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Original Research Article

Correlation of Placental Morphometry with Birth Weight and Gestational Age

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Abstract

Introduction: Placenta is the fundamental and the only organ between the mother and the fetus. It is flattened discoid mass having circular or oval in outline. Placenta and its morphometry play an essential role in the proper growth and survival of the developing fetus. ***Objective*:** To study the correlation between placental morphometry in Low birth weight and appropriate control with its gestational age. ***Materials and Methods***: It is a case-control study conducted in MES Medical College at Perinthalmanna, Kerala, India. Newborns with normal (>2.5 Kg) and low birth weight (<2.5kg), having 35-37 wks (Preterm) also, 37-42 wks, (term) of gestational age were included. In this study, 350 placentae were collected, immediately after the delivery, wash thoroughly, cleaned, and trimmed it for the morphometric analysis like shape, weight, maternal surface area, volume, thickness. ***Result*:** In this study, placental morphometry of low birth weight babies was comparatively lower than that of the normal birth weight babies. Parameters like weight, volume, and surface area of the placenta were calculated with gestational weeks, showed a positive and significant relationship with weight at birth and gestational age. ***Conclusion:*** The examination of the placenta can be helpful for the future postnatal life and resist early adulthood diseases of the neonates.

Keywords: NBW, LBW, PLACENTAL MORPHOMETRY, TERM, PRETERM.

INTRODUCTION

The placenta is an organ, which unites the developing fetus to the wall of the uterus, to transport nutrients, waste removal, and gas exchange through the mother's blood. The uniqueness of placental function is broadly recognized as having instantaneous significance for the outcome of gestation and, more recently, for promoting the life-long wellbeing of the offspring. It has an influential role and direct connection to the reduction of pregnancy complications, such as maternal, fetal, clinical disorders, and gestational age. Placental function, which in turn affects the welfare of the fetus and newborn [1,2]. Placental morphology, blood flow, and nutrient transport play an essential role in the growth pathway of the fetus[3]. During the delivery time, the weight of the baby is a reliable indicator of the neonate and mother. Baby with lower birth weight in fetal life increases the threat of death in the early months and years of the baby. However, some of the LBW babies are surviving, and some are more prone to impaired immune function and high risk of reduced IQ level, cognitive abilities, and adulthood diseases like diabetes, hypertension, and coronary artery disease (CAD) [4]. WHO defines the low birth weight babies as weight at birth less than 2,500 grams. In 2013, nearly 22 million newborns, projected 16 percent of all babies born globally that year, had low birth weight. Accurate monitoring of birth weight is challenging; as nearly half of the world's neonates are not weighed at birth[5].

Low birth weight is the dominating risk factor for infant morbidity and mortality of about 5 million death per year[6]. Deprived fetal growth has been linked with impaired ill-being in adult life; the hypothesis which examined and stated that low birth weight for gestation is associated with impaired postnatal somatic growth[7]. The placenta is the only organ that connects the two individual, mother, and fetus and an essential factor to generate a healthy baby.

The wellbeing of the baby depends on placental morphology and its good organization to transfer nutrients, gases, waste products, heat, hormones, and other regulatory molecules[8].

Very small or very early babies have an increased risk of mortality and morbidity in spite they are more superficially to have a range of morbidities, particularly neurological, respiratory, and gastrointestinal diseases. Therefore placental morphometry determines the fetal development and adulthood disease pattern[9]. Hence in the present study, the influence of placental weight, volume, surface area, and thickness were studied in different groups of birth weight by gestational age of the newborn babies in a subpopulation of Kerala. It is a well-known state for high health achievements. Major wellbeing indices are equivalent to those of developed countries[10]. Kerala has been reported to have a high proportion of LBW babies compared to other states in the developed countries[11]. This study intended to determine the proportion of LBW and the role of the placenta. Placental morphometry will help the protective factors associated with LBW and give better prenatal care for both mother and fetus.

