ORIGINAL ARTICLE

Maternal Hemoglobin and Its Relationship With fetal birth weight

MOMINA ASAF[1], MUHAMMAD KHURRAM ILYAS[2], TOOBA QASIM[3], AMER SHOAIB[4], SHAZIA IRFAN[5], AIJAZ ZEESHAN KHAN CHACHAR[6]

[1]Consultant Gynecologist Lady Wellington Hospital Lahore
[2]Senior Demonstrator Physiology, Fatima Memorial College of Medicine and Dentistry Lahore
[3]Gynaecology Department Govt. Police Line Hospital Qila Gujjar Singh, Lahore
[4]Associate Professor of Physiology, Fatima Memorial College of Medicine and Dentistry Lahore
[5]Associate Professor of Physiology, Fatima Memorial College of Medicine and Dentistry Lahore
[6]Senior Registrar, Fatima Memorial Hospital College of Medicine & Dentistry, Lahore
Correspondence to Dr. Momina Asaf, Email: mominaasaf@yahoo.com

ABSTRACT

Background: The needs of iron for mother and fetus considerably increase during pregnancy. Its deficiency can be harmful to the mother's health and the fetal in terms of birth weight.

Aim: To examine the relationship between hemoglobin level and fetal birth weight.

Methods: This was an observational study, conducted in Govt. Hospital Samanabad, Lahore between April 2021 and April 2022. A total of 106 pregnant women through non probability convenience sampling were recruited in our study. The patients were divided into two groups according to low and normal hemoglobin level. The hemoglobin<11 g/dl was considered low and the hemoglobin ≥11 g/dl was considered normal. Variables like age, Gravida, gestational age at the time of deliveryand fetal birth weight were recorded. The hemoglobin during first trimester of pregnancy was also recorded from medical records of patients.

Results: The prevalence of low hemoglobin in our study population was73.6%. The mean age of the women was 25.09±4.74years. The average gestational age at the time of delivery was 271.15±5.61 days. The participants with primigravida were in majority 54.7% as compared to the multigravida 45.3%. Pregnant females with the low Hb level were more likely to have a baby with the birth weight of less than 2500 grams. Hence there was a strong association between birth weight and Hb level (p-value= 0.038). Hemoglobin level was positively correlatedwith the fetal birth weight(r= 0.631, p-value=0.0001).

Conclusion: Maternal hemoglobin should be paid more attention even from the first trimester of the pregnancy in order to avoidhigher risk oflow birth weight fetal.

Keywords: Fetal birth weight, Hemoglobin, Pregnancy, Anemia, Gravida

INTRODUCTION

Low birth weight has been widely studied as a risk factor for the fetal morbidity and mortality[1-4]. One of main risk factors for the fetal low birth weight is low hemoglobin level during pregnancy[5]. It is considered that hemoglobin level decreases in first and third trimester and are likely to increase in second trimester during pregnancy[6]. According to the WHO anemia can be defined as the Hb<11 g/dl during first and third trimester and Hb<10.5g/dl in third trimester of the pregnancy[7]. It is observed that anemia and fetal outcomes are related to each other. Several studies have showed that the low hemoglobin level was associated with adverse fetal outcome[8-10]. It was showed by a study that anemia was related with the uneventful pregnancy outcome.[11]Anemia during pregnancy can prevail even if all the regular antenatal care is taken and can affect the pregnancy outcome in terms of fetal weight.Hence a significant association between maternal hemoglobin level and fetal birth weight was observed[12]. The relationship between Hb levels and fetal birth weight is different in each trimester of pregnancyhowever; it is frequently observed that the low Hb levels in the start of the pregnancy may lead to the adverse fetal outcome[13]. There is no sufficient evidence available about the association of fetal birth weight with Hb levels in the first trimester of pregnancy in Pakistan.

The present study was conducted to examine the maternal hemoglobin levels during first trimester of the pregnancy and its effect on the fetal birth weight.

