

# Effect of Maternal Anemia on Placental Ratio

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**Objective:** To determine the effect of maternal anemia on placental ratio. **Design:** Cohort Study. **Place and duration of study:** Unit-1, Department of Gynaecology and Obstetrics 1, Sir Ganga Ram Hospital, Lahore from August 2002 to August 2003. **Patients and the methods:** One hundred pregnant women, 50 anemic and 50 having normal range of Hb were included in the study. After delivery, weight of the new born and weight of placenta was recorded. The fetoplacental ratio was calculated for both groups and compared. **Results:** The mean weight of the newborn ( $\pm$ SD) in anemic group was  $3.12 \pm 0.45$  Kg and  $3.18 \pm 0.35$  Kg in control group. The difference was statistically non-significant ( $P=0.445$ ). The mean placental weight of anemic group was  $0.58 \pm 0.13$  Kg and that of control group was  $0.52 \pm 0.088$  Kg showing a significant increase ( $P<0.009$ ). Feto-placental ratio was  $0.193 \pm 0.035$  (Mean $\pm$ SD) in anemic patients and  $0.166 \pm 0.024$  in control group. FP ratio of anemic patients was significantly higher than control group ( $P<0.001$ ). **Conclusion:** This study confirms that anemia during pregnancy is associated with significantly large placental weight and a high fetoplacental ratio.

**Key words:** Placental weight, Weight of the newborn, Fetoplacental ratio, Maternal anemia.

Scientific interest in placenta derives not only because of its enormous diversity of form and function but also from the unique metabolic, endocrine and immunologic properties. Placenta can serve as biopsy or histological document of maternal and fetal health throughout the pregnancy<sup>1</sup>. Placental ratio, defined as relationship of placental weight to weight of the new born (placental weight in Kg/ weight of the new born in Kg), serves as a good indicator of feto-maternal health<sup>2</sup>. Placental weight closely relates to weight of the new born. However, among anemic mothers, the placenta shows increase in weight, which can be considered as a compensatory achievement<sup>3</sup>. Placental hypertrophy has been observed associated with mild and moderate degree of iron deficiency anemia and this enlargement appears to be proportional compensatory growth. Many studies have shown that individuals born with higher placental ratio are at risk of developing cardiovascular disorders including hypertension and coronary heart disease in their adult lives<sup>4-7</sup>. This may have important implication for prevention of adult hypertension<sup>8</sup>. The risk of hypertension in adult life rises with increasing placental weight and falls with increasing birth weight<sup>9,10</sup>.

The present study was designed to determine the effects of anemia on placental ratio in our hospital community. Study was based upon the hypothesis that placental weight and feto-placental ratio increases in anemia.

## Patients and methods

This study was carried out from August 2002 to July 2003 in the Department of Obstetrics & Gynaecology, Sir Ganga Ram Hospital, Lahore using a cohort designs.

One hundred women, who delivered in our hospital, were included in this study. Fifty anemic women with singleton pregnancy at term (37-40 weeks of pregnancy) with Hb level  $<11$ g/dl were selected. Fifty non-anemic women (Hb $>11$ g/dl), matched for age, parity, gestational

age and socio-economic status were selected as controls. Patients with pregnancy induced hypertension, diabetes, twin pregnancy and intra-uterine death were not included as these conditions serve as confounding factors.

The variables relevant to this study were recorded. These included age, parity, socioeconomic status, booking status, previous obstetric history, history of diabetes mellitus and hypertension. Outcome measures were weight of the newborn, weight of placenta and ratio of placental and fetal weight.

After delivery, the newborn was placed at the end of delivery table and at the same level as the mother. The umbilical cord was clamped and divided within 30 seconds of birth. After delivery, the untrimmed placenta was cleaned and cord blood drained off. It was then examined and weighed using an ordinary weighing scale. Placental ratio was calculated by following formula.

