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ASSOCIATION OF MATERNAL HEMOGLOBIN LEVELS WITH NEONATAL BIRTH WEIGHT: EVIDENCE FROM A TERTIARY CARE HOSPITAL, BAHAWALPUR

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Abstract

Background: *Maternal hemoglobin concentration is key determinant of pregnancy outcomes, directly influencing fetal growth and development. The World Health Organisation (WHO) defines anaemia during pregnancy as haemoglobin levels below 11 g/dL. This condition is very common in low- and middle-income nations, including Pakistan, and has been connected to poor neonatal outcomes like low birth weight (LBW).*

Aim and Objective: *The purpose of this study was to ascertain whether maternal haemoglobin levels and neonatal birth weight were related in pregnant women giving birth in the Central Labour Room (CLR) of the Tertiary Care Hospital in Bahawalpur. The goal was to produce localised evidence that would inform maternal health interventions and clinical decision making in Southern Punjab.*

Methodology: *71 mother-infant pairs' hospital-based data were used in a cross-sectional analytical study. Haemoglobin level, delivery method, neonatal birth weight, maternal age, gravidity, parity, and gestational age were all noted. Birth weight was determined right after delivery, and haemoglobin levels were assessed during the prenatal phase. The association between maternal haemoglobin levels and neonatal birth weight was evaluated through the use of descriptive statistics and Pearson's correlation coefficient.*

Results: *The average neonatal birth weight was 2.75 ± 0.48 kg, and the average maternal haemoglobin was 10.31 ± 0.90 g/dL. Higher maternal haemoglobin levels were linked to higher neonatal birth weights, according to a statistically significant moderate positive correlation between maternal haemoglobin level and neonatal birth weight ($r = 0.451$, $p < 0.01$).*

Conclusion: *The study shows that neonatal birth weight is significantly influenced by the haemoglobin status of the mother. For optimum foetal growth*

and to lessen the burden of LBW in resource-constrained environments, these results highlight the significance of timely iron supplementation, nutritional counselling, and routine anaemia screening during pregnancy

INTRODUCTION

Future generations' general health trajectory and neonatal outcomes are significantly influenced by maternal health. The level of haemoglobin (Hb) during pregnancy is one of the most important biomarkers of maternal health among the many others. Reduced Hb levels, also known as anaemia, are acknowledged as a major global health concern, particularly in low- and middle-income countries (Rahman, Abe et al. 2016, Tunçalp, Pena- Rosas et al. 2017). Haemoglobin helps transport oxygen to both maternal and foetal tissues. The World Health Organisation (2021) estimates that anaemia affects 40% of pregnant women worldwide, greatly raising the risk of unfavourable perinatal outcomes.

Another important factor influencing long-term physical development, cognitive potential, and newborn survival is birth weight. Less than 2.5 kg is considered low birth weight (LBW) by the World Health Organisation (WHO) (Kozuki, Lee et al. 2012) and LBW is closely associated with increased risks of neonatal morbidity, mortality, and chronic diseases in adulthood (Rahman, Abe et al. 2016). Although a variety of maternal and environmental factors, such as haemoglobin status, infections, parity, gestational age, and BMI, affect neonatal birth weight, maternal anaemia is still one of the most controllable (Young, Oaks et al. 2019).

According to estimates, approximately 51% of expectant mothers in Pakistan suffer from anaemia, which is a startlingly high prevalence among pregnant women (Mahmood and Sultan 2006, Mubashir and Kiyani 2013). In areas with limited resources, like Southern Punjab, this burden is especially heavy. LBW and other high-risk obstetric cases complicated by anaemia are routinely managed at central labour room of tertiary care hospital, a major tertiary referral centre in Bahawalpur (Grover, Sharma et al. 2023). Maternal anaemia and its effects endure in spite of standard prenatal treatments like iron supplementation, haemoglobin testing, and organised maternal health visits (WHO, 2016). This paradox implies that there are underlying context-specific elements at work that general guidelines might not be able to address.

