Placental Morphometry in Relation to Birth Weight of Full Term Newborn Babies.

Pradeep S Londhe*, Abhay B Mane **

*Associate Professor, Department of Anatomy, Chalmeda AnandRao Institute of Medical Sciences, Karimnagar, Andhra Pradesh
** Associate Professor, Department of Community Medicine, Navodaya Medical College, Raichur, Karnataka, INDIA-584103

Abstracts: Background: In obstetrics the relationship of birth weight and the perinatal outcome has long been appreciated, however an often neglected parameter is the placental changes. Placenta is a vital organ for maintaining pregnancy and promoting normal foetal development. Foetal outcome is adversely influenced by pathological changes observed in placenta. Objectives: To assess the morphology of placenta in normal and low birth weight babies. To correlate the morphometric analysis with birth weight between the two groups. Study design: Cross-sectional descriptive study. Study setting: Department of Anatomy, Chalmeda Anandrao Institute of Medical Sciences, Karimnagar, Andhra Pradesh from January to June 2011. Methods: Total 374 human placentae from uncomplicated pregnancies were studied for the morphology and compared between low birth weight babies and normal weight babies. Results: The morphometric parameters of placenta like, weight, volume were significantly lower in low birth weight group compared to normal group. Placental weight and placental volume had significant correlation with the birth weight of new born. Conclusion: The placental weight increased according to the birth weight. Placental parameters and its ratio to birth weight were significantly associated with some adverse pregnancy outcomes.[Londhep et al NJIRM 2012; 3(1) : 67-72]
Key Words: Feto-placental weight ratio, Low birth weight, Morphology, Placenta.

Author for correspondence: Dr. Pradeep S Londhe, Department of Anatomy, Chalmeda Anandrao Inst. Of Medical Sciences, Karimnagar-505001, Andhra Pradesh, India. E- mail: londhepradeep@yahoo.co.in

Introduction: Birth weight of an infant is the single most important determinant of its chances of survival, healthy growth and development. WHO estimates that globally about 25 million low birth weight (LBW) babies are born each year and constitute about 28 % of all live births in India[1]. The infant mortality rate is about 20 times higher for all LBW babies than for other babies. The conditions of placenta and cord are to some extent attributable to neonatal mortality and as an important factor in fetal growth retardation. Survival and growth of foetus is essentially dependent on formation, full development and functions of the placenta. It is a mirror which reflects the intrauterine status of the foetus. It undergoes different changes in weight, volume, structure, shape and function continuously throughout the gestation to support the prenatal life[2].

The abnormalities ultimately result in unfavourable outcome of pregnancy with reduction of fetal weight. The examination of the placenta in utero as well as postpartum, gives valuable information about the state of the foetal well being[3, 4]. Careful examination of placenta can give information which can be useful in the management of complications in mother and the newborn. Research over many years has shown that the development of placenta and the foetus represented by their weight throughout pregnancy can serve as good indicators for perinatal outcome. No prior studies have used measures other than placental weight, volume to understand how childhood health outcome as birth weight may relate to placental growth[5].

Hence, this study was done to find and correlate the morphological parameters of placenta with the birth weight of newborn babies in a subpopulation of Andhra Pradesh..

Material and Methods: The study was conducted in the Department of Anatomy. Placentae were obtained from 374 pregnant women who delivered between 36-42 weeks at Medical College Hospital from January and June 2011. Permission was taken from the Institutional Ethics Committee and the Head of Obstetrics and Gynaecology department. Exclusion criteria included maternal diseases affecting placenta such as diabetes mellitus, hypertensive disorder, maternal anaemia, vascular diseases and other medical problems. Multiple pregnancies and congenital anomalies were also excluded. Patients gave informed consent in the labour room before being included in the present study. Hospital records for the presence of any complications during maternal antepartum and

intrapartum were also reviewed. A detailed history of mother regarding the socio-demographic profile, present and past obstetric history were recorded on a predesigned, pretested proforma. All placentae were collected immediately after delivery and washed in running tap water. Any abnormality of cord and membranes was noted. The umbilical cord was cut at a distance of 5 centimetres from the site of insertion. The placentae along with cord were coded and preserved in 10 % formalin solution. The newborns' weight was recorded to the nearest gram immediately after delivery and examined for sex, visible anomalies, maturity of the baby.

Gross examination of placenta: Weight of placenta in grams, diameter of placenta in centimetre, shape of the vessels, the site of umbilical cord insertion, the membranes if it is complete or not, colour of the foetal surface, muconium stain, the shape of the placental disc, maternal surface if it is complete or not, presence of calcification were recorded. All the morphometric parameters of the placentae were recorded using standard procedures.

