



### RESEARCH ARTICLE

## PREVALENCE OF ANEMIA IN WOMEN IN BUNDHELKHAND REGION, INDIA: IT'S MATERNAL AND NEONATAL OUTCOMES

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#### Abstract

**Objective:** This study aims to estimate the prevalence of maternal anemia among pregnant women in the Bundelkhand region, Jhansi, Uttar Pradesh, and to assess its impact on maternal and neonatal outcomes.

**Materials and Methods:** A hospital record-based study was conducted at a tertiary healthcare center after obtaining the necessary ethical clearances and institutional permissions. Data were collected from hospital records and analyzed using SPSS Trial Version 22.

**Results:** A total of 300 pregnant women were included in the study, of whom 177 (59.0%) were diagnosed with anemia. Among the 300 deliveries, 89 newborns had low birth weight (LBW), with 36 (35.2%) of these cases occurring in mothers with moderate anemia. The prevalence of stillbirth/intrauterine death (IUD) was 20 (6.6%), with a significantly higher incidence (50%) observed among mothers with severe anemia.

**Conclusion:** The prevalence of maternal anemia in this study was 59.0%, highlighting its continued significance as a major public health concern. Low maternal hemoglobin levels were associated with an increased risk of adverse maternal outcomes like obstructed labor, puerperal sepsis, and neonatal outcomes, including LBW and stillbirth/IUD and, low APGAR scores, NICU admissions, and IUGR. These findings emphasize the urgent need for effective anemia prevention and management strategies during pregnancy to improve maternal and neonatal health outcomes.

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#### Introduction:-

Anemia is a prevalent condition among pregnant women, particularly in developing countries, where approximately 56% of this population is affected, as reported by the World Health Organization (WHO). The prevalence of anemia exhibits significant regional variation, ranging from 35% to 100%. In Southeast Asia, anemia is associated with approximately 80% of maternal fatalities, rendering it the second leading cause of maternal mortality in India. Numerous studies have established a correlation between anemia and intrauterine growth restriction (IUGR), which can result in adverse neonatal health outcomes and increased perinatal mortality.

Nutritional deficiencies are one of the most pressing health concerns today, with pregnant women particularly vulnerable due to their increased physiological demands. A study estimated that 87% of pregnant women in India

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experience some form of anemia. This condition often results from insufficient iron intake, the heightened iron requirements of the growing fetus, and an increase in maternal plasma volume.

The WHO defines anemia in pregnancy as a hemoglobin level falling below 11 g/dL. Low hemoglobin levels can be detrimental to fetal development and have been strongly linked to preterm delivery and low birth weight (LBW). The primary causes of anemia in developing countries encompass insufficient dietary iron, poor iron absorption, and infections, including malaria, hookworm, diarrhoea, and HIV/AIDS. Additionally, other contributing factors include medical conditions such as sickle cell disease, thalassemia, excessive blood loss during childbirth, heavy menstrual bleeding, and closely spaced pregnancies.

Given the substantial implications of anemia for maternal and neonatal health outcomes, this study aims to examine the prevalence and impact of anemia among pregnant women in the Bundelkhand region.

### **Background**

The average prevalence of anemia among pregnant women is approximately 56%, with rates ranging from 35% to 100% across various global regions. This condition is notably prevalent among women of reproductive age, particularly during pregnancy. The objective of this prospective observational study is to estimate the prevalence of anemia and to examine its associations with maternal and early neonatal morbidity and mortality in pregnant women.

### **Materials and Methods:-**

A prospective observational study was conducted at Maharani Laxmi Bai Medical College in Jhansi to assess anemia prevalence among pregnant women. The sample size was determined based on a reported prevalence rate of 59%, as indicated in the National Family Health Survey (NFHS-3). The calculation included an absolute precision of 5% and accounted for a predicted dropout rate of 3%.

The study involved examinations by obstetrics and gynaecology consultants in collaboration with postgraduate students to facilitate data collection. Participants underwent pretesting, and data were gathered utilizing a semi-structured questionnaire. Follow-up was conducted monthly with the assistance of Accredited Social Health Activists (ASHA) until one-month post-delivery. Hemoglobin (Hb) levels of the pregnant women were measured upon admission and again at the one-month follow-up to evaluate changes in anemia status.

### **Inclusion Criteria**

Attended the outpatient clinic before 16 weeks of gestation.