MATERIALS AND METHODS

The present study was carried out at MES Medical College, Perinthalmanna. Placentae were obtained from 350 women from December 2014 to November 2017. Permission for the study was taken from the Institutional Ethics Committee. Written consent obtained from mothers. The data was regarding demographic and clinical parameters of the mother; the placenta and their offspring were recorded. Placenta was collected immediately after delivery, squeezed to evacuate the blood, and washed under running tap water; after that membrane was trimmed and wiped to drain excess fluid and maternal blood.

Inclusion criteria

Pregnant women aged between 18-40yrs, gestational age between 35-42wks delivered either by vaginal route or cesarean section were included.

Exclusion criteria

Maternal diseases affecting placentae like hypertensive disorders, diabetes mellitus, vascular diseases, maternal anemia, and other medical problems were excluded.

Grouping

In the current study, neonates are grouped as 35 to 37 wks. Preterm and 37 to 42 wks as a term. Gestational age was considered from the last menstrual period. According to the birth weight and gestational weeks, the neonates were grouped as preterm normal birth weight (NBW) & preterm Low birth weight (LBW) as well as term normal birth weight (NBW) & term low birth weight (LBW).

Measurement

The placenta weighed by cutting the umbilical cord at a distance of approximately 5cm from its site of insertion. The weight of placenta measured by using a digital baby weighing scale [12].

The placental volume is taken by the water displacement method. The surface area calculated by taking the mean value of the shortest and longest diameter of the placenta. The placental surface area was calculated by a formula [13].

Surface area = π x Dl x Ds / 4 (π = 3.14, Dl is the - long diameter of the placenta, Ds – Short diameter of placenta divided 4)

Placental thickness measured by inserting a needle 2cm away from margin and 1cm from the center, respectively. All the placental morphometric parameters were recorded with proper standard procedure.

STATISTICAL METHOD

The comparison of groups by using the one-way ANOVA. SPSS vol.21 and Minitab 17 were used for the statistical analysis. $P<0.05$ were measured as statistically significant.

RESULT

The analysis includes 350 placentae from 190 preterm and 160 term deliveries. They were further grouped according to the birth weight into LBW preterm (n= 143), LBW term (n= 32), NBW preterm (n= 47) and NBW term (n=128). A comparison of the placental morphometry among the groups was presented in Table 01. The weight, volume, thickness, surface area of the placenta showed a significant difference ($P<0.001$) in their comparison.

Table-I: Comparison of placental morphology among the preterm and terms babies having low and normal birth weight

Parameters	LBW-Preterm	LBW-Term	NBW-Preterm	NBW-Term	F Value	p Value
Gestational Age (Years)	35.71 ± 0.45	39.16 ± 1.25	35.49 ± 0.51	38.85 ± 0.97	509.05	<0.001**
Birth Weight (Kg)	2.2 ± 0.25	2.15 ± 0.24	2.87 ± 0.34	3.08 ± 0.39	204.06	<0.001**
Placental Weight (g)	353.31 ± 73.15	356.56 ± 51.54	417.79 ± 54.76	472.82 ± 66.92	78.43	<0.001**
Placental Volume (mL)	237.27 ± 60.37	256.91 ± 63.49	316.17 ± 52.06	419.88 ± 71.54	193.64	<0.001**
Placental Thickness (cm)	1.96 ± 0.29	2.26 ± 0.36	2.18 ± 0.28	2.72 ± 0.39	119.70	<0.001**
Placental Surface area (cm2)	167.13 ± 33.02	179.44 ± 35.16	174.34 ± 46.05	226.71 ± 41.16	59.74	<0.001**
Groups were compared using One Way ANOVA. All values are Mean ±Standard Deviation, LBW: Low Birth Weight, NBW: Normal Birth Weight, ** Significant at p<0.01. F: One Way ANOVA statistic.						

Table-02: Distribution of birth weight in male and female preterm and term babies.

