Is there a correlation between Placental Thickness and Fetal Birth Weight?

Nour Eldin I. Ashmawy, Ahmed S. Saad, Ahmad S. Soliman, Mai H. Mohammed

Department of Obstetric and gynecology, Benha faculty of medicine, Benha University, Egypt

Correspondence to: Mai H. Mohammed, Department of Obstetric and gynecology, Benha faculty of medicine, Benha University, Egypt

Email:

dr_mai.hussein@yahoo.com

Abstract:

Backgroung: Estimating fetal weigh essential in our daily obstetric practice, especially at third trimester. It guides obstetricians to make up their decisions regarding time and mode of delivery. One of the most important factors affecting birth weight can be attributed to placental adequacy and uterine environment. The placental thickness is one of the characteristics of the placenta therefore, we decided to study the correlation between the placental thickness and the fetal birth weight. **Methods:** this is a cross sectional prospective observational study that was conducted on 200 uncomplicated pregnant women in their third trimester. Ultrasound was done for measuring the placental thickness (PT), bi-partial diameter (BPD), head circumference (HC), femur length (FL), abdominal circumference (AC) and estimated fetal weight. After delivery the birth weight was measured. Apgar score, NICU admission and Neonatal morbidity and mortality were observed. **Results:** The study found that there were positive significant correlations between placental thickness and estimated fetal birth weight r=0.899 and between placental thickness and actual birth weight r=0.933 both with p value <0.001.**Conclusion:** Placental thickness can be used as a promising parameter in predicting expected fetal birth weight (EFBW) with other fetal parameters during antenatal follow up by ultrasound.

Key words: placental thickness: fetal birth weight, ultrasound.

Introduction

As a result of the continuous growth of the fetus and expansion of the uterus, the placenta also enlarges. Its increase in surface area roughly parallels that of the expanding uterus and throughout pregnancy it covers approximately 15 to 30% of the internal surface of the uterus. The increase in thickness of the placenta results from arborization of existing villi not due to further penetration into maternal tissues *(1).*

If the fetal growth is compromised due to abnormal functioning of the placenta this can be detected by the abnormal placental measurements so it seems reasonable that evaluation of placental thickness help to determine normal development and functional of the placenta and can act as a good predictor of fetal growth and birth weight *(2).*

Ultrasound is the first-line modality in imaging the placenta, it is easy and inexpensive and can be done in most centers in two-dimensional format with simpler devices and due to its use of non-ionizing radiation *(3).*

It also enables evaluation of the placenta and detection of placental abnormalities using different parameters such as two dimensional (2D) placental thickness and volume or especial techniques like three-dimensional (3D) power Doppler *(4).*

Placental evaluation has been used to characterize placental position and morphologic changes as the placenta matures *(5).* One additional ultrasonographic parameter used to assess the placenta is placental thickness. The measurement of placental thickness is relatively simple, clinically useful and considered as the easiest placental dimension to measure *(6).*

Estimation of fetal weight is essential in our daily obstetric practice, especially at third trimester. It guides obstetricians to make up their decisions regarding time and mode of delivery to guard against complications of low birth weight and macrosomic babies during labor and puerperium *(7).*

For example, management of preterm delivery depends wholly or in part on the estimation of expected birth weight, which helps in perinatal counseling on likelihood of survival, the intervention undertaken to postpone the delivery, optimal route of delivery, or the level of hospital where delivery should occur *(8).*

Ultrasound has played an increasingly important role in the characterization of normal fetal growth and the detection of fetal growth abnormalities *(9).* This is done through measurement of fetal body parts. Numerous formulas have been published for

estimating fetal weight from one or more of these fetal body measurements: head (biparietal diameter BPD or head circumference HC), abdomen (abdominal diameter AD or abdomen circumference (AC), and femur length (FL) *(10)*. The use of multiple parameters has been shown to decrease errors in fetal weight estimation *(11)*.

According to the previous information, it seems that finding the correlation between thickness of the placenta and fetal weight, is considered to be a simple, inexpensive, non-invasive and available method which can be introduced *(12)*.

