

Original Article**Ratio of Placenta to Birth Weight in Anemic and Non-Anemic Mothers**Sanzida Khatun^{*1}, Diwakar Kumar Shah¹, Nischal Shrestha², Ashis Kumar Yadav²¹Department of Anatomy, Nobel Medical College Teaching Hospital, Biratnagar, Nepal,²Department of Obstetrics and Gynaecology, Nobel Medical College Teaching Hospital, Biratnagar, NepalArticle Received: 30th December, 2021; Accepted: 15th April, 2022; Published: 30th June, 2022DOI: <https://doi.org/10.3126/jonmc.v11i1.46065>**Abstract****Background**

The placenta is a uterine organ in pregnancy which facilitates exchange of materials between maternal and fetal circulation. Decreased maternal hemoglobin decreases oxygen supplementation to fetus among anemic mothers which may cause low birth weight. The aim of this study was to compare the ratio of placenta to birth weight among anemic and non-anemic mothers.

Materials and Methods

A comparative cross-sectional study was conducted in 82 anemic pregnancies and 203 non-anemic pregnancies in Department of Obstetrics & Gynecology, Nobel Medical College Teaching Hospital, Biratnagar. Participants with haemoglobin concentration lower than 11 g/dl were included in anemic group and 11g/dl or more in non-anemic group. The difference of means of placental weight, birth weight and placenta to birth weight ratio in anemic and non-anemic groups was determined by Student's t-test.


Results

In anemic group, mean placental weight was 578.78±141.80 g, mean birth weight was 2973.17±680.97 g and mean placenta to birth weight ratio was 0.20±0.05. In non-anemic group, mean placental weight was 575.96±128.88 g, mean birth weight was 3125.91±590.89 g and mean placenta to birth weight ratio was 0.19±0.05. Significant difference was observed in means of placenta to birth ratio in anemic and non-anemic groups (p-value 0.05).

Conclusion

Mean placental weight and mean ratio of placenta to birth weight was higher in pregnant women with anemia than in non-anemic pregnant women and significant difference was observed in means of placenta to birth ratio between anemic and non-anemic groups.

Keywords: Anemia, Birth weight, Neonate, Placenta, Pregnancy

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Introduction

The placenta is a discoid organ that develops in the uterus during pregnancy which facilitates exchange of oxygen, nutrients and waste products between physically separate maternal and fetal circulation. It also produces hormones that regulate both maternal and fetal physiology during pregnancy [1]. At term, the placenta diameter varies from 200 to 220 mm, the mean placental weight is 470 g, its mean thickness is 25 mm and the total villous surface area is 12-14 m² [2]. The ratio of placenta and birth weight has been reported as 1:6 [1].

Systemic illnesses during pregnancy are known to have effects on many organs of the body including placenta. According to WHO, anemia in pregnancy exists if maternal Hemoglobin (Hb) concentration is lower than 11 g/dl. Anemia in pregnancy is prevalent worldwide and its prevalence ranges from 35% to 100 % in different developing countries of the world [3]. In Nepal, studies reveal that the prevalence of anemia in pregnancy ranges from 45% to 66% [4,5]. Maternal Hb concentration affects the growth and size of the placenta. Decreased maternal Hb concentration induces placental hypertrophy and hyperplasia in an attempt to overcome the fetal requirement which frequently increases the placental weight among anemic mothers [6]. Similarly, fetal growth and development depends on the availability of oxygen and nutrients from placenta. Thus, decreased oxygen supplementation to the fetus among anemic mothers may cause low birth weight [7].

Anatomic examination of placenta, before its disposal, has been acknowledged to be beneficial for numerous purposes. The information achieved can be valuable to be aware of the well-being of the mother and the neonate. It can be utilized to provide early intervention to rectify the underlying cause. The aim of this study was to compare the ratio of placenta to birth weight among anemic and non-anemic mothers.