MATERIALS AND METHODS

This was an observational, conducted in Govt. hospital Samanabad between April 2021 and April 2022. The ethical approval was obtained from the ethical board of hospital. A sample of 106 pregnant females through non probability convenience sampling were selected in our sample using 5% level of significance, 95% confidence interval, 10% margin of error and 1000 anticipated number of pregnant females visiting Gymea OPD

----

of Govt. Hospital Samanabd. The patients were divided into two groups: Hb<11g/dl and Hb ≥11g/dL according to the WHO guidelines[2]. The patients with the following were excluded from the study: irregular prenatal checkups, unavailability of data regarding delivery,Lack of data regarding hemoglobin level of first trimester, individuals with less than 16 years and above 40 years of age, birth defects, multiple pregnancies, history of diabetes mellitus, hepatic and renal failure, mullerian anomalies, thyroid diseases, history of complicated pregnancy, any prior placental abnormalities and PPH. Demographic characteristics of the study population such as age, Gravida, gestational age at delivery, mode of delivery and fetal birth weight were recorded. The first trimester Hb levels were obtained from medical records. All the new born babies with the weight <2500g were considered in low weight and the babies with the birth weight >2500g were considered normal weight group.

Data was entered and analyzed in SPSS version 22. Descriptive analysis was performed for all the variables of the study. Frequency and percentages were calculated fort the categorical variables.Mean and standard deviation was calculated for the continuous variables. The association between categorical variable was assessed using Fisher's Exact test. For the comparison of variables in form of continuous, Independent sample t test was used for the between group comparison. P-value< 0.05 was considered significant.

RESULTS

This prospective study was conducted with 106 pregnant women who were divided into two groups according to their hemoglobin level. Participants with the hemoglobin level less than 11g/dl were considered in the group I 78(73.6%) and the rest were considered in Group II 28(26.4%). The mean age was 25.22±4.84 and 24.75±4.52 for the group I and II respectively (p-value=.656). There was no significant age difference between the two groups in this study. (P-value=0.364). In our study primigravida was in majority 58(54.7%) as compared to the multigravida 48(45.3%) and the prevalence of low hemoglobin was high is multigravida. Average gestational age at the time of delivery was 270.67±4.495

days and 272.50±7.90 days for group I and II respectively (p-value= 0.139) (Table 1).

In present study the fetal low birth weight in group I was higher 16(94.1%) than the group II 1(5.9%) and showed a strong association between both the variables. Pregnant females with the low Hb level were more likely to have a baby with the birth weight of less than 2500 gram. (P-value= 0.038) (Table 2).

Maternal age was associated with the likelihood of having fetal low birth weight. Mothers with multigravida were 1.924 times more likely to have fetal low birth weight. Mothers with the normal Hb levels were 8.818 times more likely to have fetal with normal birth weight so a strong association was observed between fetal birth weight and hemoglobin level of the mothers (Table 3).

Maternal hemoglobin level was observed significantly correlated with fetal birth weights. Mother with the normal Hb level was tending to have fetal with normal birth weight whereas low Hb level indicated low birth weight of fetal. (r= 0.631, p-value=0.0001) (Figure 1).

Table 1: Association of hemoglobin level with demographic variables and fetal weight

Variables		Group I 78(73.6)	Group II 28(26.4)	Total 106(100)	p-value
Age (Mean±SD)		25.22±4.84	24.75±4.52	25.09±4.74	0.656
Gravida	Primigravida	47(60.3)	11(39.3)	58(54.7)	
	Multigravida	31(64.6)	17(34.5)	48(45.3)	0.077
Gestational age	Mean±SD	270.67±4.495	272.50±7.90	271.15±5.61	0.139
Fetal weight	Low	16(94.1)	1(5.9)	17(16.0)	0.038*
	normal	62(69.7)	27(30.3)	89(84)	
	Total	78(73.6)	28(26.4)	106(100)	
	Mean±SD	2.91±0.36	3.16±0.20	2.98±0.34	0.0001

Table 2: Univariate Analysis of fetal weight with age, Gravida, gestational age and HB level