Placental Ratio = Placental Weight (Kg) / Weight of the newborn (Kg). Statistical analysis was done by computer software SPSS version 10. Student 't' test was applied to compare the two groups. P value  $<0.05$  was considered significant.

## Results

The parameters studied in both groups have been presented in Table-1. Placental weight and Feto-placental ratio of anemic patients was significantly increased ( $P<0.001$ ) as compared to control group (Table-1). Mean placental ratio was  $0.193 \pm 0.035$  in anemic group and  $0.166 \pm 0.024$  in control group showing a significant increase ( $P<0.001$ ).

Mean Hb. in anemic group was  $8.76 \pm 1.34$  g/dl and that of control group was  $11.43 \pm 0.62$  g/dl. The severity of anemia was categorized into three categories according to Hb level. Hb levels between  $10-10.9$ g/dl were categorized as mild anemia, between  $7-9.9$ g/dl as moderate anemia and  $<7$ g/dl as severe anemia. Feto-placental ratio was also studied according to degree or severity of anemia. There was an increase in placental ratio with rising degree of

anemia. The FP ratio (Mean±SD) of patients with mild anemia was  $0.193\pm0.031$ , in moderate anemia it was  $0.195\pm0.036$  and in severe anemia  $0.196\pm0.48$  (Figure-1).

Fig 1: Placental Ratio according to degree of Anemia

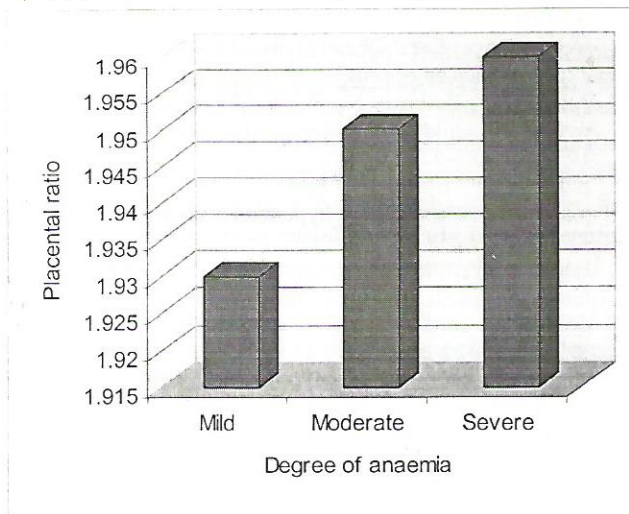


Table 1: Comparison of both groups.

Parameters	Unit	Anemic Group	Control Group	P Value
Weight of Newborn	Kg	$3.12\pm0.45$	$3.18\pm0.35$	NS**
Hb Level	g/dl	$8.76\pm1.34$	$11.43\pm0.62$	<0.001*
Placental ratio		$0.193\pm0.03$	$0.166\pm0.02$	<0.001*
Placental weight	Kg	$0.58\pm0.13$	$0.52\pm0.088$	<0.009*
Age	Yrs	$27.10\pm5.01$	$27.44\pm4.69$	NS**

Table-2: Distribution of Placental weight in Anemic and Control Groups.

Placental Weight (Kg)	Anaemic Group	Control Group	Significance of Difference
< 0.3	04	02	NS**
0.4 - 0.5	12	29	NS**
0.6 - 0.7	30	18	<0.005*
0.8 - 0.9	04	01	<0.005*

\*Significant. \*\* Non Significant (one tail)

There was no significant difference in mean birth weight between the two groups. Mean birth weight in anemic groups was  $3.12\pm0.45$ kg as compared to control group with value of  $3.18\pm0.35$  ( $P=0.445$ ). However, there was a significant increase in placental weight between the two groups. Most of the patients of anemic group had placental weight between 600–700gms, compared to control group, where most of the patients had placental weight between 400–500gms (Table 2). The mean placental weight of anemic group was  $0.58\pm0.13$ Kg and that of control group was  $0.52\pm0.088$ Kg showing a significant increase ( $P<0.009$ ).