Statistical processing of data: The collected data was entered on the excel spreadsheet, processed and analysed by SPSS 17.0 version. Descriptive statistics such as mean and standard deviation were used to summarize continuous variables. Proportions and percentages were used for categorical variables. The tests of significance applied were Chi-square test, unpaired 't' test and Correlation coefficient. The chi-square test was used to investigate the significance of association between two categorical variables while student's *t*-test was used to compare the means of continuous variables between infants with low and normal birth weights. Variables that were significant at the 5 % probability level were included in the logistic regression model in which birth weight was the dependent variable. The statistical significance of the variables in the model was examined using the Wald statistics.

Result: The total placentae collected and examined for the study were 374. There were 94 babies with birth weight less than 2500 g out of the 374 babies giving a low birth weight rate of 25.1 % or 251 per 1000 births. The birth weight was categorized into Small For gestational age (SFA) group and normal birth weight/ control group based on birth weight less than 2500 g and 2500 g and above, respectively. The age of the mothers ranged between 18 to 35 years with a mean age of 22.8 years (Standard deviation/ SD of ± 2.4) in study group and 23.6 years (SD± 2.7) in control group. The women in the low birth weight category (<2500 g) were younger than the normal, but the difference was not statistically significant (*P*>0.05). All the placental parameters like weight, surface area and volume were compared between these two groups. Table 1 shows the summary statistics of the placental parameters of these infants in relation to birth weight.

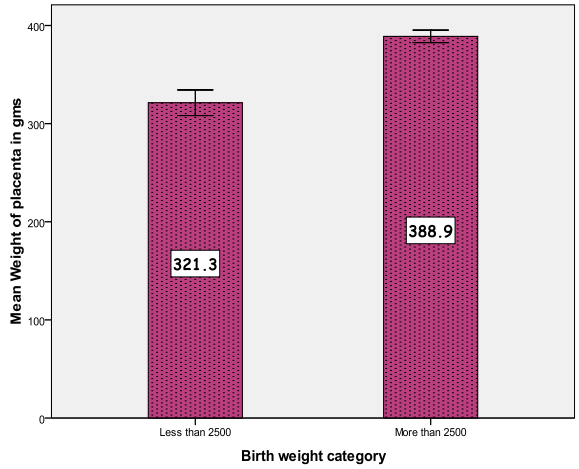
Table: 1 Placental morphometry between SFA group and Control group

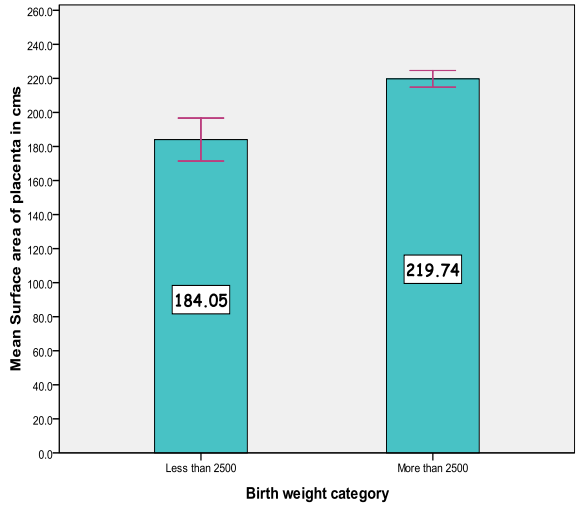
Parameters	Control Group		SFA Group		P value
	Mean	SD	Mean	SD	
Placental weight (gm)	388.9	54.1	321.2	63.7	<0.01*
Placental surface area (sq.cm)	219.7	41.6	184.0	61.6	<0.01*
Placental volume (CC)	460.4	106.1	361.1	142.0	<0.01*
Foeto-placental weight ratio	7.3	0.94	6.7	0.83	<0.01*
Birth weight of baby (gm)	2833	234	2131	293	<0.01*
Age of mothers (years)	23.6	2.7	22.8	2.4	> 0.05**

SD- Standard deviation, ** Not significant ,
* Unpaired 't' test- Highly Significant,

