**International Journal of Academic Research and Development**
**www.academicjournal.in**
**ISSN: 2455-541X**
**Received: 29-12-2021, Accepted: 13-01-2022, Published: 29-01-2022**
**Volume 7, Issue 1, 2022, Page No. 31-34**

# Association between maternal hemoglobin level and poor pregnancy outcomes: A cross-sectional study

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**Abstract**
**Background:** Anaemia is one of the most important factors influencing maternal morbidity and mortality and also the health of the newborn. It is a global health issue affecting nearly half of pregnant women. This study aimed to assess the association of maternal hemoglobin level with poor pregnancy outcomes.
**Methods:** It was a cross-sectional study that included 2 study centers. As per inclusion/exclusion criteria, this study included 650 post-partum mothers. Using Stratified random sampling study participants were enrolled. Data were collected and analyzed in SPSS 23. Using statistical tests i.e., Chi-square, etc data was analyzed.
**Results:** Anaemic mothers had a statistically significant association with low birth weight ($\chi$2-19.921, p-0.000) and babies born dead ($\chi$2-123.759, p-0.000). using multivariate logistic regression analysis mother having low hemoglobin level having higher odds of having low birth weight (OR-1.453, p-0.000, CI-1.212-1.741) and a baby born dead (OR-0.354, p-0.000, CI-0.239-0.524)
**Conclusions:** Improving anemic status during pregnancy can reduce the burden of poor pregnancy outcomes.

**Keywords:** maternal hemoglobin level, poor pregnancy outcome, low birth weight, small gestational age, born dead

## Introduction

Normal physiologic changes in pregnancy affect the hemoglobin (Hb), and there is a relative or absolute reduction in Hb concentration. Anemia is one of the well-known and most prevalent health problems globally. The World Health Organization (WHO) estimates that over 2 billion people, roughly 30% of the world's population, are affected by anemia and at least 50% of pregnant women are anemic [1]. The prevalence of anemia during pregnancy is highest in South Asia and central and west Africa [2]. In India, acc, to NHFS 5 survey, the percentage of pregnant women having hemoglobin level below 11 g/dl were found to be 52.2% with the urban and rural percentage of 45.7% and 54.3% respectively [3]. Acc to NHFS 5 survey, in Madhya Pradesh, 52.9% of pregnant women were having hemoglobin levels below 11g/dl. Out of the total percentage, 54.9% of pregnant women from the rural parts of Madhya Pradesh were having anemia. Only 23.5% of pregnant women consumed iron and folic acid supplements for 100 or more days [4]. Iron deficiency anemia is most prevalent among pregnant women. Iron deficiency anemia during pregnancy is a known risk factor for preterm birth, low birth weight, and small-for-gestational-age babies and increases the risk of postpartum hemorrhage (PPH) [5].
Physiologically, plasma volume expands by 25–80% of pre-pregnancy volumes between the second trimester and the middle of the third trimester of pregnancy [6, 7]. This induces a modest decrease in Hb levels during pregnancy.
Anemia is a common medical condition affecting pregnancy, especially in low/middle-income countries, understanding the impact that various levels of anemia have on pregnant women and their newborns is of supreme importance. This study aims to evaluate the association of maternal hemoglobin level with pregnancy outcomes.

## Method

This study was conducted among women who delivered in two hospitals Chandrikaben Rashmikant Gardi Hospital (CRGH) and Charak hospital (District Mother and Child Hospital), Ujjain. MP during the data collection period. Charak hospital is a 450 bedded hospital and about 800-900 deliveries are being conducted in a month and CRGH is 820 bedded tertiary care hospital and about 150-200 deliveries are being conducted in a month.
Anemia was classified based on the WHO criteria; HB concentration of <11 g/dl was considered as anemia. HB concentration of 10–10.9 g/dl, 7–9.9 g/dl, and <7 g/dl was considered as mild, moderate, and severe anemia, respectively

**Study design and study population**

The study was conducted using a cross-sectional design. The study population included women who delivered in these two hospitals during the data collection period. Those admitted in ICU or those not present on the bed at the time of visit or with incomplete information were excluded from the study.

Sample size and sampling technique: A sample of 629 was calculated using the sample size formula for a single proportion. A total of 650 postpartum mothers were enrolled. Stratified random sampling was used for the selection of participants from 2 centers along with simple random sampling.

**Data collection:** Data was collected after getting permission from the institute's ethical committee. The duration of the study was one and a half years. A pre-designed pre-tested questionnaire was used to collect data from postpartum mothers. Written consent was obtained after explaining the need and importance of the study to the participant. Most of the details were obtained by interview, however, some of the details like investigation etc were taken from mother and child protection card (MCP card)/ inpatient file.

