

## The Correlation between Maternal Hemoglobin level and neonatal birth weight

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### Abstract

**Background:** Maternal anemia is associated with maternal and perinatal mortality, low birth weight (LBW), premature delivery, and other adverse outcomes. The study aimed to compare and correlate between maternal Hemoglobin (Hb) level and birth weight in a group of Sudanese pregnant women at delivery.

**Methods:** Prospective cross-sectional study was conducted in Omdurman Maternity Hospital in a period of December 2016 to February 2017 on a total of 150 Sudanese pregnant women at delivery. The study population were divided into three groups; 50 were women with spontaneous preterm delivery at 28-34 week of gestation, 50 were women with low birth weight (LBW) (less than 2.5 Kg), and 50 were women with normal birth weight (NBW). Socio-demographic and obstetric data was recorded. A venous blood sample was collected from all enrolled women, Hb level was measured as part of complete blood count by hematology analyzer.

**Results:** The prevalence of anemia in the study groups were: 60% in women with preterm delivery (mean BW 1.5 kg), 40% in women with LBW (mean BW 2.0 kg), and 8% in women with NBW (mean BW 3.3 kg), the overall prevalence was 36%. The Hb level was significantly lower in preterm (mean: 10.3 g/dl) and LBW (mean: 10.7) than NBW group (mean: 12.3); p-values were < 0.00001. Moreover, there was a moderate positive correlation between maternal Hb value and birth weight in the study population; with correlation coefficient ( $r$ ; 0.40) and correlation of determination ( $R$ ; 0.7). Socio-demographic characteristic and obstetric data was compared; maternal age of < 25 years was significantly associated with LBW ( $p$ . value: 0.02) and was borderline in preterm group ( $p$ . value: 0.07).

**Conclusion:** Maternal Hb level is positively correlate with birth weight, neonates born to the anemic mothers had lower birth weight compared to non-anemic mothers. Maternal- young adult- age is associated with LBW. More attention on antenatal care and nutrition may prevent LBW.

**Keywords:** Maternal, Hemoglobin, Low Birth Weight, Preterm, Birth Outcomes

### Introduction

Anemia is a major health problem that affects 50% of the pregnant women worldwide [1]. According to the World Health Organization (WHO) [2], the diagnosis of anemia in pregnant women is established when the concentration of Hb is below 11 g/dl, this being the borderline between "physiologic anemia during pregnancy" and true anemia during pregnancy. Anemia during pregnancy is associated with high rates of maternal and perinatal mortality, low birth weight, premature delivery, and other adverse birth outcomes [3].

The association between maternal Hb levels during pregnancy and adverse outcomes is controversial. Several researchers have reported that severe anemia in early pregnancy is associated with adverse outcomes, such as low birth weight (LBW) [4-6], although others have revealed no such association [7, 8].

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A study by Yi *et al.*, showed that anemia before pregnancy was associated with an elevated risk of preterm delivery [9]. Kozuki *et al* found that moderate to severe maternal anemia have a link with intra-uterine growth retardation [10]. In Sudan, Elhassan *et al* [11] and Haggaza *et al* [12] in their study to investigate the prevalence of and risk factors for LBW, they found that 12.6% and 14.9% of the neonates had LBW; respectively, maternal anemia was the main risk factor for LBW, and maternal socio-demographic characteristics and anthropometric measurements were not associated with LBW.

Preterm birth defined by WHO as the delivery of the fetus before completed 37 weeks of gestation [13]. Preterm birth accounts for 75% of perinatal mortality and more than half the long-term morbidity world-wide. The association between maternal anemia and preterm birth remains unclear with some [14-16] but no other [17, 18] studies documenting increased risk. Studies have suggested that the link between anemia and preterm

birth may differ according to the time of anemia during gestation. In a case control study, Klebanoff *et al* . [19] found that anemia in the second trimester, was positively associated with preterm delivery; however it did not account for the large ethnic difference in preterm. More recently, a study done in Sudan by Amel et al., they found that preterm birth is frequent with incidence of 3.8%, spontaneous preterm birth being the most type (81%), with infections (periodontal) and nutrition were the risk factors [20].

However, such a controversy of the impact of maternal anemia on adverse birth outcomes encourages scientists to conduct more researches regarding this issue. Thus, our main objective of this prospective study was to compare and correlate between maternal Hb level and adverse birth outcomes (LBW and preterm delivery) in a group of Sudanese pregnant women who gave live singleton birth.