Gestational Age	Preterm		Term	
Sex	Female (N=74)	Male (N=116)	Female (N=73)	Male(N=87)
Birthweight	2.38 ± 0.39	2.35 ± 0.41	2.85 ± 0.5	2.93± 0.54

Note: All values are mean ± Standard Deviation. Term: Gestational age of 37 or above weeks, Preterm: Gestational age of 36 or lower weeks

Another comparison of neonates was made, according to the birth weight with their gestational age and gender. Of these 350 cases classified as 74 females and 116 males were preterm, and 73 females and 87 males were term babies. The term male and female birth weight was higher when compared with preterm male and female. (Table 02 and figure 01).

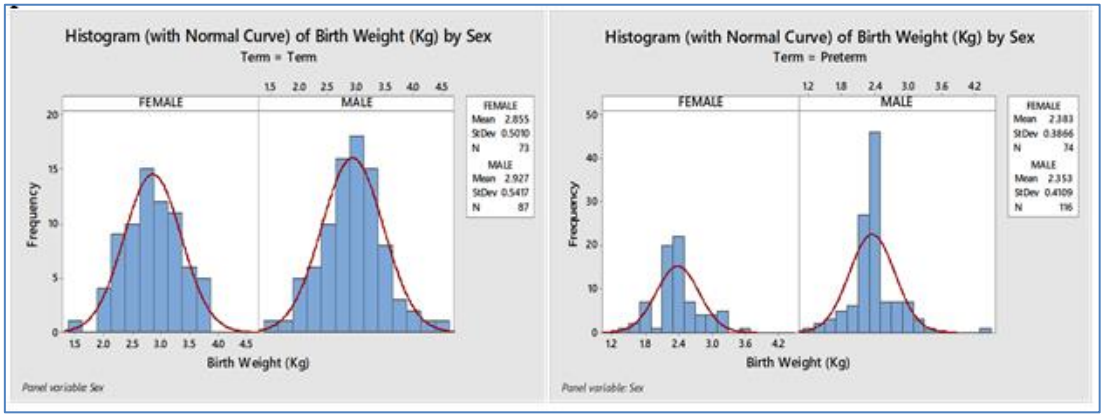


Fig-0I: Distribution of birth weight of male and female babies in (a) term and (b) preterm

Note: All values are mean ± Standard Deviation. Term: Gestational age of 37 or above weeks, Preterm: Gestational age of 36 or lower weeks

Table-03: Distribution of placenta morphometry of male and female babies in preterm and term

Placental Morphometry	Sex	Preterm	Term
Placental weight (g)	Female	369.19 ± 77.23	440.55 ± 78.44
	Male	369.3 ± 72.8	457.14± 79.14
Placental thickness(cm)	Female	2.02 ± 0.26	2.61± 0.39
	Male	2.01 ± 0.32	2.64 ± 0.45
Placental surface area (cm^2)	Female	171.37± 39	217.13 ± 44.59
	Male	167. 34±35.2	217.36 ± 44.13
Placental Volume	Female	255 ± .68	390 ± 93

Note: All values are mean ± Standard Deviation.Term: the Gestational age of 37 or More weeks, Preterm: Gestational age of 36 or less weeks.

Table 03 shows the morphometric analysis of the placenta with the gender and the gestational age. Significance difference (P<0.001) between term and the preterm placenta was observed. All morphometric measurements of placentae were consistently higher in the term in both sexes (Table 03, Fig 02).

