Association of Maternal Anemia with Low Birth Weight

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Abstract

Objective: To determine the frequency of anemia in women who were pregnant and attended a hospital with tertiary care facilities, and to compare the neonates' low-birth-weight frequency, with vs without anemia in pregnant women.

Method: A Descriptive case series study was conducted from 11th December 2021 to 10th June 2022 in Obstetrics and Gynecology Department, Services Hospital Lahore. After getting ethical review committee approval with letter reference no: IRB/2022/990/SIMS, venous blood samples of 196 women with singleton pregnancy of gestational age 37-42 weeks were collected to determine hemoglobin, red cell indices and frequency of maternal anemia. Just after delivery, neonatal weight at birth was measured to determine low-birth-weight frequency.

Results: In this study, 20 to 40 years was the range of age, and mean was 30.61 ± 4.24 years. Patients counted 113 (57.65%) were 31-40 years old. Gestational age had 38.63 ± 1.24 weeks mean while mean parity was 3.24 ± 1.31. Mean height was 157.87 ± 13.25 cm while mean weight was 71.28 ± 7.87 kg. Mean BMI was 29.26 ± 3.44 kg/m2. In this study, frequency of anemia in pregnant women was found in 89 (45.41%) patients. The frequency of LBW was 52.81% in anemic women versus 31.78% in women who did not have anemia.

Conclusion: This study resulted that, pregnant women have quite high anemia frequency and anemic women have high frequency of low-birth-weight neonates as compared to women without anemia.

Keywords: Pregnancy, Anemia, Low-Birth-Weight

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Introduction

Amongst hematological manifestations during pregnancy, Anemia is a major element that cause worldwide health issues, including Pakistan and has a major impact on women with lower socioeconomic class with lack of health facilities.[1,2] Pregnant women of countries like United Kingdom, United states of America, Germany and Australia, which are considered developed countries, are also effected by Anemia, ranging between 9% to 51%.[3,4] While in countries like Pakistan, India, Sudan, Ghana, which are developing countries, there is 44% to 81% anemia prevalence in pregnant women.[5,6]

Iron in ionic form facilitates new hemoglobin generation and it is major source of oxygen supply to vital body organs. Absence of iron availability for erythropoiesis in extracellular portion and infection in body affect the metabolic phenomenon of hemoglobin formation. Usually hemoglobin concentrations below 11g/dL is diagnostic of anemia in pregnancy. Low-birth-weight occurs due to intrauterine growth restriction caused by low hemoglobin concentration, which leads to reduced oxygen supply to fetus and affects angiogenesis of placenta. There is higher risk of low-birth-weight neonates in women who have hemoglobin levels below 10 g/dL during pregnancy vs women without anemia during pregnancy.[7]

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Amongst infants' mortality and morbidity risk factors, low-birth-weight is considered a major factor and has been studied well. The risk of morbidity and mortality is far more in infants having birth weight less than 3000 grams as compared to the infants with birth weight of 3000 grams or more.[8]

The exact mechanism which links low-birth-weight and anemia in pregnancy is not well known, despite of the fact that determinants of both are similar.[9] A study by Anwar et al. reported maternal anemia in 53.18% women with pregnancy with a strong low-birth-weight (LBW) association. The frequency of LBW was 36.3% in anemic women versus 14.6% in women without anemia.[10] While a study by Kumari did not report any significant association between maternal anemia and LBW. They reported LBW in 32.9% anemic women versus 32.4% in non-anemic women including overall frequency of anemia 78.45%.[11]

Socioeconomic and demographic factors affect maternal anemia. Therefore, local population should be identified for association between maternal anemia and low-birth-weight. As low-birth-weight contributes as major factor for infants' mortality, this study is aimed to determine maternal anemia in women who attended the hospital with tertiary care facilities, as well as its association with low weight at birth.[12] So, by early identification and treatment of anemia, we will be able to reduce the burden of low-birth-weight infants as well.

Material and Methods

In Obstetrics and Gynecology Department, a descriptive study from 11 December 2021 to 10th June 2022 was conducted. After the ethical review committee gave approval, Aa total of 196 pregnant women having age 20-40 years with singleton pregnancy having 37-42 weeks of gestation, were included through non probability, consecutive sampling.

