

## Evaluation of fetal weight with respect to placental thickness and gestational age using ultrasonography.

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**Abstract:** The placental thickness can be a useful sonographic parameter. It tends to gradually increase with gestational age in a linear fashion (~ 1 mm per week) and therefore the thickness in mm can approximate the gestational age (in weeks). Placental thickness appears to be a promising parameter for estimation of gestational age of the fetus as was also shown in animal studies. There was a strong positive correlation between placental thickness and gestational age. The measurement of the placental thickness is an important parameter for estimation of fetal age along with other parameters especially in the late mid trimester and early third trimester, where the exact duration of pregnancy is not known and other sonographic parameters also become less reliable

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### I. Introduction

The placental thickness can be a useful sonographic parameter. It tends to gradually increase with gestational age in a linear fashion (~ 1 mm per week) and therefore the thickness in mm can approximate the gestational age (in weeks). Placental thickness appears to be a promising parameter for estimation of gestational age of the fetus as was also shown in animal studies. There was a strong positive correlation between placental thickness and gestational age. The measurement of the placental thickness is an important parameter for estimation of fetal age along with other parameters especially in the late mid trimester and early third trimester, where the exact duration of pregnancy is not known and other sonographic parameters also become less reliable

### II. Material And Methods

A cross-sectional study was conducted for a period of one year on all the antenatal mothers at the radiology department of Saveetha Medical college and Hospital. All women with singleton pregnancies, women with confirmed last menstrual period, women of 11 to 40 weeks of gestation who were referred to radio diagnosis department for antenatal checkup were included in the study. Patients with Patients with PIH, Anaemia, Diabetes mellitus, hydropsfetalis, intra uterine growth restriction, congenital malformations, twins, polyhydramnios, placental anomalies, placenta praevia, poor visualization of placenta were excluded from the study. A total of 50 antenatal mothers were included in the study. The placental thickness in mm was measured at the level of cord insertion site. The transducer was oriented to scan perpendicular to both the chorionic and basal plates as tangential scan will distort the measurement of the thickness of the placenta. All the other routine parameters like BPD, HC, AC and FL were also measured.

**Study Design:** Cross-sectional study.

**Study Location:** Department of radiology, /Saveetha medical college and hospital, Chennai.

**Study Duration:** June 2017 to May 2018.

**Sample size:** 50 patients.

**Subjects & selection method:** The study population A cross-sectional study was conducted for a period of one year on all the antenatal mothers at the radiology department of Saveetha Medical college and Hospital. All women with singleton pregnancies, women with confirmed last menstrual period, women of 11 to 40 weeks of gestation who were referred to radio diagnosis department for antenatal checkup were included in the study. Patients with Patients with PIH, Anaemia, Diabetes mellitus, hydropsfetalis, intra uterine growth restriction,

congenital malformations, twins, polyhydramnios, placental anomalies, placenta praevia, poor visualization of placenta were excluded from the study. A total of 50 antenatal mothers were included in the study. The placental thickness in mm was measured at the level of cord insertion site. The transducer was oriented to scan perpendicular to both the chorionic and basal plates as tangential scan will distort the measurement of the thickness of the placenta. All the other routine parameters like BPD, HC, AC and FL were also measured.

**Inclusion criteria:**

1. 1. Singleton pregnancies
2. 2. Women with confirmed last menstrual period.
3. 3. Women of 11 to 40 weeks of gestation who are referred to radio diagnosis department for antenatal checkup

**Exclusion criteria:**

1. 1. PIH
2. 2. Anaemia.
3. 3. Diabetes mellitus.
4. 4. Hydropsfetalis
5. 5. Intra uterine growth restriction.
6. 6. Congenital malformations
7. 7. Twins
8. 8. Polyhydramnios
9. 9. Placental anomalies
10. 10. Placenta praevia
11. 11. Poor visualization of placenta.

**Procedure methodology**

All the patients were scanned with a moderately distended bladder in supine position. The transducer was placed on the skin surface after applying the couple agent.

The placental thickness in mm was measured at the level of cord insertion site. The transducer was oriented to scan perpendicular to both the chorionic and basal plates as tangential scan will distort the measurement of the thickness of the placenta.

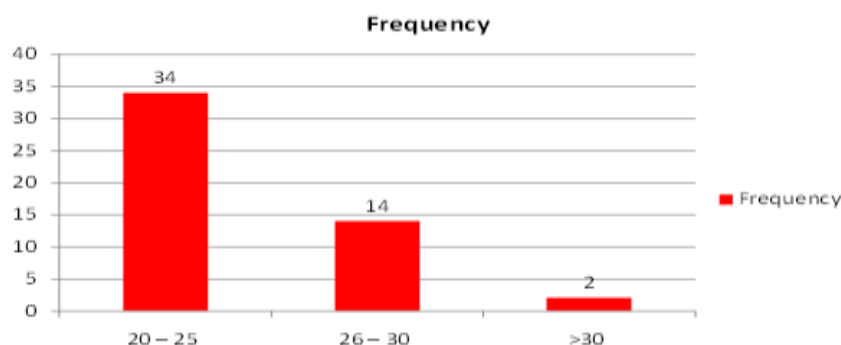
**III. Result:**

**Table 1: Age wise distribution of the antenatal mothers**

Age group (in years)	Frequency	Percentage	Mean	SD
20 – 25	34	68%	24.2	3.2
26 – 30	14	28%		
>30	2	4%		
<b>Total</b>	50	100%		

Table 1 shows the age wise distribution of the antenatal mothers. It is seen from the table that majority of our study subjects were in the age group between 20 and 25 years with a mean age of 24.2 years. The minimum age in our study subjects was 20 and the maximum age was 32 years.

