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Research Article

Evaluation of Fetal Mid-Thigh Soft Tissue Thickness and Femur Length for Estimation of Fetal Birth Weight

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Abstract

Accurate calculation of fetal weight relies on two equally important factors: the use of a formula with strong intrinsic properties, and the use of sonographic biometric parameters that are not susceptible to errors in measurement. From a statistical perspective, the inclusion of multiple variables in a model improves multicollinearity chances and decreases each measurement's internal error.

Precisely predicting estimated fetal weight during childbirth may have a significant impact on successful obstetric management, especially in the case of suspected macrosomia or low birth weight. Macrosomic fetuses can cause maternal and neonatal complications during childbirth, and low-born fetuses are at increased risk for perinatal morbidity and mortality.

The main aim of the study was to assess the accuracy of measurement of mid-thigh soft tissue thickness and femur length, in estimation of expected fetal birth weight

The study was conducted during the period January 2017 to August 2019, at Tanta University hospitals, Obstetrics & Gynecology department. 65 pregnant ladies at term (between 37-40weeks) were included in the study.

Results: Mean difference between fetal weight by Hadlock formulae and actual fetal weight is -10.88g; percent difference is (0.32%). The difference statistically insignificant p>0.05.

Mean difference between fetal weight by Scioscia's formulae and Actual fetal weight is 2.83; the percent difference is (0.08%). The difference statistically insignificant p>0.05.

Good agreement between Hadlock formulae and Actual Fetal Weight Kappa value (0.73).Also shows moderate agreement between Scioscia's formulae and Actual Fetal Weight Kappa value (0.52). area under curve Hadlock formulae (0.79), Scioscia's formulae (0.78) for detecting fetal weight ≥3500gm among pregnant women at 39-40 weeks of gestation.

Conclusion: The mid-thigh soft tissue thickness and femur length can be used in estimation of expected fetal birth weight like as other sonographic parameters. The validity of Scioscia's formulae is not better than Hadlock formulae in detection of fetal weight less than 3500 gm. The validity of both formulae Scioscia's and Hadlock in detection of fetal weight more than 3500 gm. Reduced and cannot be dependable in extremes of weight.

Key words: femur length; fetal birth weight

Introduction:

Predicting the estimated fetal weight (EFW) during labor has a significant impact on adequate obstetric management, especially in cases of alleged macrosomia or low birth weight. During childbirth, macrosomic fetuses can cause maternal and neonatal complications and fetuses with low birth weight are at increased risk of perinatal morbidity and mortality **[1].**

In clinical practice, the EFW developed in the third trimester, typically around 30 weeks gestation, is widely used to predict the EFW on term, provided the fetus has a steady growth, but in all cases, it is not the truth **[2].**

Several studies have shown that fetal weight estimation in the third trimester does not enable us to determine the correct proportions of neither the small fetus nor the large fetuses, thereby raising the need to assess fetal weight closer to birth **[3].** There are many calculations available to determine fetal weight based on standard fetal ultrasound measurements and the most precise are circumferential parameters such as head and abdominal circumference. Sadly, these parameters are more susceptible to intra-and inter-observer variability, particularly when these measurements are technically more difficult to obtain **[4].**

Scioscia M, et al, (2008) published a study proposing a novel method for EFW using femur length (FL) and mid-thigh soft tissue thickness (MSTT) measurements, including adipose tissue plus lean mass. With this formula, the authors sought to avoid imprecise and time-consuming circumferential measurements, allowing it to be applied conveniently even during labor **[5,6].**

Aim of the work:

To assess the accuracy of measurement of mid-thigh soft tissue thickness and femur length, in estimation of expected fetal birth weight.

Patients and methods

This was a prospective cohort study conducted during the period January 2017 to August 2019, at Tanta University hospitals, Obstetrics & Gynecology department. The subjects of the study were 65 singleton pregnant women admitted by elective cesarean section or labor induction and vaginal delivery within 48 hours for expected delivery at term (between 37-40weeks).

Selection of Patient:

❖ **Inclusion criteria:**

1. Pregnant women at term admitted to the obstetric ward and planned for delivery within 48 hours was be included in the study.
2. Viable single fetus.
3. Cephalic presentation.
4. Women aged 20-35 years.
5. Normal amniotic fluid index for gestational age.
6. Estimated gestational age is ranging between 37-40 weeks gestation.