This study was aiming to evaluate the correlation between placental thickness (as estimated with trans-abdominal ultrasound) and fetal birth weight (as estimated with trans-abdominal ultrasound then measured after birth with a pediatric weight scale).

Patient and methods

This is a cross sectional prospective observational study that was conducted in the department of Obstetrics and Gynecology in Benha university hospitals.

Two hundred uncomplicated pregnant women aged between 18 to 35 years old were admitted to the department of Obstetrics and Gynecology in Benha

university hospitals for elective cesarean section delivery. The study was conducted from December 2018 to June 2019.

All patients provided an informed written consent after they were fully instructed about the investigation. The study was approved by Institutional Ethics Committee.

Inclusion criteria were females with age range of 18 to 35 years old, singleton viable pregnancy, gestational age more than 36 weeks and sure date of LMP with history of regular menstruation or early ultrasound scan in the first trimester.

Cases with any medical disorder with pregnancy such as: preeclampsia, diabetes, anemia ,IUGR, hydrops fetalis, fetuses with congenital anomalies, polyhydraminos or oligohydramnios, abnormal placentation, placenta with variation in insertion of umbilical cord, morbid obesity were excluded from the current study.

Included women were subjected to: History taking, abdominal examination and ultrasound for assessment of gestational age, amount of liquor, fetal position and presentation, fetal heart sounds, uterine contraction and scar of previous surgeries

Placental thickness was calculated from the echogenic chorionic plate to placental myometrial interface near the mid-placental portion. The myometrium and subplacental

veins were excluded in the measurements. All placental measurements were taken during the relaxed phase of the uterus as contractions can spuriously increase the placental thickness. The thickness increases during contraction due to distension of intervillous spaces by maternal blood. The length and surface of placenta can also increase due to distension of intervillous space. Placental thickness depends on amount of fetal blood, maternal blood and placental tissue. Correct identification of placental myometrial interface is important for proper measurements of placenta. Placental thickness was measured in mm and calculated by averaging the three best measurements for each case.

Placental thickness was obtained by ultrasonography and correlated with fetal parameters such as femur length (FL), biparietal diameter (BPD), head circumference (HC) and the abdominal circumference (AC) was used to predict estimated fetal birth weight (EFBW) according to Hadlock formula as primary outcome. Secondary outcome measures include birth weight, apgar score, NICU admission and neonatal morbidity and mortality. **(13)**

The collected data was analyzed by statistical package of social science (SPSS) version 20 for the correlation between placental thickness and other parameters.

P value <0.05 was considered statistically significant (*) while >0.05 statistically insignificant P value <0.01 was considered highly significant (**) in all analyses.

Results

Total of 200 women were included in the study. The mean maternal age in our study was 26.48±5.29.More than half (65.5%) of women, their age ranged from20 to 29 years, 27% of the cases were between 30-35 years old, only 7.5% of the cases were less than 20 years old (Table 1) The mean gestational age of women was 38.26±0.98. Only 20% of the cases were PG while 80% were MG. 39.5% of the cases were multipara, 37 % were primipara, 23.5 % were nullipara (47 cases out of 200, 40 of them were PG and 7 were due to abortion) (Table 2). The mean placental thickness (Mean±SD) between the ranges of 33.36 - 47.4 mm was 40.76±2.78 mm ,while the mean estimated fetal birth weight was 3478.91±319.82 grams and the mean of the actual birth weight was 3410.83±342.1 grams.

The pearson's correlation coefficient between the mean placental thickness and the mean estimated fetal birth weight was 0.899, proving the significant positive correlation between placental thickness and estimated fetal birth weight. Thus as the placental thickness increases, the estimated fetal birth

weight increases (p-value <0.001) .The pearson's correlation coefficient between the mean placental thickness and the mean of the actual birth weight was 0.933, proving the significant positive correlation between placental thickness and birth weight. Thus as the placental thickness increases, the birth weight increases (p-value <0.001)

As shown in table 4 there was a high positive correlation between placental thickness and estimated fetal weight as correlation coefficient 'r' was 0.899 (fig.1). There was also a high positive correlation between placental thickness and actual birth weight as correlation coefficient 'r' was 0.933 (fig. 2).