**Fig 1: Age wise distribution of the antenatal mothers**

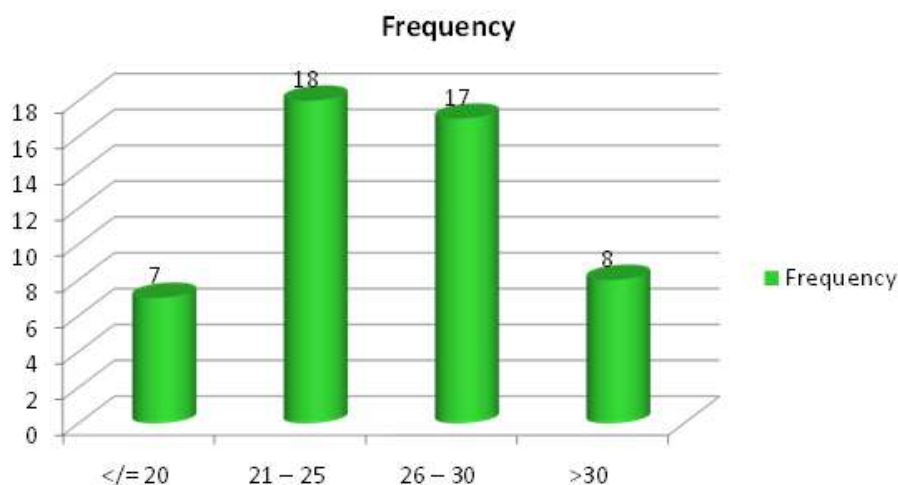


**Table 2: Distribution of the study subjects based on their gestational age**

Gestational age (in weeks)	Frequency	Percentage	Mean	SD
</= 20	7	14%	25.9	4.8
21 – 25	18	36%		
26 – 30	17	34%		
>30	8	16%		
<b>Total</b>	50	100%		

Table 2 shows the distribution of the study subjects based on their gestational age. It is seen from the table that majority of the subjects had the gestational age between 21 – 30 weeks, which means most of them were in the 2<sup>nd</sup> and early 3<sup>rd</sup> trimester. The mean gestational age for our study population was 25.9 weeks.

**Fig 2: Distribution of the study subjects based on their gestational age**

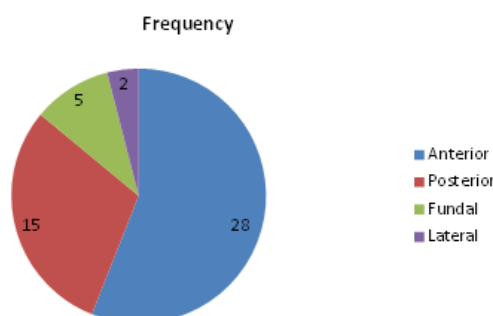


**Table 3: Distribution of the study subjects based on the position of placenta**

Placental position	Frequency	Percentage
<b>Anterior</b>	28	56%
<b>Posterior</b>	15	30%
<b>Fundal</b>	5	10%
<b>Lateral</b>	2	4%
<b>Total</b>	50	100%

Table 3 shows the distribution of the study subjects based on their position of placenta detected through the ultrasonogram. It is seen from the table that majority of the subjects placental position was found to be anterior followed by posterior. Only 10% and 4% of the study subjects had the placental position as fundal and lateral respectively.

**Fig 3: Distribution of the study subjects based on the position of placenta**

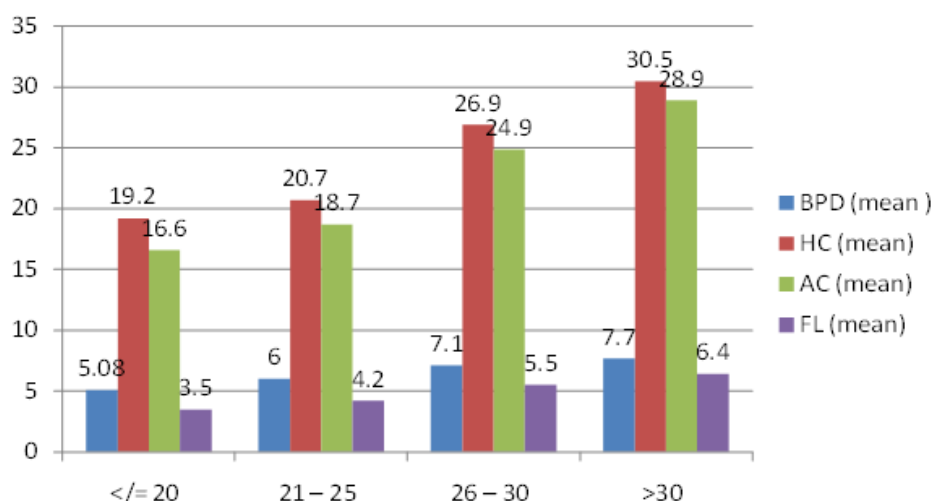


**Table 4: Mean and SD of the various foetal parameters measured in USG based on the gestational age**

Gestational age	BPD (mean ± SD)	HC (mean ± SD)	AC (mean ± SD)	FL (mean ± SD)
<= 20	5.08 ± 0.29	19.2 ± 1.0	16.6 ± 1.3	3.5 ± 0.51
21 – 25	6.0 ± 0.78	20.7 ± 2.0	18.7 ± 2.1	4.2 ± 0.52
26 – 30	7.1 ± 0.71	26.9 ± 1.1	24.9 ± 1.3	5.5 ± 0.48
>30	7.7 ± 0.67	30.5 ± 1.4	28.9 ± 1.7	6.4 ± 0.54

Table 4 shows the mean and SD of the various foetal parameters measured through ultrasonogram based on their gestational age. It is depicted from the table that all the foetal parameters like biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and the femur length (FL) were appropriate for the gestational age.

