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Original Research Article

Prevalence and Severity of Anemia Among Antenatal Women attending Tertiary Care Hospital: A Prospective Study

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Abstract:

Background: Pregnancy anemia is a significant public health issue, particularly in the developing world, due to its possible fetal and maternal outcome. Its etiology is multi-factorial with iron, folate, and vitamin B12 deficiency being most common.

Objective: To assess the prevalence, severity, and etiologic spectrum of anemia in antenatal women attending a tertiary care hospital.

Methodology: The Prospective observational study compared data of 130 pregnant women with anemia who came to the Obstetrics OPD, Phulo Jhano Medical College and Hospital, Dumka, Jharkhand, for Antenatal check up in one year. Hematological parameters were analysed using an automated CBC analyzer and serum iron, ferritin, folate, and vitamin B12 by routine biochemical and immunoassay methods. Anemia was graded based on WHO criteria.

Results: The average age was 26.03 ± 5.87 years, and 54.6% were rural. Mild anemia was the most frequent (54.6%), followed by moderate (40.8%) and severe (4.6%). Microcytic hypochromic anemia was the most frequent (52.3%). The most frequent cause was iron deficiency (33.8%), followed by folate deficiency (20.0%), combined vitamin B12 and folate deficiency (18.5%), combined iron, vitamin B12, and folate deficiency (16.2%), and isolated vitamin B12 deficiency (11.5%). Hemoglobin was significantly correlated positively with serum iron ($r = 0.394$, $p < 0.001$) and negatively with ferritin ($r = –0.303$, $p < 0.001$) and vitamin B12 ($r = –0.201$, $p < 0.022$).

Conclusion: Anemia among antenatal women in this group is extremely common, mostly mild to moderate, and perhaps the most frequent etiology is iron deficiency. Early detection and targeted nutrition interventions can improve maternal and neonatal outcomes.

Keywords: Anemia, Pregnancy, Iron Deficiency, Folate, Vitamin B12, Antenatal Care, Prevalence, Severity.

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Introduction

Anemia, a global public health concern, is especially common during pregnancy and is an important public health issue in developing and developed countries. It is etiologically multifactorial and geographically, economically, and nutritionally dependent. Complications can result in adverse outcomes in mother and fetus and cause high maternal and perinatal morbidity and mortality. Anemia is physiologically more susceptible in pregnant women due to rising iron requirements, plasma volume expansion, and changes in nutrient metabolism and thus, early diagnosis, and treatment are important for a favorable pregnancy outcome [1].

Iron deficiency is the most common cause of anemia in pregnancy and is generally responsible for iron deficiency anemia (IDA). The condition not only

puts the health of the pregnant woman at risk but is also known to have a considerable effect on fetal development. IDA in pregnancy if untreated can go on to produce adverse effects such as intrauterine growth restriction, preterm birth, low birth weight, and compromised neonatal iron stores [2,3],. Although it is suggested that iron deficiency in pregnant women is the cause of neonates with low iron status, there is little evidence to clearly establish such an association. It is shown in certain studies that iron acquisition by the fetus is independent of maternal iron status; however, such a process may still subject the fetus to suboptimal iron status with maternal stores reduced to severe deficiency [4].

Serum ferritin (SF) estimation is considered to be the most reliable biomarker of the body's iron stores and, when estimated in early pregnancy, can be a predictor of iron deficiency anemia [5]. Pregnancy anemia, however, is not due to iron deficiency alone. Other micronutrient deficiencies, most significantly folate and vitamin B12, are an integral part of its pathogenesis. Serum folate and vitamin B12 levels drop to nearly half their non-pregnant levels during pregnancy due to physiological changes like hemodilution, renal function changes, and hormonal changes [6]. These drops are also complemented by the increased metabolic demands of the pregnancy, particularly in the third trimester when the maternal folate turnover can be as high as 400 µg/day because of high cell division rates.

Short interpregnancy intervals — categorized as less than 6 months, 6–11 months, and 12–17 months — are associated with increased maternal folate depletion. Nutritional deficiency has negative implications in the subsequent pregnancy, increasing the risk for the defects of neural tube defects, preterm birth, and low birth weight [7]. Vitamin B12 deficiency is, however, relatively more prevalent in women who adhere to strict vegetarian diets for long durations because of the high concentration of the nutrient in animal-based foods. It is also a prevalent issue in most developing countries, where not only women of childbearing age but children as well present high rates of deficiency [8].

As many nutritional etiologic factors are interrelated, pregnancy anemia is etiologically multifactorial, and meticulous evaluation is needed. This is particularly so in the setting of tertiary-level care hospitals, as the patients represent a heterogeneous cross-section of socioeconomic and nutritional status. The integration of complete blood count (CBC) indices and biochemical parameters — namely, serum iron, ferritin, vitamin B12, and folate levels — yields a better and integrated profile of maternal hematological and nutritional status. These evaluations can guide targeted interventions, ultimately translating into improved maternal and neonatal outcomes.