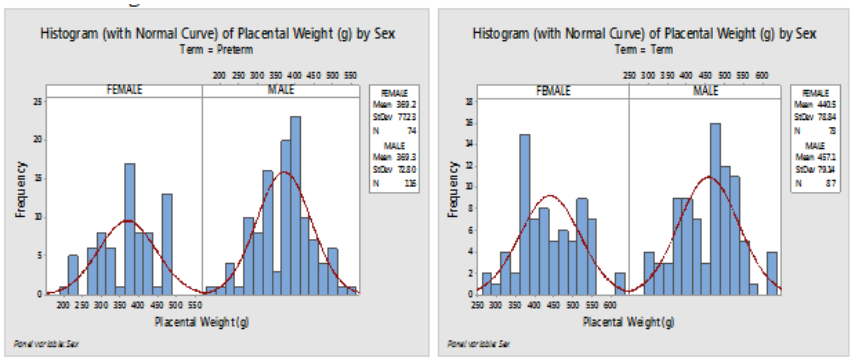
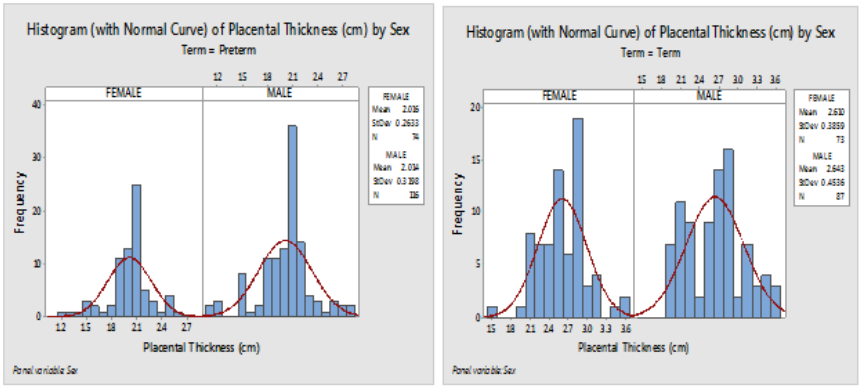
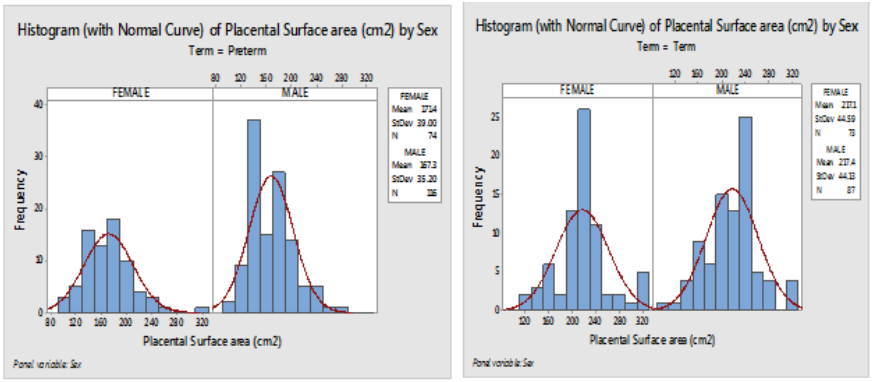


Fig-02: Distribution of placenta morphometry of male and female babies in preterm and term Placental weight

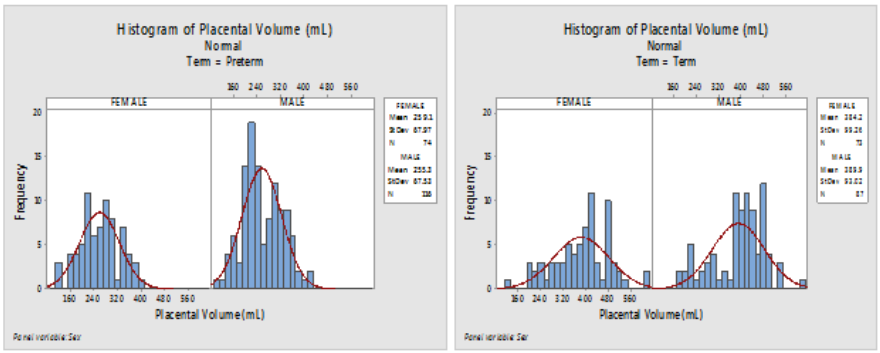
Placental Thickness



Placental surface area



Placental volume



StDev: Standard Deviation, N: Number of babies, Term: Gestational age of 37 or More weeks, Preterm: Gestational age of 36 or fewer weeks.