Individuals aged 16 years and older

Singleton Pregnancy

Complete medical records of the pregnancy

### **Exclusion Criteria**

Women with evidence of tuberculosis, diabetes mellitus, and essential hypertension, thalassemia, hemophilias were excluded from the study.

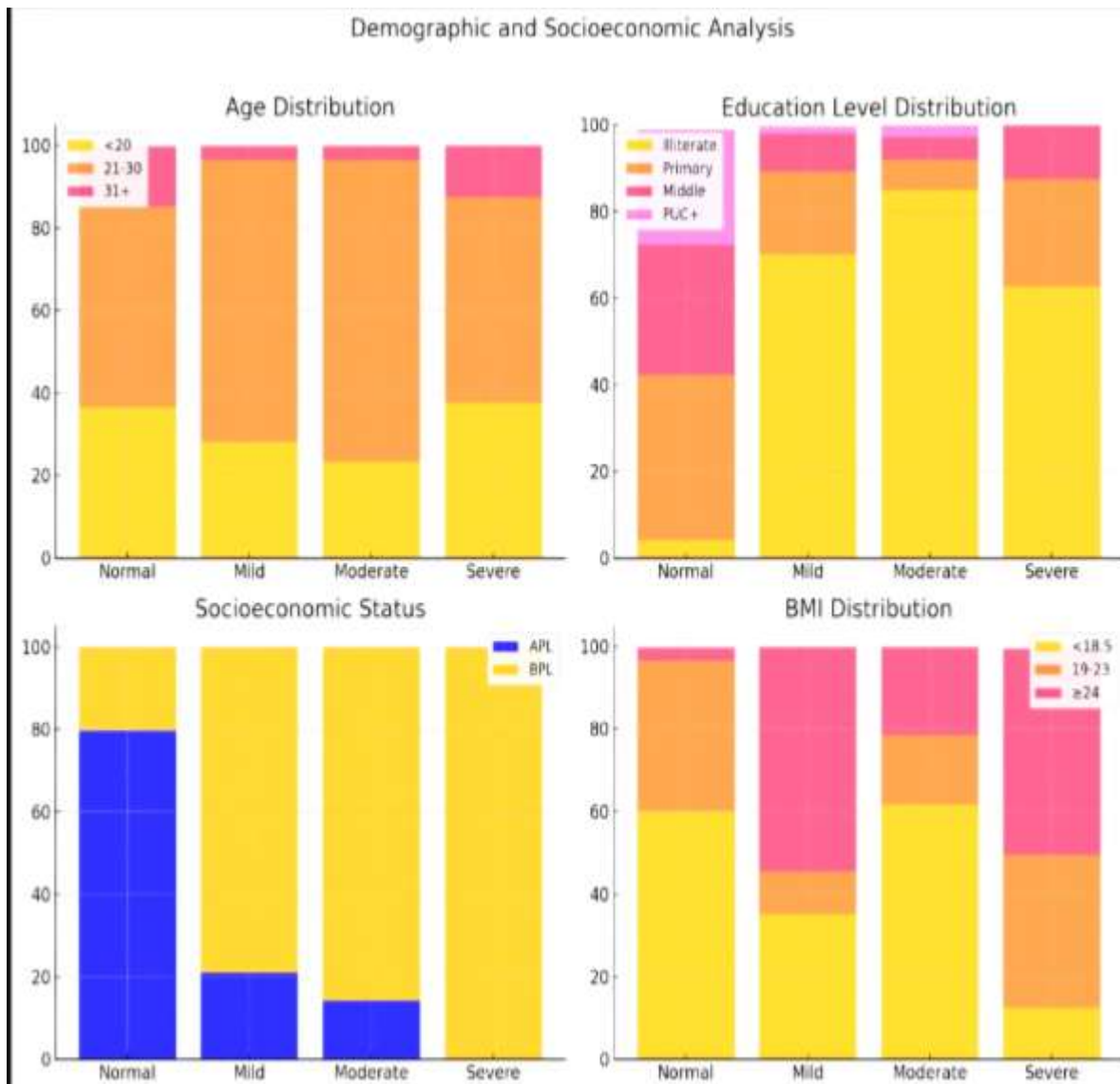
The patients underwent a complete blood count, a peripheral smear examination, and a hematocrit estimation. Although malaria prevalence is high in certain endemic regions of India, this study found no cases of malaria among the participants. This conclusion is supported by the peripheral smear examination conducted on all patients. The absence of malaria cases may be attributed to the hospital's focus on an urban population and the effectiveness of the National Malaria Control Program.

