<u>Original research article</u>

DETERMINANTS OF PLACENTA VARIATIONS: LOW BIRTH WEIGHT BABIES V/S NORMAL BIRTH WEIGHT BABIES

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Abstract

The low birth weight babies are susceptible to hypoxia, fetal distress, long term handicap and fetal death and are at increased risk for perinatal morbidity and mortality. There is a proven direct relationship between socioeconomic status, maternal health, placental growth, fetal well-being and finally fetal outcome; fetal outcome being the best predictor of health status of the society.

For the study, 60 discarded placenta and umbilical cord were collected at random from deliveries (both vaginal and caesarian). Thirty out of the sixty placentae were from controls (birth weight ≥ 2500gms) and thirty from low birth weight deliveries (birth weight <2500gms).

Maternal factors like age, low socioeconomic status, educational status, haemoglobin level were significantly associated with low birth weight. The study also showed that approximate birth weight can be calculated with the level of maternal haemoglobin.

Keywords: Placenta, hemoglobin, birth weight

Introduction

Only eutherian mammals possess placenta. The human placenta is discoid, because of its shape; haemochorial, because of direct contact of the chorion with the maternal blood and deciduate because some maternal tissue is shed at parturition. The placenta is attached to the uterine wall and establishes connection between the mother and foetus through the umbilical cord. The fact that maternal and fetal tissues come in direct contact without rejection suggest immunological acceptance of the fetal graft by the mother [1].

In the first trimester, growth of the placenta is more rapid than of the foetus, but by 17 weeks, placental and fetal weights are approximately equal. It occupies 30% of uterine wall. At term the placental weight is approximately 1/6th of the fetal weight. The term placenta is a flattened discoidal mass with an circular or oval outline, and presents after separation from the uterine wall fetal and maternal surfaces and peripheral margin [2].

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Placenta is covered internally by the amniotic membrane, chorion plate and externally by the basal plate and the intervillous space lies between these two plates. The umbilical cord is attached to the chorionic plate.

World Health organization (WHO) has defined low birth weight (LBW) as one whose birth weight is less than 2500 gm, irrespective of the gestational age. Very low birth weight (VLBW) infants weigh less than 1500 gm and extremely low birth infants weigh 1000 gm or less than 1000 gm [3].

Low birth weight is an important indicator of reproductive health and general health status of population. Low birth weight is considered as the single most important predictor of infant mortality. The prevalence of low birth weight in India was found to be 26%. Health education, socio-economic development, maternal nutrition and increasing use of health services during pregnancy are all important for reducing low birth weight [4]. Socio-economic status classification is considered according to updated Prasad's socio economic status classification for 2013 [5].

'Placenta' or the 'After birth' begins to meet the demands of the embryo as early as from the third week of intrauterine life, even before the mother is aware of her pregnancy. The placenta is the accurate record of the infant's perinatal experiences. The human placenta is the functional centre of the maternal fetal system and is responsible for respiratory, nutritional, excretory, endocrine and immunological functions [6, 7].

Low birth weight infants showed more frequently signs of perinatal compromise (Abnormal amniotic fluid volume, non reassuring patterns of fetal heart rate, malformation, lower Apgar scores and lower gestational age at birth) and were associated with a greater risk of cesarean delivery [8].

In accordance with data from Dolan *et al*, Low birth weight was found to be associated with congenital malformation, as low birth weight infants were three times at risk of presenting it [9].

NFHS 3 confirms that the proportion of births with a low birth weight is lesser among children born to older women (age at birth >=20 years) as also families with higher wealth quintiles [10].

Methodology
- Placenta of low birth weight deliveries and normal birth weight deliveries (Both vaginal and caesarian) was collected.
- Relevant data from the mothers (By history and case records) was collected
- Newborn data from newborn assessment record was collected

Inclusion criteria
- Placenta of low birth weight deliveries and birth weight ≥ 2500gm (Both vaginal and caesarian) was collected.
- For the purpose of study, low birth weight babies are considered whose birth weight is less than 2500 gms.

Exclusion criteria
- Deliveries before the period of viability are excluded.
- Placentas of Intrauterine death of foetus before the period of viability are excluded.
- Multiple pregnancies (Twins, triplets) are excluded.