Table (1): Distribution of the studied group according to age:

Age (Y)	No	%
<20	15	7.5
20-29	131	65.5
30-35	54	27.0
Range	18-43	
Mean ±SD	26.48±5.29	
Median (IQR)	26(22-30)	

Table (2): Distribution of the studied group according to gestational age, gravidity and parity:

Gestational age (wk)		
Range	36-40	
Mean ±SD	38.26±0.98	
Median (IQR)	38.0(38-39.0)	
Gravidity	No	%
Primi-gravida	40	20.0
Multigravida	160	80.0
Parity	No	%
Nullipara	47	23.5
Primipara	74	37.0
Multipara	79	39.5

Table (3): Distribution of mean placental thickness with estimated fetal birth weight and actual birth weight at different gestational ages:

Gestational age (wk)	Placental thickness (mm) Mean ± SD	EFBW (gm) Mean ± SD	Actual birth weight (gm) Mean ± SD
36 wk (4 cases)	36.0±1.41	2936.5±145.64	2800±141.42
37 wk (42 cases)	38.19±1.98	3170.76±186.75	3090.19±221.42
38 wk (75 cases)	40.47±2.06	3426.76±234.05	3372.73±259.89
39 wk (55 cases)	42.36±2.19	3677.8±232.58	3603.98±260.51
40 wk (23 cases)	43.3±2.4	3821.78±264.96	3756.52±280.17
All groups (200 cases)	40.76±2.78	3478.92±319.82	3410.83±342.07

Table (4) : Correlation of mean placental thickness with estimated fetal birth weight and actual birth weight:

	Total no. of cases (n)	Range	Mean	SD	P-value	Pearson correlation
PT (mm)	200	33.36-47.4	40.76	2.78		
EFBW (gm)	200	2521-4240	3478.91	319.82	<0.001**	0.899
Actual BW (gm)	200	2410-4200	3410.83	342.1	<0.001**	0.933
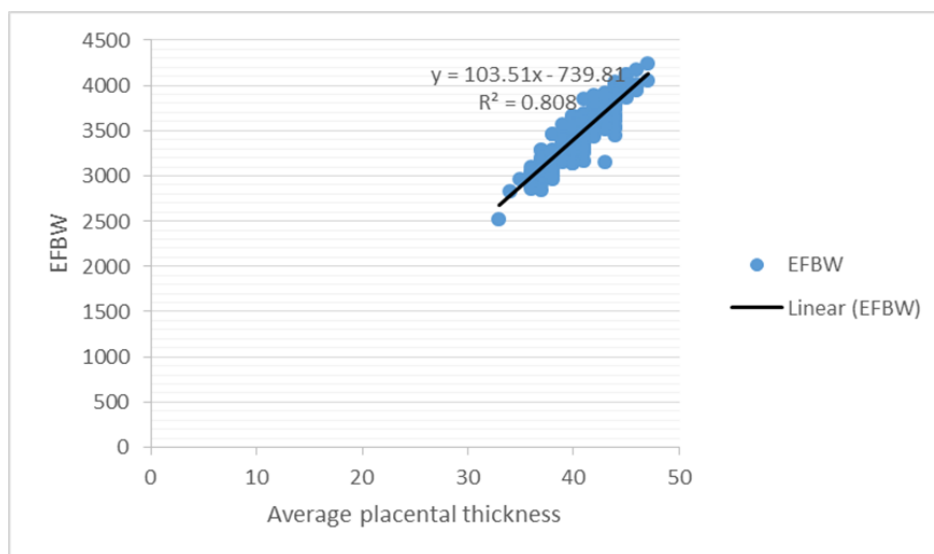
Figure (1): Correlation of mean placental thickness with estimated fetal birth weight.
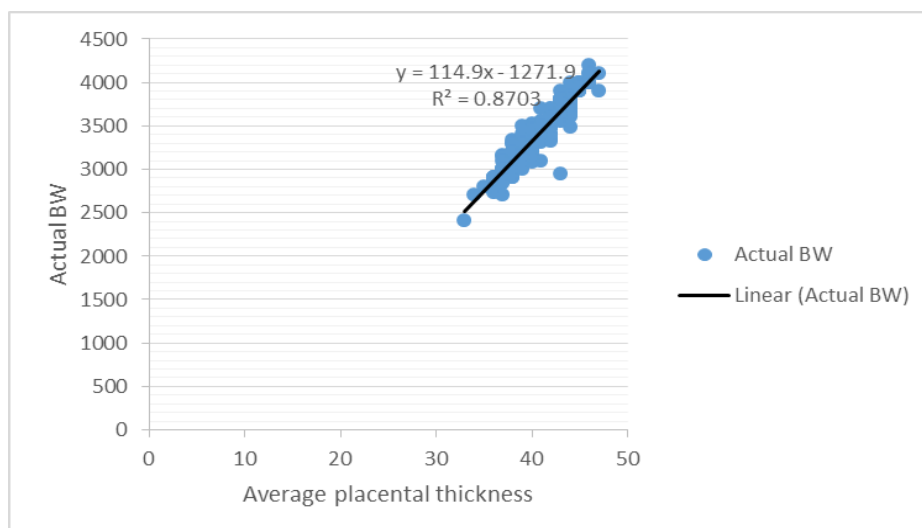
Figure (2): Correlation of mean placental thickness with actual birth weight.