This study involved all pregnant women who delivered between September 5, 2022, and September 5, 2023. The necessary information was gathered from antenatal records and interviews conducted using a pretested questionnaire. Neonatal parameters, including birth weight, gestational age at delivery, and perinatal outcomes (such as live birth, intrauterine death (IUD), and intrauterine growth restriction (IUGR)) were collected both at the time of delivery and thereafter.

The hemoglobin (Hb) measurements of the pregnant woman were taken using a HemoCue analyzer (HemoCue Hb 301). Anemia was classified according to the World Health Organization (WHO) criteria, where a Hb concentration of less than 11 g/dl is considered indicative of anemia. Specifically, Hb concentrations are categorized as follows: 10–10.9 g/dl for mild anemia, 7–9.9 g/dl for moderate anemia, and less than 7 g/dl for severe anemia.

1. Group 1: normal hemoglobin (Hb)  $\geq 11$  g/dl;
2. Group 2: mild anemia Hb, 9–10.9 g/dl;
3. Group 3: moderate anemia, Hb 7–8.9 g/dl;
4. Group 4: Hb, less than 7 g/dl

The pregnant women were counseled about their HB level and the importance of consumption of iron and folic acid tablets, locally available iron-rich foods, regular antenatal checkups, etc. The typing of anemia was done using the standard peripheral blood smear examination method.



Gestational age was calculated from the 1st day of the last menstrual period. Pre-eclampsia was defined as women with gestational hypertension and proteinuria as per the criteria of the International Society for the Study of Hypertension in Pregnancy (ISSHP). IUGR was defined as the fetal growth (measured by ultrasound) less than the 10th centile for that gestational age. Preterm delivery was defined as delivery after 24 and before 37 completed weeks of gestation.

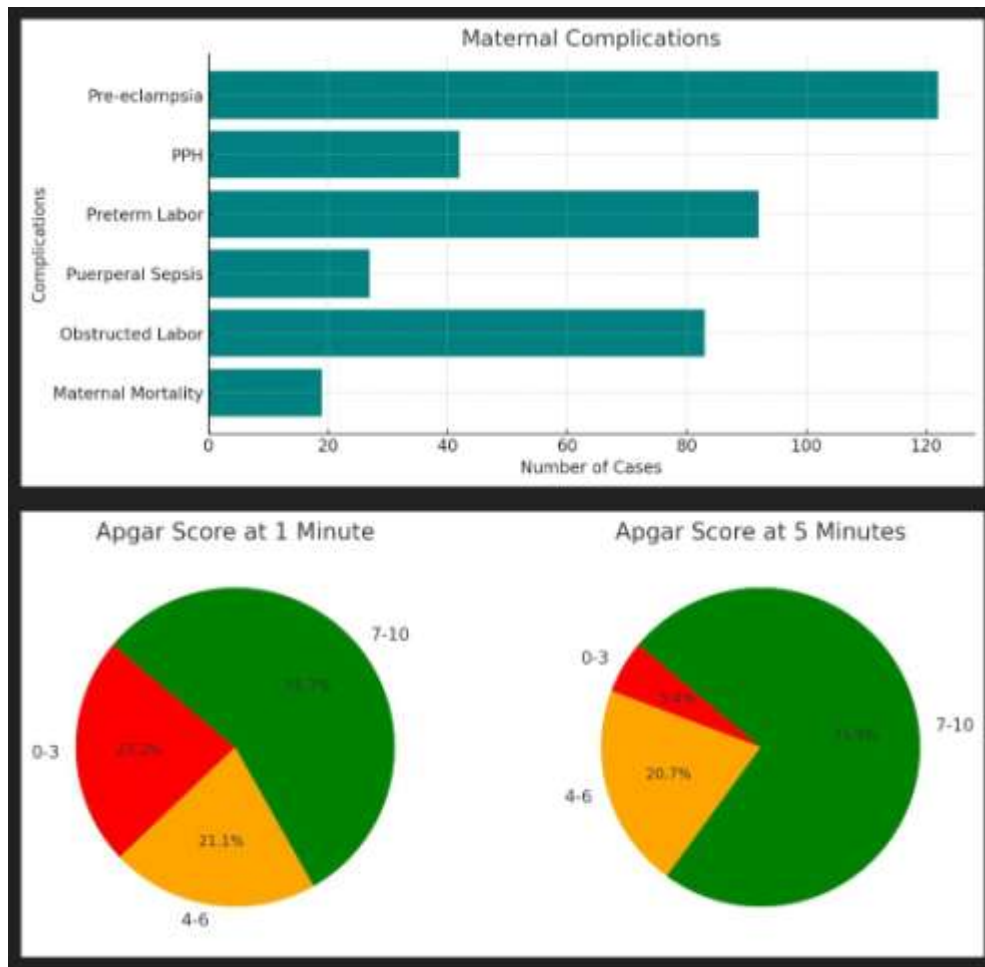
IUD was defined as a fetus without cardiac activity, confirmed on ultrasound, at any time after 24 weeks of pregnancy. Perinatal mortality includes both late fetal deaths (stillbirth) and early neonatal deaths, which last from the 28th week of gestation to the 7th day after birth. Apgar scores of neonates at 1 and 5 min were recorded. Apgar score was estimated based on heart rate, muscular tone, nasal catheter response, and baby appearance. Neonates with birth weight <2.5 kg were defined as LBW babies.

