small for gestational babies.

In our study FMASTT showed a positive linear relationship with fetal birth weight with r value of 0.631 and $p < 0.01$. the findings are consistent to the study by Mudher et al [7] which showed The mean humeral soft tissue thickness was statistically higher in infants weighing at least 4000 g than in those weighing less than 4000g (14.35 mm versus 11.6 mm) P value < 0.001.

In this present study, the cut off value of FMASTT for small and large for gestational age babies derived from receiver operative characteristics (ROC) curve were 10.05 mm and 12.4 mm respectively. For SGA, FMASTT showed negative predictive value of 92.1% and however, the diagnostic accuracy was 81.7%.

Mudher et al [7] compared diagnostic accuracy of clinical, sonographic and fetal humeral soft tissue measurement to identify new borns with macrosomia , the study showed sonographic measurement of fetal humeral soft tissue thickness had the highest sensitivity (87.2%) and negative predictive value (78.7%), while the sonographic fetal weight estimation had the highest specificity (85.7%) and positive predictive value (89%). While the clinical estimation of fetal weight had the lowest accuracy compared with sonographic fetal weight estimation and sonographic fetal humeral soft tissue thickness measurement. In our study, For LGA, FMASTT showed negative predictive value of 100% and a diagnostic accuracy of 90 %. Likely due to small sample size and Proportion of Large for gestational age babies included in the present study. The number of previous studies conducted on fetal mid arm soft tissue thickness was limited, hence a satisfactory comparison on the results of diagnostic predictability of FMASTT is difficult

In our study FTSTT showed a positive linear relationship with fetal birth weight with r value of 0.848 and $p < 0.01$ which is a strong correlation. the findings is consistent with study by Solyman et al [8] which showed high statistically significant correlation (Pearson's correlation) with EFW by Hadlock's formula ($P < 0.001$) and birth weight ($P < 0.001$).

Scioscia et al [9] studied the correlation between FTSTT and detecting macrosomia. measured FTSTT in 62 full-term pregnant women 48h before delivery and correlated FTSTT to the fetal birth weight and found a significant positive correlation between FTSTT.

The mean FTSTT in the present study is 16.4 ± 4.2, the cut off value of FASTT for small and large for gestational age babies derived from receiver operative characteristics (ROC) curve were 14.35 mm and 24.45 mm respectively. For SGA , FASTT showed sensitivity 88.2 % , specificity 81.4 % and negative predictive value of 95.2 % and however, the diagnostic accuracy was 83.3 %. For LGA, FASTT showed sensitivity 100 % , specificity 96.4 % and negative predictive value of 100 % and however, the diagnostic accuracy was 96.7 %.

Elhamamy et al [10] studied the accuracy of measurement of mid-thigh soft tissue thickness and femur length, in estimation of expected fetal birth weight. They compared the scioscia's formula 48 and hadlock formula. Scioscia's formula – the formula which uses fetal thigh soft tissue thickness showed greater specificity of 83.3 % than hadlock formula (66.7%).

Previous studies on fetal soft tissue thickness and prediction of fetal small for gestational age were very rare. Possibly because fetal macrosomia is more likely to cause neonatal and maternal mortality and morbidity than small for gestational babies. Planning and determining the mode of delivery will be crucial for such cases. Hence may be more studies very directed to find methods to accurately predict large for gestational age babies. In out study, for predicting small for gestational age FASTT appears to be a best among the variables studied. And for predicting large for gestational age FTSTT appears to be a best among the variables studied.

CONCLUSIONS:

Ultrasound measurement of soft tissue thickness in various areas of the body is a strong predictor of fetal weight. For accurate sonographic term fetal weight assessment this technique is easy, simple and quick to use. It can be used as an alternative method when the correct plane of standard measurements are not possible.

REFERENCES:

1. Bhat RG, Nathan A, R A, Vasudeva A, Adiga P, Bhat PV, et al. Correlation of Fetal Abdominal Subcutaneous Tissue Thickness by Ultrasound to Predict Birth Weight. J Clin Diagn Res. 2014 Apr;8(4):OC09-OC11.
2. Kalantari M, Negahdari A, Roknsharifi S, Qorbani M. A new formula for estimating fetal weight: The impression of biparietal diameter, abdominal circumference, mid-thigh soft tissue thickness and femoral length on birth weight. Iran J Reprod Med. 2013 Nov;11(11):933–8.
3. Khalifa EA, Hassanein SA, Eid HH. Ultrasound measurement of fetal abdominal subcutaneous tissue thickness as a predictor of large versus small fetuses for gestational age. Egyptian Journal of Radiology and Nuclear Medicine. 2019 Dec 12;50(1):80.
4. Warska A, Maliszewska A, Wnuk A, Szyszka B, Sawicki W, Cendrowski K. Current knowledge on the use of ultrasound measurements of fetal soft tissues for the assessment of pregnancy development. J Ultrason. 2018 Mar;18(72):50–5.
5. Gnanasigamani S, Vadivel S, Subramaniam B, Raja Ganesan S, Thiyagarajan P, Chellathurai A. "A NOVEL ATTEMPT IN ESTIMATION OF FETAL WEIGHT USING NEW SOFT TISSUE MEASUREMENTS." ijsr. 2021 May 1;1–3.
6. Forouzmehr A, Shahrokh A, Molaei M. Estimation of Birth Weight Using Sonographically Measured Fetal Abdominal Subcutaneous Tissue Thickness. Iran J Radiol [Internet]. 2004 [cited 2023 Jan 22];2(1 & 2). Available from: https://brieflands.com/articles/iranjradiol-79247.html#abstract
7. Mudher S, Al-Hilli N. Antepartum Detection of Macrosomic Fetus: Clinical Versus Sonographic, Including Humeral Soft Tissue Thickness. 2009 Jan 1;
8. Solyman A, AbdelMoneim S, Mousa W, Attalla MohammedFM, Abdelgied A. Antenatal ultrasound measurement of fetal-thigh soft-tissue thickness as a predictor of fetal birth weight. Menoufia Med J. 2021;34(2):724.
9. Scioscia M, Scioscia F, Vimercati A, Caradonna F, Nardelli C, Pinto LR, et al. Estimation of fetal weight by measurement of fetal thigh soft-tissue thickness in the late third trimester. Ultrasound in Obstetrics & Gynecology. 2008;31(3):314–20.
10. Elhamamy N. Evaluation of Fetal Mid-Thigh Soft Tissue Thickness and Femur Length for Estimation of Fetal Birth Weight. Auctores Publishing LLC, editor. JWHCI. 2020 Jun 26;3(2):01–10.