**Statistical analysis:** Data were analyzed using IBM statistical package for the social sciences (SPSS) version 23 for Windows10. For Analysis descriptive statistics were calculated to summarize the sample characteristics. A Chi-square test was applied to all variables to see the association with all four poor pregnancy outcomes (born dead (stillbirth), LBW, preterm, and IUGR) and mode of delivery. Logistic regression was applied for predicting poor pregnancy outcomes. A p-value of less than 0.05 was considered to be statistically significant.

**Ethical consideration:** Ethical approval was obtained from the institutional ethical committee of R. D. Gardi medical college, Ujjain. Confidentiality and data security were assured.

Participation was made voluntary as each participant was at liberty to opt out at any point in the study.

**Result**

**Frequency distribution of sociodemographic factors of study participants**

Mothers' age ranges from 17 years to 40 years with a Mean age was 25.38 years. Only 31.2% of post-partum mothers had education more than high school. Only 19.1% of post-partum mothers belong to the socioeconomic class above III (i.e., class I & II of modified BG Prasad). It was observed that 64% of post-partum mothers belong to below poverty line (BPL) families. About 57.3% of post-partum mothers reside in rural areas. Parity distribution of postpartum mothers was 59.8% were multipara. About 70.8% of mothers were married before 20 years of age. It was found that 63.4% of post-partum mothers live in a joint or 3 generations family About 42.5% live in Kutcha houses. It was observed that 27.5% of study participants do not have access to toilet facilities at their homes. Similarly, 27.4% of study participants do not use toilet facility, rather they practice open field defecation as shown in table 1.

**Table 1:** Frequency distribution of sociodemographic factors of study participants

| Factor | Category | Frequency | Percent | Factor | Category | Frequency | Percent |
|---|---|---|---|---|---|---|---|
| Mother's age group | <= 20 Years | 66 | 10.2 | Socio-economic class | Above class III | 124 | 19.1 |
| | 21-30 years | 499 | 76.8 | | Class III | 147 | 22.6 |
| | >30 years | 85 | 13.1 | | Below class III | 379 | 58.3 |
| Place of Delivery | Ambulance | 13 | 2.0 | Housing | Kutcha | 276 | 42.5 |
| | Govt | 480 | 73.8 | | Pucca | 276 | 42.5 |
| | Private | 157 | 24.2 | | Kutcha-pucca | 98 | 15.1 |
| Mother's education | Illiterate | 119 | 18.3 | Father's education | Illiterate | 70 | 10.8 |
| | <High school | 328 | 50.5 | | <high school | 237 | 36.5 |
| | >=High school | 203 | 31.2 | | ≤high school | 343 | 52.8 |
| Mother's occupation | Professional | 10 | 1.5 | Father's occupation | Professional | 26 | 4.0 |
| | Skilled | 100 | 15.4 | | Skilled | 309 | 47.5 |
| | Semi-skilled | 172 | 26.5 | | Semi-skilled | 307 | 47.2 |
| | Unemployed | 368 | 56.6 | | Unemployed | 8 | 1.2 |
| Toilet facility at home | No | 179 | 27.5 | Use of Toilet During Pregnancy | No | 178 | 27.4 |
| | Yes | 471 | 72.5 | | Yes | 472 | 72.6 |
| Religion | Christian | 4 | 0.6 | Caste | General | 128 | 19.7 |
| | Hindu | 422 | 64.9 | | OBC | 288 | 44.3 |
| | Jain | 15 | 2.3 | | SC | 161 | 24.8 |
| | Muslim | 195 | 30.0 | | ST | 65 | 10.0 |
| | Sikh | 14 | 2.2 | | Others | 8 | 1.2 |
| Married at the age of | ≤20 year | 460 | 70.8 | Residence type | Rural | 349 | 53.7 |
| | >20 year | 190 | 29.2 | | Urban | 301 | 46.3 |
| Marital period | ≤5 year | 339 | 52.2 | No of rooms in the house | ≤5 | 607 | 93.4 |
| | 6-10 year | 248 | 38.2 | | 6-10 | 35 | 5.4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | >10 year | 63 | 9.7 | | >10 | 8 | 1.2 |
| Cash incentive | Received | 54 | 8.3 | | BPL | 416 | 64.0 |
| | Not received | 596 | 91.7 | Poverty | APRIL | 234 | 36.0 |
| Parity | Multipara | 389 | 59.8 | | Nuclear | 238 | 36.6 |
| | Primipara | 261 | 40.2 | Type of Family | Joint+3 generation | 412 | 63.4 |

**Maternal anemia associated with poor pregnancy outcomes**

It was observed that 1in 2 mothers of the study centers suffered from anemia. Anemia is one of the Significant factors for poor pregnancy outcomes. Mothers who were suffering from anemia at the time of admission had a higher proportion of babies born dead (8.1%) than non-anemic mothers (3%). Similarly, a baby born to anemic mothers had a higher percentage of weight less than 2.5 kg (42.6%). The risk of newborns being born dead (OR-0.344) or having low birth weight (OR-1.61) increases in anemic mothers as shown in table 2.