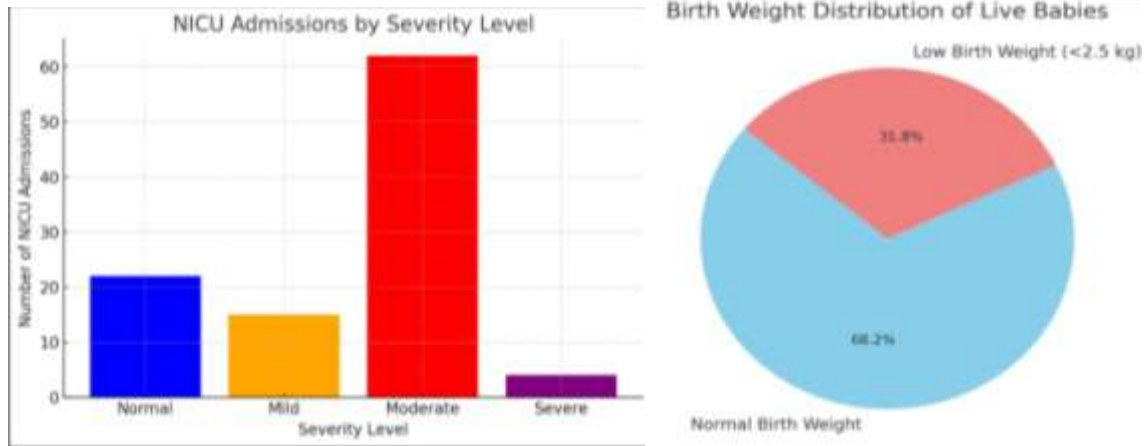
**Table 1:-** Mean values of the parameters.

Parameters	Normal n=123	Mild n=57	Moderate n=112	Severe n=8
TOTAL = 300				
Mean weight	55kg	52	50	46
Mean baby weight	2780g	2620 g	2430g	2000 g
Mean age	25	26	30	27
Mean g. age	37wk	26 wk	32 wks	34 wk
Mean haemoglobin	10.6g/dl	9.8	8.7	5.2
Mean hb correction in follow-up	2 wks	2 wks	4 wks	6 wks

**Statistical Analysis**

The data were entered into Microsoft Excel 10.0 and analyzed using IBM SPSS Statistics Version 22.0 (IBM, United States). After the analysis, the prevalence of anemia among the participants was calculated. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as percentages. Statistical significance for categorical variables was determined using the chi-square test, correlation coefficient, and logistic regression. A P-value of less than 0.05 was deemed statistically significant.





### Result:-

In this study, a total of 300 pregnant mothers were included, and out of these, 177 (59.0%) were found to be anemic. Among the anemic mothers, 57 (19%) were classified as having mild anemia, while 112 (37.3%) were categorized as moderately anemic. Additionally, 8 mothers (2.6%) were identified as severely anemic. The mean hemoglobin level among the mothers was 8.57 g/dL (SD = 0.78).

