Original Article

Prevalence and Determinants of Anaemia in Pregnant Women: A Comprehensive Analysis of Demographic and Clinical Factors

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ABSTRACT

Background: Anaemia during pregnancy is a significant global health issue, particularly in developing countries like India, where it poses risks to both maternal and fetal health, leading to complications such as preterm birth and low birth weight. Despite public health initiatives, the prevalence remains high, necessitating an understanding of its causes and associated haematological profiles.

Objective: The study aims to assess the prevalence and severity of anaemia among pregnant women, while also examining various haematological parameters and identifying socio-economic, dietary, and healthcare-related factors contributing to anaemia.

Methods: A cross-sectional observational study was conducted with a sample of 300 pregnant women attending antenatal care from January to June 2024. Data were collected through structured questionnaires and blood samples for haematological analysis. Statistical analyses were performed to determine the prevalence of anaemia and its associations with demographic and clinical variables.

Result: The study found that the average age of participants was 29.8 years, with 86% taking iron and folic acid supplements. The overall haemoglobin level was 11.80 g/dL, with 52 participants diagnosed with anaemia, primarily mild (59.62%). Significant differences were observed in demographic factors such as age, BMI, residence, and educational status between anaemic and non-anaemic women.

Conclusion: The findings indicate that anaemia among pregnant women is influenced by various demographic and clinical factors, including age, BMI, and education. The study underscores the importance of regular antenatal care and targeted public health strategies to address nutritional deficiencies and improve healthcare access for vulnerable populations.

Keywords: Anaemia, Pregnancy, Haematological Profile, Antenatal Care, Public Health, India, Socio-economic Factors, Nutritional Deficiencies.

INTRODUCTION

Anaemia during pregnancy is a pressing health concern globally, particularly in developing countries like India.[1, 2] It poses significant risks to both maternal and fetal health, often leading to complications such as preterm birth, low birth weight, and increased perinatal mortality.[3, 4] Despite numerous public health initiatives, the prevalence of anaemia among pregnant women remains high, making it imperative to understand its underlying causes and associated haematological profiles.[5, 6] This study aims to assess the prevalence of anaemia and other haematological parameters among pregnant women attending antenatal care, providing crucial data to inform better health interventions.

The physiological demands of pregnancy result in notable changes in a woman's haematological profile, necessitating close monitoring to ensure both maternal and fetal well-being. Anaemia, characterized by reduced haemoglobin levels, can exacerbate these changes, further compromising health outcomes.[7, 8] By evaluating various haematological parameters, including red blood cell count, mean corpuscular volume, and serum ferritin levels, this study seeks to paint a comprehensive picture of the haematological status of pregnant women. Such an assessment is crucial for identifying at-risk individuals and tailoring appropriate treatment strategies.

Antenatal care visits offer a critical touchpoint for monitoring and managing maternal health, providing an opportunity to screen for and address anaemia and other haematological abnormalities.[9, 10] This study will focus on pregnant women attending antenatal care, a period where timely intervention can significantly impact pregnancy outcomes. The data collected from these women will not only highlight the prevalence of anaemia but also provide insights into potential socio-economic, dietary, and health care-related factors contributing to their haematological status.

This study on the assessment of anaemia and other haematological profiles of pregnant women is of paramount importance for public health in India. By systematically analyzing the haematological parameters of women attending antenatal care, the research aims to uncover critical insights that can guide future health policies and interventions. The findings are expected to contribute to a deeper understanding of maternal

anaemia, ultimately leading to improved health outcomes for mothers and their babies.

The objective of this study is to assess the prevalence and severity of anaemia among pregnant women attending antenatal care at a tertiary care hospital in Eastern India. By examining various haematological parameters, such as haemoglobin levels, red blood cell count, mean corpuscular volume, and serum ferritin levels, the study aims to identify at-risk individuals and understand the underlying socio-economic, dietary, and healthcare-related factors contributing to anaemia. The ultimate goal is to generate actionable insights that can inform targeted interventions and improve maternal and fetal health outcomes in the region.

MATERIALS AND METHODS

This research employed a cross-sectional observational study design, which is particularly suited for assessing the prevalence and correlates of anaemia among a defined population. Such a design allows for the collection of substantial data across various demographic groups within a limited timeframe, facilitating an analysis of prevalence rates and potential risk factors associated with anaemia.