## Discussion

In our study fetoplacental ratio in control group was found to be  $0.166\pm0.024$  (Mean±SD) and that in anemic group was  $0.193\pm0.035$ . The increase in fetoplacental ratio among anemic patients was quite significant ( $P<0.001$ ) which is consistent with results found by and Beisher et al<sup>11</sup> as well as Lao & Wong<sup>12</sup>. The finding of the present study are also supported by study done by Lao and Wong, according to which anemia causes significant increase ( $P=0.001$ ) in fetoplacental ratio<sup>9</sup>. Godfery et al has also shown that there were independent statistically significant trends towards increasing placental ratios in association with lower maternal haemoglobin ( $P<0.0001$ ) and with larger falls in mean corpuscular volume<sup>8</sup>. Researches have shown that the highest placental ratios occurred in anemic women, the lowest ratios in women with high hemoglobin and little or no fall in MCV<sup>8,10,13</sup>.

We observed that as severity of anemia increased, placental ratio also increased although the difference was quite small. The largest ratio was found in the most anemic women and this finding is quite consistent with findings of Godfery et al<sup>8</sup>, who studied fetoplacental ratio in relation to Hb. and MCV and observed that for each level of MCV as Hb falls, the placental ratio rises and for each level of Hb as parity of mother decreases, the placental ration increases indicating that anemia causes rise in placental ratio.

We found that there was a fall in birth weight in anemic patients as compared to that in control group but the difference was not significant ( $P=0.445$ ). The finding is consistent with the observations of Lao and Tan ( $P=0.035$ )<sup>10</sup>. Avinger and Zeibeles also described results consistent with our study. According to them birth weight in anemic group was 3-5gms less than in non-anemic group but insignificant difference was solely due to lesser weight of mother in anemic group<sup>3</sup>. Levario-Carrillo in his study observed that placental weight in babies of anemic patients was  $558\pm108$  grams and that non-anemic group was  $527\pm107$  grams ( $P=0.18$ ) showing an insignificant fall in birth weight of newborns of anemic mothers<sup>14</sup>. Levario-Carrillo observed a trend towards an increase in placental weight and placental ratio in patients fulfilling the anemic criteria ( $P=0.04$ ) but a significant effect on the weight and height of newborn was not determined suggesting that changes present in placenta would be enough to ensure a fetal growth<sup>14</sup>. Studies have suggested that large placental weight and high placental ratio are known predictors of higher adult blood pressure<sup>4-6</sup>. It has been observed that risk of essential hypertension falls with increasing birth weight and increases with increasing placental weight. It has been proposed that individuals who have a high placental ratio are at highest risk<sup>1</sup>. In a study of 4 years old children in Salisbury, blood pressure was related to maternal anemia and low MCV. The relation of pregnancy anemia and low MCV with blood pressure at 4 years age

suggests that factors influencing haemoglobin synthesis during pregnancy may be associated not only with discordance between placental weight and birth weight but also with adult hypertension<sup>15</sup>. Mamed Kadyrov<sup>16</sup> in his study assessed placental villous vascularisation in anemic women (Hb<9g/d) and third trimester of pregnancy by immuno-histochemical identification of villous capillaries and compared with that of gestational age matched groups of women with normal control group (Hb>11g/dl) and intermediate group (Hb 9-11g/dl). Maternal anemia in early pregnancy was seen to influence the pattern of placental vascularisation. Such changes might alter placental vascular impedance during early fetal life, thereby exerting important effects on cardiovascular development<sup>16</sup>.

The rationale behind the present study was to initiate a discussion among the contemporary researchers regarding the long term sequels of intrauterine stress caused by anemia, which could best be studied when newborn and its placenta are studied simultaneously. The usefulness of the study can only be appreciated if newborns are followed in the early neonatal life, during childhood and adult life for any evidence of increased risk to hypertension and other cardiovascular diseases.