The present prospective study attempts to assess the prevalence and severity of anemia in antenatal women presenting to a tertiary care centre. It also attempts to analyze the nutritional profile status by examining the serum iron profile, vitamin B12, and folate levels, thereby providing evidence-based recommendations for the preventive and therapeutic management of anemia in pregnancy.

Rationale of Study

With no potential risk to life of patient in this study, we benefit by getting data of anemia in pregnancy and will be able to manage anemia in pregnancy and to prevent its various consequences.

Materials and Methods

Study Design: This is a prospective, observational hospital-based study conducted to determine the prevalence and severity of anemia among antenatal women.

Study Area: The study was carried out at the Department of Obstetrics and Gynecology, Phulo Jhano Medical College and Hospital, Dumka, Jharkhand, India.

Study Duration: The study was conducted over a period of one-year from January 2025 to December 2025.

Sample Size: A total of 130 pregnant women diagnosed with anemia during their antenatal OPD visits were included.

Study Population: The study population consisted of antenatal women attending the Obstetrics outpatient department who were found to be anemic during routine antenatal check-ups.

Data Collection: Laboratory Investigations were done in Clinical laboratory and SRL Laboratory, PJMCH, Dumka.

2.1 Inclusion Criteria

- Pregnant women attending antenatal OPD.
- Diagnosed with anemia according to WHO criteria:
  - Mild anemia: Hemoglobin 9–11 g/dl
  - Moderate anemia: Hemoglobin 7–9 g/dl
  - Severe anemia: Hemoglobin <7 g/dl
- Availability of complete hematological and biochemical test reports.
- Those Subjects who gave consent for the study

2.2 Exclusion Criteria

- Non-pregnant women.
- Pregnant women without anemia.
- Patients with incomplete medical or laboratory records.
- Patients with known chronic illnesses (e.g., chronic kidney disease, malignancy) that could influence anemia status.

- Those Subjects who did not gave consent for the study.

Procedure: All antenatal women who gave consent for study and attending outpatient department during the study period, Blood investigation were reviewed and diagnosed with Anemia. All relevant demographic information, haemoglobin, concentration, complete blood count, iron profile, serum folate and vitamin B12 were obtained from records. Cases were classified and classified mild, moderate and severe anaemia using WHO classification and criteria for epidemiological purposes. All obtained data were safely compiled to a structured database for statistical analysis purpose.

Statistical Analysis: Data was presented as mean ± standard deviation for continuous variables, and numbers and percentages for categorical variables. Statistical analysis was performed using SPSS version 25 (IBM, Chicago, USA). The Chi-square test was performed for categorical variables, and the T-test or ANOVA was used for the continuous variables ,where appropriate. A p-value < 0.05 was considered statistically significant.

Result: Table 1 shows that the mean age of antenatal women was 26.03 ± 5.87 years, ranging from 18 to 31 years, with a slight predominance from rural areas (54.6%) compared to urban (45.4%). A majority followed a vegetarian diet (57.7%) and were Hindu (58.5%), while 44.6% were illiterate. Based on WHO guidelines for anemia severity, most women had mild anemia (54.6%), followed by moderate (40.8%) and severe cases (4.6%). Morphological classification revealed that microcytic hypochromic anemia was most common (52.3%), followed by normocytic normochromic (24.6%) and macrocytic types (23.1%).

Table 1: Clinical and demographic features of the research population	
Age (Range: 18–31 years)	26.03 ± 5.87
Variables	**N (%)**
Locality	
Rural	71 (54.6)
Urban	59 (45.4)
Diet	
Non-vegetarian	55 (42.3)
Vegetarian	75 (57.7)
Religious	
Muslim	54 (41.5)
Hindu	76 (58.5)
Education	
Illiterate	58 (44.6)
Literate	72 (55.4)
Severity of Anaemia (WHO guideline)	
Severe (<7 g/dl) (Grade 3)	6 (4.6)
Moderate (7–9 g/dl) (Grade 2)	53 (40.8)
Mild (9–11 g/dl) (Grade 1)	71 (54.6)
Morphological Classification	
Macrocytic	30 (23.1)
Normocytic Normochromic	32 (24.6)
Microcytic Hypochromic	68 (52.3)

Table 2 shows that iron deficiency was the most common cause of anemia among antenatal women (33.8%), followed by folate deficiency (20.0%). Combined vitamin B12 and folate deficiency accounted for 18.5% of cases, while iron with vitamin B12 and folate deficiency was observed in 16.2%. Isolated vitamin B12 deficiency was the least common etiology, seen in 11.5% of cases.