**Fig 4: Mean and SD of the various foetal parameters measured in USG based on the gestational age**



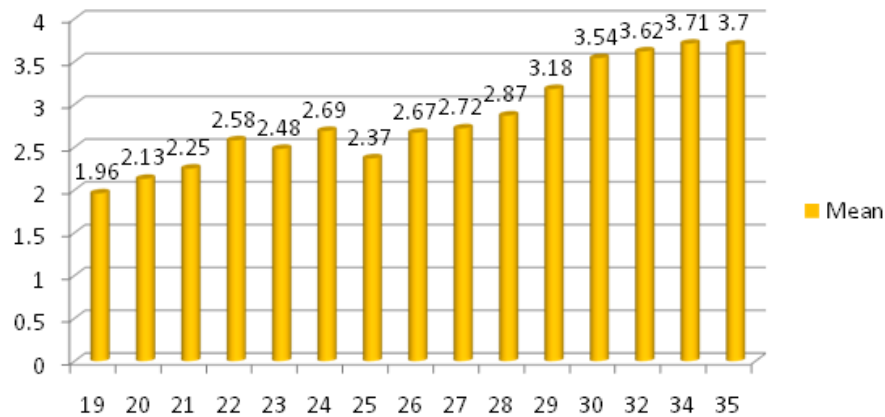
**Table 5: Gestational age wise placental thickness among the study subjects**

Gestational age (in weeks)	No of cases (n=50)	Mean	SD	P value
19	2	1.96	0.31	<.0001
20	5	2.13	0.33	
21	6	2.25	0.41	
22	5	2.58	0.12	
23	4	2.48	0.21	
24	2	2.69	0.33	
25	1	2.37	-	
26	1	2.67	-	
27	1	2.72	-	
28	4	2.87	0.35	
29	6	3.18	0.41	
30	5	3.54	0.28	
32	3	3.62	0.31	
34	2	3.71	0.15	
35	3	3.70	0.56	

P value derived by applying student T test

Table 5 shows the association between gestational age and the placental thickness. It is inferred from the table that there exist a statistical significant association between gestational age and the placental thickness, as gestational age increases the placental thickness shows a gradual increase.

**Fig 5: Gestational age wise mean placental thickness among the study subjects**  
**Mean**



**Table 6: Correlation between gestational age and placental thickness**

Correlations			
		Gestational age	Placental thickness
Gestational age	Pearson Correlation	1	.787**
	Sig. (2-tailed)		.000
	N	50	50
Placental thickness	Pearson Correlation	.787**	1
	Sig. (2-tailed)	.000	
	N	50	50

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 6 shows the correlation between gestational age and the placental thickness. The Pearson's correlation shows a strong positive correlation between the gestational age and the placental thickness and the correlation between the two parameters found to be statistically significant ( $p < .01$ ).

