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Sonographic Estimation of Fetal Gestational age using Binocular Diameter

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Abstract | **Original Research Article**

Fetal ocular biometry is a valuable resource for the evaluation of fetal growth and as a clue to the detection of congenital abnormalities during pregnancy. The purpose of the study was to sonographically estimate the gestational age using binocular diameter. This cross sectional study was carried out in the department of radiology of different hospital in Khartoum state, Sudan. Measurements were obtained only when the fetal face was directly perpendicular to the uterine wall, since measurements in an oblique plane were considered to be unreliable. The correlation between binocular distance (BD) in cm and gestational age (GA) in weeks was calculated. This correlation was highly significant (r = 0. 973; p<0.001). Excellent correlation was found to exist between binocular diameter and gestational age. In the absence of known date of last menstrual period or where fundal height does not agree with dates, these parameters are valuable in estimating the gestational age of the fetus.

Keywords: Fetal binocular distance; pregnancy and gestation age.

INTRODUCTION

The study of the human fetal face has recently benefited from advances in prenatal ultrasonography. It often allows a prenatal diagnosis in the field of facial, orbital and ocular defects. Biometry is known to be fundamental in the definition of all malformation syndromes [1]. Several elements of the normal anatomy (orbits, forehead) can be identified as early as the 12th week of gestation. Before 14 weeks, the soft tissues of the face are too thin to be reliably imaged with current ultrasound equipment [2]. Fetal ocular biometry is a valuable resource for the evaluation of fetal growth and as a clue to the detection of congenital abnormalities during pregnancy. Conditions such as hypotelorism, hypertelorism, micro- or anophthalmia and cataracts can be indicative of many congenital anomalies and syndromes and the orbits, being conspicuous and easily measured, provide an accessible tool for imagers and clinicians to use as they attempt to determine a proper course of action as early as possible. Timely and accurate diagnosis can be crucial to improving prognosis, prenatal consultation, and management of pregnancy and birth. Timely and accurate diagnosis can be crucial to improving prognosis, prenatal consultation, and management of pregnancy and birth. Several published studies have characterized normal fetal eye development using ultrasound [3].

Objectives

The purpose of this study was to estimate the gestational age of fetal using binocular diameter using ultrasound.

MATERIALS AND METHODS

This cross sectional study was carried out in the department of radiology of different hospital in Khartoum state, Sudan during the period of July 2016 to June 2018. In all the cases BPD, FL, AC, Binocular distance (BD) in cm and gestational age in weeks were measured by ultrasonography. Patients with multiple pregnancies, fetal congenital anomaly, pregnancy complicated by premature ruptures of membrane and poly or oligohydramnios and breech presentation were excluded from the study. Each patient was voluntary enrolled into the study without any specific indication. The measurement was performed only once for each patient. The fetal outer binocular distance was identified in the occipitotransverse or occipito-posterior-fetal positions. With the head in the occipito-posterior position, the transducer was placed in a plane that transected the occiput, orbits, and nasal processes. Measurements were obtained only when the fetal face was directly perpendicular to the uterine wall, since measurements in an oblique plane were considered to be unreliable. The ultrasonography was performed by using (HD15 System; Philips Ultrasound, Bothell, Washington) 5-12- MHz linear-array transducer by the same radiologist. The compatibility of the data to the

normal distribution was graphically checked and ensured by using Shapiro-Wilk test only to find out that the data at hand did not comply with the normal distribution. The representation of continuous data was presented by using median values (minimum - maximum). To determine the factors that affect the identification of TFA, we used the Spearman correlation analysis and linear regression analysis by making use of backward: LR. P<0.05 value was considered statistically significant throughout the study. As for ethical consideration all patients information not throughout this study and had known that the data had taken for the research.