Variables		Low birth weight	Normal birth weight	p-value
Age (Mean±SD)		28.71±5.23	24.40±41	0.0001**
Gravida	Primigravida	6(10.3)	52(89.7)	0.111
	Multigravida	11(22.9)	37(77.1)	
Gestational age	Mean±SD	270.41±5.11	271.29±5.71	0.556
Hemoglobin	Low	16(20.5)	62(79.5)	0.038*
	Normal	1(3.6)	27(96.4)	

Table 3: Multivariate Analysis of fetal weight with age, Gravida, gestational age and HB level

Variables		Adjusted OR	95% CI	Pseudo R^2	LR model
Age		0.846	0.745-0.962	Cox & Snell R Square=0.153 Nagelkerke R Square= 0.262	p=0.001
Gravida	Primigravida	1.924	0.55-6.737		
	Multigravida				
Gestational age		0.986	0.874-1.112		
Hemoglobin	Low	8.818	1.026-75.762		
	Normal				

P value 0.001

Figure 1: Correlation between hemoglobin level and fetal weight
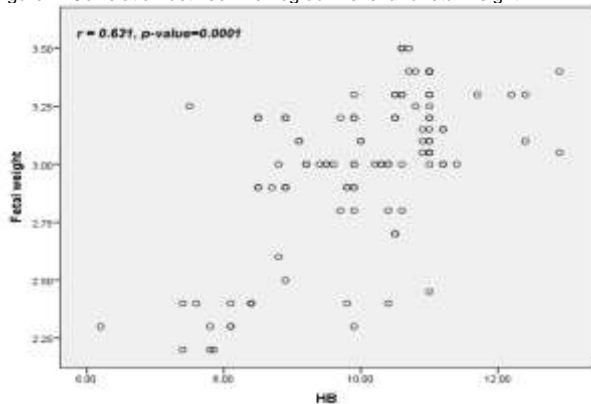
DISCUSSION

In normal pregnancy a significant drop in hemoglobin level is caused by the plasma volume expansion. Low level of hemoglobin is among the most common medical disorders in pregnancy and their association with the pregnancy outcome is more important to be studied[14]. Thus, the current study to determine relationship of maternal hemoglobin level with the birth weight of fetal was conducted. Fetal birth weight is an important factor in fetal mortality during the first year of its life. It is also a good indicator how well women has supported her fetus during the entire pregnancy period[14]. To some researchers the extent to which the hemoglobin level can affect the fetal outcome and maternal health is uncertain,

however some reported higher risk of fetal low birth weight is associated with the maternal low hemoglobin level[15-19]. Our study has shown the striking association of birth weight with hemoglobin level. In ourstudy low hemoglobin concentrationrate was 73.6% during first trimester of pregnancy. The hemoglobin level of mothers during first trimester of pregnancy showed a strong association with the birth weight of neonatal. The maternal hemoglobin <11g/dl was found to be related to the risk of low birth weight.Findings of present study revealedprevalence oflow hemoglobin level was much higher as compared to United States (5.7%), Canada (11.5%) and Germany (12.3%), Japan (14.8%) and Singapore (23.8%)[20]. The results of our study revealeda significant associationbetween maternal hemoglobin level and fetal birth weightoutcomeeven after controlling it by effect modifiers like age gravida and gestational age at the time of delivery which was comparable with the previous studies[21,22]. The cases with the maternal hemoglobin concentration >11 g/dl were more likely to have comparatively higher fetal birth weight and lower risk of LBW which showed that hemoglobin level needs to be appropriate even from the start of the pregnancy for fetal weight growth.Findings similar to our study were also observed in previous studies[22-26]. A study conducted showed that the birth weight was normal when the maternal hemoglobin was 110–129 g/L and it decreased when the hemoglobin was 130 g/L[24]. The evidence provided in our study that low maternal hemoglobin during the first trimester of pregnancy was associated with the fetal low birth weight, hence it filled in the gap of related research. Low hemoglobin level during pregnancy may cause inadequate nutrient supply to the fetus, which can badly affect the fetal and can cause low birth weight[23, 27]. Another study revealed that hemoglobin level should be taken care to avoid adverse effect on fetal outcome[28]. To the best of our knowledge, the current researchexamined relationship between

maternal hemoglobin level during thefirst trimester of pregnancy and outcome in terms of fetal birth weightandit revealed that the fetal weight growth could be affected by the low hemoglobin level. So we believe that 'it is matter of concern and it should be paid more attention even from the start of the pregnancy in order avoid adverse fetal outcome.