**Fig 6: Linear regression between gestational age and placental thickness**

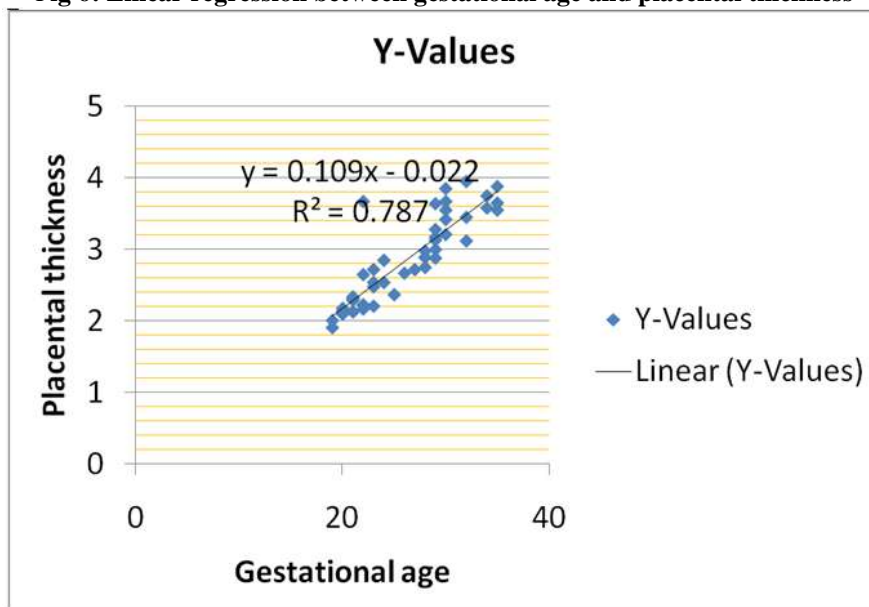


Fig 7: Linear regression between gestational age and BPD

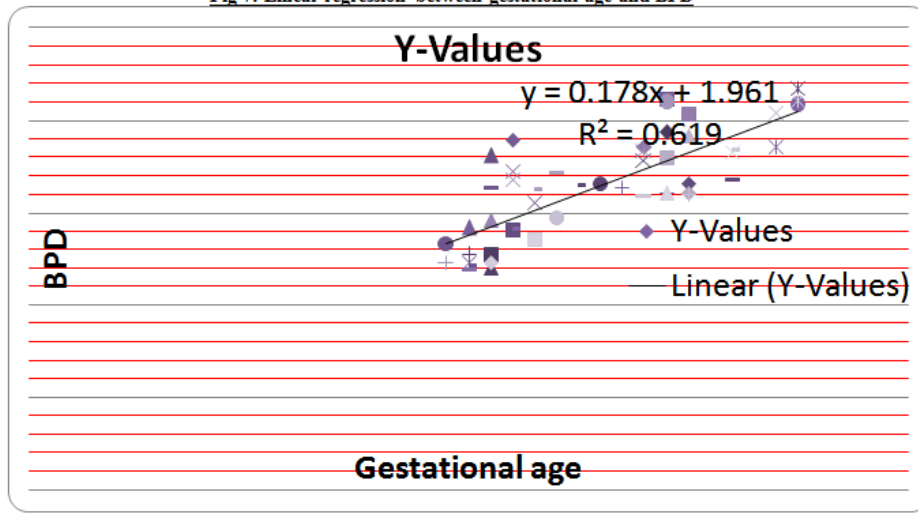


Fig 8: Linear regression between gestational age and AC

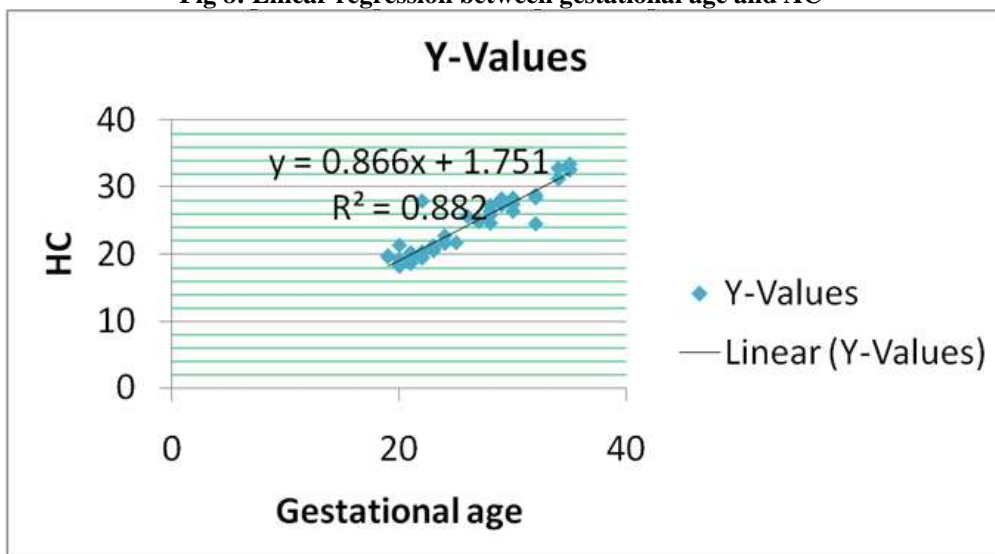


Fig 9: Linear regression between gestational age and AC

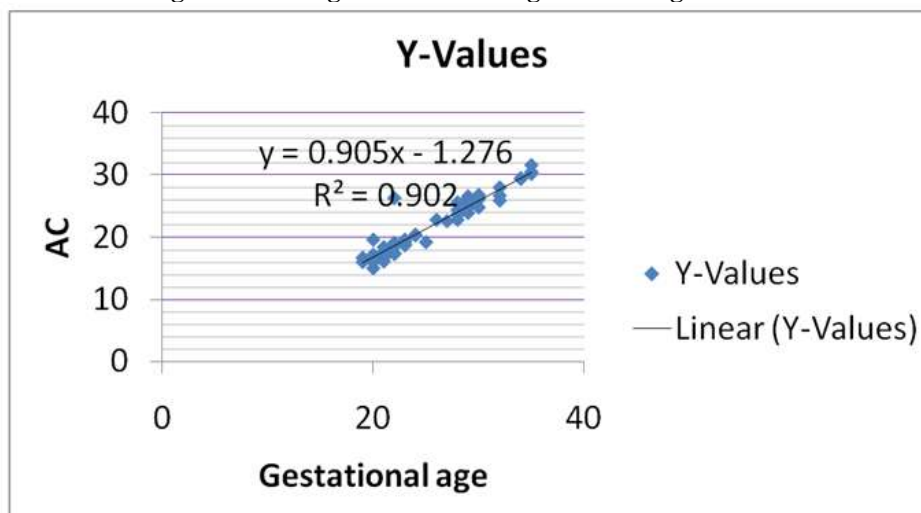


Fig 10: Linear regression between gestational age and FL

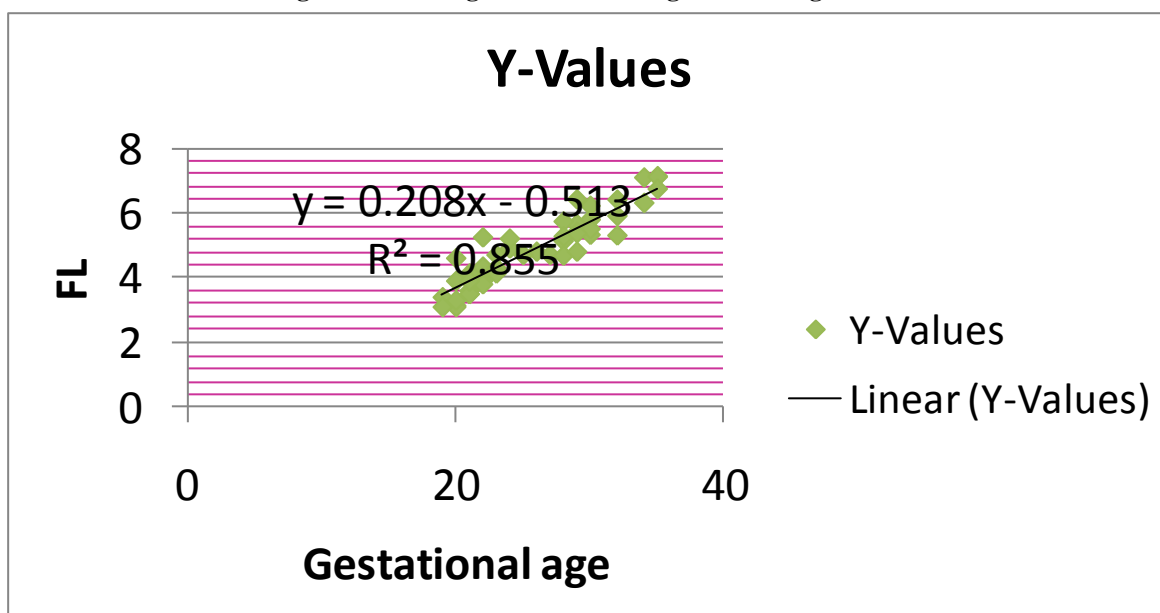


Fig 6 -10 shows the linear regression between the gestational age and the other foetal parameters used to assess the gestational age and it is seen from the graphs that there is a perfect linear regression between BPD, HC, AC and FL with gestational age and similar to these parameters a perfect linear regression exist between gestational age and the placental thickness.

Table 7: Correlation between placental thickness and foetal weight

Correlations			
		Placental thickness	Foetal weight
Placental thickness	Pearson Correlation	1	.809**
	Sig. (2-tailed)		.000
	N	50	50
Foetal weight	Pearson Correlation	.809**	1
	Sig. (2-tailed)	.000	
	N	50	50
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 7 shows the correlation between placental thickness and foetal weight. It is seen from the table that there is a strong positive correlation between the two parameters as the thickness of the placenta increases the foetal weight increases. This correlation was found to be statistically significant ( $P < .01$ ).