### Conclusion

Our results indicate that anemia during pregnancy is associated with significantly large placental weight and a high fetoplacental weight ratio.

This was a small study and it might appear unusual because so far no such study has been carried out which is quoted in our national literature. Further larger studies should be carried out to see the long term consequences of this altered ratio and its relationship with adult cardiovascular diseases. If any link between modifiable antenatal factors and pathogenesis of adult cardiovascular disease can be found out, it may have important implications for prevention of adult hypertension and other cardiovascular diseases.

Study of variations in placental ratio on fetal outcome would, however, be incomplete because immediate effect on neonatal outcome could be assessed. Larger prospective study would be needed to determine whether maternal iron deficiency anemia belong to the group of modifiable antenatal factors that could influence the future of offspring. It is hoped that this study becomes forerunner of much larger studies.

### References

1. Leichng J, Marcickiewicz J, Chazan B, Troszynski M. Clinical value of the Feto-placental ratio. *Probl Med Wiek* Rozwoj 1983; 12: 174-80.
2. Burkhardt T, Schaffer L, Schneider C, Zimmermann R, Kurmanavicius J. Reference values for the weight of freshly delivered term placentas and for placental weight-birth weight ratios. *Eur J Obstet Gynecol Reprod Biol*. 2005 Dec 22; [Epub ahead of print]
3. Auinger W, Zeibekis N. The influence of anaemia on the weight of child and placenta. *Geburshilfe Frauenheilkd* 1977; 37: 589-92.
4. Barker DJP, Bull AR, Osmond, Simmond SJ. Fetal and placental size and risk of hypertension in adult life. *Br Med J* 1990; 301: 259-62.
5. Barker DJP, Osmond C, Simmonds SJ, Weild GA. The relation of small head circumference and thinness of birth to death from cardiovascular disease in adult life. *Br Med J* 1993; 306: 422-26.
6. Hindmaish PC, Geory MP, Rodeck CH, Jackson MR, Kingdom JC. Effect of early maternal iron stores on placental weight and structure. *Lancet* 2000; 356: 696.
7. Ruangvutitert P, Titapant V, Kerdphoo V. Placental ratio and fetal growth pattern. *J Med Assoc Thai* 2002; 85:488-95.
8. Godfery KM, Redmn CWG, Barker DJP, Osmond C. The effect of maternal anaemia on the ratio of weight of the new born to maternal weight. *Br J Obstet Gynaecology* 1991; 98: 886-91.
9. Barker DJP, Osmond C, Golding J, Kuh D, Wadsworth MEJ. Growth in utero, blood pressure in childhood and adult life, and mortality from cardiovascular disease. *Br Med J* 1989; 298: 564-67.
10. Lao TT, Tan KF. Placental ratio and anaemia in 3<sup>rd</sup> trimester of pregnancy. *J Reprod Med* 2000; 45: 923-28.
11. Beisher NA, Sivasambo R, Vohra S, Silpiromkosol S, Reid S. Placental hypertrophy in severe pregnancy anemia. *J Obstet gynaecol Br Commw* 1970;77:398-409
12. Lao TT, Wong WM. Placental ratio – its relationship with mild anaemia. *Placenta* 1977; 18: 593 – 96.
13. Rusia V, Malam N, Agarwal N, Sikka M, Sood SK. Effect of maternal iron deficiency anemia on fetal outcome. 1995;38:273-9.
14. Levario-Carrillo M, Hernandez M, Vasquez ME, Chavez D, Sanchez C. Effect of iron deficiency anaemia on placenta and birth weight. *Ginecol Obstet Mex* 2003; 71: 75-81.
15. Law CM, Barker DJP, Bull AR, Osmond C. Maternal and fetal influence on blood pressure. *Arch Dis Child* (in press).
16. Mamed Kadyrov, Georg Kosanke, John Kingdom, Peter Kaufmann. Increased fetoplacental angiogenesis during first trimester in anaemic women. *Lancet* 1998; 352: 1747-49.