Women having hemoglobin (Hb) <10 g/dL were labelled as anemic. Low Birth Weight (LBW): Neonates having birth weight <2500 grams were labelled as LBW. Birth weight of each baby was measured immediately after birth using a digital weight scale specified for measurement of neonatal birth weight in grams. Patients with multiple like twins or more preg-nancies, co-morbidities such as eclampsia or gestational diabetes were excluded. World Health Organization (WHO) software was used to calculate sample size with the following assumptions: Confidence level=95%, Proportion of Anemia in pregnant females=53.18%[14], Absolute Precision= 7%. A written consent was taken from each participant. A performa was for each patient that contained age, gestational age, height, weight, parity and BMI of the pregnant women who were inclu-ded in the study. Venous blood samples were drawn which were sent to hematology laboratory to determine the frequency of maternal anemia. Till neonate's birth, all patient were followed. Birth weight of neonate was measured just after birth to determine the LBW. The collected information was analyzed with SPSS version 25. For continuous variables like age, gestational age, parity, BMI, height and weight, descriptive statistics were applied for standard deviation and mean calculation while for categorical variable such as maternal anemia and LBW, percentage and frequency was found out. For determination of maternal anemia association with LBW, Chi Square test was used. Through stratification, effect modifiers, e.g., BMI, parity, age and gestational age, were controlled. To determine the association of these effect modifiers with maternal anemia and association of maternal anemia with LBW, post-stratification Chi square test was applied. P-value < 0.05 was considered as significant association.

Table 1: *Distribution of Patients (n= 196) according to age, gestational age, parity and BMI*

Age (in years): **Mean ± SD = 30.61 ± 4.24 years**	**No. of Patients**	**%Age**
20-30	83	42.35
31-40	113	57.65
Total	196	100.0
Gestational Age (in weeks): **Mean ± SD = 38.63 ± 1.24 weeks**		
37-39	145	73.98
40-42	49	26.02
Total	196	100.0
Parity: **Mean ± SD = 3.24 ± 1.31**		
Primiparous	35	17.86
Multiparous	161	82.14
Total	196	100.0
BMI (kg/m ^{2}): **Mean ± SD = 29.26 ± 3.44 kg/m^2**		
⩽27	73	37.24
>27	123	62.76
Total	196	100.0

Results

This study includes 20 to 40 years age range, with 30.61 ± 4.24 years, mean age. Patients counted 113 (57.65%) were 31-40 years old. Gestational age had mean of 38.63 ± 1.24 weeks, while mean parity was 3.24 ± 1.31. Mean height was 157.87 ± 13.25 cm while mean weight was 71.28 ± 7.87 kg. Mean BMI was 29.26 ± 3.44 kg/m^2. With respect to age groups, gestational age, parity and BMI, Anemia stratification is shown in Table No. II. Frequency of anemia in pregnant women was found in 89 (45.41%) patients as shown in Figure I. The low birth weight (LBW) frequency was 52.81% in women having anemia versus 31.78% in women who did not have anemia as shown in (Table III).

Table 2: *Stratification of Anemia with respect to age groups, gestational age, parity and BMI*

Age in Years	Anemia		p-value
	Yes	No	
20-30	41 (49.40%)	42 (50.60%)	
31-40	48 (42.48%)	65 (57.52%)	**0.336**
Gestational Age (weeks):			
37-39	65 (44.83%)	80 (55.17%)	
40-42	24 (48.98%)	25 (51.02%)	**0.614**
Parity			
Primiparous	11 (31.43%)	24 (68.57%)	
Multiparous	78 (48.45%)	83 (51.55%)	**0.067**
BMI (kg/m^2)			
⩽27	43 (58.90%)	30 (41.10%)	
>27	46 (37.40%)	77 (62.60%)	**0.004**

Table 3: *Comparison of the frequency of low birth weight in pregnant women with vs without anemia.*

Anemia	low birth weight		p-value
	Yes	No	
Yes	47 (52.81%)	42 (47.19%)	**0.003**
No	34 (31.78%)	73 (68.22%)	