Disscusion

The placenta 'the sprightliness of fetus in utero' is the site of interaction between two individuals: the mother and the developing fetus. Being a highly vascular fetal organ; it maintains the feto-maternal circulation via a connection (the umbilical cord) *(14).*

Since its function is to supply oxygen and nutrition for the embryo, the proper growth and weight of the fetus at the birth depend on the adequacy of the placenta and its function. Therefore, normal placental development during pregnancy is necessary for a healthy fetus and any defect in the natural evolution of the placenta will affect the growth and development of the fetus and the prognosis of pregnancy *(13).*

The study showed that the age of the majority of cases (65.5%) was between 20-29 years old, while 27% of the cases were between 30-

35 years old and only 7.5% of the cases were less than 20 years old. Mean age of pregnant women was 26.48±5.29 years and the median age was 26(22-30) years .

The mean gestational age of the studied cases was 38.26±0.98 wks & the median ??? was 38.0(38-39.0) wks. Only 20% of the cases were PG while 80% were MG. 39.5% of the cases were multipara, 37 % were primipara, 23.5 % were nullipara (47 cases out of 200, 40 of them were PG and 7 were due to abortion.

The mean and the median of the measured fetal parameters (BPD, HC, FL, and AC) and the gestational age based on each parameter calculated by the ultrasound machine according to Hadlock formula. Mean PBD of the studied cases was 9.45±0.49 cm, the

median was 9.48 (9.31-9.64) cm and the mean gestational age calculated from PBD measured was 38.66±1.03 wks and the median was 38.71(37.86-39.43) wks. Mean HC of the studied cases was 33.46±0.79 cm, the median was 33(33-34) cm and the mean gestational age calculated from HC measured was 38.29±1.14 wks and the median was 38.29(37.57-39.14) wks.

Mean FL of the studied cases was 7.41±0.50 cm, the median was 7(7-8) cm and the mean gestational age calculated from FL measured was 38.10±1.08 wks and the median was 38.14(37.29-38.97) wks. Mean AC of the studied cases was 34.43±1.22 cm, the median was 34(34-35) cm and the mean gestational age calculated from AC measured was 38.38±1.14 wks and the median was 38.36(37.57-39.14) wks .

The mean EFBW (calculated from PBD, FL, AC) according to Hadlock formula by the ultrasound machine) was 3478.91±319.82 gm and the median was 3472(3232.25-3719.25) gm. The actual birth weight that was measured immediately after birth using a pediatric weight scale , showed that most of the cases (97.5%) were between 2500-4000 gm, while only 2.0 % of the cases were >4000gm and only 0.5 % were<2500 gm. The mean birth weight was 3410.83±342.1 gm and the median was 3445(3150-3647.5) gm .