Furthermore, the mean age of the mothers was 27.1 years (SD = 3.34), and the mean birth weight of the infants was 2518 g (SD = 0.39). The mean age, parity, and gestational age in all four groups are shown in Table 1. Group 4 had a maximum prevalence of severe anemia with a mean hemoglobin of 5.2 gm/dl. Maximum patients within the age group of 21-30 yrs were suffering from anemia with 68.4% mild anemia (Group 2), Moderate anemia (Group 3), i.e., 82 (73.2%), and severe anemia (Group 4) (50%) which was found to be significant.

Maximum illiterate patients were found to be anemic with Group 2 -40(70%), Group 3 -95 (84.8%) and Group 4 -5 (62.5%) which was found to be significant. When comparing the occupations of women, Most women suffering from anemia were homemakers, which was found to be significant with groups 2 - 36 (63.1%), group 3 -90(80.3%), and group 4 -4(50%).

Upon comparing socioeconomic Most of the women with anemia belonged to below poverty line BPL - 174(58%), which was found to be statistically significant. Maximum women with anemia were underweight with a BMI (<18.5). Group 3 had a maximum of women with BMI <18.5, i.e., 69 (61.5%), which was found to be statistically significant.

Among patients belonging to the severe anemia group, the maximum delivered at <36 wks of gestational age 5 (62.5%) Higher parity (3 or more children) is linked with severe anemia.

Normal delivery decreases as anemia severity increases (96.4% in mild cases vs. 0% in severe cases).

LSCS (C-section) is significantly higher in moderate and severe cases (17.8% and 50%, respectively).

Instrumentation-assisted delivery is highest in severe anemia cases (50%).

Higher non-compliance (58%) to iron + folic acid supplementation is seen in moderate and severe anemia.

### Neonatal Outcomes:

Live births: Decrease with anemia severity (95.9% in normal vs 50% in severe anemia).

Increase in Intrauterine deaths (2.4% in normal vs 50% in severe anemia).

Birth weight: Low birth weight (<2.5 kg) is more frequent in anemic mothers (31.7% overall, 50% in severe cases). Normal birth weight in 80% of women with normal Hb.

Apgar scores: Poor Apgar scores (0-3 at 1 min) increase with anemia severity (50% in severe cases).

NICU admissions: Higher NICU admissions in moderate and severe anemia cases (60.7% and 100%, respectively).

Neonatal mortality: Mortality increases with anemia severity (5% in normal vs. 75% in severe cases).

#### **Maternal Complications:**

Obstructed labor is significantly associated with anemia (50% in severe cases,  $p < 0.000025$ ).

Preterm labor and puerperal sepsis show statistical significance ( $p < 0.00473$ ) increases with the severity of anemia.

Maternal mortality is highest in severe anemia cases (25%).

#### **Discussion:-**

Anemia continues to be a significant health issue for pregnant women, especially in developing countries, where it poses substantial risks to both maternal and neonatal health. This study found that the prevalence of maternal anemia was 59%, with particularly high rates among women aged 21 to 30 years. Key factors associated with moderate anemia included low literacy levels, being a homemaker, belonging to the below-poverty-line (BPL) category, and having two or more previous pregnancies.

The study also identified an increased risk of adverse neonatal outcomes among anemic mothers. The perinatal mortality rate was 15%, and anemic mothers were eight times more likely to experience perinatal loss compared to their non-anemic counterparts. Moreover, the incidence of intrauterine growth restriction (IUGR) was 1.7 times higher in pregnancies complicated by anemia. The chances of delivering a low-birth-weight infant and having a newborn with a low Apgar score at five minutes increased by 2.7 times and four times, respectively.

The prevalence of maternal anemia documented in this study was slightly higher than that reported in the National Family Health Survey (NFHS-4), which may be due to the smaller sample size of this study. However, these findings align with previous research in rural Maharashtra (**Kumar et al.**), Mysore (**Siddalingappa et al.**), and other regions. The increased risk of perinatal mortality among anemic mothers is consistent with studies conducted by **Nair et al.** and **Lone et al.**, reaffirming the established link between maternal anemia and adverse neonatal outcomes.

Additionally, the findings indicate a significant correlation between anemia and an elevated risk of postpartum hemorrhage (PPH). This is consistent with earlier research showing that pregnant women with moderate to severe anemia have a considerably higher likelihood of experiencing PPH. A study by **Nair et al.** reported a 17-fold increase in the risk of PPH among women with moderate to severe anemia.