THE RESULTS AND DISCUSSION

This was cross sectional study done to correlate BOD with gestational age done in 120 cases of normal pregnant women in second and third trimester of their pregnancies, the study found that the mean GA BPD, FL and AVG was 25.87± 5.25, 26.19± 5.46, 26.0± 5.32, while BOD .IOD, BOTH orbital diameter, OD and ratio was 40.23± 8.76, 15.74± 3.34, 24.31± 6.42, 12.15± 3.21, 0.78± 0.15 as shown in table (1).

Table-1

Variables	N	Minimum	Maximum	Mean	Std. Deviation
BPD W	120	15.29	38.57	25.8762	5.25769
FL W	119	15.29	38.00	26.1993	5.46987
GAAVG	120	15.29	37.43	26.0071	5.32542
BOD	120	19.0	68.0	40.233	8.7618
IOD	120	8.0	26.0	15.742	3.3494
Orbital diameter (both)	120	24.00	45.00	24.3117	6.42337
OD (one)	120	12.00	22.50	12.1558	3.21169
Ratio (IOD\OD)	120	.45	1.65	.7828	.15484
Valid N (listwise)	119				

The study found that there was significant strong linear association between GA BPD and BOD (R^2=0.89), y = 0.5673x + 3.0528, also linear association between GA BPD and IOD (R^2=0.69), y = 1.3095x + 5.2626, The study found that there was significant strong linear association between GA BPD and ODy = 0.7759x + 6.8729, R^2 = 0.81, no linearity in association of ratio with GA BPD y = 10.148x + 17.933. This was in the same line with (Kaygusuz İ, Köşüş A, Köşüş N, Duran M), they found that there is significant strong linear association between GA BPD and OD [4]. R^2 = 0.0893 as shown in figure 1,2,3,4.