There are conflicting results in the literature assessing the relationship between maternal haemoglobin levels and neonatal birth weight worldwide. According to some research, there is a significant inverse correlation between LBW and lower Hb concentrations (Haider and Bhutta 2017). Contradictory evidence is presented by others. For example, Young et al. (2019) found a U-shaped relationship between maternal Hb levels and poor neonatal outcomes, such as LBW and preterm birth (Young, Oaks et al. 2019).

Pregnancy requires significant haematologic adaptation from a physiological standpoint. While red cell mass increases more modestly, plasma volume expands significantly during gestation, by as much as 50% by term to accommodate foetal growth (Sekhavat, Davar et al. 2011). Dilutional anaemia, which is regarded as a normal adaptation during pregnancy, is the result of this disparity. According to Laflamme (2011), haemoglobin levels normally decrease during the first and second trimesters before increasing once more as the pregnancy approaches term (Laflamme 2011). Haemoglobin levels below 11.0 g/dL in the first and third trimesters and below 10.5 g/dL in the second trimester are considered anaemia, per WHO guidelines (WHO 1998).

Anaemia in the first and third trimesters is linked to a markedly higher risk of giving birth to LBW babies, according to a systematic review by Ahankari and Leonardi-Bee (2015). In order to reduce unfavourable neonatal outcomes, they underlined the significance of regular haemoglobin monitoring during pregnancy and prompt anaemia management (Ahankari and Leonardi-Bee 2015). This connection was further supported by Tabrizi and Barjasteh (2015), who demonstrated that in Iran, maternal anaemia was substantially linked to both LBW and intrauterine growth restriction (IUGR) (Tabrizi and Barjasteh 2015). Similar to this, Safithri, Kania et al. (2019) suggested that maternal haemoglobin levels

affect uteroplacental circulation, oxygenation, and nutritional transfer all of which have a direct effect on foetal weight gain (Safithri, Kania et al. 2019).

Evidence-based decision-making is hampered locally by the dearth of organised, population-specific research on this topic. In the absence of local data, the majority of obstetricians at central labour room of tertiary care hospital, rely on clinical judgement and international guidelines. In order to better inform regional healthcare protocols, Qureshi et al. (2016) emphasised this gap and argued for context-specific maternal health research (Qureshi, Sheikh et al. 2016).

Three urgent observations provide the justification for this investigation. First, among women who present to central labour room of tertiary care hospital, maternal anaemia is still very common. Second, even when antenatal care protocols were followed, LBW is consistently observed. Third, there isn't any local institutional research at the hospital to help clinicians manage anaemia in a way that directly enhances neonatal outcomes.

The purpose of this study is to investigate the relationship between neonatal birth weight and maternal haemoglobin levels in women giving birth at central labour room of tertiary care hospital, Bahawalpur. The study aims to produce context-specific evidence by looking at retrospective clinical data, which will help maternal health professionals, clinicians, and policymakers create interventions that will improve maternal and newborn outcomes in South Punjab.

Research Objectives:

1. To determine the association between maternal hemoglobin level and neonatal birth weight.
2. To estimate the prevalence of anemia in pregnant women admitted at central labour room of tertiary care hospital, Bahawalpur.

Research Question:

What is the association between maternal hemoglobin level and neonatal birth weight in pregnant women at CLR, BVH Bahawalpur?

Literature Review

2.1 Introduction

Understanding the relationship between maternal haemoglobin (Hb) levels and neonatal birth weight requires a thorough grasp of maternalfetal physiology and epidemiology. In low- and middle-income countries (LMICs), maternal anaemia is still a major concern, while birth weight is a crucial factor in determining neonatal survival, growth, and long-term health. This chapter provides context for the current study, reviews local and global evidence, and identifies knowledge gaps.