Materials and Methods

A comparative cross-sectional study was conducted in In-patient Department of Obstetrics & Gynecology, Nobel Medical College Teaching Hospital, Biratnagar from November, 2020 to October, 2021. The ethical clearance letter was received from Institutional Research Committee (IRC-NMCTH) of the institution prior to the study. The informed consent was signed by the participants before acquiring data. The participants included mothers who had singleton deliveries at term. The pregnant women of age group 18 to 40 years were included in this study as this age

group represented the general population of pregnant women presenting to department of obstetrics and gynecology of Nobel Medical College Teaching Hospital, Biratnagar. Retained or morbidly adherent placenta and multiple pregnancies were excluded from the study. The minimum sample size obtained using sample size calculation formula for testing difference of two proportions (taking 31.2% prevalence of low birth weight [8] among deliveries from anemic mothers as p_1 and 9.4% prevalence of low birth weight [8] in non-anemic mothers as p_2) was 54 for each group. The study was, however, conducted in 82 anemic pregnancies and 203 non-anemic pregnancies. Participants with Hb concentration lower than 11 g/dl in labour were included in anemic group and Hb concentration of 11g/dl or more were included in non-anemic group.

The placentas were collected immediately following the delivery, thoroughly washed with tap water and the surfaces were dried by gently pressing with blotting paper. The membranes were removed and the umbilical cord was sectioned close to the site of placental insertion. Then the weight of placenta was measured in grams with the help of an electronic digital weighing machine. The weights of the neonates were also measured in grams with the same weighing machine immediately after delivery. Variables recorded were maternal age, maternal Hb concentration in labour, gestational age in weeks, gender of the newborn, birth weight and placental weight. The ratio of placenta to birth weight was derived by dividing the placental weight and birth weight.

The data analysis was done using statistical package for social sciences (SPSS) 16 software. Student's t-test (Independent samples t-test) was run to determine the difference of means of placental weight, birth weight and placenta to birth weight ratio in anemic and non-anemic groups.

Results

In this study, the total number of participants was 285 and the age of participants ranged from 18 to 40 years with the mean of 26±5 years. The placental weight ranged from 250 g to 1200 g with the mean of 576.77±132.48 g. The birth weight ranged from 1000 g to 4700 g with the mean of 3081.96±620.80 g. The mean ratio of placenta to birth weight was 0.19±0.05 with a range of 0.10 to 0.44.

Out of total participants, 82 (28.8%) were anemic whereas, 203 (71.2%) were non-anemic. Table 1 demonstrates the distribution of mean maternal



age and mean maternal Hb concentration among anemic and non-anemic mothers. The mean Hb concentration of anemic group was 9.99 ± 0.93 g/dl and that of non-anemic group was 12.15 ± 0.85 g/dl. Table 2 demonstrates mean placental weight, mean birth weight and mean placenta to birth weight ratio among anemic and non-anemic groups. Significant difference* was observed in means of placenta to birth ratio in anemic and non-anemic groups (p-value 0.05*).

Table 1: Mean maternal age and mean maternal Hb concentration in anemic and non-anemic groups

	Anemic group	Non-anemic group	Total
Frequency (Percentage)	82(28.8%)	203(71.2%)	285(100%)
Mean Maternal Age \pm S.D. (years)	26 \pm 5	26 \pm 5	26 \pm 5
Mean maternal Hb \pm S.D. (g/dl)	9.99 \pm 0.93	12.15 \pm 0.85	11.53 \pm 1.38

Table 2: Means of placenta weight, birth weight and placenta to birth weight ratio (PBWR) in anemic and non-anemic groups

	Anemic group	Non-anemic group	p-value
Placental Weight (g)	578.78 \pm 141.80	575.96 \pm 128.88	0.87
Birth Weight (g)	2973.17 \pm 680.97	3125.91 \pm 590.89	0.78
PBWR	0.20 \pm 0.05	0.19 \pm 0.05	0.05*

Table 3: Means of placenta weight, birth weight and placenta to birth weight ratio (PBWR) in male and female newborns