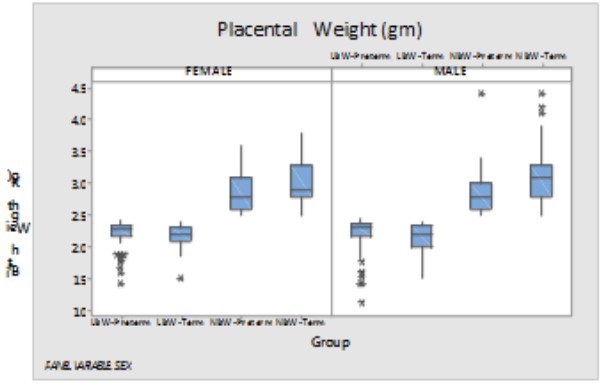


Fig-03: Box plot of placental weight by birth weight groups and sex
LBW: Low Birth Weight, NBW: Normal Birth Weight

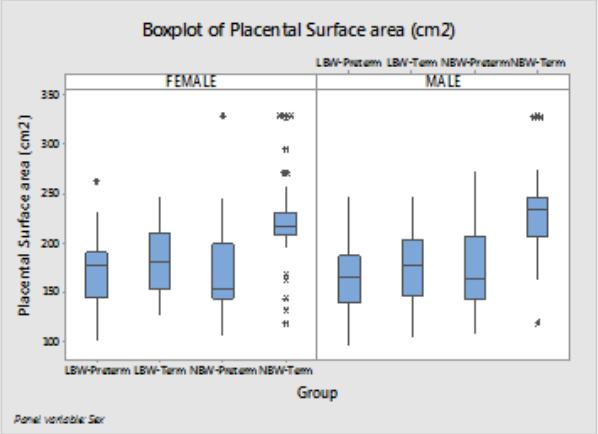


Fig-04: Box plot of the placental surface area by birth weight groups and sex.
LBW: Low Birth Weight, NBW: Normal Birth Weight

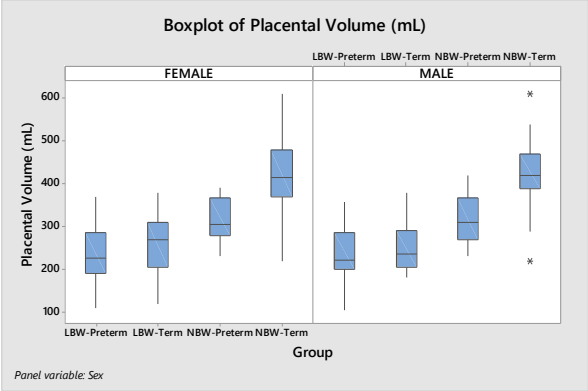


Fig-05: Box plot of placental volume by birth weight groups and sex.
LBW: Low Birth Weight, NBW: Normal Birth Weight

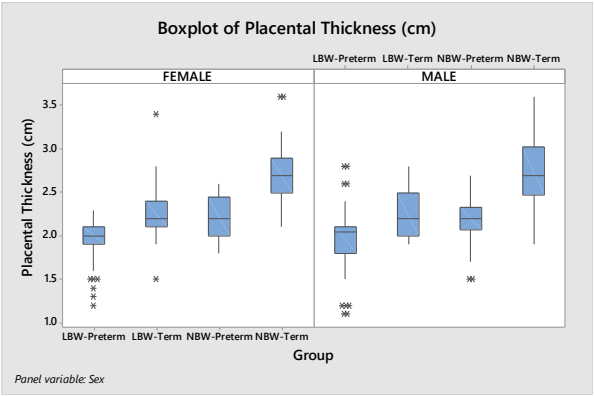


Fig-06: Box plot of placental thickness by birth weight groups and sex.
LBW: Low Birth Weight, NBW: Normal Birth Weight

DISCUSSION

This study confirms and expands earlier observations on birth weight and the placental morphometry. Placental morphometry varies with the dietary accessibility that leads to variation in placental weight, vascular development, and reduced antigenic growth factors. Placenta responds to exogenous insults and tries to adapt to the varying nutritional level of the mother. If this response of the placenta fails, it will affect fetal growth. The mean birth weight observed in this study was 2.2 ± 0.25 in LBW preterm and 2.15 ± 0.24 in LBW term, whereas NBW preterm was 2.87 ± 0.34 and 3.08 ± 0.39 in NBW term respectively.