❖ **Exclusion criteria:**

1. Women aged < 20 and >35 years.
2. Women with any risk factors which would affect fetal growth such as hypertension and diabetes.
3. Breech presentation.
4. Oligohydramnios.
5. Fetal growth restriction.
6. Congenital anomalies.

All cases participated in the study were submitted to the following:

1) Verbal consent.
2) Detailed history taking regarding ;
3) Detailed clinical examination:

-General examination: including vital signs, body mass index and lower limb edema.

-Local examination (Abdominal examination): to confirm cephalic presentation.

4) Ultrasound examination: for fetal weight estimation 48 hours or less before elective cesarean section.

All measurements were performed in the fetal ultrasonic unit using a 5.0 MHz convex probe (General Electric Logic p5) & Voluson730 pro trans-abdominal ultrasound.

In a single occasion, each fetus had been examined. Gestational age had been determined from the last menstrual period and confirmed by ultrasound, it was given in exact weeks. The patient lied in flat position, and after good exposure, application of conducting gel, A rapid overview performed first to confirm positive fetal life , longitudinal lie and cephalic presentation then parameters like Bi-parietal diameter (BPD), Head circumference (Hc) Abdominal Circumference (AC), Femur length (FL) and Mid-thigh soft tissue thickness (MTSTT) were measured respectively.

Technique:

Biparietal diameter (BPD):

The longitudinal axis of the head was first calculated by finding the echo of the midline obtained from the falx cerebri taking into account the head's attitude. Next, the scanning probe was rotated 90 degree and named to correct the longitudinal axis inclination. The inner brain structures were examined until the basal ganglia and thalami were seen from the side to the midline of the head segment. **[7].**

Head circumference (HC):

After the long axis of the fetus is found, the transducer is turned 90 degrees to create a cross-sectional image of the fetal trunk, maintaining the angle of 90 degrees until the lower spine and the iliac crest are formed, then the transducer is rotated until an entire femur is imaged. The length of the femur is calculated to distal metaphysis from the greater trochanter **[7]**.

Abdominal Circumference (AC):

AC Using the ellipse method, was measured in the same way as the head circumference. The long axis of the fetal body and its inclination were determined by identifying the aorta's longitudinal axis. The transducer was then rotated to match the long axis via an angle of 90 degrees. The transducer was then transferred to the plane that included the umbilical venous complex portal and obtains the fetal stomach **[7].**

Femur Length (FL):

The transducer is turned 90 degrees after the long axis of the fetus is identified to create a cross-sectional image of the fetal trunk, retaining the angle of 90 degrees until the lower spine and the iliac crest are established, then the transducer is rotated until a complete femur is imaged. The length of the femur is determined from the larger trochanter to the distal metaphysis **[7].**

Mid-thigh soft tissue thickness:

The mid-thigh STT was measured linearly from the outer edge of the skin down to the outer edge of the femur shaft using the same framed image. This measurement was taken in the middle of the fetal leg, so that the upper and lower trochanters were turned upward to ensure the correct view of the lateral side of the femur **[8].**

The estimated fetal body weight was calculated twice as follow:

1-Using the Hadlock formula determined by the programmed computer software, using B: the mid-thigh STT was measured linearly from the outer edge of the skin to the outer edge of the femur shaft using the same framed image. This measurement was taken at the mid-third of the fetal leg, so that the upper and lower trochanters were turned upward to ensure correct view of the femur.

2-Using Scioscia's formula, which had been calculated manually using FL and MTSTT as follow:

EFW= −1687.47 + (54.1× FL) + (76.68 ×MT STT)

N.B: FL by millimeter, MTSTT by millimeter.

The actual birth weight (ABW) of the infant was measured immediately after delivery and after cutting of the umbilical cord and clamping it 5 centimeters from the fetal abdomen without any towels or clothes. All fetuses were measured using the same calibrated scale.

This prospective study was analyzed and evaluated by comparing the results of EFBW using the previously illustrated Scioscia's formula [using femur length (FL) and Mid-thigh soft tissue thickness (MTSTT)] and already established commonly used Hadlock's formula [using bi-parietal diameter (BPD),head circumference(HC) abdominal circumference (AC) and femur length (FL)] with actual birth weight.