The mean Apgar score of the studied cases was 9.32±1.04 and the median was 10(9-10).

Only 23 cases out of 200 needed NICU admission.

The range of placental thickness measurements was 33.36 - 47.4 mm, the mean was 40.76±2.78 mm and the median was 41(39-43) mm.

There is a highly significant correlation between mean placental thickness and gestational age (wks) (calculated from different fetal parameters measured by the ultrasound machine according to Hadlock formula) with p value <0.001. There is also a highly significant positive correlation between mean placental thickness and EFBW (calculated from measured fetal parameters according to Hadlock formula) with r=0.899, p value <0.001. There is also a highly significant positive correlation between mean placental thickness and actual birth weight (r =0.933, p value <0.001) .

There is a positive correlation between mean placental thickness and the four fetal parameters measured (BPD,HC,FL,AC) with rho = 0.798, 0.743, 0.681, 0.851 correspondingly and p value <0.001.There is also a positive correlation between mean placental thickness and gestational age (wk) and Apgar score with p value <0.001.There is no correlation between mean placental thickness and parity (p value 0.127) but there is a correlation with gravidity (p value <0.001) .

The mean placental thickness in cases aged 20-29 years old was 40.84±2.73 mm , in those aged 30-35 years old was 40.19±2.67 mm and in those aged <20 years old was 42.07±3.17 mm (the highest placental thickness value among different age groups).The mean placental thickness in MG cases was 40.36±2.60 mm while in PG cases was 42.33±2.9 mm (higher placental thickness values).

The mean placental thickness in multipara was 40.2±2.74 , in primipara was 40.43±2.46 while in nullipara was 42.19±2.87 (the highest placental thickness value). The highest placental thickness values were in PG and nullipara. The mean placental thickness in cases that their newborns did not need NICU admission was 40.95±2.54mm, while in those who needed NICU admission was 39.26±3.95mm (lower values of placental thickness in those who needed NICU admission). P value 0.006, so there is a significant correlation between placental thickness and the need for NICU admission.

The above result can lead the placental thickness to be an initial parameter for fetal weight estimation. This help to know the normality of fetal weight or predicting any abnormalities such as intrauterine growth restriction (IUGR).

All these results goes with results of multiple previous studies of the same concern as the study done by Noor N et al **(13)** ;they found

that the mean placental thickness was 31.63±4.79mm and the mean estimated fetal birth weight was 2145.86±121.24 grams. The Pearson's correlation coefficient between the two was 0.982. Thus, proving the significant positive correlation between placental thickness and estimated fetal birth weight (p-value <0.001). They concluded that placental thickness measured at the level of umbilical cord insertion appears to be a promising parameter for estimation of fetal weight as well as an accurate sonographic tool in assessing fetal weight.

Our results matches also with the study conducted by Karami Rasoul et al **(12)** which found a significant correlation between the placental thickness in the second and third trimester of pregnancy with fetal weight at these times (r=0.539, p=0.005 ;r=0.541,p=0.005). They found that per 100 gm of fetus gain in the second trimester the placental thickness increased by 1 millimeter, per 250 gm of fetus gain in the third trimester the placental thickness increased by 0.4 mm.

Also the results of our study are similar to results of the study done by Kashika Nagpal et al (2018) **(15)** which found that Apgar score and neonatal outcome was good in women with normal placental thickness and was compromised in women with thin and thick placentae. There was a good correlation between placental thickness and birth weight according to Pearson's correlation analysis (r

= 0.405 at 32 weeks and r = 0.740 at 36 weeks). The Pearson's correlation coefficient (r) between placental thickness and Apgar score at 32 weeks was 0.281 and at 36 weeks was 0.303 (p value = 0.003) which is statistically significant. So Concluded that placental thickness is a good prognostic factor in assessing neonatal outcome and should be measured in addition to biometric parameters in antenatal women undergoing ultrasound.