- Mothers with type 1 diabetes mellitus, with combined diabetes and hypertension, positive VDRL were excluded from the study.

Test

Independent sample t- test / unpaired t-test

The cases were studied dividing into two experimental groups.

- Group A – 30 placentae from deliveries of birth weight ≥ 2500gm
- Group B – 30 placentae from low birth weight deliveries (<2500gm).

Results

Majority of the mothers of the group A as well as group B were in the age group of 21-25, about 21 (70%) cases each. About 7 (23.33%) cases of group A and 2 (3.33%) cases of group B were in the age group of 26-30 years of age and 2 (3.33%) cases of group A and 7 (23.33%) cases of group B were below the age of 20 years.

Table 1: Age distribution of the study groups

Parameters		Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		Total	
		No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
Maternal age in years	≤ 20	2	3.33	7	23.33	9	15
	21 - 25	21	70	21	70	42	70
	26 - 30	7	23.33	2	3.33	9	15

In Group A, 29 (96.66%) mothers belonged to above poverty line group and 1(3.33%) was below poverty line. Majority of the mothers of Group B, about 19 (63.33%) were below poverty line and 11 (36.66%) belonged to above poverty line group.

Table 2: Socioeconomic status of the study groups

Parameters		Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		Total	
		No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
Socioeconomic status	Below poverty line	1	3.33	19	63.33	20	33.33
	Above poverty line	29	96.66	11	36.66	40	66.66

The educational status of majority of mothers of group A, about 29 (96.66%) was SSLC and above and one (3.33%) was below SSLC whereas in group B about 17 (56.66%) were below SSLC and 13 (43.33%) mothers were SSLC and above.

Table 3: Educational status of the study groups

Parameters		Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		Total	
		No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
Educational Status	SSLC & Above	29	96.66	13	43.33	46	76.66
	Below SSLC	1	3.33	17	56.66	14	23.33

In group A, about 20 (66.66%) were primigravidae and 10 (33.33%) multigravidae. In group B, 17 (56.66%) were primigravidae and 13 (43.33%) were multigravidae.

Table 4: Parity index of the study groups

Parameters		Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		Total	
		No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
Parity index	Primigravida	20	66.66	17	56.66	37	61.66
	Multigravida	10	33.33	13	43.33	23	38.33

The BMI of majority of the mothers was between 18.5 to 24.9 kg/mt^2, about 28 (93.3%) in group A and 20(66.7%) in group B. The BMI of 10 (33.33%) mothers of group B was below 18.5 kg/mt^2.

Table 5: Maternal BMI of the study groups

Parameters		Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		Total	
		No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
Maternal BMI (kg/mt^2)	< 18.5	0	0	10	33.33	10	33.33
	18.5 to 24.9	28	93.3	20	66.7	48	80
	25 to 29	2	6.7	0	0	2	3.33

The maternal haemoglobin level at the time of delivery was between 10-11 g% in 2 (6.66%) mothers of group A and 17 (56.66%) mothers of group B. About 28 (93.3%) mothers had haemoglobin level more than 11 g% in group A and one (3.33%) mother in group B. Maternal haemoglobin level was below 10 g% in 12 (40%) mothers of group B.

Table 6: Maternal haemoglobin level of the study groups

Parameters		Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		Total	
		No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
Level of haemoglobin (g%)	< 10 g%	0	0	12	40	12	20
	10 -11 g%	2	6.66	17	56.66	19	31.66
	>11 g%	28	93.3	1	3.33	29	48.33

Table 7: Comparison of mean of various variables

Variable	Group A (Placentas of normal birth weight)		Group B (Placentas of low birth weight < 2500g)		p Value
	Mean	SD	Mean	SD	
Maternal age	23.93	2.27	22.7	2.82	0.067[*]
Birth weight	2963.33	230.04	1991.67	383.07	<0.001[**]
Placental weight	479.85	32.37	385.10	59.86	<0.001[**]
Placental volume	448.50	41.21	370.17	48.95	<0.001[**]
Placental diameter	18.88	0.95	16.67	2.13	<0.001[**]
Placental thickness	1.82	0.25	1.75	0.30	<0.001[**]
Maternal lobes	25	3	19	4	<0.001[**]
Placental coefficient	0.162	0.011	0.197	0.028	<0.001[**]
Feto-placental ratio	6.19	0.43	5.17	0.76	<0.001[**]
Body mass index	22.81	1.2	19.86	1.6	<0.001[**]