Limitations: Some of the limitations of current study are as follows: First of all the present the present study was administered in a single public hospital andits results only revealed correlation or association between maternal hemoglobin level and its outcome in terms of fetal weight by controlling for maternal age, gestational age and gravida, which may stops us from the generalization of our results to the other population. Secondly, although the study was done by controlling some effect modifiers like maternal age, gestational age and gravida, there were still a lot of unnoticed effect modifiers that were not investigated in this study and need to be studied for better picture of the scenario. The data regarding weight gain of mothers during pregnancy was unavailable so its possible effect on the relationship of hemoglobin level of mothers during pregnancy with birth weight of fetal was not studied.

Recommendations: More comprehensive and well-designed studies are neededto determine the relationship between hemoglobin level and pregnancy outcome by controlling all possible effect modifiers including demographic variables and medical history contributing in cause of anemia during pregnancy. Further interventional studies can be conducted to assess the effects of iron and folic acid supplementations on fetal outcome and maternal health. Also, the biological mechanisms responsible for the association between fetal weight and hemoglobin level can be studied.

CONCLUSION

Maternal hemoglobin in the first trimester had significant association with fetal birth weight. The low hemoglobin level could be harmful to fetal weight growth. So it is a matter of concern and it should be paid more attention even from the start of the pregnancy in order avoid adverse fetal outcome

Ethical approval: Given
Conflict of interest: The author declares no conflict of interest
Funding sources: None
Contribution of authors: MA: Data and sample collection, article compilation**, MKI:** Data and sample collection, article compilation, **TQ**: Study design, discussion, **AS:** Methodology, discussion, **SI:** statistical analysis discussion, **AZKC:** Conception of Study, Study Design, Data Analysis, Article writing, literature research, drafting the article, Final approval of the manuscript