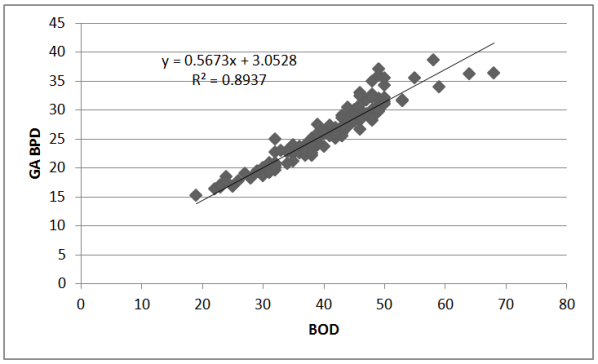

Fig-1: scatterplot shows relationship between BPD and BOD

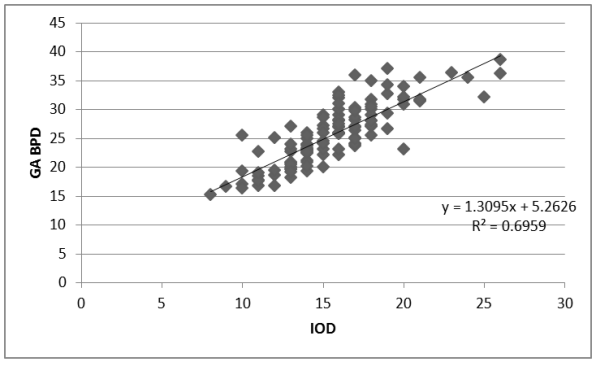

Fig-2: scatter plot shows relationship between BPD and IOD

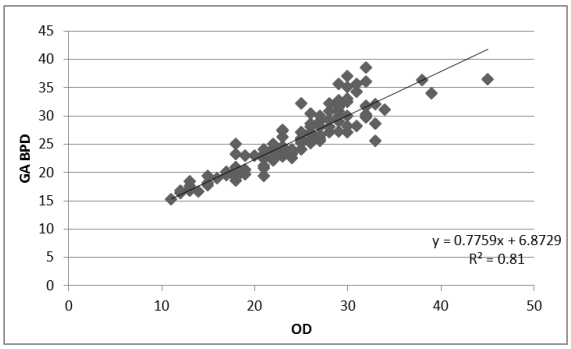

Fig-3: Scatter plot shows relationship between BPD and OD

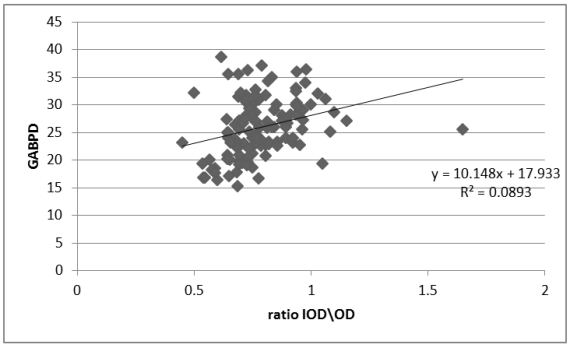

Fig-4: scatter plot shows relationship between BPD and ratio

The study found that there was significant strong linear association between GA FL and BOD y = 0.5866x + 2.5978, R^2 = 0.8903, also linear association between GA FL and IODy = 1.347x + 4.9861, R^2 = 0.6858, the study found that there was significant strong linear association between GA FL and ODy = 0.8046x + 6.4955, R^2 = 0.811, no linearity in association of ratio with GA FL ,y = 10.522x + 17.967, R^2 = 0.0894 as shown in figure 5, 6,7,8, this was matches with Islam M, Akter T, Islam S, Alam F, Goswami U, Uddin S, *et al*. They found that there is association between GA FL and IODy [5].