Table 2: Etiology-based classification of anaemic patients	
Variables	**N (%)**
Vit B12 + Folate deficiency	24 (18.5)
Iron + Vit B12 + Folate deficiency	21 (16.2)
Vit B12 deficiency	15 (11.5)
Folate deficiency	26 (20.0)
Iron deficiency	44 (33.8)

Table 3 indicates that the mean hemoglobin level among the study population was 8.69 ± 2.94 g/dL, with a mean red blood cell count of 3.38 ± 1.59 million/mm³ and red cell distribution width of 18.75 ± 4.76%. Mean corpuscular

volume was 82.33 ± 13.06 fL, mean corpuscular hemoglobin was 27.26 ± 5.42 pg, and mean corpuscular hemoglobin concentration was 31.08 ± 2.73 g/dL. Platelet count averaged 207.57 ± 116.05 ×10⁹/L, and white blood cell count was 11.76 ± 6.45 ×10⁹/L. Regarding nutritional parameters, the mean folate level was 14.76 ± 2.56 ng/mL, vitamin B12 was 210.21 ± 107.70 pg/mL, ferritin was 49.65 ± 10.70 ng/mL, total iron binding capacity was 314.21 ± 107.70 µg/dL, unsaturated iron binding capacity was 256.44 ± 124.44 µg/dL, and serum iron was 35.95 ± 21.55 µg/dL.

Table 3: The study population's dietary characteristics and complete blood count status	
Variables	**Mean ± SD**
CBC	
Red Cell Distribution Width (%)	18.75 ± 4.76
Mean Corpuscular Hemoglobin Concentration (g/dL)	31.08 ± 2.73
Platelets (10⁹/L)	207.57 ± 116.05
Mean Corpuscular Volume (fL)	82.33 ± 13.06
White blood cells (10⁹/L)	11.76 ± 6.45
Mean Corpuscular Hemoglobin (pg)	27.26 ± 5.42
Red blood cells (million/mm³)	3.38 ± 1.59
Hemoglobin (g/dL)	8.69 ± 2.94
Nutritional Parameters	
Folate (ng/mL)	14.76 ± 2.56
Total Iron Binding Capacity (µg/dL)	314.21 ± 107.70
Vitamin B12 (pg/mL)	210.21 ± 107.70
Ferritin (ng/mL)	49.65 ± 10.70
Unsaturated Iron Binding Capacity (µg/dL)	256.44 ± 124.44
Iron (µg/dL)	35.95 ± 21.55

Table 4 shows that hemoglobin levels had a significant positive correlation with serum iron ($r = 0.394$, $p < 0.001$) and a significant negative correlation with ferritin ($r = –0.303$, $p < 0.001$) and vitamin B12 ($r = –0.201$, $p = 0.022$), while the correlation with folic acid was positive but not statistically significant ($r = 0.119$, $p = 0.178$). Serum iron showed no significant correlation with ferritin, vitamin B12, or folic acid. Ferritin demonstrated a significant positive correlation with vitamin B12 ($r = 0.343$, $p < 0.001$) and folic acid ($r = 0.229$, $p = 0.009$). These findings suggest complex interrelationships between hematological and nutritional parameters in anemia among antenatal women.

Table 4: Analysis of the relationship between haemoglobin levels and iron, ferritin, vitamin B12, and folic acid.					
Variables	**Hb**	**Iron**	**Ferritin**	**Vitamin B12**	**Folic acid**
Folic acid	r = 0.119, p = 0.177497	r = 0.026, p = 0.769039	r = 0.229, p = 0.008775*	r = 0.123, p = 0.163266	1
Vitamin B12	r = –0.201, p = 0.021844*	r = –0.074, p = 0.402745	r = 0.343, p = 0.000065*	1	r = 0.123, p = 0.163266
Ferritin	r = –0.303, p = 0.000458*	r = –0.035, p = 0.692601	1	r = 0.343, p = 0.000065*	r = 0.229, p = 0.008775*
Iron	r = 0.394, p = 0.000004*	1	r = –0.035, p = 0.692601	r = –0.074, p = 0.402745	r = 0.026, p = 0.769039
Hb	1	r = 0.394, p = 0.000004*	r = –0.303, p = 0.000458*	r = –0.201, p = 0.021844*	r = 0.119, p = 0.177497

Discussion

This study examined prevalence, severity, and etiological determinants of anemia in antenatal women and, more importantly, the correlation between hematological and nutritional biomarkers." The majority of our patients presented with mild anemia (54.6%), followed by 40.8% with moderate anemia and 4.6% with severe anemia. This prevalence is in agreement with previous reports for Bali, Indonesia, where Suega et al. (2002) [9] reported a high prevalence of mild anemia in pregnancy, citing iron deficiency as the major etiological determinant and emphasizing prevention in the form of food fortification and iron supplementation. Similarly, national surveys have reported a prevalence of mild anemia in pregnant subjects, with an incidence of 63.5% in 1990 and 51.4% in 1995 (Tanaka et al., 1997) [10].