Statistical Analysis:

All data for windows (SPSS Inc., Chicago, IL, USA) were collected, tabulated, and statistically analyzed using SPSS 20.0. Quantitative data were expressed as mean ± SD and (minimum-maximum) and qualitative data as absolute frequencies (number) & relative frequencies (percentage) were expressed. T-test was used to compare normally distributed classes. Comparison of Paired t test. P-value < 0.05 was considered statistically significant ≥ 0.05 was considered statistically insignificant.

Receiver Operating Characteristic (ROC)

The Youden index was used to determine optimum cut-off. And measure the following: Sensitivity: likelihood that a test result will be positive when the disease is present (true positive rate, expressed as a percentage Specificity: probability that a test result will be negative if the disease is not present (true negative rate, expressed as a percentage Accuracy: equal to true positive + accurate).

Kappa coefficient

Here is one possible interpretation of Kappa coefficient measure agreement of two measures.

Poor agreement = Less than 0.20

Fair agreement = 0.20 to 0.40

Moderate agreement = 0.40 to 0.60

Good agreement = 0.60 to 0.80

Very good agreement = 0.80 to 1.00

Simple linear and multilinear regression:

Situations frequently occur in which we are interested in the dependency of a dependent variable on several independent variables

Formally, the model for multiple linear regressions, given *n* observations, is

$Y = a + \beta_1 X_1 + \beta 2X2 + \beta_3 X_3 + \ldots\ldots$

Y= the variable that we are trying to predict

X = the variable that are using to predict

a= the intercept (Constant)

β = coefficient of x, represent the mean change in the dependent variable) for one unit of change in the predictor variable (independent), while holding other predictors in the model constant

test =test of significant.

Results:

Table 1 shows the mean age of studied group is 26 year and minimum age is 19 year and maximum age is 34 year. Mean gestational age of studied group is 38 week and minimum Gestational age is 37 and maximum is 40 week. This table also define that prim gravid is 18.5% of studied group. As shown, there was no statistically significant difference between male and female regarding fetal weight by Hadlock formulae, Scioscia's formulae and Actual fetal weight per gm (**Table 2,3)**.

Variables	***Studied group (n=65)***
Age per year	
Mean ±SD	26±4.6
Minimum-Maximum	19 -34
Gestational age per week	
Mean ±SD	38±0.8
Minimum-Maximum	37-40
Parity	
Prim gravid	12(18.5)
Multipara	53(81.5)

Table 1: Mean and standard deviations of age per years, Gestational age per week and frequency distribution of parity for studied group (n=65).

Variables	Studied group No (%)
mid-thigh STT(mm)	
Mean ±SD	13.6±.7
mean FL(mm)	
Mean ±SD	76..3±.1.02
mean BPD(mm)	
Mean ±SD	87.3±6.1
mean AC(mm)	
Mean ±SD	321.2±20.4
mean AFW(gm)	
Mean ±SD	3562.4±147

Table 2: Mean and standard deviations of MTSTT, FL, BPD, and AC per mm and AFW per gm**.**

The mean of female Fetal Abdominal Circumference is 338.8 and male Fetal Abdominal Circumference is 337.9 the difference statistically insignificant p>0.05. Female Fetal mid- Thigh soft tissue is 13.7 and male Fetal mid- Thigh soft tissue is 12.6 the difference statistically significant p>0.05 (**Table 3)**.

Variables per gm.	*Male*	*Female*	*Paired t*	*P*
Actual fetal weight				
Mean ±SD	3384±155.5	3402.7±176.1	-0.437	0.463(NS)
Minimum	3120	3167		
Maximum	3810	3902		
Hadlock formulae				
Mean ±SD	3399.2±158.3	3405.5±200.5	-0.140	0.103(NS)
Minimum	3120	3167		
Maximum	3810	3902		
Scioscia's formulae				
Mean ±SD	3347.06±168 .5	3422.3±204.9	-0.174	1.59 (NS)
Minimum	3120	3167		
Maximum	3810	3902		

Table 3: Mean difference between fetal weight by Hadlock formulae, Scioscia's formulae and Actual fetal weight per gm. in **male** and **female**.

The Mean difference between fetal weight by Hadlock formulae and actual fetal weight is -10.88g; percent difference is (0.32%). The difference statistically insignificant p>0.05 (**Table 4)**.