Study Population

The study population comprised pregnant women attending antenatal care clinics at Department of Obstetrics & Gynaecology of tertiary care hospital from January 2024 to June 2024. A sample size of 300 was determined using convenience ensuring a representative cohort of diverse socioeconomic backgrounds and gestational ages.

Inclusion criteria involved women aged 18 years and above, with confirmed pregnancies, while exclusion criteria comprised those with known chronic illnesses, recent blood transfusions, or those not providing informed consent.

Data Collection Instruments

Questionnaire: A structured questionnaire was employed for demographic and clinical data collection, comprising sections on personal particulars, obstetric history, dietary habits, socio-economic status, and any associated symptoms of anaemia. The questionnaire was pre-tested on a small group of participants to validate its clarity and reliability before full implementation.

Blood Sample Collection: A critical aspect of the haematological assessment involved the collection of venous blood samples performed by trained laboratory personnel. Following aseptic techniques, 5 mL of blood was drawn from each participant's antecubital vein using sterile vacutainer tubes. Blood samples were then transported under cold chain conditions to the laboratory for analysis to ensure the integrity of the samples.

Laboratory Analysis: The analysis of the blood samples was conducted in accordance with standardized protocols to ascertain various haematological parameters.

Haemoglobin Measurement: The primary criterion for assessing anaemia was the measurement of haemoglobin concentration, determined using a fully automated haematology analyzer. Haemoglobin levels were categorized based on World Health Organization (WHO) guidelines, where levels below 11 g/dL were indicative of anaemia in pregnant women.

In addition to haemoglobin concentration, the following parameters were also assessed:

- Hematocrit (HCT)
- Mean Corpuscular Volume (MCV):
- Mean Corpuscular Hemoglobin Concentration (MCHC)
- Red Blood Cell (RBC) Count and Indices

Iron Studies: Given the importance of iron deficiency as a common cause of anaemia during pregnancy, additional tests for serum ferritin, serum iron, total iron binding capacity (TIBC), and transferrin saturation were conducted. These tests provided insight into the iron metabolism status of the participants.

Statistical Analysis

Data collected from questionnaires and laboratory results were entered into [Graph Pad ver 8.4.3] for analysis. Descriptive statistics, including means, standard deviations, and proportions, were calculated to summarize demographic and clinical characteristics. The prevalence of anaemia and its subtypes was determined and compared across various demographic groups using the Chi-square test, with a significance level set at $p < 0.05$. Additional correlational analyses were performed to investigate relationships between dietary habits, socioeconomic factors, and haematological profiles.

RESULTS

Table 1: Baseline Demographic and Clinical Characteristics (n = 300)

Variables	Values
Age in years in Mean ± SD	29.80 ± 6.60
Body Mass Index in Mean ± SD	25.70 ± 3.70
Taking Iron and Folic Acid Supplementation, n (%)	
Yes	258 (86.00)
No	42 (14.00)
Gestational Age, n (%)	
1st Trimester	51 (17.00)
2nd Trimester	108 (36.00)
3rd Trimester	141 (47.00)

The average age of the participants was 29.8 years with a standard deviation of 6.6 years. Their average body mass index was 25.7 with a standard deviation of 3.7. A majority of the women (86%) were taking iron and folic acid supplementation, while 14% were not. In terms of

gestational age, 17% were in the first trimester, 36% in the second trimester, and 47% in the third trimester. [Table 1]

The overall haematological profile of the pregnant women (n = 300) shows that the red blood cell (RBC) count averaged 3.94 ± 0.85 x 106/mm^3. Haemoglobin levels overall were 11.80 ± 2.57 g/dL, with second-trimester women at 11.60 ± 2.66 and third-trimester women at 11.90 ± 2.70 (p=0.382691). The packed cell volume (PCV) was 34.41 ± 6.49% overall. Mean corpuscular volume (MCV) was 94.20 ± 6.89 fL, and the mean corpuscular haemoglobin (MCH) was 33.20 ± 2.60 pg, significantly differing between trimesters (p=0.000010). Notably, the platelet count showed a significant decrease in the third trimester (p=0.002157). [Table 2]

Table 2: Overall haematological profile of all pregnant women & comparison between 2nd and 3rd trimester pregnant women