	Male	Female	p-value
Placental Weight (g)	590.49(\pm 138.59)	558.44(\pm 122.01)	0.039**
Birth Weight (g)	3130.12(\pm 603.76)	3017.62(\pm 639.70)	0.134
PBWR	0.193(\pm 0.048)	0.191(\pm 0.049)	0.769

Table 4: Means of placenta weight, birth weight and placenta to birth weight ratio (PBWR) of male and female newborns in anemic and non-anemic groups

		Anemic group	Non-anemic group
Placenta Weight (g)	Male	595.56(\pm 149.50)	587.98(\pm 133.51)
	Female	546.43(\pm 121.66)	562.02(\pm 122.53)
Birth Weight (g)	Male	3062.04(\pm 620.25)	3163.85(\pm 595.43)
	Female	2801.79(\pm 767.93)	3081.91(\pm 585.66)
PBWR	Male	0.198(\pm 0.041)	0.191(\pm 0.051)
	Female	0.209(\pm 0.072)	0.186(\pm 0.039)

Among the total newborns, there were 163 (57.2%) males and 122 (42.8%) females. In the anemic group, there were 54 (65.9%) male and 28 (34.1%) female newborns. In the non-anemic

group, there were 109 (53.7%) male and 93 (46.3%) female newborns. Table 3 demonstrates distribution of mean placenta weight, mean birth weight and mean placenta to birth weight ratio according to the gender of the newborn in total study population. Significant difference** was observed in means of placenta weight in male and female newborns (p-value 0.039**). Table 4 demonstrates gender wise distribution of mean placenta weight, mean birth weight and mean placenta to birth weight ratio in anemic and non-anemic groups.

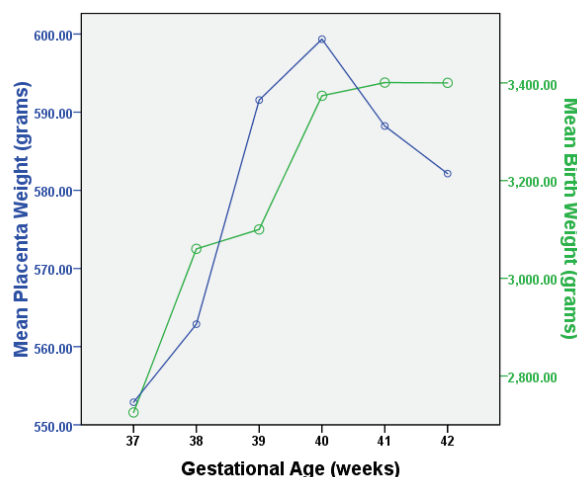


Figure 1: Mean placenta weight and mean birth weight by gestation

Table 5: Means of placenta weight, birth weight and placenta to birth weight ratio (PBWR) by gestational age in anemic and non-anemic groups

Gestational Age N (%)		Anemic group	Non-Anemic group
37 weeks N=71 (24.9%)	Placenta Weight (g)	525.00(\pm 132.29)	563.82(\pm 147.40)
	Birth Weight (g)	2352.50(\pm 609.89)	2871.57(\pm 765.59)
	PBWR	0.232(\pm 0.063)	0.203(\pm 0.049)
38 weeks N=59 (20.7%)	Placenta Weight (g)	550.67(\pm 104.91)	567.05(\pm 105.62)
	Birth Weight (g)	2890.00(\pm 810.91)	3118.18(\pm 528.28)
	PBWR	0.202(\pm 0.053)	0.185(\pm 0.043)
39 weeks N=71 (24.9%)	Placenta Weight (g)	625.00(\pm 135.83)	572.22(\pm 120.39)
	Birth Weight (g)	3076.92(\pm 384.51)	3113.33(\pm 427.12)
	PBWR	0.205(\pm 0.046)	0.187(\pm 0.053)
40 weeks N=53 (18.6%)	Placenta Weight (g)	609.09(\pm 192.12)	596.79(\pm 138.30)
	Birth Weight (g)	3540.91(\pm 545.35)	3329.76(\pm 447.09)
	PBWR	0.170(\pm 0.033)	0.180(\pm 0.037)
41 weeks N=17 (6.0%)	Placenta Weight (g)	591.67(\pm 128.13)	586.36(\pm 138.01)
	Birth Weight (g)	3408.33(\pm 349.88)	3396.36(\pm 720.66)
	PBWR	0.174(\pm 0.033)	0.177(\pm 0.048)
42 weeks N=14 (4.9%)	Placenta Weight (g)	550.00(\pm 173.21)	595.00(\pm 125.72)
	Birth Weight (g)	3500.00(\pm 204.12)	3360.00(\pm 394.26)
	PBWR	0.156(\pm 0.042)	0.177(\pm 0.032)