2.2 Maternal Anemia and Its Global Burden

One of the most prevalent nutritional deficiencies affecting pregnant women worldwide is anaemia, which is defined as a decreased haemoglobin concentration. According to estimates from the World Health Organisation (WHO, 2021), anaemia affects about 40% of pregnant women globally, with South Asia and Sub-Saharan Africa having the highest rates (Owais, Merritt et al. 2021). According to data from Pakistan's National Health Survey, the prevalence among pregnant women is between 50% and 60%, with a disproportionate impact on rural and disadvantaged populations (Mahmood and Sultan 2006). The majority of cases of irondeficiencyanaemia are caused by inadequate nutrition, parasitic infections, and restricted access to prenatal care (Rahman, Abe et al. 2016).

2.3 Importance of Birth Weight

One of the best indicators of neonatal mortality and morbidity is still birth weight. According to Kozuki, Lee et al. (2012), the WHO defines low birth weight (LBW) as less than 2.5 kg, a threshold associated with increased risks of infection, malnutrition, and long-term developmental delays (Kozuki, Lee et al. 2012). Infant mortality is greatly increased by LBW, particularly in LMICs with inadequate neonatal care facilities. The multifactorial determinants of birth weight, such as maternal nutrition, health status, gestational age, socioeconomic factors, and use of prenatal care, are well documented by epidemiological research (Sukrat, Wilasrusmee et al. 2013, Young, Oaks et al. 2019).

2.4 Relationship Between Maternal Hb and Birth Weight: Global Evidence

The relationship between maternal anaemia and neonatal outcomes, specifically birth weight, has been the subject of numerous studies. A seminal

study conducted in South Asia found a strong negative relationship between birth weight and low maternal haemoglobin levels, particularly less than 9 g/dL, which is associated with a higher risk of LBW and small forgestationalalage (SGA) babies (Kozuki, Lee et al. 2012). In a similar vein, Rahman and colleagues (2016) verified that moderate to severe anaemia (Hb < 10 g/dL) is linked to a higher risk of LBW and preterm birth through a systematic review and metaanalysis across LMICs (Rahman, Abe et al. 2016).

Other research, though, has produced more complex or even contradictory findings. In a thorough metaanalysis, Young et al. (2019), for example, reported a U-shaped relationship: poor placental perfusion at either extreme may impair foetal growth(Young, Oaks et al. 2019). This relationship was found to be associated with both low and excessively high maternal Hb concentrations. Furthermore, moderate anaemia did not significantly affect birth weight in some regions, according to Haider and Bhutta (2013) (Haider and Bhutta 2017). This could be because of variations in the aetiology of anaemia or compensatory maternal adaptations.

2.5 Contextual and Regional Insights

Although international research expands our knowledge, there are few studies that focus on a particular region. Although there has been little in-depth examination of the relationships between Hb and BW, data from urban tertiary centres in Pakistan indicate a high prevalence of maternal anaemia and related neonatal outcomes. The ongoing prevalence of maternal anaemia and LBW was confirmed by (Grover, Sharma et al. 2023) during a clinical audit in South Punjab; however, their analysis did not thoroughly examine the direct relationship between Hb values and neonatal weight. Similar to this, localised evidence is needed to guide antenatal interventions, according to healthcare providers in the area (Qureshi, Sheikh et al. 2016). However, the studies that are currently available are either limited or unpublished.

Maternal anaemia and neonatal LBW may be related, according to some rural community surveys conducted in nearby provinces; however, confounders such as maternal socioeconomic status, infection burden, and antenatal nutrition were not sufficiently controlled for (Sukrat, Wilasrusmee et al. 2013). As a result, there isn't a solid hospital-based study looking at the relationship between Hb and birth weight in a tertiary care population like BVH, Bahawalpur, where high-risk pregnancies converge.