**Table 2**: Maternal anemia and pregnancy outcomes

| **Anemic** | **Pregnancy end results** | | **Birth weight** | | **Total** |
|---|---|---|---|---|---|
| | Born live | Born dead | < 2.5 kg | >= 2.5 kg | |
| Yes | 317 (91.9%) | 28 (8.1%) | 147 (42.6%) | 198 (57.4%) | 345 (100%) |
| No | 296 (97.0%) | 9 (3.0%) | 96 (31.5%) | 209 (68.5%) | 305 (100%) |
| | $\chi$2-8.045, p-0.005 | | $\chi$2-8.572, p-0.003 | | |
| | OR-0.344, p-0.006, CI-0.160-0.742 | | OR-1.616, p-0.004, CI-1.171-2.231 | | |

*$\chi$2- chi-square, OR -odd's ratio, 95% CI- confidence interval

** no association found between anemia and IUGR and preterm

**Hemoglobin level and pregnancy outcomes**

Hemoglobin level is inversely proportional to poor pregnancy outcomes. As seen in Table 3 that as the hemoglobin level increases the percentage of having babies born dead and the percentage of babies born with low birth weight also decreases. It was revealed that hemoglobin level <7gm/dl had a higher proportion of having babies born dead (68.8%) and low birth weight (75%). The risk of having Babies born dead and babies born with weight less than 2.5 kg increases by 0.354 times and 1.4 times with a decrease in hemoglobin level. It was observed that hemoglobin level at the time of delivery was highly significantly associated with pregnancy end results ($\chi$2-123.756, p-0.000) and low birth weight ($\chi$2-19.921, p-0.000) of newborns as shown in table 3

**Table 3:** Hemoglobin level and pregnancy outcome

| **Hemoglobin level** | **Pregnancy end results** | | **Birth weight** | | **Total** |
|---|---|---|---|---|---|
| | Born live | Born dead | < 2.5 kg | >= 2.5 kg | |
| <7 g/dl (severe) | 5 (31.3%) | 11 (68.8%) | 12 (75.0%) | 4 (25.0%) | 16 (100%) |
| 7.0-9.9 g/dl (moderate) | 147 (93.6%) | 10 (6.4%) | 73 (46.5%) | 84 (53.5%) | 157 (100%) |
| 10.0-10.9 g/dl(mild) | 165 (95.9%) | 7 (4.1%) | 62 (36.0%) | 110 (64.0%) | 172 (100%) |
| >=11 g/dl (non anaemic) | 296 (97.0%) | 9 (3.0%) | 96 (31.5%) | 209 (68.5%) | 305 (100%) |
| | $\chi$2-123.759, p-0.000 | | $\chi$2-19.921, p-0.000 | | |
| | OR-0.354, p-0.000, CI-0.239-0.524 | | OR-1.453, p-0.000, CI-1.212-1.741 | | |

*$\chi$2- chi-square, OR -odd's ratio, 95% CI- confidence interval

** no association found between hemoglobin level and IUGR and preterm

**Discussion**

Out of 650 pregnant women in this study, more than half (54.5%) of them were suffering from anemia. It is relevant to the previous study which stated that half population of pregnant women in the world is affected by anemia. (8) In this study, we found that maternal anemia is associated with poor pregnancy outcomes. Maternal hemoglobin concentration is inversely proportional to the risk of having poor pregnancy outcomes. Birth weight has a direct relationship with hemoglobin concentration. (9) Our study suggests that lower hemoglobin concentration increases the risk of having a baby born dead (stillbirth). Our study is not the first study to show an association between maternal anemia and baby born dead. Previous studies have shown a crude association between maternal anemia and a baby born dead (10-12) In our study we were not able to find any association with small for gestation age and preterm.

**Limitations**

This was a cross-sectional hospital-based study. Many of the data on the study variable was collected from hospital records. Hemoglobin levels were not analyzed at different pregnancy trimesters. In some of our comparisons, the sample size may have limited our ability to detect a significant association.

**Conclusion**

The study findings suggest a significant association between pregnancy outcome and hemoglobin levels during pregnancy. These issues need to be resolved to reduce the burden of poor pregnancy outcomes. Improving anemic status through compliance with medication and nutrition will reduce this burden.

Recommendations: Since Anaemia is highly prevalent instead of so many government efforts. Compliance with IFA tablets needs to be assessed. Educating pregnant women and family members for availing antenatal care should be ensured especially their spouse for compliance if IFA tablets and proper nutrition. Adequate sleep and proper nutrition are to be pregnant women must be adhered to.

**Funding:** None

**Conflict of interest:** None

**Ethical approval:** Ethical clearance for the study was taken from the institutional ethical committee of R.D. Gardi Medical College, Ujjain, Madhya Pradesh before starting the study. Ethical clearance number IEC Ref no-136

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