Babies born with low birth weight face a higher risk of dying during their early months and years. Those who have impaired immune function and increased risk of diseases are likely to remain undernourished, with reduced muscle strength, throughout their lives and to suffer a higher incidence of diabetics and heart diseases. The mean ± SD of birth weight was different in male and female babies. Mean ± SD of birth weight was 2.35 ± 0.41 in male preterm and 2.93 ± 0.54 in term male, whereas in female preterm babies it was 2.38 ± 0.38 and 2.85 ± 0.5 in the term. This value of term babies was similar to the previous study conducted in the northern part of Kerala, by M K Money *et al*.[13]. Much study says birth weight was significantly associated with the gestational age.

The weight of the baby correlated significantly with the weight, volume, thickness, and surface area of the placenta, with the gestational age. It is established that an increase the weight of the placenta increases the weight of the baby, suggesting that increased gestational age tends to have bigger babies. The placental weight ranged between 353.31 ± 73.15 (LBW preterm) to 472.82 ± 66.92(NBW term). This value is the same as the previous study conducted by Rupa l Balihallimath *et al*. In 2011 Roseboom ET, *et al*. says that small placentae are associated with the small fetus[14] Many studies revealed that the mean placental weight varies in different areas according to their

ecological factors, nutritional status, and genetic factors.

Virupaxi RD *et al*. studied at Karnataka in South India stated that placental morphometric parameter, volume, and weight lower in early gestational age compared with the term normal group[15]. The average value of the placental volume of LBW is 237.27 ± 60.37 and 256.91 ± 63.49 in both preterm and term. While the volume of NBW is 316.17 ± 52.06 and 419.88 ± 71.54 in preterm and term, In the present study, we got a positive correlation of placental volume in low birth weight babies with normal in preterm and term.

Kowsalya. V, Vijayakumar R, *et al*. studied in Puducherry, suggested that there is a significant role in placental surface area and no. of cotyledons in LBW term and NBW term neonates[16]. In their studies, the surface area was 152 ± 37 sq cm in low birth weight babies and 241 ± 44 sq.cm in normal birth weight neonates. In the present study, the surface area was 167.13 ± 33.02 and 179.44 ± 35.16 in preterm, and term LBW, 174.34 ± 46.05 and 226.71 ± 41.16 was the value of the NBW babies in preterm and term babies.

Graham J. Burton and Abigail L. Fowden *et al*. [17] states that the placental thickness comes as 2.5 cm is the average normal; however, Burton *et al*. reported that the thickness range between 2 cm to 4 cm. In this study, the thickness range around 1.96 ± 0.29 and 2.26 ± 0.36 in LBW preterm and term. Whereas NBW, its range comes around and 2.18 ± 0.28 and 2.72 ± 0.39 in both pre-term and term.

CONCLUSION

This study revealed that augmentation of fetal weight could take place and balanced with the efficiency of the placenta. This study gives a band of clear evidence that the placenta is not just an impulsive perform between mother and fetus, but is capable of making available signals from the mother and insisting the requirement originating from the fetus. These necessities balanced by the morphometric parameters like weight, surface area, volume, of placenta have opened a positive and robust relationship with their gestational age and birth weight. So the morphometry of the placenta was excellent predictors of the birth weight and significant liability to the fetal progress. Recent research revealed that postnatal growth could modify in the utero by the observation of the placenta along with the fetus in the noninvasive techniques like ultrasonography, will support to predict and avoid the low birth weight neonates and stay away from the early adulthood diseases in their postnatal life. The eventual goal of doing research and placental assessment is to assure that; required babies are healthy babies for hale and hearty society.