2.6 Gaps and Controversies

1. Heterogeneity of Findings: The development of universal clinical guidelines is hampered by the conflicting or nonlinear associations found in global studies.
2. Local Context Deficit: Although Pakistan has a high rate of maternal anaemia, there is a lack of thorough, locally focused research assessing particular maternal haemoglobin thresholds and how they affect neonatal weight, especially at tertiary facilities like BVH.
3. Variable Interactions: Many studies do not examine the shape of the relationship (linear vs. Ushaped) or take into consideration confounders (e.g., parity, gestational age, booking status).
4. Practice Disconnect: Without evidence specific to local populations, clinicians in the area frequently rely on national or WHO recommendations, which may lead to less-than-ideal management techniques.

2.7 Rationale for the Present Study

A vital need for local, context-sensitive evidence is addressed by this study in light of these shortcomings. Through the examination of central labour room of tertiary care hospital, Bahawalpur's retrospective data, the study will:

- Calculate the relationship between the newborn's birth weight and the mother's haemoglobin levels.
- Determine if the relationship is linear or nonlinear.
- Calculate the burden of LBW and the local prevalence of anemia in this tertiary centre environment.
- Give South Punjab empirical data to support community health planning, prenatal care, and clinical judgments.

2.9 Summary

In conclusion, maternal anemia is still a major problem on a global and regional scale and is closely linked to poor neonatal outcomes, such as LBW. Although there is evidence linking low maternal

hemoglobin to lower birth weight, results can vary depending on the situation. There is a notable lack of regional data, particularly from South Punjab's tertiary hospitals. By examining the Hb and birth weight relationship using hospital based data from central labour room of tertiary care hospital, the current study seeks to close these gaps and provide evidence that is relevant to both clinical practice and policy.

Methodology

To evaluate the relationship between maternal haemoglobin levels and neonatal birth weight in pregnant women admitted to the central labour room of tertiary care hospital, Bahawalpur, this study used a correlational cross-sectional design. Retrospective data taken from hospital delivery records was used in the study. Women with singleton pregnancies who had recorded maternal haemoglobin levels and neonatal birth weights at delivery were included in the study population. Women with incomplete records, stillbirths, or multiple gestations were not included. The final sample size consisted of 71 cases, chosen based on the completeness and availability of hospital records using a nonprobability consecutive sampling technique.

A structured extraction sheet was used to gather the data, and SPSS (version 23) was used for analysis. The association between haemoglobin levels and birth weight was investigated using Pearson correlation, and descriptive statistics (mean, standard deviation, frequency) were calculated for clinical and demographic variables. The Institutional Review Board (IRB) of tertiary care hospital, granted ethical approval, and stringent confidentiality protocols were implemented to safeguard patient identities. The study's limitations include the inability to account for confounding factors like maternal nutrition or socioeconomic status and the potential for the singlecenter, retrospective design to restrict how broadly the results can be applied.

Results

Descriptive Statistics:

This study included 71 pregnant women who gave birth at the central labour room of tertiary care hospital, Bahawalpur. The majority of participants were in the peak reproductive age group, with a small number of adolescent and older mothers represented. The mean maternal age was 26.3 ± 4.68 years, with a minimum age of 17 and a maximum age of 40.

Table:1 Demographics

Variables	Mean	Std. Deviation	Min. Value	Max. Value
Age (Years)	26.3	4.68	17	40
Gestaional Age (Weeks)	35.58	1.32	32	39.3
Gravida	3.2	1.25	1	6
Parity	2.11	1.16	0	5
Maternal Hb Level (g/dl)	10.31	0.90	8.10	12.3
Neonatal Weight (kg)	2.75	0.48	2	4

With a range of 32 to 39.3 weeks and a mean gestational age at delivery of 35.58 ± 1.32 weeks, it appears that many deliveries took place prior to fullterm gestation. With a range of 1 to 6, the mean gravida was 3.2 ± 1.25, indicating that most women were multiparous. A significant number of participants had prior live births, while some were primiparous, as indicated by the mean parity of 2.11 ± 1.16, which ranged from 0 to 5.