Variables per mm.			T	p
	Female	Male		
Fetal Abdominal Circumference Mean± SD	338.8± 7.5	337.9±6.5	0.48	0.64(NS)
Fetal Mid- Thigh soft tissue Mean± SD	13.7±2.3	12.6±1.6	2.2	0.03(S)

Table (4): shows difference between **female** and **male** regard Fetal Abdominal Circumference and Fetal mid- Thigh soft tissue.

The Mean difference between fetal weight by Scioscia's formulae and Actual fetal weight is 2.83, the percent difference is (0.08%). The difference statistically insignificant p>0.05 (**Table 5)**.

Variables per gm.	*Actual fetal weight*	*Hadlock formulae*	*Mean difference*	*Paired t*	*P*
Mean ±SD	3392±165	3402±179.6	-10.88 (0.32%)	0.89	0.38(NS)
Minimum	3120	3167			
Maximum	3810	3902			

Table (5): Mean difference between fetal weight by Hadlock formulae and Actual fetal weight per gm.

The Mean difference between fetal weight by Scioscia's formulae and Hadlock formulae is -13.7 g, the percent difference is (0.4%). The difference statistically insignificant p>0.05 (**Table 6)**.

Variables per gm.	*Actual fetal weight*	**Scioscia's formulae**	*Mean difference*	*Paired t*	*P*
Mean ±SD	3392±165	3389±191	2.83 (0.08%)	0.25	0.8(NS)
Minimum	3120	3050			
Maximum	3810	3866			

Table (6): Mean difference between fetal weight by Scioscia's formulae and Actual fetal weight per gm.

As showed in (**Table 7)** there is good agreement between Hadlock formulae and Actual Fetal Weight Kappa value (0.73). Also shows moderate agreement between Scioscia's formulae and Actual Fetal Weight Kappa value (0.52). Hadlock formulae is more sensitive than Scioscia's formulae for detection of fetal weight ≤ 3500gm with Sensitivity 90.6% for Hadlock formulae and 85% for Scioscia's formulae and accuracy 90.8% for Hadlock formulae and 83% for Scioscia's formulae which means that Hadlock is more dependable in detection of fetal weight less than 3500 gm (**Table 8)**.

Variables per gm.	Scioscia's formulae	*Hadlock formulae*	*Mean difference*	*Paired t*	*P*
Mean ±SD **Minimum** **Maximum**	3389±191 3050 3866	3402±179.6 3167 3902	-13.7 (0.4%)	0.66	0.55

Table 7: Mean difference between fetal weight by Hadlock formulae and Scioscia's formulae per gm.

	Agreement No (%)	disagreement No (%)	Kappa coefficient	P
Actual fetal weight versus *Hadlock* formulae	59(91)	6(9)	0.73	0.0001(S)
Actual fetal weight versus Scioscia's formulae	54(83)	11(17)	0.52	0.0001(S)

Table 8: Agreement between *Hadlock* formulae, Scioscia's formulae and actual fetal weight **(actual fetal weight ≤3500gm or >3500 gm.)**

Hadlock formulae is more sensitive than Scioscia's formulae for detection of fetal weight >3500gm among pregnant women at 39-40 weeks of gestation with Sensitivity 91% for Hadlock formulae and 72.7% for Scioscia's formulae and accuracy 78% for both formulae which means that Scioscia's formulae is not dependable in detection of fetal weight more than 3500 gm among pregnant women at 39-40 weeks of (**Table 9,10)** & (**Figure 1,2).**

	Hadlock formulae	Scioscia's formulae
Area under curve(AUC)	0.97	0.92
95% confidence interval(95%CI)	0.93-1	0.86-0.99
P value	0.0001(S)	0.0001(S)
Optimal cut off	≤3500gm	≤3500gm
Sensitivity%	90.6%	85%
Specificity%	91.7%	75%
Accuracy	90.8%	83%

Table (9): validity of Hadlock formulae and Scioscia's formulae for detecting fetal weight **≤ 3500gm.**

	Hadlock formulae	Scioscia's formulae
Area under curve(AUC)	0.79	0.78
95% confidence interval(95%CI)	0.59-0.98	0.58-0.98
P value	0.02(S)	0. 023(S)
Optimal cut off	>3500gm	>3500gm
Sensitivity%	91%	72.7%
Specificity%	66.7%	83.3%
Accuracy	78%	78%