**significant *non-significant

There was no significant difference in maternal age among the normal and low birth weight groups. The mean maternal age in normal birth weight group (Group A) was 23.93 yrs whereas in low birth weight group (Group B) was 22.7.The p value was not significant(p =0.067)

There was significant difference in birth weight among normal and low birth weight group. The mean birth weight in normal birth weight group (Group A) was 2963.33g whereas in low birth weight group (Group B) was 1991.67g. The difference between the two groups was statistically significant ($p<0.001$)

The mean placental weight in group A was 479.85grams whereas in group B, mean placental weight was 385.10 grams. The difference between two groups was statistically significant ($p<0.001$).

The mean placental volume in group A was 448.50 ml whereas in group B, mean

placental volume was 370.17 ml. The difference between two groups was statistically significant ($p<0.001$)

The difference between the mean placental diameter & placental thickness in group A and group B was statistically significant ($p<0.001$). Mean maternal lobes of placentae in each group. The mean maternal lobes in group A were 25 whereas in group B, mean maternal lobes were 19. The difference between two groups was statistically significant ($p<0.001$)

Placental Ratio is the ratio of placental weight to fetal weight. Mean placental co-efficient in each group. The mean placental co-efficient in group A was 0.162 whereas in group B, mean placental co-efficient was 0.197. The difference between two groups was statistically significant ($p<0.001$)

Feto-placental ratio is the ratio of fetal weight to placental weight. The mean feto-placental ratio in group A was 6.19 whereas in group B, mean feto-placental ratio was 5.17. The difference between two groups was statistically significant ($p<0.001$)

The mean BMI in group A was 22.81 and in group B was 19.86. The difference between two groups was statistically significant ($p<0.001$)

The mean maternal lobes in group A was 25 and in group B was 19. The difference between two groups was statistically significant ($p<0.001$)

Table 8: Correlation co-efficient of different parameters of the total group (n=60)

| Parameters	Correlation co-efficient (r)	p Value
Birth weight & Placental weight	0.861	< 0.001[**]
Placental volume and Haemoglobin	0.765	< 0.001[**]
Placental weight and Haemoglobin	0.798	< 0.001[**]
Haemoglobin and Birth weight	0.915	< 0.001[**]
Birth weight and maternal lobes	0.568	< 0.001[**]
Birth weight and body mass index	0.819	< 0.001[**]