Fig 11: Linear regression between placental thickness and foetal weight

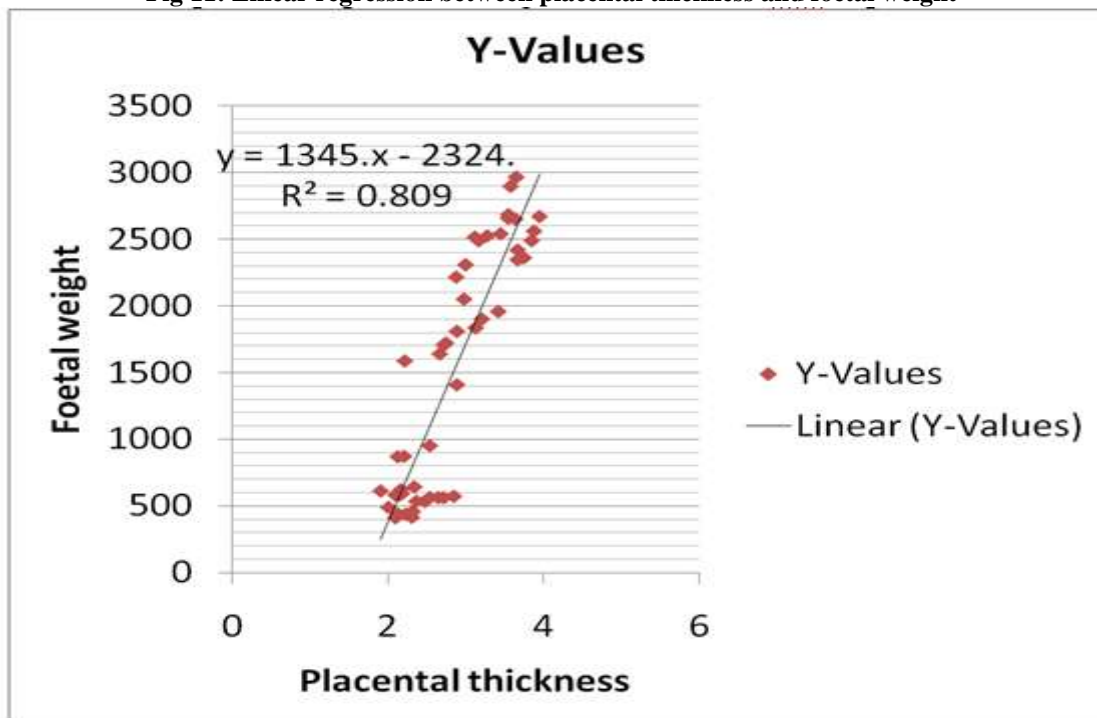


Fig 12: Linear regression between BPD and foetal weight

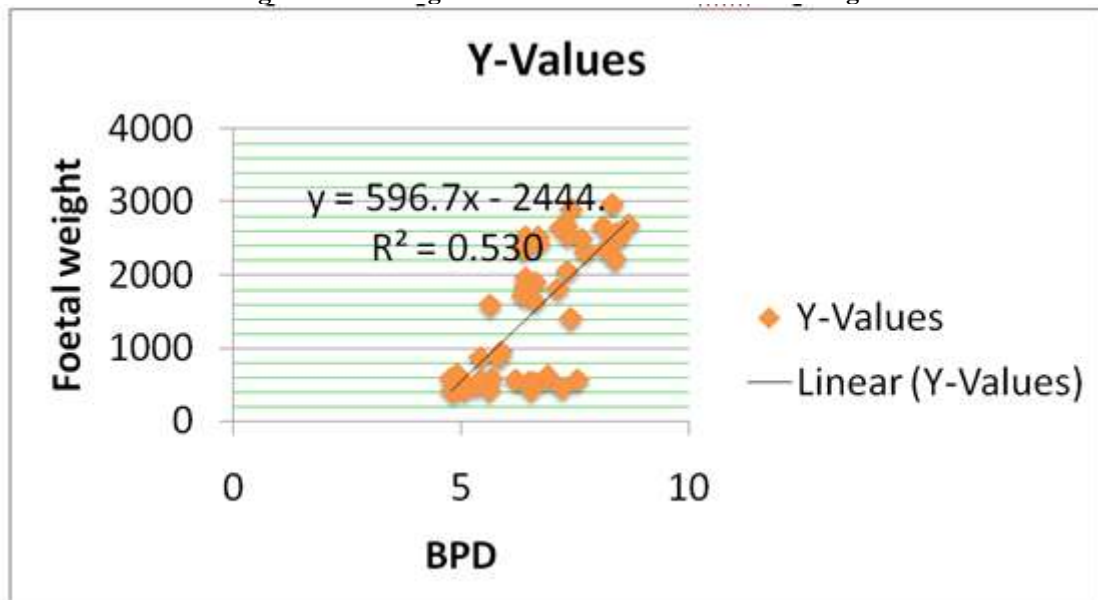




Fig 13: Linear regression between HC and foetal weight

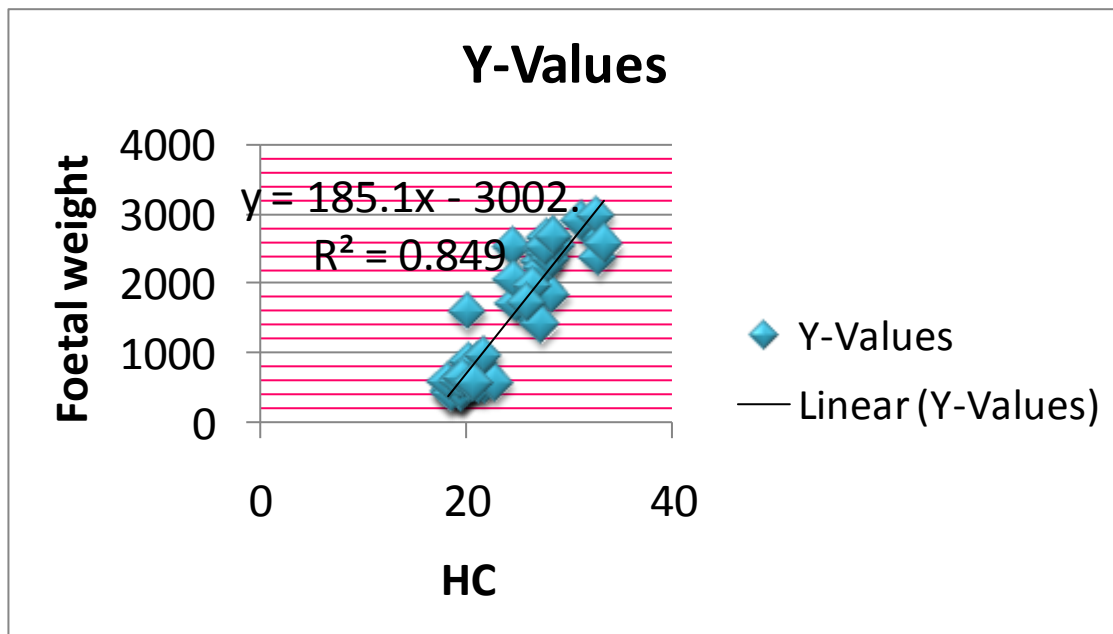


Fig 14: Linear regression between AC and foetal weight

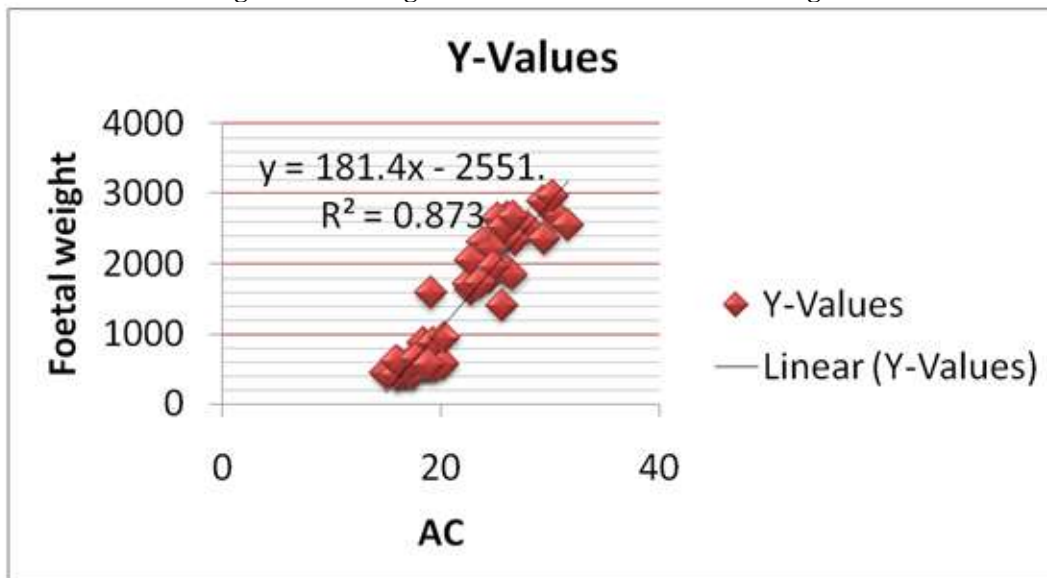


Fig 15: Linear regression between FL and foetal weight

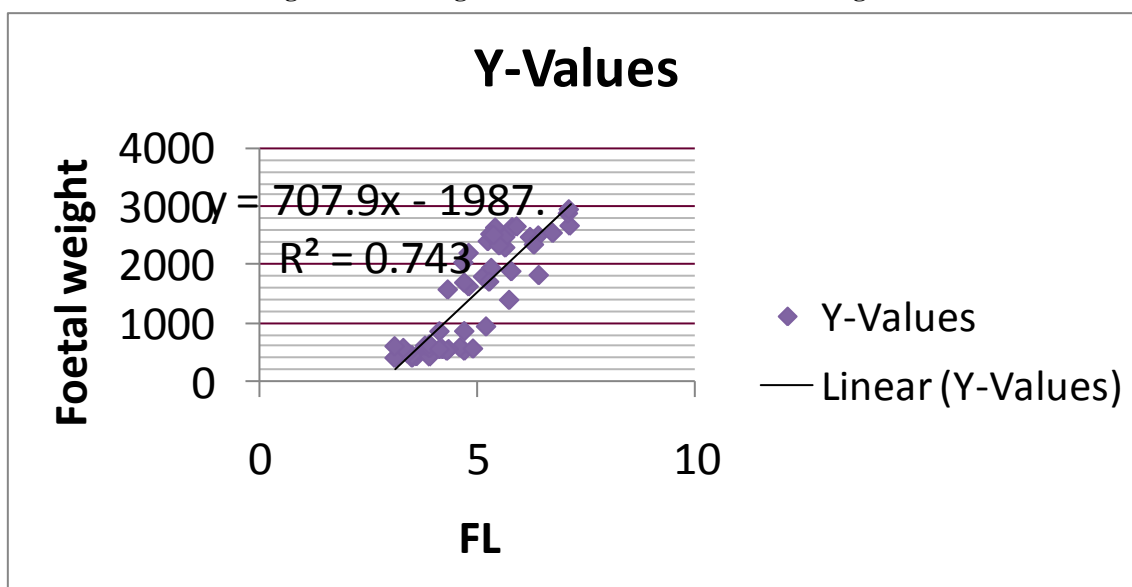


Fig 11 -15 shows the linear regression between the foetal weight and the other foetal parameters used to assess the foetal weight and it is seen from the graphs that there is a perfect linear regression between BPD, HC, AC and FL with foetal weight and similar to these parameters a perfect linear regression exist between foetal weight and the placental thickness.

#### IV. Discussion:

Determination of GA is important because it provides valuable information regarding the wellbeing or potential problems of the fetus and directly affects the medical treatment plan for the fetus. Placenta has been noted to increase as pregnancy advances in age.<sup>78</sup>

From the present study we found a perfect linear correlation between the gestational age and the placental thickness and also between the placental thickness and the foetal weight. The linear equation between the gestational age and the placental thickness which we derived in our study was

$$\text{Placental thickness} = 0.109 + 0.022 \times \text{gestational age}$$

and similarly the equation between the foetal weight and placental thickness was

$$\text{Foetal weight} = 1345 + 232 \times \text{placental thickness}$$

A study done by P.Mittal et al among 600 antenatal cases of all gestational ages (more than 10wks of gestation) excluded the patients with PIH, IUGR, DM, Hydrops Fetalis, congenital malformation and twins. After estimating the fetal age by CRL, BPD, FL, HC, AC, Placental Thickness was measured in each case.<sup>79</sup> It was observed that the placental thickness gradually increased from 15mm at 11wks of gestational age to 37.5mm at 39wks. From the 22<sup>nd</sup> week to 35<sup>th</sup> week of gestation the placental thickness coincide almost exactly with the gestational age in weeks. Another study done by Anupamajain et al (2001) in which he analyzed 500 normal antenatal cases of more than 10weeks gestation. Mean values of placental thickness was calculated for different gestational ages. It was observed that the mean placental thickness increased from 15mm at 10weeks to 36mm at 39weeks of gestation. Placental thickness matched almost equally from 27weeks to 33weeks of gestation.<sup>80</sup>