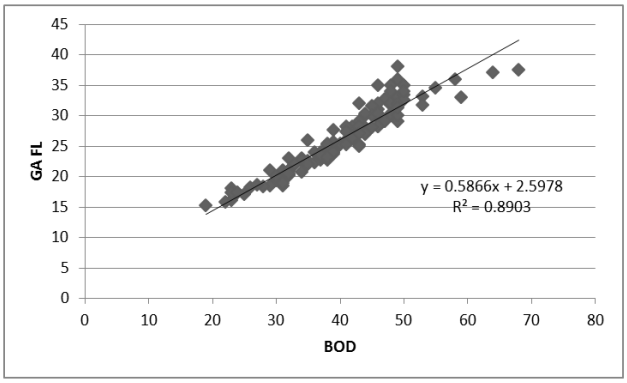

Fig-5: Scatterplot shows relationship between BOD and GAFL

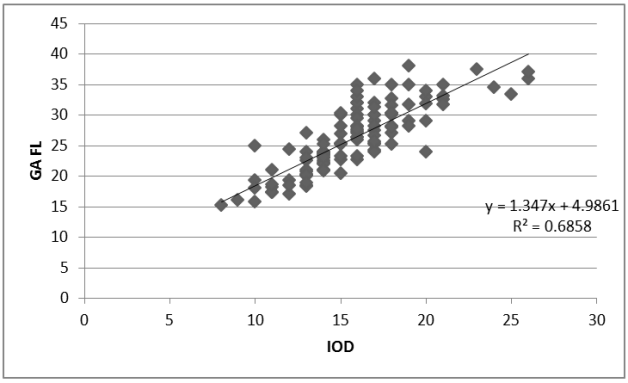

Fig-6: Scatter plot shows relationship between IOD and GAFL

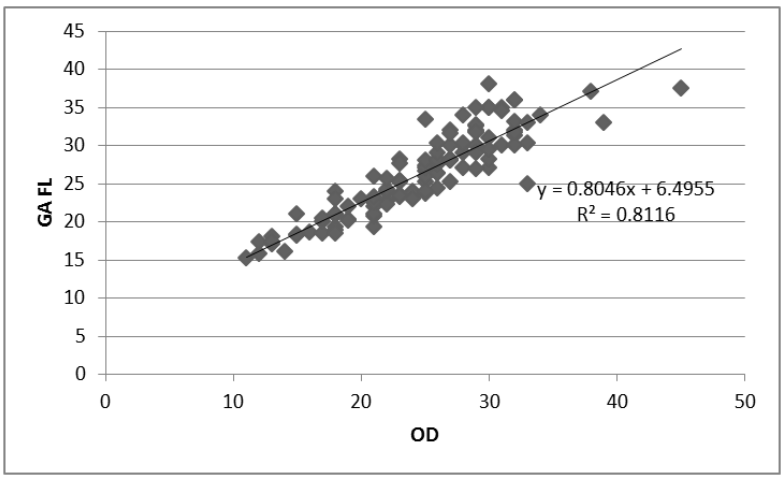

Fig-7: Scatter plot shows relationship between OD and GAFL

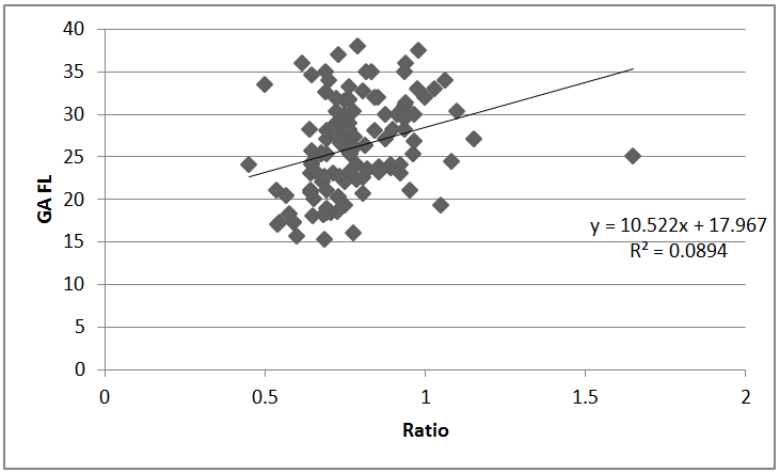

Fig-8: Scatter plot shows relationship between ratio and GAFL

The study found that there was significant strong linear association between GA AVG and BOD y = 0.5768x + 2.7998, R^2 = 0.9006, also linear association between GA AVG and IODy = 1.3275x + 5.1098 R^2 = 0.6971, the study found that there was significant strong linear association between GA AVG and ODy = 0.7902x + 6.6545,R^2 = 0.8188, no linearity in association of ratio with GA AVG ,y = y = 10.344x + 17.91 R^2 = 0.0904 as shown in fig 9, 10,11,12, this is agree with study done by Shan BP, Madheswaran M, they found that there is strong linear association between GA AVG and BOD [6].