**significant
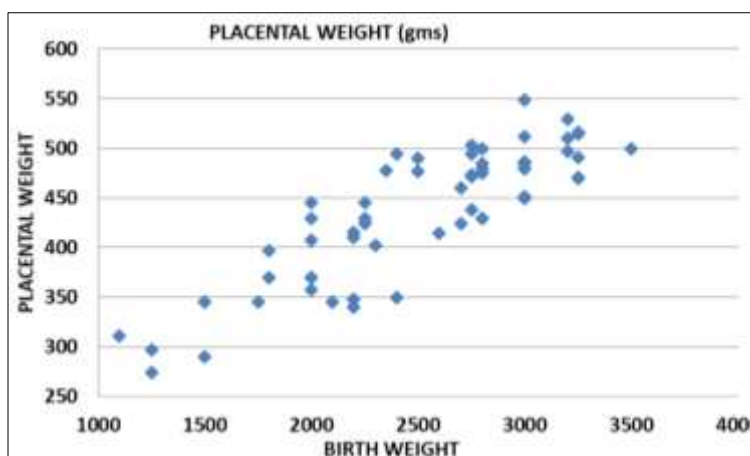
Graph 1: Scatter graph showing the relationship between birth weight & placental weight
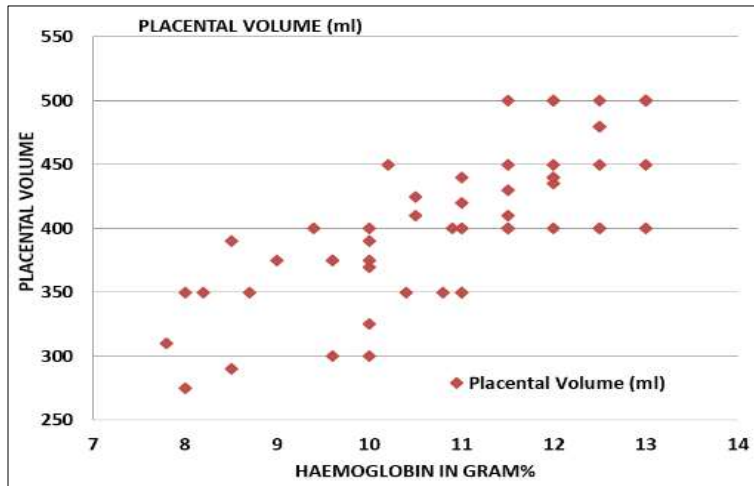
Graph 2: Scatter graph showing the relationship between haemoglobin level & placental volume
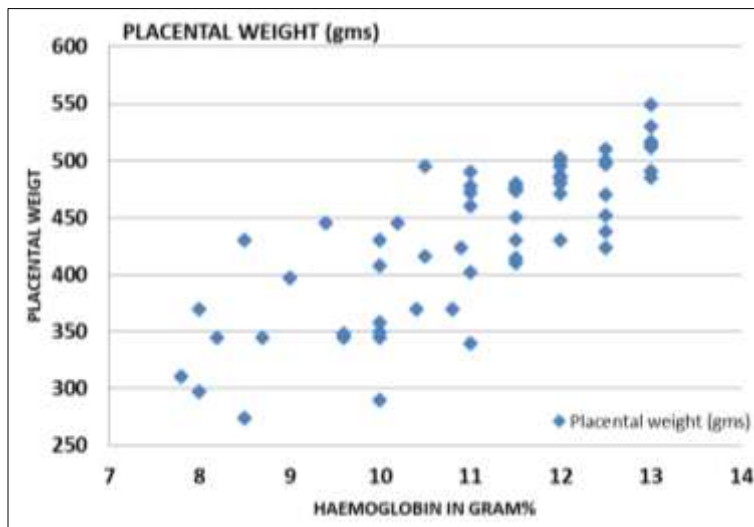
Graph 3: Scatter graph showing the relationship between haemoglobin level & placental weight
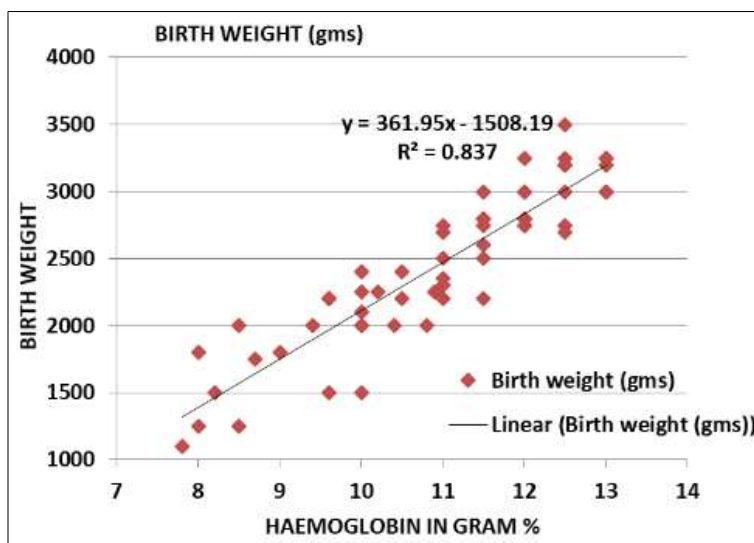
Graph 4: Scatter graph showing the relationship between maternal haemoglobin level & birth weight

As depicted in the graph 4, the approximate birth weight can be calculated by the level of maternal haemoglobin,

To predict birth weight, the equation is given by,

y=a+bx where,

a = constant,

b= co-efficient of x,

x= haemoglobin level

Correlation coefficient $r^2 = 0.837$ $p< 0.001$ (significant)

y= 361.952x - 1508.196

Discussion

In the present study about 23.33% of the mothers of low birth weight babies were less than 20 years of age.