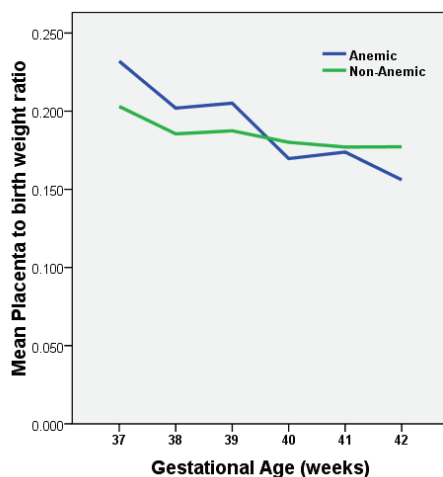


Figure 2: Mean placenta to birth weight ratio by gestation in anemic and non-anemic groups

As depicted in figure 1, the birth weight increased with the advancing gestation, whereas, the placenta weight increased with advancing gestation till 40 weeks, after which it declined. It is also to be noted that, among the total study population, only 6.0% and 4.9% deliveries occurred in 41 and 42 weeks of gestational age, respectively. There were 24.9%, 20.7%, 24.9% and 18.6% deliveries which occurred in 37, 38, 39 and 40 weeks of gestational age, respectively. Figure 2 depicts decline in the placenta to birth weight ratio with advancing gestational age. The decline was more pronounced in anemic group.

Discussion

Maternal Hb concentration affects the growth and development of placenta and the fetus [6,7]. The measures like placenta weight and birth weight are widely available. The relationship between these measures and maternal Hb concentration can be useful for predicting the optimal utero-placenta circulation and fetal nutrition. The present study reports the comparative analysis of placental weight, birth weight and placenta to birth weight ratio among anemic and non-anemic mothers. In current study, mean placental weight among anemic mothers (578.78 ± 141.80 g) was found to be slightly more than mean placental weight among non-anemic mothers (575.96 ± 128.88 g). In contrast to this finding, in a similar study performed in Nepal, the mean placental weight was, however, found to be lower in anemic mothers (427.8 ± 84.7 g) than in non-anemic mothers (553.25 ± 76.65 g) [9]. In a cohort study conducted in Cameroon, the mean placental weight among anemic cases (499.7 ± 101.4 g) was found to be more than in non-anemic cases (408.5 ± 45.2 g) which is

