e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(5); 1841-1845

Original Research Article

Study of Relationship between Foetus, Neonatal & Maternal Hemoglobin Level

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Received: 25-02-2024 / Revised: 23-03-2024 / Accepted: 26-04-2024
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Conflict of interest: Nil

Abstract:

Background: Maternal haemoglobin levels affect pregnancy outcomes and the mother's and neonate's health. This cohort study examined the relationship between the mother's blood haemoglobin levels over the three trimesters and the neonates at birth.

Methods: About 200 pregnant Territory Care Centre patients participated in the study. Researchers measured the mother's haemoglobin in the third trimester. After giving birth, they checked foetal and neonatal cord blood levels. To summarise haemoglobin levels, descriptive statistics such mean ± SD, range, median (IQR), and percentages were used. An ANOVA comparing trimesters and a correlation analysis were performed to determine associations between maternal, foetal, and neonatal haemoglobin levels.

Results: Maternal haemoglobin levels dropped from 11.5 ± 1.2 g/dL in the first trimester to 11.2 ± 1.0 g/dL in the second trimester. It went up a little to 11.8 ± 1.3 g/dL in the third trimester. When the neonatal were born, their haemoglobin levels were always higher than their mothers' levels. They were measuring 14.0 ± 1.5 g/dL. A lot of neonatal haemoglobin (13.8 ± 1.4 g/dL) was also seen. During the second and third trimesters, the number of participants whose haemoglobin levels were less than 11 g/dL went down.

Conclusion: This study shows how changes in a mother's blood levels during pregnancy affect the health of the neonatal and the mother. A healthy mother is very important during pregnancy because higher amounts of haemoglobin in the neonatal and mother indicate that the placenta is moving oxygen around well. Finding and treating maternal anaemia early may improve the result of the pregnancy, which shows how important it is to give full care to mothers.

Keywords: Anaemia, Foetal Hemoglobin, Maternal Health, Neonatal Outcomes, Pregnancy.

Introduction

During pregnancy, haemoglobin in the mother's blood makes sure that the neonatal gets enough oxygen [1]. For the best growth and development of the foetus, maternal and neonatal haemoglobin levels must be checked during prenatal care and neonatal health assessment.

Background of Hemoglobin Levels in Pregnancy: Red blood cells carry oxygen all over the body with the help of the protein haemoglobin. During pregnancy, a woman's haemoglobin levels are affected by many bodily changes, such as her blood volume going up and her hormones changing [2].

The mother's and neonate's increased air needs produce these modifications. Because plasma volume rises during pregnancy, haemoglobin levels normally drop. Iron deficiency anaemia can drop these levels significantly [3]. Foetuses and neonates' haemoglobin levels alter greatly during growth. The uterus' predominant haemoglobin is foetal (HbF) and it is replaced by adult haemoglobin (HbA) after birth [4].

Hemoglobin Levels in Foetus, Neonate, and Mother: Mother and neonatal haemoglobin levels during pregnancy provide vital health data. Anaemia screening and treatment can avoid premature birth, low birth weight, and neonatal death [5]. Haemoglobin levels indicate oxygen uptake and neonatal anaemia risk. Early neonatal health development is possible. Health care providers can better tailor prenatal and postnatal care by studying mother and neonatal haemoglobin levels. By managing maternal haemoglobin levels, healthcare providers can improve neonatal health and prevent pregnancy complications [6].

Objectives of the Study

1. To discover if maternal haemoglobin levels during pregnancy affect neonatal haemoglobin levels after birth.
2. To understand how maternal haemoglobin affects gestational age and birth weight.
3. To Survey Territory Care Centre patients for maternal anaemia and its relationship to neonatal anaemia.

Maternal Hemoglobin Levels during Pregnancy: Haemoglobin concentration reduces in the first trimester as plasma volume expands, reaches its lowest point around mid-pregnancy, and then rises again as the neonatal nears term. [7] The mother and developing foetus have greater oxygen needs, thus this physiological adaptation helps meet them. [8] Suggests that socioeconomic status, parity, and maternal age may affect maternal haemoglobin levels.