Our series had the most prevalent morphological subtype being microcytic hypochromic anemia (52.3%), which is consistent with the classical presentation of iron deficiency anemia (IDA) during

pregnancy. This according to the study of Tripathi et al. (2012) [11], who established that iron deficiency remains the single most frequent cause of anemia in pregnancy, even in severe anemia. However, our finding of a high frequency of macrocytic anemia (23.1%) is contrary to theirs where macrocytic anemia was exceedingly frequent among women presenting with severe anemia. The frequency of macrocytic anemia among our population indicates a high frequency of vitamin B12 and folate deficiency, as further confirmed by our etiological findings with a prevalence of vitamin B12 deficiency in 11.5% and folate deficiency in 20.0%, with an added 18.5% of combined B12 and folate deficiency.

Our vitamin B12 and folate deficiency rates are comparable to those in Venezuela, where Garcia-Casal et al. (2005) [12] reported deficiencies of 61.34% and 36.32% among pregnant women, respectively. Although our percentages are lower than we had in this study, the overlap between our deficiencies suggests a multifactorial, and not an iron-deficiency-mediated, process. This serves to emphasize the importance of careful nutritional assessment and supplementation in pregnancy, particularly in populations with dietary habits that may limit animal source micronutrient consumption. Indeed, our dietary survey revealed that the majority (57.7%) of the participants were vegetarians, and this may partly account for the increased rate of vitamin B12 deficiency.

The biochemical associations in this study provide additional information about the multifactorial pathophysiology of pregnancy anemia. A strong positive correlation between hemoglobin and serum iron ($r = 0.394$, $p < 0.001$) was observed, as would be expected from the known role of iron in erythropoiesis. But the negative correlation between ferritin and hemoglobin ($r = –0.303$, $p < 0.001$) is unexpected, keeping in mind ferritin as an iron storage depot. This may be explained by the inflammatory nature of pregnancy or concomitant infection, where ferritin is an acute-phase reactant with consequent elevated levels in the setting of functional iron deficiency. The same has been reported in inflammatory conditions where ferritin is not a reliable indicator of the iron stores (Suega et al., 2002) [9].

The negative correlation between hemoglobin and vitamin B12 ($r = –0.201$, $p = 0.022$) in our findings is also significant. This is due to the combined states of deficiency, where co-existent deficiencies of iron and B12 have variable impacts on hematological parameters. Schorah et al. (1993) [13] previously noted that pregnant women with low vitamin B12 status are associated with adverse fetal outcome, including neural tube defect and anencephaly, and hence detection and treatment of such deficiency carry clinical importance.

The second most significant finding was the positive correlation between ferritin and both vitamin B12 ($r = 0.343$, $p < 0.001$) and folate ($r = 0.229$, $p = 0.009$), showing that women with improved nutritional status had more micronutrients. While this correlation may partly be due to diet diversity and improved socioeconomic status, it also reflects interdependence of micronutrient metabolism in hematopoiesis.

Compared to other regions, our mean hemoglobin level (8.69 ± 2.94 g/dL) was lower than the 9.8–10.5 g/dL range typically found in Southeast Asian community-based pregnant women surveys (Suega et al., 2002) [9]. The extremely high rate of microcytic hypochromic anemia and the high load of most nutritional deficiencies suggest that our study sample may face compounded risk factors such as dietary restriction, rural residence (54.6%), and poor antenatal nutritional care.

Finally, our findings concur with earlier literature in validating that pregnancy anemia is generally mild to moderate in intensity and of iron deficiency etiology. However, the comparatively high rates of macrocytic anemia and multiple micronutrient deficiencies in our setting are not corroborated by studies that have controlled iron deficiency anemia. The findings validate the need for consideration beyond a straightforward iron supplementation approach to antenatal care, and follow-up on follicle and vitamin B12 screening and supplementation. We need more studies to determine the role of inflammation, dietary diversity, and socioeconomic status in shaping the anemia pattern in pregnant women in such settings.

Conclusion

The study demonstrated a high prevalence of anemia among antenatal women in the tertiary care setting studied with most of the cases having either mild or moderate severity with a predominance of microcytic hypochromic morphology. The most common etiology of anemia was iron deficiency followed by folate deficiency and multiple deficiencies as the cause of anemia. Furthermore, iron deficiency anemia is widely considered multi-faceted, as is the case for the many nutrient deficiencies for this population. Nutritional markers and hematological indices demonstrated a strong association between hemoglobin and iron status and less consistent relationships of hemoglobin with vitamin B12 and folate status. Overall, this study clearly demonstrates the need for comprehensive nutrition assessment, along with early screening and intervention strategies to manage and prevent anemia during pregnancy.

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