REFERENCE

1. Sirpurkar, M., & Anjankar, V. P. (2015). Study of correlation between placental morphology and adverse perinatal outcome in different conditions affecting pregnancy. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, *4*(4), 1166.
2. Latendresse, G., & Founds, S. (2015). The Fascinating and Complex Role of the Placenta in Pregnancy and Fetal Well-being. *Journal of midwifery & women's health*, *60*(4), 360-370.
3. Balihallimath, R. L., Shirol, V. S., Gan, A. M., Tyagi, N. K., & Bandankar, M. R. (2013). Placental morphometry determines the birth weight. *Journal of Clinical and Diagnostic Research: JCDR*, *7*(11), 2428.
4. Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., De Onis, M., Ezzati, M., ... & Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. *The lancet*, *371*(9608), 243-260.
5. Sharma, D., Sharma, P., & Shastri, S. (2017). Genetic, metabolic and endocrine aspect of intrauterine growth restriction: an update. *The Journal of Maternal-Fetal & Neonatal Medicine*, *30*(19), 2263-2275.
6. Borle, R. M. (2014). *Textbook of oral and maxillofacial surgery*. JP Medical Ltd.
7. Dezateux, C., Lum, S., Hoo, A. F., Hawdon, J., Costeloe, K., & Stocks, J. (2004). Low birth weight for gestation and airway function in infancy: exploring the fetal origins hypothesis. *Thorax*, *59*(1), 60-66.
8. Power, M. L., Schulkin, J. (2012). The evolution of the human placenta. JHU Press, Oct 1.
9. Katz, J., Lee, A. C., Kozuki, N., Lawn, J. E., Cousens, S., Blencowe, H., ... & Adair, L. (2013). Mortality risk in preterm and small-for-gestational-age infants in low-income and middle-income countries: a pooled country analysis. *The Lancet*, *382*(9890), 417-425.
10. Raghunath, D., Kujur, A., Dixit, S., Sabnani, S., Yadav, S., & Saroshe, S. (2016). Multivariate Analysis of the Factors affecting Low Birth Weight-A Case-Control Study in a Tertiary hospital of Central India. *Annals of Community Health*, *4*(3), 18-24.
11. Radhakrishnan, T., Thankappan, K. R., Vasan, R. S., & Sarma, P. S. (2000). Socioeconomic and demographic factors associated with birth weight: a community based study in Kerala. *Indian pediatrics*, *37*(8), 872-875.
12. Lawn, J. E., Blencowe, H., Oza, S., You, D., Lee, A. C., Waiswa, P., ... & Mathers, C. (2014). Every Newborn: progress, priorities, and potential beyond survival. *The Lancet*, *384*(9938), 189-205.
13. Money, M. K., Katherine, T. E., Sreevishnu, S., & Sujith, E. U. (2017). Rate of caesarean section in a rural community of North Kerala: A cross-

sectional study. *The Journal of Community Health Management*, *4*(2), 63-69.

14. Roseboom, T. J., Painter, R. C., van Abeelen, A. F., Veenendaal, M. V., & de Rooij, S. R. (2011). Hungry in the womb: what are the consequences? Lessons from the Dutch famine. *Maturitas*, *70*(2), 141-145.
17. Virupaxi, R. D., Potturi, B. R., & Shirol, V. S. (2011). Morphology of placenta and its relation with small for date babies in 950 Live births. *Recent Research in Science and technology*, *3*(2).
18. Kowsalya, V., Vijayakumar, R., Valli, G., Bharath, K. P., Srikumar, R., & Kishor Kumar, C. (2013). Morphometry examination of placenta in birth weight of full-term newborns in Puducherry, India. *Pakistan J. Biol. Sci*, *16*, 895-897.
19. Burton, G. J., Sebire, N. J., Myatt, L., Tannetta, D., Wang, Y. L., Sadovsky, Y., ... & Redman, C. W. (2014). Optimising sample collection for placental research. *Placenta*, *35*(1), 9-22.