Impact of Maternal Hemoglobin Levels on Foetal and Neonatal Outcomes: Haemoglobin levels affect the developing foetus and mother's health substantially. Low maternal haemoglobin, which indicates anaemia, can cause preterm delivery, IUGR, and low birth weight [9]. Insufficient maternal haemoglobin during pregnancy can increase neonatal morbidity and mortality. However, high maternal haemoglobin levels can cause preeclampsia and gestational hypertension, which are rare. Due to their delicate balance, maternal haemoglobin levels must be monitored and managed during pregnancy to optimise mother and neonatal health.

Factors Influencing Hemoglobin Levels in Pregnancy: Genetics, iron intake, nutrition, chronic conditions, and infections might affect pregnancy haemoglobin levels. Low-resource pregnant women without prenatal care and nutritional supplementation are more likely to develop iron deficiency anaemia, a leading cause of low maternal haemoglobin [10].

Gaps in Current Research Related to Hemoglobin Levels in Pregnancy: Maternal haemoglobin levels are connected to neonatal health throughout pregnancy, but longer-term studies are needed to prove this and eliminate confounding factors. Innovative therapies like iron supplementation and tailored nutrition may alter maternal haemoglobin and neonatal outcomes. To promote global neonatal and mother health, more inclusive research methodologies are needed to address ethnic and geographic haemoglobin level inequalities. These knowledge gaps must be solved to provide evidence-based prenatal care policy to improve mother and neonatal health worldwide.

Methods

Study Design: At Territory Care Centre, researchers retrospectively examined maternal, foetal, and neonatal haemoglobin levels. Retrospective studies use medical record data to illuminate past events and consequences without affecting patient treatment. This approach allows correlations between variables over time to reveal haemoglobin dynamics during pregnancy and delivery.

Sample Size and Study Location: The researchers sampled 200 pregnant women and their neonatal from Territory Care Centre for prenatal and postnatal care. This statistically significant sample size showed a robust association between maternal haemoglobin levels throughout pregnancy and neonatal outcomes.

Inclusion Criteria

1. Pregnant women who visited Territory Care Centre.
2. Full medical records include the mother's and neonatal's haemoglobin levels during pregnancy and birth.

Exclusion Criteria

1. Incomplete medical records or missing haemoglobin data in pregnant women.
2. Territory Care Centre does not provide critical care for neonates with congenital abnormalities impacting haemoglobin levels.
3. Unrecorded maternal or neonatal haemoglobin values within prescribed timeframes.

Data Collection Methods: We examined Territory Care Center's electronic medical records for this information. Mothers' age, parity, socioeconomic status, medical history (including chronic disease and nutritional condition), and laboratory results (including haemoglobin levels during each trimester) are collected. Neonatal data includes neonatal' weight, gestational age, Apgar ratings, and umbilical cord blood sample neonatal haemoglobin levels. Important information must be collected using this systematic method to accurately assess maternal-neonatal haemoglobin status connections.

Ethical Considerations and Approval: Territory Care Center's IRB approved the study before data was gathered. The Declaration of Helsinki standards ensure that patient data is kept private and anonymous. All data is processed in accordance with institutional privacy regulations, and only permitted data collectors and analysts have access to patient medical information. Anonymized data and a retrospective design permitted the study to waive informed consent, decreasing participant risks without compromising research validity.

Results

Demographic Table

Table 1: Demographic Table

Demographic Characteristic	Frequency (%)
Age (years)	20-30: 40%, 30-40: 50%, 40-50: 10%
Parity	Nulliparous: 60%, Multiparous: 40%
Socioeconomic Status	Low: 30%, Middle: 50%, Upper: 20%
Medical History	None: 70%, Chronic disease: 30%
Nutrition Status	Adequate: 60%, Deficient: 40%

The demographic table summarises Territory Care Centre's study population's key characteristics. Most participants were 20–30 years old (40%), with 50% in 30–40 and 10% in 40–50.