Our results also matches with results of the study conducted by Pawan et al., **(16)** who observed that the maximum mean placental thickness at 26th week is 29.76 ±2.163 and at 38th week is 38.12 ± 2.09 mm. The mean fetal weight at 26th week was 879.5± 59.15 and at 38th week was 3169.66± 187.5, indicating an increase in placental thickness with fetal weight in fairly linear manner (r=079, p =0001: r =0.50, p =0.004).

Elsafi Ahmed et al **(17)** also conducted a study that its indicated that there was a linear relationship between placental thickness, average gestational age (R2=0.9593) and growth parameters including biparietal diameter (BPD) and femur length (FL).

It also showed linear relationship between the variables R2=0.923 and 0.921 respectively, as the FL and BPD increased the PT was also increased by 0.389 and 0.405 respectively during both second and third trimesters.

The study concluded that a thickness of less than 25mm during the third trimester was considered less than normal, and might be an indication of intrauterine growth retardation, and thickness of more than 45mm, was considered thicker than normal; which might be an indication of maternal diabetes, hypertension, fetal hydrops, and other abnormalities.

Also the results of the study by Afrakhteh M et al **(18)** matched with our results. This study found that the values of mean birth and placental weights were 305.56±657.0 and 551.7±104.8 grams respectively. Ultrasonographic measures of placental thickness in second and third trimester and changes between them were 21.68±4.52, 36.26±6.46 and 14.67±5.67 mm respectively. There was a significant positive correlation between placental thickness and birth weight in the second and third trimesters (r=0.15, p=0.03; r=0.14, p=0.04 correspondingly).

Karthikeyan T et al **(19)** results also matched with our results .The maximum mean PT in the 1st, 2nd, 3rd and the combined trimesters were 16.5 mm, 23.78 mm, 35.81 mm and 28.49 mm respectively. There was a significant positive correlation between PT and BPD, AC, FL, ABC, HC and EFBW. They observed that subnormal PT may be an earliest indicator of IUGR, which can be treated if it was diagnosed early Also enlarged placenta (placentomegaly) was suspected if

the PT was > 40 mm at term and if it was associated with gestational diabetes mellitus, intra uterine infections, hydrops foetalis, anaemia and α- thalassaemia type. So, an increased PT for that GA should raise a suspicion about the possible disease conditions, so the measurement of PT should therefore be carried out routinely during the obstetric USG.

The study done by Abu PO et al.,**(20)** results showed that both placental thickness and estimated fetal weight increased in fairly linear manner with gestational age. They found a significant positive correlation between placental thickness and estimated fetal weight in the second and third trimesters (p< 0.05).

Regression analysis yielded linear mathematical relationships between estimated fetal weight and placental thickness in the second and third trimesters, but the marked variations in fetal weights corresponding to particular placental thickness limit the usefulness of this relationship.

Ohagwu et al.,(14) results showed that placental thickness at 26th week of gestation was 32.52±4.94 and placental thickness at 38th week was 42.49±5.79. There was a fairly linear increase in placental thickness with gestational age. Also there was significant positive correlation between placental thickness and biparietal diameter (BPD) in

both the second and third trimesters. They found a linear correlation even with the AC "Abdominal Circumference", which is a very important parameter in calculating fetal weight, which means that the placental thickness might be the earliest sign of fetal anomalies.

References

1. Sadler TW . Longman's medical embryology. 9th edition. Baltimore, MD: Lippincott WilliamsandWilkins;2004 p. 117-48.

2. Wolf H, Oosting H, Treffers PE. A longitudinal study of the relationship between placental and fetal growth as measured by ultrasonography. Am J Obstet Gynecol. 1989;161(5):1140-45.

3. Verma AK, Malhotra V, Yadav R, Chavhan R. Placental thickness estimation by ultrasonography and its correlation with gestational age in normal pregnancies in late 2nd and 3rd trimester. Asian Pac. J. Health Sci., 2017; 4(4):130-32.