Durnwald et al analyzed 167 singleton viable pregnancies. Women with suspected abruption, placenta previa, fibroid, uterine and fetal anomalies, abnormal fluid volume were excluded. Placental thickness was measured at mid point of placental mass. Placental thickness was measured at the fundal, anterior, posterior implantation sites. The purpose of the study was to identify differences in sonographic placental thickness with advancing gestation and based on implantation site. It was observed that there was step wise increase in placental thickness with increasing gestation (15.8mm, 27.1mm, 37.6mm for 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> trimester respectively). In the third trimester the placental thickness of posterior and fundal placenta was significantly greater than anterior placenta.<sup>81</sup> Parity and BMI doesn't affect placental thickness. Tongsong T et al (2004) established a nomogram for placental thickness for each week of gestational age ranged from 9 to 37weeks. By regression analysis, placental thickness (in mm) = gestational age in weeks x 1.4 - 5.6 (r = 0.82). This nomogram may be a useful aid in the early detection of placental abnormalities like hydrops fetalis. (Hb Bart's disease).<sup>82</sup> Muhammad Haneef et al studied 100 cases of gestational age of more than 12weeks.<sup>83</sup> Placental

thickness increased from 16mm at 12weeks to 39mm at 40weeks. Ghosh UK et al analyzed 120 uncomplicated pregnancies of 32 to 40weeks of gestation. Placental diameter and thickness were measured. Placental diameter increased with advancing pregnancy where as placental thickness decreased with increasing gestational age. In 75% of cases a single ultrasound measurement of placental thickness can predict gestational age within + 14days in the last 8weeks of pregnancy.<sup>84</sup> W.K. Hoddick et al reviewed sonograms of 200 single ton pregnancies. Placental thickness was measured and correlated with menstrual age. Placental thickness increased with advancing menstrual age. At no stage of pregnancy was the normal placenta greater than 4cm in thickness.<sup>85</sup> Grannum et al in the ultrasonographic study of placenta have shown that there is gradual decrease in the thickness of placenta as the placenta matures.<sup>86</sup> Bleker et al have shown that the surface area of the placenta increases linearly.<sup>87</sup> Nyberg and Finberg also reported that as a rule of thumb, placental thickness in mm parallels gestational age in weeks.<sup>88</sup> Habib FA studied placental diameter and thickness by ultrasound at 36weeks of gestation in 70 singleton pregnancies a warning limit of placental diameter of 18cms and placental thickness of 2cm at 36weeks of gestation were calculated to predict the low birth weight in infants. Ultra sonographic placental thickness appears to be of prognostic value in identifying the subsequent occurrence of IUGR.<sup>89</sup>

Elchalal U et al analyzed 561 normal single ton pregnancies to establish the correlation of sonographically thick placenta with perinatal mortality and morbidity.<sup>90</sup> Thick placenta was determined as placenta that was above the 90<sup>th</sup> percentile. A linear increase of placental thickness was found to correlate with gestational age throughout pregnancy. Sonographically thick placenta is associated with increased perinatal risk with increased mortality related to fetal anomalies and higher rates of both SGA and LGA infants at term. Tongsong T et al evaluated the efficacy of placental thickness at mid pregnancy in predicting fetal Hb Bart's disease in pregnancy at risk. Placental thickness of more than 13mm was considered abnormal for 18 to 21weeks of gestation. Mean placental thickness for normal pregnancy and pregnancies with Hb Bart's fetuses were significantly different. For couple at risk, if placental thickness is normal then the risk of having Hb Bart's fetus is markedly decreased.<sup>82</sup>

Ghosh A et al measured placental thickness by ultrasound at 10 to 21weeks of gestation in 231 pregnancies at risk for homozygous Alpha thalassemia. The sensitivity in detecting the affected pregnancies after 12weeks was 0.95 and by 18weeks it reached 1. Thus the selection of pregnancies at risk by measurement of placental thickness will reduce the number of invasive diagnostic procedures.<sup>91</sup>

The results of the above mentioned studies are almost in par with the present study showing a linear relationship between the gestational age and placental thickness and between the placental thickness and the foetal weight.

There was a fairly steady increase in placental thickness and estimated fetal weight with gestational age. This relationship exists in the second and third trimesters; the period during which most of the fetal weight is gained. A feature of this observed relationship was the wide variations of placental thickness corresponding to particular fetal weight. We think that it could be as a result of uncertainties involved in measuring maximum placental thickness. A slight obliquity of the scanner probe can exaggerate measurements. This makes it unsuitable to be used routinely to predict fetal weight during obstetric ultrasound.

Previous studies have suggested that low-birth weight infants can be predicted from ultrasound measurements of placental diameter and thickness, and that diminished placental size precedes fetal growth restriction.<sup>92,93</sup> The cause of diminished placental size is still being debated but there is a link between small placentas and preeclampsia, chromosomal abnormalities, severe maternal diabetes mellitus, chronic fetal infection and intrauterine growth restriction. There have been suggestions that uterine artery doppler in the second trimester may in addition to measurement of placental diameter and thickness help in predicting low-birth weight infants. Several investigators have suggested that diminished fetal growth may be a consequence of hemodynamic compromise.<sup>94,95</sup> In our study, we did not carry out doppler investigation of the umbilical vessels to ascertain the relationship between blood flow and fetal weight estimates. This is obviously a limitation which we suggest further studies should include. This will show how blood flow disturbances relate to placental size and fetal weight.

## **V. Conclusion**

The result of this study shows a strong positive correlation between gestational age and placental thickness and also between placental thickness and estimated fetal weight. Thus, placental thickness can be used as a fairly accurate indicator for estimating the gestational age and of normality of fetal weight, but because of wide variations in placental thickness corresponding to particular fetal weight a more thorough search should be undertaken when a fetus is considered to be at risk. Also in our study the thickness of placenta did not show any variation with the location of placenta. Abnormal placental thickness in the early stages helps to detect IUGR, hydramnios and diabetes mellitus. Hence placental thickness is considered as a useful index in determining the gestational age as well as in estimating the foetal weight.

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