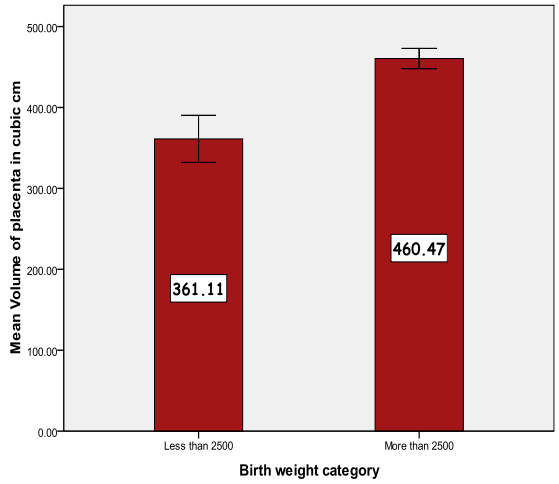
The mean placental weight ± standard deviation (SD) was 321.2 ± 63.7 g in SFA group and 388.9 ± 54.1 g in normal weight/ control group. The mean placental surface area ± SD was also lower in SFA group (184.0 ± 61.6 sq.cm) than control group (219.7± 41.6 sq.cm) and the difference was statistically significant. Morphometric parameters of placenta were significantly lower in small for gestational age group babies as compared to full term normal birth weight group babies as shown in Graph 1.

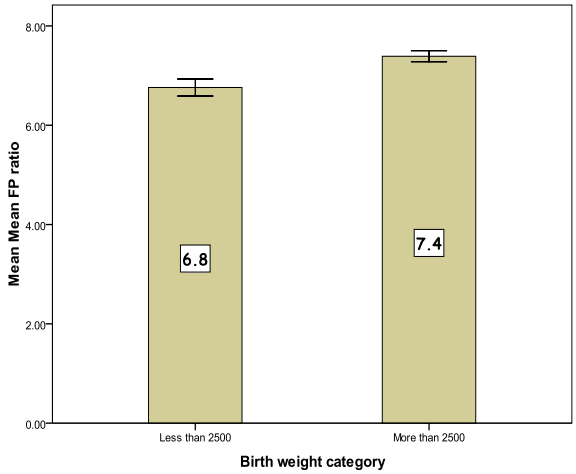
Graph 1: Comparison of Mean Placental weight and mean surface area between two groups





Graph 2: Comparison of Mean Placental volume and mean FP ratio between two groups





The mean placental volume and fetoplacental weight ratio were also lower in SFA group than control group as depicted in Graph 2. This difference between two groups was significant.

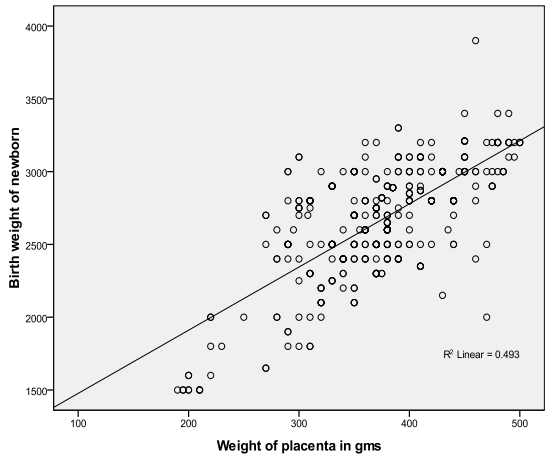
The placentae from SFA group showed significantly higher mean number of cotyledons and infarcted areas than control group. Fresh infarctions were seen more on the surface of 10 placentae (10.6%) in SFA group than 15 placentae (5.4%) in control group. Calcification was found more in placentae in study group than controls. This showed that infarction and calcification were significantly more in SFA group babies as compared to control groups (Table 2).

Table 2: Gross morphology of placenta in SFA group and normal birth weight group.(* Unpaired t test <0.01- Highly Significant, # Chi-square test <0.01- Highly Significant)

Parameters	Control Group		SFA Group		P value
	Mean	SD	Mean	SD	
No. of cotyledons	16.5	1.4	14.03	2.0	<0.01*
No. of infarcted area	4.8	1.4	10.8	2.1	<0.01*
No. of calcified areas	3.4	1.1	11.1	1.6	<0.01*
Marginal insertion of cord (%)	1.8		8.5		<0.01#
Presence of infarcted areas (%)	5.4		10.6		<0.01#

Placental parameters that correlated significantly with birth weight were placental weight (r=0.702, *p < 0.01*), surface area (r=0.567, *p < 0.01*) and volume (r=0.870, *p < 0.01*). These findings are shown by scatter diagrams in Graph 3 & Graph 4.