Regarding the mode of delivery, this study found that anemic mothers had a higher incidence of cesarean sections (C-sections) compared to non-anemic mothers. This finding aligns with prior research by **Karflahin et al.**, which indicated that while severely anemic mothers were more likely to deliver vaginally, those with mild anemia had a reduced probability of achieving a normal delivery.

#### **Conclusion:-**

This study highlights the widespread issue of maternal anemia, which remains a significant public health concern. The findings reveal a robust association between maternal anemia and negative outcomes, including perinatal mortality, low birth weight (LBW), and intrauterine growth restriction (IUGR). Furthermore, a low Apgar score at both 1 and 5 minutes is correlated with maternal anemia. Severe anemia is strongly linked to unfavorable neonatal outcomes and elevated maternal complications.

In light of these findings, intervention strategies must prioritize the prevention of severe anemia to enhance birth outcomes. Additionally, neonatal intensive care unit (NICU) resources should be strategically allocated to support anemic mothers, given their high rates of NICU admissions.

**Study Limitation**

As a result of our thorough data analysis, our study faced several limitations. At times, the causes of anemia overlapped, making it challenging to determine whether it worsened gradually or suddenly. This situation highlights the need for comprehensive information about maternal hemoglobin levels throughout all three trimesters. Additionally, our study raises important questions that require further investigation, particularly concerning infants born to anemic mothers. Addressing these issues will enhance our understanding of anemia and its impact on infant development in the following months.

**Table 2:-** Demographic parameters comparison.

Parameters	Normal n=123	Mild n=57	Moderate n=112	Severe n=8	Total n=300	P value
Age (yrs)	45 (36.5%)	16 (28%)	26 (23.2%)	3(37.5%)	90(30%)	0.00206 (S)
<20						
21-30	60(48.7%)	39(68.4%)	82 (73.2%)	4(50%)	185(61.6%)	
31 or more	18(14.6%)	2(3.5%)	4(3.5%)	1(12.5%)	25(8.3%)	
Education						
illiterate	5(4%)	40(70%)	95(84.8%)	5(62.5%)	145(48.3%)	< 0.00001 (S)
primary	47(38.2%)	11(19.2%)	8(7.1%)	2(25%)	68(22.6%)	
middle	38(30%)	5(8.7%)	6(5.3%)	1(12.5%)	50(16.6%)	
PUC and above	33(26.8%)	1(1.7%)	3(2.6%)	0	37(12.3%)	
Occupation						
homemaker	35(28.4%)	36(63.1%)	90(80.3%)	4(50%)	165(55%)	<0.00001 (S)
labourer	61(49.5%)	9(15%)	12(10.7%)	3(37.5%)	85(28.3%)	
business	5(4.0%)	8(14%)	6(5.3%)	1(12.5%)	20(6.6%)	
job	22(17.8%)	4(7.9%)	4(3.5%)	0	30(10%)	
Socioeconomic						
APL	98(79.6%)	12(21.0%)	16(14.2%)	0	126(42%)	<0.00001 (S)
BPL	25(20.3%)	45(78.9%)	96(85.7%)	8(100%)	174(58%)	
BMI						
<18.5	74(60%)	20(35.%)	69(61.6%)	1(12.5%)	164(54.6%)	<0.00001 (S)
19-23	45(36.5%)	6(10.5%)	19(16.9%)	3(37%)	73(24.3%)	

>=24	4(3.2%)	31(54.3%)	24(21.4%)	4(50%)	63(21%)	
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**Table 3:-** Comparison of pregnancy parameters.