4. Chen M, Leung KY, Lee CP, Tang MH, Ho PC. Placental volume measured by three-dimensional ultrasound in the prediction of fetal alpha (0)- thalassemia: a preliminary report. Ultrasound Obstet Gynecol. 2006; 28(2):166-72.

5. Kobayashi M, Hellman LM, Fillisti L. Placental localization by ultrasound. Am J Obstet Gynecol. 1970; 106: 279-85.

6. Adhikari Ridhi, Pravin Kumar Deka, Ashok Tayal, Pramod Kumar Chettri. Ultrasonographic Evaluation of Placental Thickness in Normal Singleton Pregnancies for Estimation of Gestation Age. International Journal of Medical Imaging. Vol. 3, No. 6, 2015, pp. 143-7.

7. Zhang X, Joseph KS, Cnattingius S, Kramer MS .Birth Weight Differences Between Preterm

Stillbirths and Live Births. Analysis of Population-based Studies From the U.S. and Sweden, BMC Pregnancy Childbirth.2012;12 (119)

8. Akinola S, Oluwafemi K, Erest O, Niyi O, Solomon O, Salami S . Clinical versus sonographic estimation of fetal weight in Southwest Nigeria. J Health Popul. 2007;25(1):14-23.

9. Bernstein IM, Horbar JD and Badger GJ. Morbidity and mortality among very low birth weight neonates with intrauterine growth restriction. The VermontOxford Network. Am J Obstet Gynecol. 2000; 182:198-206.

10. Rumack.Carol.M et al, 2011, Diagnostic Ultrasound, 4th ed, Elsevier Mosby, Philadelphia, 1502.

11. Benson CB and Doubilet PM .Head-sparing in fetuses with intrauterine growth retardation: does it really occurs? Radiology, 2004; 161:75.

12. Karami Rasoul, Borji Soheila, Soltani Mohammad, Memari Behzad, Faghihzadeh Soghrat, Masoumkhani Fatemeh. Assessing the correlation of placental thickness with fetal weight in second and third trimester. JMSCR Vol||06||Issue||03||Page 720-726||March 2018.

13. Noor N,Akanksha J,Shazia p,Syed Manazir A.Ultrasonographic measurement of placental thickness and its correlation with estimated fetal weight.Int J Reprod Contraseptive Obstet Gynecol.2018 Jan;7(1):287-90.

14. Ohagwu CC, Abu PO, Ezeokeke UO, Ugwu AC. Relationship between placental thickness and growth parameters in normal Nigerian fetuses. Afr J Biotechnol 2009; 8(2):133-38.

15. Kashika Nagpal, Pratima Mittal,Shabnam Bhandari Grover. Role of Ultrasonographic Placental Thickness in Prediction of Fetal Outcome: A Prospective Indian Study. The Journal of Obstetrics and Gynecology of India (September–October 2018) 68(5):349–354

16. Pawan singhal, Pratishtha Potdar. Correlation Between Placental Thickness in The Second and Third Trimester and Fetal Weight. INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH Volume: 5 | Issue: 5 | May 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48.

17. Elsafi Ahmed Abdalla Balla, Magdolein Siddig Ahmed, Caroline Edward Ayad, Abdelmoneim Saeed Ahmed. Prediction of Fetal Growth by Measuring the Placental Thickness Using Ultrasonography. Journal of Gynecology and Obstetrics. Vol. 2, No. 2, 2014, pp. 26-31.

18. Afrakhteh M, Moini A, Sanei M, Raza H. Correlation between placental thickness in the second and third trimester and fetal weight. Rev bras Gynaecol Obstet. 2013;35(7):317-23

19. Karthikeyan T, Subramaniam RK, Johnson W, Prabhu K. Placental thickness & its correlation to gestational age & foetal growth parameters – a cross sectional ultrasonographic study. Journal of Clinical and Diagnostic Research. 2012 December, Vol-6(10): 1732-5.

20. Abo PO. Correlation Between Placental Thickness and Estimated Fetal Weight in Nigerian Women, Ibnosina Journal of Medicine and Biomedical Science,2009; 3: 80 – 85 .