Graph 3: Correlation between Mean Placental weight and birth weight of newborns



The logistic regression analysis suggested that placental volume and placental weight were the statistically significant variables for the prediction of low birth weight having adjusted for placental surface area and placental thickness. (Table 3)

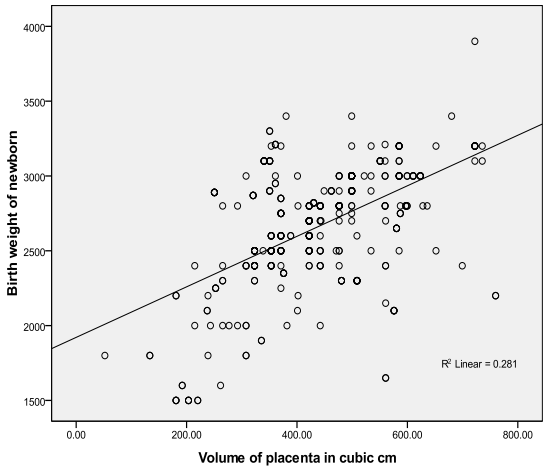
Table 3. Regression coefficient in the logistic model for predicting low birth weight from placental parameters

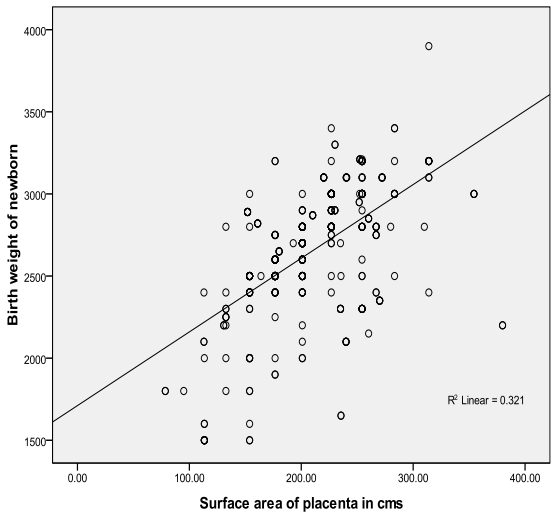
Variables	Regression coefficient				
	B	SE (B)	Wald statistics	OR	95% CI
Constant	8.709	1.14	57.53		
Placental weight	0.019	0.003	39.50	1.01	1.00 - 1.025
Placental volume	0.006	0.001	12.44	1.05	1.002-1.007
Overall prediction rate= 82.1%					

OR-Odd's ratio, CI- Confidence Interval

Discussion: In obstetrics the relationship of birth weight and the perinatal outcome has long been appreciated, however an often neglected parameter is the morphometry of the placenta, an organ which plays a key role for foetal growth. It receives less attention throughout pregnancy in obstetrics in contrast to the foetal weight.

Graph 4: Correlation between Mean Placental volume, mean surface area and birth weight of newborns





Morphometric parameters of placenta like weight, surface area and volume were significantly lower in small for gestational age group as compared to normal group and statistically significant (p<0.01). This study shows that placental diameter and thickness measurements are valuable parameters for predicting low birth weight infants. Relations between birth weight and placental area and placental volume have also been described by other studies[6, 7, 8]. A study from India[9] reported that the placental weight was less in both LBW full-term and preterm infants than that of corresponding normal weight infants. This has been attributed to the significant alteration in the morphometry of placenta due to increase in the cytotrophoblastic cellular proliferation and syncytial knot formation in the placental villi that result in the disturbance of hormonal factors. Hence an altered morphometry

of placenta results into IUGR and low birth weight of the baby.

Many factors such as race, socioeconomic problems, health problems, etc are associated with placental weight[9]. Studies have shown that diminished placental size precedes foetal growth retardation[10]. In another study of small for gestational age group babies, placentae findings were less in small for gestational age group babies than that of normal group[11, 12]. Clappe *et al*[13] and Kinare *et al*[14] reported an association between second trimester placental volume and birth weight. Bjoro[15] and Laurini[16] found out that infarction was more in small for gestational age group babies as compared to normal group. The present study showed that placental weight increased according to birth weight, which concurs with other studies[17, 18]. Placental weight was strongly correlated with newborn birth weight. Hence placental parameters serve as a good and easily comparable measurement for placental size and as a proxy measurement for the quality and efficiency of the placenta and thereby birth weight of newborn babies.

This study confirms an earlier observation by Lurie *et al*. that low fetal-placental weight ratio was associated with low foetal weight[19]. Heinonen *et al.*[20] in 2001 demonstrated that SGA infants show lower feto-placental weight ratios than normal weight infants. From this study it is clear that measurement of early placental parameters improves the ability to predict birth size. This may be helpful in earlier identification of at risk foetus and thus facilitate preparation for management at least in neonatal and childhood period. The gross placenta should be more fully assessed, as birth weights discordant with placental size and shape measures appear to have lasting impact.