Table 10: validity of Hadlock formulae and Scioscia's formulae for detecting fetal weight**>3500gm** among pregnant women at **39-40 weeks** of gestation

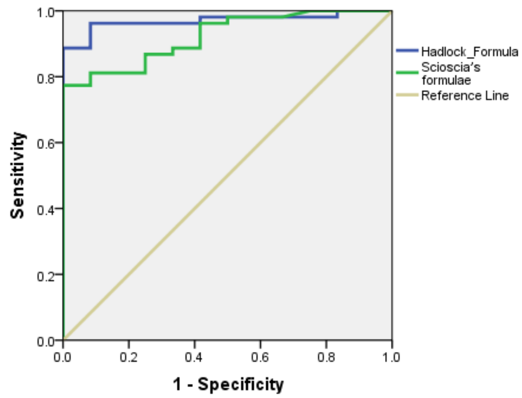

Figure 1: area under curve Hadlock formulae, Scioscia's formulae and actual fetal weight ≤ **3500gm.**

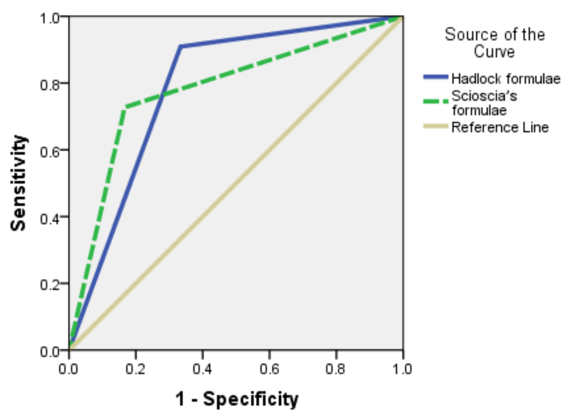

Figure 2: area under curve Hadlock formulae (0.79), Scioscia's formulae (0.78) for detecting fetal weight>3500gm among pregnant women at **39-40 weeks** of gestation.

Discussion

Assessment of fetal weight, an important factor in assessing fetal survival, is necessary to detect any disruptions in fetal growth such as restriction of intrauterine development, and macrosomia. Both are at greater risk of mortality and perinatal morbidity. Thus, a reliable birth weight estimation will help to prevent some of these complications in the management of labor **[9 ,10].**

AC is widely accepted as the most valuable sonographic biometric parameter in fetal weight estimation; however, it is subjected to a significant intra-and inter-observer variability compared with linear measurements. Obtaining high quality images for measuring AC is not an easy job for some operators. Measurements taken from low quality images can lead to increased inter observer variability **[11].**

The present study has proposed that sonograghic measurements of fetal mid-thigh soft tissue thickness (MTSTT) in relation to femur length (FL) as a possible parameter for assessment of fetal birth weight.

The aim of our study was to evaluate the accuracy and usefulness of measuring femur length and mid-thigh soft tissue thickness in assessment of fetal birth weight by using Scioscia's formula.

This is a prospective cohort study that was conducted during the period January 2017 to August 2019, at Tanta University hospitals, Obstetrics & Gynecology department and recruiting a total of 65 pregnant women who consented to participate in this study. All women considered for this study were at third trimester between 37-40 weeks gestation (confirmed by ultrasound and sure date of last menstrual period) and planned for delivery within 48 hours.

- On analysis of results of the study we found that the mean age of studied group is 26 year and minimum age is 19 year and maximum age is 34 year. Mean gestational age of studied group is 38 week and minimum Gestational age is 37 and maximum is 40 week, and primigravida was 12(18.5),multipara 53(81.5)

And this result nearly similar to the result in the study of **Abuelghar et al., 2014** that assess Fetal mid-thigh soft-tissue thickness: a novel method for fetal weight estimation and found that the mean age of participants was 27.6 ± 5.5 years, the mean gestational age was 38.7 + 1.2 weeks. Among the study population, 67 women (22.3 %) were Para 1, 80 (26.7 %) were Para 2, 89 (29.7 %) were Para 3, 45 (15.0 %) were Para 4, 18 (6 %) were Para 5, and 1 (0.3 %) was Para 6 **[6].**

- Regarding the impact of sex difference on calculation of fetal weight the present study found that mean sonographically measured fetal abdominal circumference (AC) was 338.8± 7.5 for females and 337.9±6.5 for males. The mean mid-thigh soft tissue thickness (MTSTT) was 13.7±2.3 for females and 12.6±1.6 for males. The actual birth weight was 3384±155.5 for males and3402.7±176.1 for females. The estimated fetal weight by Hadlock formulae was 3399.2±158.3 for males and 3405.5±200.5 for females. The estimated fetal weight by Scioscia's formulae was3347.06±168 .5 for males and 3422.3±204.9 for females.