The maternal haemoglobin level ranged from the lowest at 8.10 g/dL to the highest at 12.3 g/dL, with a mean of 10.31 ± 0.90 g/dL. This mean value suggests that a significant percentage of participants were anaemic (Hb < 11 g/dL) according to WHO criteria. Neonatal birth weight ranged from 2.0 kg to 4.0 kg, with a mean of 2.75 ± 0.48 kg. The minimum value indicates the presence of low birth weight (LBW) infants in the study cohort, even though the average birth weight is within the normal range.

Mode of Delivery:

The distribution of delivery methods among study participants is shown in Figure 1. Only 13 (18.3%) of the 71 deliveries were made spontaneously vaginally (SVD), whereas 58 (81.7%) were delivered by caesarean section (C-section). This suggests that compared to typical vaginal births, the study population had a significantly higher prevalence of C-section deliveries. Obstetric complications, foetal distress, maternal anaemia, or other medical indications may be the cause of the high rate of surgical deliveries.

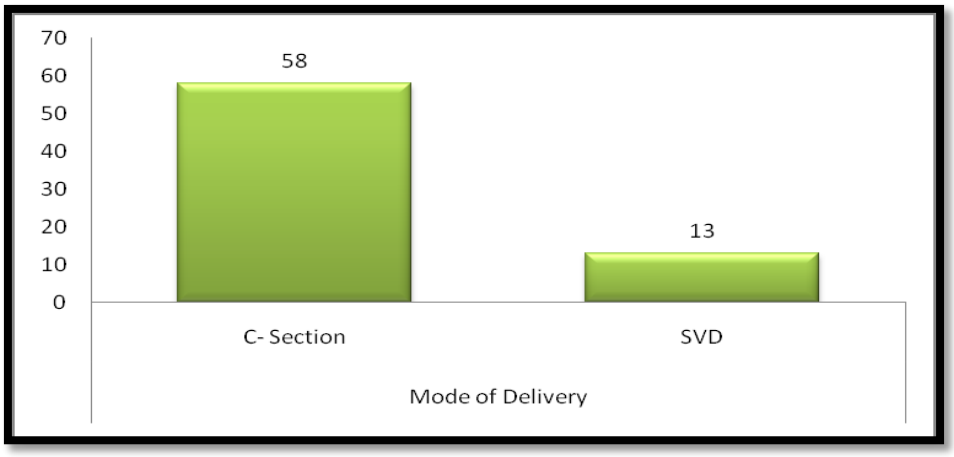

Figure 1: Mode of Delivery

Post Partum Hemmorrhage:

The prevalence of postpartum haemorrhage (PPH) among study participants is shown in the bar chart: 17 women (23.9%) experienced PPH out of 71 deliveries, whereas 54 women (76.1%) did not. This means that almost one-fourth of the participants were impacted by this potentially fatal obstetric complication, underscoring the significance of efficient preventive and management strategies in the clinical setting.