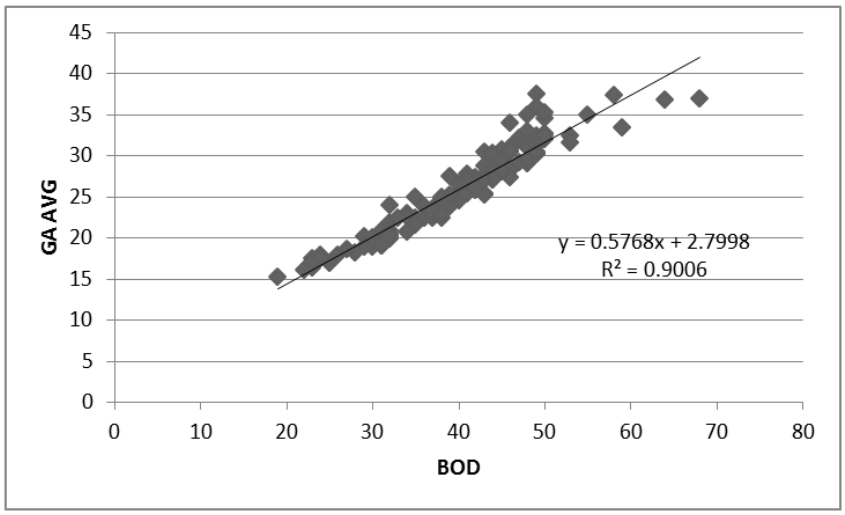

Fig-9: Scatter plot shows relationship between BOD and GA AVG

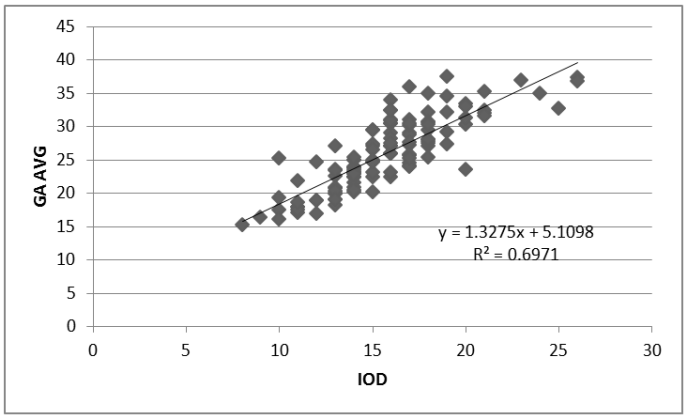

Fig-10: Scatter plot shows relationship between IOD and GA AVG

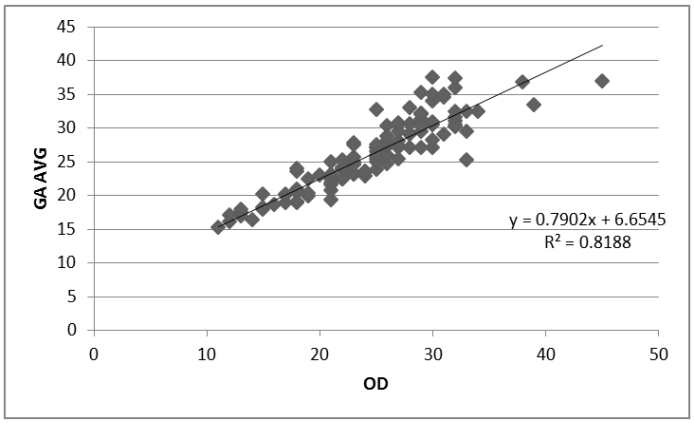

Fig-11: Scatter plot shows relationship between OD and GA AVG

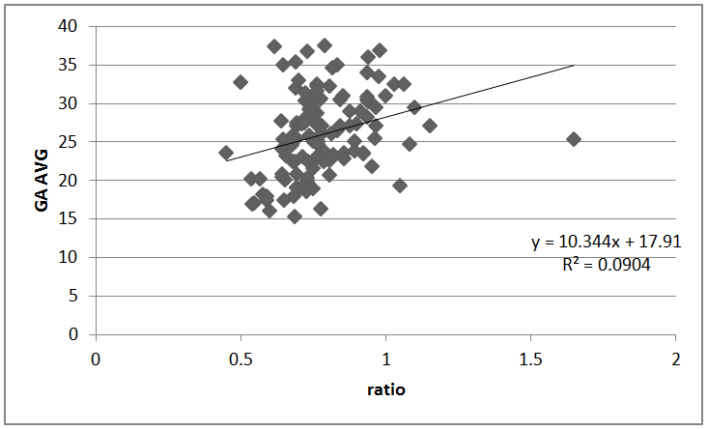

Fig-12: scatter plot shows relationship between ratio and GA AVG

Fig-13: Ultrasound image shows fetal Binocular Diameter, pregnant women with 27 weeks

Fig-14: Ultrasound image shows fetal Binocular Diameter, pregnant women with 37 weeks + 3days

Fig-15: Ultrasound image shows fetal Binocular Diameter, pregnant women with 29 weeks