Gestational age	Normal n=123	Mild n=57	Moderate n=112	Severe n=8	Total n=300	P value
<36 wks	30(24.3%)	17(29.8%)	40(35.7%)	5(62.5%)	92/300( 30.6%)	0.5878 (NS)
>36 wks	93(75.6%)	40(70.1%)	72(64.2%)	3(37.5%)	208/300(69.3%)	
<b>Parity</b>						
1	75(60.9%)	3(5.2%)	8(7.1%)	0	86/300(28.6%)	<0.00001 (S)
2	12(9.7%)	50(87.7%)	56(50%)	2(25%)	120/300(40%)	
3 or more	36(29.2%)	4(7.0%)	48(42.8%)	6(75%)	94/300(31.3%)	
<b>Inter-pregnancy Interval</b>						
<1 Year	40(32.5%)	26(45.6%)	66(58.9%)	6(75%)	138/300(46%)	0.00024 (S)
>1 Year	83(67.4%)	31(54.3%)	46(41%)	2(25%)	162/300(54%)	
<b>Supplementation(Iron +Folic Acid)</b>						
Taken	86(69.9%)	35(61.4%)	30(26.7%)	5(62.5%)	156/300(52%)	<0.00001 (S)
Not Taken	37(30%)	22(38.5%)	82(73.2%)	3(37.5%)	174/300(58%)	

**Table 4:-** Deliveries and babies parameters comparison in pregnancy.

Delivery	Normal n=123	Mild n=57	Moderate n=112	Severe n=8	Total n=300	P value
Normal	56(45.5%)	55 (96.4%)	85 (75.8%)	0	196 (65.3%)	<0.00001 (S)
Instrumentation	2( 1.6%)	2 (3.4%)	7( 6.4%)	4 (50%)	15 (5.4%)	
LSCS	65( 52.8%)	0	20( 17.8%)	4 (50%)	89 (29.6%)	
<b>Outcome</b>						
Perinatal	2( 1.6%)	8( 14%)	15 (13.3%)	0	25(8.3%)	<0.00001 (S)
Live	118 (95.9%)	46 (80%)	87 (77.6%)	4(50%)	255(85%)	
IUD	3( 2.4%)	3 (5.2%)	10 (8.9%)	4(50%)	20(6.6%)	
<b>Birth weight of live babies</b>						
Normal	96( 80.0%)	29( 53.7%)	66 (64.7%)	0	191/280(68.6%)	0.00033 (S)
LBW<2.5 kg	24 (20%)	25 (46.2%)	36(35.2%)	4(50%)	89/280(31.7%)	
Apgar score at 1 min	n=120	n=54	n=102	n=4	n= 280	
0-3	10 (8.3%)	7(12.9%)	44 (43.1%)	4 (50%)	65/280 (23.2%)	<0.00001 (S)
4-6	18 (15%)	15 (27.7%)	26( 25.4%)	0	59/280 (21%)	

7-10	92(76.6%)	32 (59.2%)	32 (31.3%)	0	156/280 (55.7%)	
Apgar score at 5 min					N = 280	
0-3	3(2.4%)	4(7.0%)	8(7.1%)	0	15/280(5.3%)	<0.00001 (S)
4-6	7(5.6%)	8(14%)	40(35.7%)	3(75.5%)	58/280(20.7%)	
7-10	110(89.4%)	42(73.6%)	54(48.2%)	1(25.5%)	207/280(73.9%)	
Meconium stained liquor (n=300)	17(13.8%)	30(52.6%)	65(58%)	6(75%)	118/300(39.3%)	<0.00001 (S)
IUGR N=300	30(24.3%)	7(12.2%)	40(35.7%)	4(50%)	81/300(27.3%)	
Nicu (live)admission n= 280	22(18.3%)	15(27%)	62(60.7%)	4(100%)	103/280(36.7%)	0.00044 (S)
Neonatal mortality n=280	6(5%)	5(9.2%)	13(12.7%)	3(75%)	27/280(9.6%)	0.04156 (S)

**Table 5:-** Comparison of maternal complications in different groups of anemic women.

Comorbidities n=300	Normal n=123	Mild n=57	Moderate n=112	Severe n=8	Total n=300	P value
Pre-eclampsia	45(36.5%)	30(52%)	44(39.2%)	3(37%)	122(40.6%)	0.6290 (NS)
Pph	8(0.65%)	10(17%)	18(16%)	6(75%)	42(14%)	0.3089 (NS)
Preterm labour	30(24.3%)	17(29.8%)	40(35.7%)	5(62.5%)	92(30.6%)	0.00473 (S)
Puerperal sepsis	3(0.24%)	7(12%)	14(12.5%)	3(37.5%)	27(9%)	0.00473 (S)
Obstructed labour	55(44.7%)	0	24(21.4%)	4(50%)	83(27%)	0.000025 (S)
Maternal Mortality	6(4.8%)	3(5.2%)	8(7.1%)	2(25%)	19(6.3%)	0.248858 (NS)

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