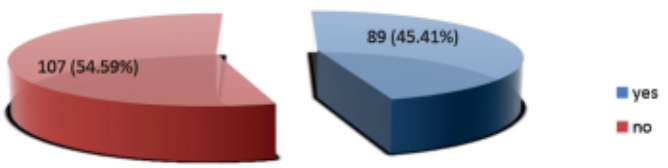

Figure I: *Frequency of anemia in pregnant women (n=196).*

Discussion

Low-birth-weight occurs due to intrauterine growth restriction caused by low hemoglobin concentration, which leads to reduced oxygen supply to fetus and affects angiogenesis of placenta.[13] There is higher risk of low-birth-weight neonates in women who have hemoglobin levels below 10g/dL during pregnancy vs women without anemia during pregnany.[13] In 2011, it was estimated that 38.2% was the prevalence of anemia in pregnancy. Including North America, where is reaches up to 20%, this phenomenon affects the pregnant women worldwide. In Europe, maternal anemia was found to be 24.5 %, where as in Africa, it was 44.6%. Asia and Oceania had 39.3% and 29% maternal anemia prevalence respectively while in Caribbean and Latin America it was found to be 28.3%.[14] Anemia in pregnancy occurs worldwide, affecting not only pregnant women but also leading to undesirable gestational outcomes,[14] that's why it demands prime attention for identification and treatment. Considering the reviews that included women of diverse regions with varying socioeconomic statuses, there is limited study in this aspect. A systemic review, established up to 2014, showed only cohort study, established the association of different outcomes of gestation with various socioeconomic status ranging between lower to middle class.[15] Another review which included cohort as well as case-control methods, was concluded up to 2010 and published in 2013. This review established association of anemia in pregnant women with low weight at birth of infants.[16] Different reviews published between 2012-2015 emphasized the role and effect of iron supplementation associated with low-birth-weight.[17] My study shows that 89(45.41%) pregnant women had anemia. The frequency of LBW was 52.81% in anemic women versus 31.78% in non-anemic women. The linking mechanism of anemia in pregnancy with LBW is not well understood. However, studies done previously have shown that the resultant weight of new born might be affected due to intrauterine growth restriction which is secondary to development of anemia in pregnancy.[18] During the second trimester of pregnancy, about 30-40 ml/Kg plasma is produce physiologically which leads to development of hypervolemia. Contrary to this, the blood cells do not form to this extent, and hemodilution happens which may lead to anemia in pregnancy. Fetal hypoxia is the result of affected angiogenesis of placenta which is stimulated by decreased hemoglobin concentration levels.[19] As placental transportation of nutrients and oxygen to fetus is reduced due to decreased hemoglobin levels,

the potent stimulus for fetal and uterine growth depletes and it results in reduced uterine blood perfusion, increased vascular resistance and restricted growth of trophoblastic surface, that ejects arterial blood of mother into placenta. Resultantly, a compromised fetal-placental connection leads to reduction in gas exchange across placenta and eventually, low-birth-weight occurs.[20] Goldenberg et al,[21] described in study that presence of anemia in pregnant females leads to detrimental effects on their newborns. As the nutritional supply to the growing fetus is compromised to varying extent, the results depend upon severity of anemia in pregnant females. Presence of maternal anemia has a direct relation with gestational age. The most affecting duration is first trimester, in which the growing fetus gets more affected as compared to second or third trimester. Similarly, the resultant effects regarding premature delivery due to premature rupture of membranes associated with low birth weight and post-natal risks of prematurity are much higher in pregnant females who have severe maternal anemia during first trimester as compared to second or third trimester. Mavalankar et al,[22] found that there was greater risk in pregnant females who had anemia during pregnancy to have low-birth-weight babies as compared to those women who did not have anemia during pregnancy. Jones et al,[23] studied and found that there was increased incidence of anemic mothers having low birth weight babies. But on the other hand, its difference from group containing non-anemic mothers was not significant ($p= 0.11$). Badshah et al,[24] found in study that pregnant women having anemia belonging from tribal areas of Pakistan had a strong positive association with low-birth-weight infants showing difference ($p<0.01$) as compared to infants of those mothers who did not have anemia during pregnancy. Moreover, it was also established that there was increased small for gestational age risk in pregnant women with anemia as compared to the women without anemia. Lone et al,[25] in a multi-disciplinary study, showed 1.9 times increased (95% Confidence interval (CI): 1.0-3.4) risk of low-birth-weight incidence in pregnant women with anemia.

Conclusion

This study resulted that, pregnant women have quite high anemia frequency and anemic women have high frequency of low-birth-weight neonates as compared to women without anemia. So, we recommend that public awareness programs should be arranged regarding this major public health issue among women of reproductive age group and for treating clinicians as well, for early screening and management of maternal anemia in order to reduce the low-birth weight neonates.

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Authors Contribution

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EO, FT: Writing of Manuscript