## Subjects and methods

A prospective cross-sectional study was conducted in Omdurman Maternity Hospital-Khartoum in a period of December 2016 to February 2017. A total of 150 Sudanese pregnant women who were admitted to labor room and fulfill the inclusion criteria were enrolled. The First group was women with spontaneous preterm delivery (N/50), the second group was women who gave LBW (N/50) after full term delivery, and the third one were women who gave NBW (N/50).

*Ethical approval:* The present study was approved by the department of Hematology at Faculty of Medical Laboratory Sciences-Khartoum University. Signed consent form was taken from all enrolled women.

*Data collection:* Information included neonate gender and weight was recorded using a questionnaire. Socio-demographic characteristics, reproductive and medical data for the all included women were also recorded; this include maternal age, History of LBW/preterm and miscarriage, family history of LBW, inter-pregnancy interval, parity number, and exposure to any other chronic disease.

*Inclusion and Exclusion Criteria:* Women who were negative for HIV/ HBsAg/ and gave live singleton birth was included. Women who gave neonate with major congenital anomalies or Syndrome complexes, or delivered with cesarean section, or had history of tobacco/ Alcohol/narcotic drug intake, and with heart/renal disease were excluded.

*Procedure:* EDTA-venous blood sample (2 ml) was collected from all enrolled women at delivery; Hb level was measured as part of complete blood count by hematology analyzer. Maternal anemia was considered if Hb was < 11 g/dl. Neonates were weighed immediately and LBW considered if birth weight was < 2.5 kg. Preterm delivery was defined as labor before completed 37 weeks gestational age.

*Data analysis:* Student's t-test and Fisher's exact test were used to analyze and compare variables between study groups. A two tailed P- value of <0.05 was considered statistically significant.

## Results

In this study we compared the Hb values in a group of Sudanese pregnant women at delivery; women with spontaneous preterm delivery (mean age: 28 years), women with LBW (mean age: 28), and women who gave NBW (mean age: 30). The birth weight was differed significantly in the study groups (p. values were < .00001), with mean of 1.5 Kg in preterm, 2.0 in LBW, and 3.3 in NBW group, Table I. However, maternal age was not varied significantly in the study groups.

**Table 1** Comparison of mean (range) of Hb & birth weight in the study groups

	Study groups			T-test, p. value
	Preterm(N/50)	LBW(N/50)	NBW(N/50)	
Maternal Age	28(19-38)	28(19-37)	30(20-40)	0.1
Weight/Kg	1.5(0.9-2.6)	2.0(1.1-2.4)	3.3 (2.6-4.5)	< .00001
Hb g/dl	10.7(6.7-13.3)	10.9(5.2-13.5)	12.3(10.1-14.2)	< .00001
PCV%	32.2(15-43)	33.4(15-41)	37.9(32-43)	< .00001
RBCsX10 <sup>6</sup> / μl	3.8(2.5-4.9)	3.9(2.1-5.2)	4.5(3.6-5.5)	< .00001

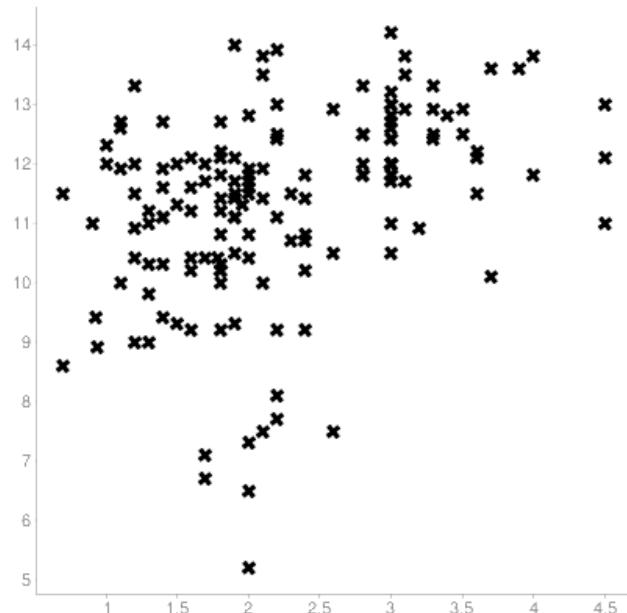
The prevalence of anemia (Hb < 11 g/dl) in the study groups were as follow: 60% in women with preterm delivery, 40% in pregnant women with LBW, and 8% in women with NBW, with overall prevalence of 36%, Table II.