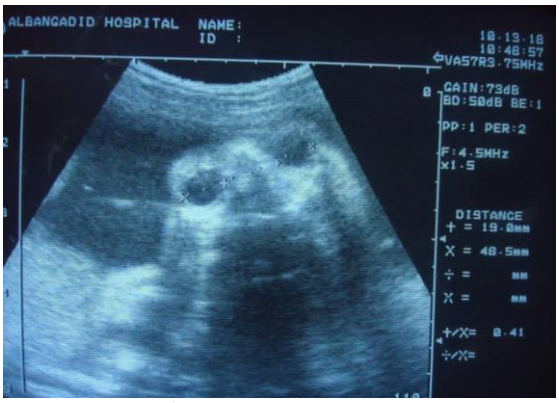

Fig-16: Ultrasound image shows fetal Binocular Diameter, pregnant women with 24 weeks

Fig-17: Ultrasound image shows fetal Binocular Diameter, pregnant women with 27 weeks

The study found that there was significant strong correlation between BPD weeks , FL weeks and AVG weeks and BOD, IOD, OD, for BOD and BPD, FL, GA AVG(r= 0.945.0.944,0.949) respectively, for IOD and BPD, FL, GA AVG (r= 0.834,0.828 and 0.835) , for OD and BPD, FL , GA AVG (r= 0.900,0.901 and 0.905), also significant weak correlation between ratio and BPD, FL, GA AVG (r= 0.299,0.299, 0301 respectively) p value for each <0.01 (table 2), Again this is in the same line with study done by Islam M, Akter T, Islam S, Alam F, Goswami U, Uddin S *et al*. They found that there is association between GA FL, BPD and IODy [5].

The study found that BOD in second trimester ranges from 19-43 means 34.18±5.88 mm while in third trimester was 39-68 with mean 47.63±5.34 mm, t- test was done and show that there was significant difference in measurement of BOD, IOD, OD and ratio in second and third trimester with 99% confidence interval p<0.01. Table (3) t- test for compare means.

Table-3

		BOD	IOD	OD	One OD	Ratio
BPD W	Pearson Correlation	.945**	.834**	.900**	.900**	.299**
	Sig. (2-tailed)	.000	.000	.000	.000	.001
	N	120	120	120	120	120
FL W	Pearson Correlation	.944**	.828**	.901**	.901**	.299**
	Sig. (2-tailed)	.000	.000	.000	.000	.001
	N	119	119	119	119	119
GA AVG	Pearson Correlation	.949**	.835**	.905**	.905**	.301**
	Sig. (2-tailed)	.000	.000	.000	.000	.001
	N	120	120	120	120	120

Table-4

Trimester		BOD	IOD	OD	Ratio	P value
second trimester	Mean	34.182	13.742	20.4394	.7502	<0.01 with 99% confidence intervals
	Std. Deviation	5.8832	2.2824	4.39275	.16450	
	Minimum	19.0	8.0	11.00	.45	
	Maximum	43.0	20.0	33.00	1.65	
third trimester	Mean	47.630	18.185	29.4444	.8227	
	Std. Deviation	5.3458	2.7818	3.79506	.13303	
	Minimum	39.0	13.0	23.00	.50	
	Maximum	68.0	26.0	45.00	1.15	
Total	Mean	40.233	15.742	24.4917	.7828	
	Std. Deviation	8.7618	3.3494	6.09862	.15484	
	Minimum	19.0	8.0	11.00	.45	
	Maximum	68.0	26.0	45.00	1.65	

CONCLUSION

The accurate estimation of fetal weight can help in predicting macrosomic fetuses, determining the mode of delivery and reducing perinatal morbidity and mortality. The normative data found in this study may be helpful for the detection of congenital fetal anomalies with more consistent measurements than are currently available. The real-time ultrasound scanners have given a number of ultrasonic biometric parameters. The most commonly used among these are foetal bi-parietal diameter, head circumference, abdominal circumference and femur length. From this study we recommended that o use binocular diameter was studied here and an excellent correlation was found to exist between binocular diameter and gestational age.

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