REFERENCES

1. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. *Bull World Health Organ.* 1987; 65(5):663–737.
2. World Health Organization. Meeting of Advisory Group on Maternal Nutrition and Low Birth weight Genebra: WHO; 2002.
3. Moraes IB. Risk factors for underweight at birth. Campinas, São Paulo: Universidade Estadual de Campinas, 2001.
4. UNICEF. Low Birth weight: Country, regional and global estimates. New York: UNICEF; 2004.
5. Figueiredo AC, Gomes-Filho IS, Batista JE, Orrico GS, Porto EC, Cruz Pimenta RM *et al*. Maternal anemia and birth weight: A prospective cohort study. PloS one. 2019; 14(3):e0212817.
6. Laflamme EM. Maternal hemoglobin concentration and pregnancy outcome: a study of the effects of elevation in El Alto, Bolivia. *Mcgill J Med.* 2011;13:47
7. WHO/ UNICEF/UNO. IDA. Prevention, assessment and control. *Report of a WHO/UNICEF/UNO Consultation. Geneva: WHO.* 1998.
8. Vural T, Toz E, Ozcan A, Biler A, Ileri A, Inan AH. Can anemia predict perinatal outcomes in different stages of pregnancy? *Pak J Med Sci.* 2016;32:1354–9
9. Figueiredo AC, Gomes-Filho IS, Silva RB, Pereira PP, Da Mata FA, Lyrio AO *et al.* Maternal anemia and low birth weight: a systematic review and meta-analysis. Nutrients. 2018; 10(5):601.
10. Jung J, Rahman MM, Rahman MS, Swe KT, Islam MR, Rahman MO *et al.* Effects of hemoglobin levels during pregnancy on adverse maternal and infant outcomes: a systematic review and meta- analysis. Annals of the New York Academy of Sciences. 2019; 1450(1):69-82.
11. Sehgal R, Kriplani A, Vanamail P, Maiti L, Kandpal S, Kumar N. Assessment and comparison of pregnancy outcome among anemic and non-anemic primigravida mothers. *Indian J Public Health.* 2016; 60:188–94.
12. Shrestha A, Shrestha S. A correlative study between maternal hemoglobin concentration during third trimester and fetal birth weight of babies born at Kathmandu Medical College and Teaching Hospital. Journal of Pathology of Nepal. 2020; 10(2):1756-9.
13. Alemu B, Gashu D. Association of maternal anthropometry, hemoglobin and serum zinc concentration during pregnancy with birth weight. Early Human Development. 2020; 142:104949.
14. Hack M, Flannery DJ, Schluchter M, Cartar L, Borawski E, Klein N. Ou tcomes in young adulthood for very-low-birth-weight infants. *N Engl J Med* 2002; 346:149–57.
15. Lone FW, Qureshi RN, Emanuel F. Maternal anemia and its impact on perinatal outcome. *Trop Med Int Health* 2004; 9:486–90.
16. Steer PJ. Maternal hemoglobin concentration and birth weight. *Am J ClinNutr* 2000; 71:1285S–7S.
17. El   Guindi W, Pronost J, Carles G, Largeaud M, El Gareh N, Montoya Y, *et al..* Severe maternal anemia and pregnancy outcome. *J GynecolObstetBiol Report* 2004; 33:506–9.
18. Bisai S, Mahalanabis D, Sen A, Bose K, Datta N. Maternal   early second trimester pregnancy weight in relation to birth outcome among Bengali Hindus of Kolkata, India. *AnnHumBiol* 2007; 34:91–101.
19. Chang SC, O'Brien KO, Nathanson MS, Mancini J, Witter FR. Hemogl obin concentrations influence birth outcomes in pregnant African-American adolescents. *JNutr* 2003; 133:2348–55.
20. WHO. Worldwide Prevalence of Anemia 1993–2005: WHO Global Database on Anemia; WHO: Geneva, Switzerland, 2008; pp. 1–51
21. Jwa SC, Fujiwara T, Yamanobe Y, Kozuka K, Sago H. Changes in maternal hemoglobin during pregnancy and birth outcomes. BMC pregnancy and childbirth. 2015; 15(1):1-0.
22. Chen JH, Guo XF, Liu S, Long JH, Zhang GQ, Huang MC, Qiu XQ. Impact and changes of maternal hemoglobin on birth weight in pregnant women of Zhuang Nationality, in Guangxi. Zhonghualiu Xing Bing xuezazhi= ZhonghuaLiuxingbingxueZazhi. 2017 1; 38(2):154-7.
23. Steer, P.J. Maternal hemoglobin concentration and birth weight. Am. J. Clin. Nutr. 2000, 71, 1285S–1287S.
24. Ali SA, Tikmani SS, Saleem S, Patel AB, Hibberd PL, Goudar SS *et al*. Hemoglobin concentrations and adverse birth outcomes in south Asian pregnant women: findings from a prospective maternal and neonatal health registry. Reproductive health. 2020; 17(2):1-3.
25. Steer P, Alam MA, Wadsworth J, Welch A. Relation between maternal hemoglobin concentration and birth weight in different ethnic groups. BMJ 1995 25; 310 (6978): 489-91.
26. Dewey KG, Oaks BM. U-shaped curve for risk associated with maternal hemoglobin, iron status, or iron supplementation. The American journal of clinical nutrition. 2017 1; 106(suppl_6):1694S-702S.
27. Singla PN, Tyagi M, Kumar A, Dash D, Shankar R. Fetal growth in maternal anemia. Journal of tropical pediatrics. 1997 1; 43(2):89-92.
28. Liu D, Li S, Zhang B, Kang Y, Cheng Y, Zeng L, Chen F, Mi B, Qu P, Zhao D, Zhu Z. Maternal Hemoglobin Concentrations and Birth Weight, Low Birth Weight (LBW), and Small for Gestational Age (SGA): Findings from a Prospective Study in Northwest China. Nutrients. 2022; 14(4):858.