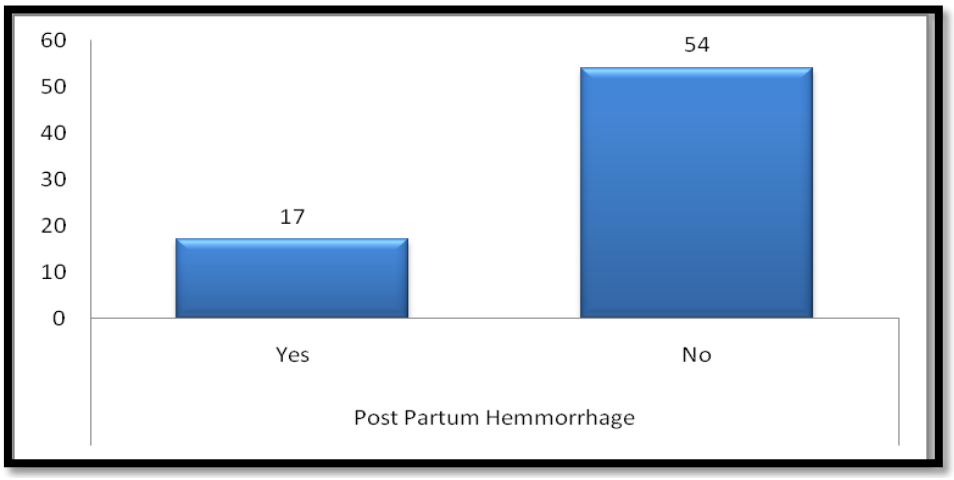

Figure 2: Post Partum Hemmorrhage

Inferential Statistics:

Pearson's correlation analysis showed a moderate positive relationship between the mother's haemoglobin level and the baby's birth weight ($r = 0.451$, $p < 0.01$). This means that higher haemoglobin levels were strongly linked to higher birth weights. Based on data from 71 mother-infant pairs, this relationship was statistically significant at the 1% level.

Correlation

Variable	Statistics	Weight (Kg)	Maternal Hb Level
Weight (Kg)	Pearson Correlation	1	0.451
	Sig. (2-tailed)		0.001
	N	71	71
Maternal Hb Level	Pearson Correlation	0.451	1
	Sig. (2-tailed)	0.001	
	N	71	71

Table 2: Pearson Correlation

Discussion:

This study's results give us important information about how maternal haemoglobin levels affect the birth weight of babies born to women who gave birth at the central labour room of tertiary care hospital, Bahawalpur. Pearson's correlation coefficient showed a statistically significant moderate positive relationship ($r = 0.451$, $p < 0.01$) between the amount of haemoglobin in the mother's blood and the weight of the baby at birth. This means that anaemia in pregnant women may have a big effect on how well their babies grow in this group.

This finding fits with what a number of other studies have found. Lone et al. (2004) found that having anaemia while pregnant was strongly linked to having a baby with a low birth weight, especially when haemoglobin levels dropped below 10 g/dL (Lone, Qureshi et al. 2004). In a metaanalysis of low- and middle-income countries, Rahman et al. (2016) found that maternal anaemia raised the risk of having a low-birth-weight baby by as much as 30% (Rahman, Abe et al. 2016). In an Indian population, Kalaivani (2009) also showed a strong connection between low maternal haemoglobin and lower neonatal weight (Kalaivani 2009).

The results of this study, however, are in contrast to those of Baig, Jamal et al. (2020), who found no statistically significant correlation between neonatal birth weight and maternal haemoglobin in a Lahore tertiary hospital(Baig, Jamal et al. 2020). These discrepancies could be caused by variations in sample sizes, regional dietary customs, haemoglobin measurement timing, or obstetric procedures. According to Young et al. (2019), there may be a U-shaped relationship rather than a straightforward linear one between maternal haemoglobin levels and unfavourable outcomes (Young, Oaks et al. 2019).

In line with national statistics for Pakistan, particularly in rural and impoverished areas like Southern Punjab, the average haemoglobin level in our study (10.31 g/dL) suggests a high prevalence of anaemia among participants (Zaidi, Riaz et al. 2015). The prevalence of low birth weight cases (minimum 2.0 kg) highlights the persistent public health concern, even though the mean neonatal birth weight (2.75 kg) was within the normal range. These results support the necessity of focused prenatal anaemia prevention measures.

It is necessary to recognise certain limitations, though. The study's retrospective design depended on hospital records, which might be lacking in some variables or incomplete, including maternal BMI, socioeconomic status, and food consumption. Furthermore, the results may not be as broadly applicable to other populations due to the singlecenter design. To confirm these findings, it is advised that future research employ prospective designs with bigger, more varied samples and control for confounding variables.

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