Conclusion: The morphometry of placenta like weight, surface area and volume show significantly lower values in the SGA group than the normal birthweight group. Placental parameters are directly proportional to the birth weight of babies. The early measurements of placenta by non-invasive technique like ultrasonography will be helpful in early identification of at risk fetus and better management of such pregnancies. In conclusion, the measurement of placental parameters in all sonographic assessment of pregnancy may become a valuable additional tool to help increase our ability in predicting low birth weight infants. Because of this the placenta should be moved into the focus of research interest in future also.

References:

1. Park K. In: Textbook of Preventive and Social Medicine. 20th ed. Jabalpur: Banarsidas Bhanot Publishers. 2009: 460-61.
2. Roberts JM, Cooper DW. Preeclampsia trio. Pathogenesis and genetics of preeclampsia. The Lancet 2001; 357: 53-6.
3. Teasdale F. Gestational changes in the functional structure of the human placenta in relation to fetal growth: a morphometric study. Am J Obstet Gynecol. 1980; 137: 560-3.
4. Kouvalainen K, Pynnonen Al, Makarainen M, Peltonen T. Weights of placental membranes and umbilical cord. Duodecim. 1971; 87:1210-14.
5. Virupaxi RD, Potturi BR, Shirol VS, Desai SP, Hukkeri VB. Morphology of Placenta and its Relation with Small for Date Babies in 950 Live Births. Rec Res Sci Tech 2011, 3:123-126.
6. Das B, Dutta D, Chakraborthy S, Nath P. Placental morphology in hypertensive disorders of pregnancy and its correlation with fetal outcome. J Obstet Gynecol India 1996; 46 (1): 40-46.
7. Udainia A, Jain ML. Morphological study of placenta in pregnancy induced hypertension with its clinical relevance. J. Anat. Soc. India 2001; 50 (1) 24-27.
8. Younoszai MK, Howarth JC. Placental dimensions and relations in preterm, term and growth retarded infants. Am J Obstet Gynecol 1969; 103: 265-71.
9. Jaya DS, Kumar NS, Bai LS. Anthropometric indices, cord length and placental weight in newborns. Indian Pediatr. 1995; 32(11):1183-8.
10. Perry IJ, Beevers DG, Whincup PH, Bareford D. Predictor of ratio of placental weight to fetal weight in multiethnic community. BMJ 1995; 310: 436-39.
11. Wolf, Oosting H, Trefferspe. A longitudinal study of the relationship between placental

fetal growth measured by ultrasonography. Am J Obstet Gynecol 1989; 161: 1140-5.
12. Seth A, Tyagi S, Rath G, Gurg K. Intra-uterine growth retarded placenta a morphological study. J Anat Soc India 1992; 120: 49-52.
13. Thame M, Osmond C, Wilks R, Bennet FI. Second trimester placental volume and infant size at birth. Am J Obstet Gynecol 2001; 98: 279-83.
14. Clappe JH, Rizk KH. Appleby-Wineberg SK, Grass JR. Second trimester placental volume predicts birth weight at term. J Soc Gynecol Investig 1995; 2:19-22.
15. Kinare AS, Natekar AS, Chinchwadkar MC, Yajnik CS, Coyaji KJ, Fall CH,Howe DT. Low midpregnancy placental volume in rural Indian women: A cause for low birth weight? Am J Obstet Gynecol2000 Feb;182(2):443-8.
16. Bjoro K. Vascular anamolies of the umbilical cord. J Early Human Develop 1981; 8: 119-27.
17. Laurini R, Laurin J, Marskar K. Placenta in Pre-eclamptic toxemia. Acta Obstet Gynecol Scand 1994; 73: 529-34.
18. Little RE, Zadorozhnaja TD, Hulchiy OP, Mendel NA, Shkyryak-Nyzhnyk ZA, Chyslovska N, et al. Placental weight and its ratio to birthweight in a Ukrainian city. Early Hum Dev 2003; 71: 117-27.
19. Bonds DR, Gabbe SG, Kumar S, Taylor T. Fetal weight/placental weight ratio and perinatal outcome. Am J Obstet Gynecol 1984; 149: 195-200.
20. Lurie S, Feinstein M, Mamet Y, Human fetal-placental weight ratio in normal singleton near-term pregnancies, Gynecol Obstet Invest. 1999; 48:155-7.
21. Heinonen S, Taiplae P, Saarikoski S, Weights of placentae from small-for-gestational age infants revisited, Placenta 2001; 22:399-404.