A study by M Sharma *et al* on 193 neonates showed that the proportion of LBW was comparatively higher among babies born to mothers who were below 20 years of age (50.0%) [11].

A hospital based cross sectional study among 325 women delivering live infants by Agarwal *et al* found that the highest prevalence of LBW was among mothers aged <18 years (42.86%) [12].

M. Benjamin Sagayaraj *et al*., carried out a prospective study on 100 low birth weight babies which showed that the maternal age less than 20 and above 35 years as compared to 20 to 35 years confers a significant risk (9.09% v/s 6.41%) for low birth weight baby mortality ($p< 0.05$) [13].

The present study showed about 63.33% of mothers of low birth weight newborns belonged to lower socio-economic group.

Low Birth Weight (LBW) is a sensitive indicator of the socio-economic conditions and indirectly measures the health of the mother and the child.

A study by AK Jawarkar *et al*. showed that mother from poorest socio-economic strata (Class V) had 23 times higher odds of giving birth to low birth weight baby than one who belongs to upper socio-economic strata (Class I) [14].

Prevalence of delivering LBW among women with high socioeconomic status was low. The women with high socioeconomic status have better nutrition, good environmental condition and have better care than women with poor socioeconomic status.

In the present study the educational status of 56.66% of mothers of low birth weight babies was SSLC and below.

Maternal age, education, and socioeconomic status were found to be significant factors associated with the birth weight of the newborn.

In a hospital based case control study done by Deshpande Jayant D with 200 cases of low birth weight mothers and 200 controls of age 18–35 years who delivered a live-born singleton baby, the percentage of illiterate and primary education was more in cases (35.5%) as compared to control group (24.5%) [15].

A hospital based cross sectional study among 325 women delivering live infants by Agarwal *et al* found that 52.39% of the mothers were illiterate [12].

In the present study among the mothers of low birth weight babies, 56.66% were primigravidae and 43.33% were multigravidae.

A hospital based cross sectional study among 325 women delivering live infants by Agarwal *et al* found that low birth weight among Primiparous mothers was found to be (42.86%) and in parity of >5 (23.80%) [12].

In the study by Kaushal SK *et al*, it was seen that the percentage of low birth weight increased with an increase in parity. Primipara mothers were comparatively at lower risk (38.06%) of delivering LBW babies as compared to multiparous mothers (61.94%) [16].

The present study showed that the BMI of 33.33% mothers of low birth weight babies was below 18.5 kg/m^2.

A study by Naidu AN and Rao NP reported the odds ratio for LBW among Indian mothers to be three times more in severe chronically energy deficient (CED) low BMI groups when compared to normal BMI groups [17].

Study by Joshi H S *et al*., on 256 newborns showed that there is significant association between BMI of mother and LBW ($\chi2=17.57$, $p<0.001$) [18].

According to a study by R. Sultan *et al*. on 180 low birth weight babies, Lower maternal BMI showed higher risk to have LBW infants [19].

In the present study the maternal haemoglobin level at the time of delivery was between 10-11 g % in 6.66% mothers of group A and 56.66% mothers of group B. About 93.3% and 3.33% of mothers had haemoglobin level more than 11 g % in group A and group B respectively. Maternal haemoglobin level was below 10 g % in 40% of mothers of group B.

Anaemia is an important risk factor for utero placental insufficiency and is associated with late abortions, prematurity, low birth weight and stillbirths the sum effect of which is increased perinatal loss. It is also reported to be associated with cognitive and affective dysfunction in the infants.

Sharma S.R *et al* found mother's level of haemoglobin to be associated with LBW (93% of 155 cases) [20]. Lower concentration of maternal haemoglobin is one of the risk factors for LBW among children.

Conclusion

- Present study showed low birth weight was more common among primigravidae than multigravidae though it was statistically insignificant. (p Value = 0.232)
- Higher percentage of low birth weight was also noticed among mothers with BMI values lower than 18.5 kg/m^2 which was statistically significant. (p Value <0.001)
- Maternal haemoglobin level was significantly lower in mothers of low birth weight newborns than mothers of normal birth weight newborns. (p Value <0.001)

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