Agreement with our study, the study of **Broere-Brown et al., 2016** found that HC and AC were larger in males than in females (0.30 SD [95% CI 0.26,0.34] and 0.09 SD [95% CI 0.05, 0.014], respectively). However, FL in males was smaller compared to female fetuses (0.21 SD [95% CI 0.17, 0.26]) [12].

- The current study assessed Mean difference between fetal weight by Hadlock formulae and Actual fetal weight per gm. and found that Mean difference between fetal weight by Hadlock formulae and actual fetal weight is -10.88 g; percent difference is (0.32%). The difference statistically insignificant p>0.05.

This agrees with the study of **Kurmanavicius et al., 2004** that found that among the five formulas for fetal weight estimation, the highest intraclass correlation coefficient was generated with both Hadlock formulas.

The best was Hadlock formula using 3 fetal biometry parameters (HC, AC and FL). The lowest intraclass correlation was found with Shepard formula. Accuracy of some of these formulas was shown to be more than previous ones with less percentage of error (4 ,5). The present study assessed fetal weight by Scioscia's formulae and found that Mean difference between fetal weight by Scioscia's formulae and Actual fetal weight is 2.83; the percent difference is (0.08%). The difference statistically insignificant p>0.05.

In accordance with our study, **Kalantari et al., 2013** conducted prospective cohort study to find the impression of soft tissue thickness on birth weight and represent a new predictive formula. They included 114 pregnant women with normal singleton term (36-42w) pregnancies who delivered within 72 hours. They measured abdominal circumference, biparietal diameter, femur length and mid-thigh soft tissue thickness. The actual neonatal birth weight was also measured after birth. Linear regression model was used and R square and P-value was reported. They concluded that adding mid-thigh soft tissue thickness to the other variables in predictive models of fetal weight would provide a good estimation (r (2) =0.77) and in cases that measuring abdominal circumference is suboptimal mid-thigh soft tissue thickness may be a good replacement. Which support our finding in this study **[13].**

In contrast of concurrent study, **Barros et al., 2016** Conducted a prospective study to determine the accuracy of fetal weight prediction by ultrasonography using the same method in our study that included longitudinal measurements of femur length (FL) and mid-thigh soft tissue thickness (STT). The study involved 145 singleton uncomplicated term pregnancies within 48 hours of delivery. Only pregnancies admitted to the labor ward with a cephalic fetus.

They found that there was a poor correlation between actual birth weight and the estimated fetal weight using a formula based on femur length and mid-thigh soft tissue thickness, both linear parameters. That differs from our study that we found that there was a good correlation between actual birth weight and expected fetal weight using a formula based on femur length and mid-thigh soft tissue thickness **[14].**

- This study shows good agreement between Hadlock formulae and Actual Fetal Weight Kappa value (0.73).Also shows moderate agreement between Scioscia's formulae and Actual Fetal Weight Kappa value (0.52).

In the current study, we tested the different sonographic biometric parameters, choosing the mid-thigh STT and FL for the following reasons: compared to the circumferences, linear parameters are more reproducible and can be easily measured by healthcare providers with little expertise throughout ultrasonography (Scioscia et al., 2008), both are easily obtained from the FL measurers **[15].**

While in the study that was prospective observational study to with term singleton pregnancy along with other standard biometric parameters, i.e. BPD, HC, AC and FL, and MTSTT. The predicted birth weight was compared with actual neonatal birth weight soon after delivery and regression coefficients (R2) were determined for each of prediction models for comparing the accuracies. They found that addition of mid Find out how the inclusion of mid-thigh soft tissue thickness (MTSTT) in fetal weight measurement formulas historically focused on biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) increases the estimate of birth weight (BW). MTSTT has been tested in 100 women within 1 week of delivery -thigh soft tissue thickness (MTSTT) to other biometric variables in models of fetal weight estimation improves neonatal birth weight prediction. This sup ports our finding in this study **[16].**