consistent with the finding of present study [10]. In current study, mean birth weight among anemic mothers (2973.17 ± 680.97 g) was found to be slightly lower than that among non-anemic mothers (3125.95 ± 590.89 g). In another study performed in Nepal, the mean birth weight was lower in anemic group (2860 ± 570 g) than in non-anemic group (3010 ± 390 g) similar to the findings of current study [9]. In the other hand, the finding in the study performed in Cameroon revealed higher mean birth weight among anemic cases (3328 ± 96.7 g) than among the non-anemic cases (3243.5 ± 328.2 g) which differed from the finding of the current study [10]. A study demonstrated that mean placental to birth weight ratio was similar in different races ($19.5 \pm 3.3\%$ in Asian, $20.0 \pm 4.0\%$ in European and $20.4 \pm 5.3\%$ in Afro-Caribbean women) [11]. In our study, the placenta to birth weight ratio was slightly higher in anemic (0.20 ± 0.05) than in non-anemic (0.19 ± 0.05) cases and significant difference was observed in means of placenta to birth ratio between anemic and non-anemic groups (p-value 0.05). Whereas, in another similar study performed in Nepal, the mean placenta to birth weight ratio was found to be lower in anemic group (0.15 ± 0.05) than in non-anemic group (0.18 ± 0.618) [9]. The cohort study performed in Cameroon demonstrated lower mean birth weight in anemic cases (2973.17 ± 680.97 g) than in non-anemic cases (3125.95 ± 590.89 g) similar to present study [9]. Lelic et al [12] found in their study that placenta of anemic women revealed increase of blood vessels in terminal villi but the mass and volume of placenta didn't differ much from the placenta of non-anemic women. In contrast to this finding, Godfrey et al [13] found that large placental weight was associated with lower maternal Hb concentration and decreased maternal mean cell volume during pregnancy. In their study, it was found that highest ratio of placental to birth weight was associated with largest falls of mean cell volume during pregnancy. Beischer et al [14] reported 2% incidence of heavy placenta (weighing more than 900 g) in 196 patients with thalassemia minor and 294 patients with anemia. The mean placenta to birth weight ratio was 0.22 and 0.24 when placenta weighed more than 700 g and more than 900 g, respectively, among anemic mothers which are close to the finding of present study. Another study revealed significantly reduced placental weight, birthweight and decreased number of placental cotyledons in severely anemic pregnancies (with maternal Hb concentration 60 g/l or



lower) but the placental volume and surface area showed no constant relation with the maternal Hb concentration. The placenta to birth weight ratio was significantly higher in severely anemic group as compared to non-anemic group [15]. Crowe et al [16] reported effects of maternal anemia during pregnancy on placental size, fetal and neonatal growth and blood pressure development in rats. A pronounced postnatal rise in systolic blood pressure associated with maternal anemia was demonstrated which was not related to greater placental to birth weight ratio.

In the present study, the mean placenta to birth weight ratio was found to be decreasing with advancing gestational age. The decrease in the ratio was more pronounced in the anemic group. Panti et al [17], in their study, revealed decreased placenta to birth weight ratio with advancing gestational age similar to the findings of the current study. In many placental studies, other factors affecting placental and birth weight was evaluated. A study performed in Italy demonstrated increase in placenta to birth weight ratio in pregnancy related hypertensive diseases, small for gestational age infants, newborn needing cardiopulmonary resuscitation or neonatal intensive care unit, poor outcome pregnancies and pregnancies from in-vitro fertilization or intracytoplasmic sperm injection [18]. Another study performed to find out fetal-placental weight ratio in normal singleton near-term pregnancies showed decreased fetal to placental weight ratio in teenage women and in cases with low birth weight [19]. Bleker et al [20] suggested in their study that pregnancy lasts longer in presence of relatively heavier placenta. He also demonstrated that poor placental development was prevalent in primiparous pregnancies in comparison to multiparous pregnancies and in twin births in comparison to singleton births. It was suggested that small placenta may be the cause of poor fetal growth rather than being the consequence of poor fetal growth.

The limitations of this study reside in the fact that it was conducted in a single institution with a limited number of participants. The association between variables like placental weight, birth weight and placenta to birth weight ratio were correlated with very few factors such as maternal Hb concentration, maternal age and gestational age. It is suggested that future studies including larger number of participants should be conducted to improve the scope of benefits from the study.

Conclusion

Mean placental weight and mean ratio of placenta to birth weight was higher in pregnant women with anemia and significant difference was observed in means of placenta to birth ratio in anemic and non-anemic groups. Mean birth weight was lower among anemic women than among non-anemic women. Systemic conditions tend to have impact on the anatomy of placenta which eventually affects the growth and well being of the fetus. Maternal Hb concentration must be monitored and maintained during pregnancy to achieve the optimal health of the mother and fetus.

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Conflict of interest: None

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