The parity distribution indicated 60% nulliparous and 40% multiparous, reflecting the patients' diverse obstetric histories. Thirty percent were poor, fifty percent middle class, and twenty percent upper class. Medical data showed that 70% of women had no chronic diseases, whereas 30% had, raising worries about their pregnant health. Nutrition status showed that 60% of pregnant women had enough nutrition and 40% were deficient, indicating varying dietary choices. This demographic information provides a complete picture of the study population, which is essential for assessing the potential effects of these variables on mother and neonatal health outcomes related to gestational haemoglobin levels.

Presentation of Findings

Table 2: Presentation of Findings

Hemoglobin Level (g/dL)	First Trimester	Second Trimester	Third Trimester	Foetal (Cord Blood)	Neonatal (Cord Blood)
Mean ± SD	11.5 ± 1.2	11.2 ± 1.0	11.8 ± 1.3	14.0 ± 1.5	13.8 ± 1.4
Range	9.8 - 13.7	9.5 - 12.8	10.2 - 14.5	12.5 - 15.5	12.0 - 15.0
Median (IQR)	11.3 (10.8 - 12.0)	11.0 (10.5 - 11.8)	11.7 (11.0 - 12.5)	14.2 (13.5 - 14.8)	13.9 (13.2 - 14.5)
Percentage < 11 g/dL	25%	30%	20%	15%	18%

The table shows haemoglobin levels in the mother, foetus, and neonatal throughout pregnancy and after birth. The first trimester mean maternal haemoglobin level was 11.5 g/dL, with a standard variation of 1.2 g/dL, demonstrating that levels were consistent across the sample. The level of haemoglobin is usually fine, with a median of 11.3 g/dL (IQR: 10.8–12.0) and a range of 9.8–13.7. The average amount of haemoglobin in the mother was 11.0 g/dL (IQR: 10.5–11.8), but it ranged from 9.5 to 12.8 g/dL in the second trimester. It then went down to 11.2 g/dL ± 1.0 g/dL. The foetus and neonatal had higher haemoglobin levels than the mother, indicating efficient oxygen transfer through the placenta (14.0 g/dL ± 1.5 g/dL, range: 12.5 g/dL - 15.5 g/dL, median: 14.2 g/dL, IQR: 13.5 - 14.8). From the second to the third trimester, the percentage of participants with haemoglobin levels below 11 g/dL decreases, suggesting good maternal nutrition and health.

Statistical Analysis Methods Used

SPSS 25 was used for statistical analysis. Descriptive statistics including mean, SD, median, IQR, and range were used to summarise haemoglobin levels. All subjects had haemoglobin levels below 11 g/dL during each trimester, foetal, and neonatal. ANOVA was used to compare trimester mean haemoglobin levels. If significant differences were found, post-hoc Tukey testing was used for pairwise comparisons. The relationship between maternal haemoglobin and foetal/neonatal outcomes was examined using Pearson correlation coefficients. A significance level of $p < 0.05$ was employed.

Discussion

The physiological alterations described in research support the normal trend of maternal haemoglobin levels decreasing from the first to the second trimester and then slightly increasing in the third. This indicates that pregnancy requires more oxygen transport since foetal and neonatal haemoglobin levels are higher than mother levels at delivery. Haemoglobin levels in the foetus and neonatal were much higher than those in the mother, which was important for development and growth. It suggests the placenta transfers oxygen well. Percentages of people with haemoglobin levels below 11 g/dL emphasise the importance of monitoring and regulating maternal nutrition and health to avoid unfavourable pregnancy outcomes connected to maternal anaemia.

Table 3: Comparison Table of Studies on Maternal Hemoglobin Levels

Study Title	Study Type	Sample Size	Key Findings	Limitations
Current Study	Retrospective Cohort	200	Decline in maternal hemoglobin from first to third trimester. Higher foetal and neonatal hemoglobin at birth.	Single-center study, retrospective design limits causal inference. Potential data biases.
Study 1 [13]	Prospective Cohort	500	Stable maternal hemoglobin across trimesters. Moderate foetal hemoglobin levels.	Limited to urban populations. Lack of long-term follow-up on neonatal outcomes.
Study 2 [14]	Cross-sectional	300	Correlation between maternal anaemia and low birth weight.	Reliance on self-reported data. Variability in anaemia definition across different settings.
Study 3 [15]	Meta-analysis	200	Meta-analysis of 15 studies. Significant association between maternal anaemia and preterm birth.	Heterogeneity across included studies. Potential publication bias.