Another study that emphasizes our result is that conducted **by Abdalla N. et al., 2015** to assess Correlation between ultrasonographic soft-tissue thickness measurement of the fetal thigh (FTSTT) and selected anthropometric fetal and maternal parameters **(17).**

A total of 140 women with a single-term pregnancy were included in the report. Maternal and fetal anthropometric measurements have been analyzed. Hadlock formula was used to estimate fetal weight using head circumference (HC), abdomen. FTSTT was measured using the method of **Scioscia M. et al.,2008** which used also in our study. Then, statistical analysis of the correlation between FTSTT and maternal anthropometric and fetal ultrasonographic parameters was performed. **[5]**

They concluded that FTSTT measurement may be helpful in estimating fetal weight, but it is not useful in the diagnosis of fetal macrosomia. Which support our finding in this study. Among ultrasonographically calculated fetal weight and BPD, HC, AC, FL and FTSTT, as well as between FTSTT and neonatal birth weight and duration, and maternal pregnancy and weight of pre-delivery (5). We concluded that FTSTT calculation may be useful in fetal weight estimation, but it is not useful in fetal macrosomy diagnosis.

- The present study assess validity of Hadlock formulae and Scioscia's formulae for detecting fetal weight≤3500gm, and found that area under curve Hadlock formulae (0.79), Sensitivity% (90.6%), Specificity% (91.7%) while according to Scioscia's formulae AUC was (0, 92), Sensitivity% (85%), Specificity% (75%).

Also, in agreement with our study, **Scioscia M. et al., 2014** In 2014, a retrospective study was conducted to determine the accuracy of birthweight sonographic estimation in suspected macrosomic fetuses. This research assessed their equation performance based on linear soft tissue measurement above the fetal femur's external side. Sixty-two fetal patients were registered with alleged macrosomia Sonographic measurements were taken within 48 h that means a lower internal error in the prediction. This study supports the potential of this new approach for the estimation of birth weight in large fetuses based on sonographic linear measurements only **[8].**

From a purely statistical point of view, the presence of different variables in a formula increases the risk of multicollinearity and enhances the internal error of each measurement. Clinically, the proposed formula can be of practical use in situations in which head measurements cannot be taken properly due to fetal head engagement.

On the other hand, we excluded all breech presentations from this study, in which the fetal hip can be down into the pelvis, causing the thigh profile to be distorted. These events, however, only represent a small percentage of all deliveries. In addition, linear measurements are easier to obstetricians / midwives with little sonographic training and linear mea compared to circumferences **[18]**. Fetal weight testing is a critical and common aspect of antenatal care, not only in labor and delivery management, but often during high-risk pregnancy management and growth monitoring.

Restriction of intrauterine growth, or both. The potential complications associated with vaginal delivery include shoulder dystocia, brachial plexus injury, bone injury, and intrapartum asphyxia for excessively large fetuses, whereas maternal risks include birth canal and pelvic floor injury, increased vaginal and caesarean delivery rates, and postpartum hemorrhage. Although deletion of outlier data is a controversial practice in statistics, outlier values play an important role in mathematics. A formula derivation is based on a mathematical approach to finding the best fitting curve for a given set of points, so data quality control was carried out using Grubb's method. Extreme outliers were discarded. Multiple linear regression analysis was used to derive the birth weight prediction equation, with actual birth weight as the dependent variable **[19]**

Our analysis emphasizes the application of STT to other ultrasonic parameters to boost fetal weight prediction models and recommends more research on the subject of replacing AC with STT. We hope this can be useful in clinical practice particularly when measuring AC is distorted.

Conclusion:

By comparing the expected fetal weight by Scioscia's formulae and Actual fetal weight the results were comparable so we can depend on Scioscia's formulae in detection of fetal weight. The validity of Scioscia's formulae is not better than Hadlock formulae in detection of fetal weight less than 3500 gm.

The validity of both formulae Scioscia's and Hadlock in detection of fetal weight more than 3500 gm. Reduced and cannot be dependable in extremes of weight.

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