**Table 2** Socio-demographic characteristics of the study groups

Characteristic	Study groups			Fisher test, P. value
	NBW	LBW	Preterm	
Anemia(Hb < 11g/dl)	4	20	30	0.0003
	46	30	20	0.0001
Maternal Age/year > 25 < 25	41	23	32	0.02
	9	27	18	0.07
Fetus gender M F	27	27	30	1.0
	23	23	20	0.68
Parity No ≥3 ≤2	20	25	21	0.42
	30	25	29	1.0
Inter-pregnancy interval/m >24 < 24	11	8	10	0.61
	39	42	40	1.0
History of miscarriage Yes No	17	16	10	1.0
	33	34	40	0.17
History of LBW Yes No	0	2	3	0.49
	50	48	47	0.24
Family History of LBW Yes No	6	7	13	1.0
	44	43	37	0.12

The Hb level was significantly lower in preterm (mean: 10.3 g/dl) and LBW (mean: 10.7) than NBW group (mean: 12.3); p-values were < .00001, Table I.

Moreover, there was a moderate positive correlation between maternal Hb level and birth weight in the study population; with correlation coefficient ( $r$ ); 0.40 and correlation of determination ( $R$ ); 0.7, *Fig 1*. Socio-demographic characteristic and obstetric data was compared in the study groups; maternal age of  $< 25$  years was significantly associated with LBW (*p*. value : 0.02) and was borderline in preterm group (*p*. value: 0.07) in comparison to NBW group, Table II.



**Figure 1** Correlation coefficient ( $r$ ): Hb/birth weight in the study group (N/150)

## Discussion

Maternal anemia is a common health problem in most developing countries. Pregnancy outcomes may vary depending on its type and severity. Although the association between maternal anemia and adverse birth outcomes has been studied widely, the literature is still inconsistent.

Preterm birth and LBW have been demonstrated to contribute significantly to early neonatal deaths [21, 22]. Some studies have demonstrated that severe anemia ( $< 7.0$  g/dl) is associated with birth weight figures which are 200 - 400 g lower than in women with higher ( $> 10$  g/dl) hemoglobin values [23].

In this prospective cross-sectional study an attempt has been made to compare the maternal Hb levels in a group of pregnant women with different birth outcomes (NBW, LBW and preterm delivery) at delivery.

This study revealed that the overall prevalence of anemia at delivery is 36% ( $n=150$ ) among the study groups. Worldwide, several studies have shown a higher degree of anemia in pregnancy, ranged from 43 to 87% [24-27]. In this study, low prevalence of anemia may be related to our small sample size and more frequent iron supplementation consumption. Since the enrolled women

had more visits for prenatal care so they were aware of taking iron supplements. Therefore, it seems that iron deficiency anemia is reasonably lower in this study in comparison to other studies.

The present study also revealed that 60%, 40%, and 8% of women with; preterm delivery, LBW, and NBW, respectively, were anemic. Moreover, Hb level was significantly lower in preterm and LBW than NBW group. Elhassan *et al*., investigated the risk factors for LBW in a case control study in Sudan; they found that significantly more women in a group of LBW had anemia, 65 (67.0%) vs. 27(27.8%) in control group with NBW [11].

A positive correlation between maternal Hb values and birth weights was found in the study group. The higher hemoglobin levels are correlated with higher birth weight values and vice versa. Neonates born to the anemic mothers had lower birth weight compared to non-anemic mothers. Other studies [28-31] are in harmony with the present study and demonstrated the importance of normal hemoglobin level on birth outcome. There is a substantial amount of evidence showing that maternal iron deficiency anemia during pregnancy can be resulted in low birth weight [23]. For example, Bodeau-Livinec *et al*., found women without anemia during the third trimester, in compared to women with severe anemia were at higher risk of low birth weight after adjustment for potential confounding factors [32]. Our study also compared the socio-demographic characteristic and obstetric data; maternal age of  $< 25$  years was significantly associated with LBW and was borderline in preterm group in comparison to NBW group. This was in line with the study of Weng *et al*., who found that infants born to teenagers and women at advanced age possess greater risks for stillbirth, preterm birth, neonatal death, congenital anomaly, and low birth weight, their data suggested that the optimal maternal ages to minimize adverse birth outcomes are 26~30 years [33]. Another study by Restrepo-Méndez *et al*., Who found that excess risk of LBW and preterm among babies born to teenage mothers as a whole, but not for mothers aged  $< 16$  or  $\geq 35$  years [34].

## Conclusion

Neonates born to the anemic mothers had lower birth weight compared to non-anemic mothers. The positive correlation between maternal Hb level and birth weight revealed in this study demonstrates that maternal anemia should be seen as an important predictor for increased perinatal risk. Maternal -young adult- age is associated with LBW. However, more attention on antenatal care and nutrition may prevent LBW and preterm delivery.

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