This retrospective cohort analysis helps explain how maternal haemoglobin dynamics affect neonatal and foetal outcomes. Foetal and neonatal cord blood samples had higher haemoglobin levels at birth, while maternal levels dropped considerably from the first to the third trimester. These findings emphasise the necessity of placental transport and oxygenation for foetal development. Study 1, a prospective 500-person cohort, lacked comprehensive neonatal outcomes follow-up. The researchers found similar maternal haemoglobin levels across trimesters. This study showed the need for longitudinal examinations to fully understand how the mother's haemoglobin status affects the neonate's health. Study 2, a 300-person cross-sectional study, examined low birth weight and maternal anaemia. It found a substantial association, although self-reported data and different anaemia definitions may make the conclusions unreliable or unapplicable. Study 3, a 200-person meta-analysis of 15 studies, found a link between preterm delivery and maternal anaemia. Due to publication bias and study heterogeneity, the aggregated results may have been weaker. Overall, these studies show the complex link between maternal haemoglobin and pregnancy outcomes. This study shows distinct patterns in haemoglobin levels throughout time and emphasises the need for standardised techniques and rigorous follow-up to better understand and treat maternal anaemia in different populations.

Strengths and Limitations of the Study

Its extensive retrospective design allowed the study to analyse a large sample size across trimesters and at delivery, one of its key strengths. The implications of haemoglobin dynamics on foetal and neonatal health during pregnancy have been better understood thanks to rigorous statistical methods. The study cohort's haemoglobin variations were better comprehended with demographic factors such age, parity, socioeconomic position, and medical history. The study's retrospective approach makes causal inferences challenging and introduces data availability and completeness biases. Because they employ medical records for data collection, two healthcare providers may have used different documentation and data quality standards. As a single-center study, results may not apply to wider groups with different demographics and geographic factors.

Recommendations for Future Research

Future research should examine haemoglobin levels during pregnancy and postpartum using biochemical and clinical indicators to assess long-term impacts on mother and neonatal health. Nutritional therapy and healthcare may enhance maternal haemoglobin status and minimise pregnancy-related anaemia issues, however prospective trials are needed. Comparative studies of diverse populations and regions are needed to understand regional haemoglobin dynamics and their effects on neonatal and maternal health. Recent advances in biomarker technologies and genetic profiling may illuminate the inherited factors that affect haemoglobin management during pregnancy, making personalised maternal healthcare possible. Healthcare professionals, researchers, and governments must work together to improve maternal haemoglobin levels and pregnancy outcomes worldwide. This study illuminates haemoglobin dynamics during pregnancy and delivery, but further research is needed to address gaps and eliminate barriers in maternal health care.

Conclusion

This retrospective cohort analysis revealed maternal, foetal, and neonatal haemoglobin dynamics during pregnancy and birth. The finding that cord blood samples at birth have higher haemoglobin concentrations and maternal haemoglobin levels decline from the first to the third trimester is significant. These results show

how important it is for foetal growth for the placenta to move nutrients and oxygen around. The study's clinical outcomes emphasise the importance of monitoring and controlling the mother's haemoglobin levels during pregnancy for best results.

Research shows that treating pregnant anaemia early minimises the risk of low birth weight and early delivery. Utilise food advice and iron supplements to enhance the mother's haemoglobin and the neonatal's health. It appears that demographics and location affect maternal haemoglobin, requiring further study.

These findings should be validated and studied in bigger, more diverse longitudinal studies to establish if other factors affect pregnant women's haemoglobin levels. Pregnant women need adequate haemoglobin levels, and this study recommends new maternal anaemia treatments.

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