Complete Blood Count Results	Overall (n = 300)	2nd Trimester (n = 108)	3rd Trimester (n = 141)	P-Value (Unpaired t-test)
RBCs, × 10^6/mm^3	3.94 ± 0.85	3.97 ± 0.92	3.90 ± 0.83	0.529851
Haemoglobin (g/dL)	11.80 ± 2.57	11.60 ± 2.66	11.90 ± 2.70	0.382691
PCV (%)	34.41 ± 6.49	33.98 ± 6.36	34.59 ± 7.13	0.484095
MCV (fL)	94.20 ± 6.89	93.59 ± 6.65	95.35 ± 7.66	0.058451
MCH (pg)	33.20 ± 2.60	32.42 ± 1.56	33.67 ± 2.53	0.000010
MCHC (g/dL)	35.22 ± 1.21	35.24 ± 1.07	35.21 ± 1.15	0.833675
RDW (%)	10.83 ± 2.07	10.68 ± 1.32	10.93 ± 1.91	0.245669
WBCs, × 10^3/mm^3	9.14 ± 2.66	9.22 ± 2.63	9.25 ± 2.57	0.928069
Neutrophils, × $10^{3/}$/mm^3	6.22 ± 2.31	6.36 ± 2.38	6.40 ± 2.20	0.890973
Lymphocytes, × $10^{3/}$/mm^3	2.12 ± 0.53	2.11 ± 0.50	2.09 ± 0.49	0.751980
Platelet count 10^3/mm^3	231.75 ± 72.80	242.10 ± 85.02	214.25 ± 56.41	**0.002157**

The distribution of anaemia severity among the study participants (n = 52) indicates that the majority of cases were mild, with 31 individuals (59.62%). Moderate anaemia was observed in 14 participants (26.92%), while severe anaemia affected 7 participants (13.46%). These figures highlight that nearly three-fifths of the anaemic population experienced only mild anaemia, with a smaller proportion dealing with moderate and severe forms. [Table 3]

Table 3: Distribution of Anaemia according to severity [n=52]

Severity	Anaemia number (%)	Percentage
Mild	31	59.62
Moderate	14	26.92
Severe	7	13.46

Table 4: Comparison of Demographic and Clinical Variables between Anaemic and Non-Anaemic Pregnant Women

Variables	Anaemic (%, n = 52)	Non-Anaemic (%, n = 248)	P-Value (Chi-square)
Age			
< 20	30 (57.7)	36 (14.5)	<0.0001*
20–25	13 (25.0)	94 (37.9)	
≥ 26	9 (17.3)	118 (47.6)	
BMI			
< 19.8	18 (34.6)	7 (2.8)	0.0025**
≥ 19.8	34 (65.4)	241 (97.2)	
Residence			
Urban	31 (59.6)	240 (96.8)	0.0007**
Rural	21 (40.4)	8 (3.2)	
Educational status			
Illiterate	13 (25.0)	25 (10.1)	<0.0001*
Primary	22 (42.3)	48 (19.4)	
Secondary and above	17 (32.7)	175 (70.5)	

Gestational age			
1st trimester	4 (7.7)	43 (17.3)	0.0005*
2nd trimester	33 (63.5)	63 (25.4)	
3rd trimester	15 (28.8)	142 (57.3)	
Parity			
Para 0	35 (67.3)	138 (55.6)	0.1265**
Para 1+	17 (32.7)	110 (44.4)	
Number of ANC visits			
1	22 (42.31)	95 (38.31)	0.0183*
2	23 (44.23)	74 (29.84)	
3+	7 (13.46)	79 (31.85)	

The comparison of demographic and clinical variables between anaemic (n = 52) and non-anaemic (n = 248) pregnant women reveals significant differences. A higher percentage of anaemic women were under 20 years old (57.7%) compared to non-anaemic women (14.5%, p<0.0001). Anaemic women also had a significantly lower BMI, with 34.6% having a BMI less than 19.8 compared to 2.8% of non-anaemic women (p=0.0025). Urban residence was more common among anaemic women (59.6%) compared to non-anaemic women (96.8%, p=0.0007). Education levels showed that anaemic women were less likely to have secondary or higher education (32.7%) compared to non-anaemic women (70.5%, p<0.0001). Regarding gestational age, a higher percentage of anaemic women were in the second trimester (63.5%) compared to non-anaemic women (25.4%, p=0.0005). Parity and the number of ANC visits also showed significant differences, indicating that anaemic women tend to have fewer visits (p=0.0183). These findings underline the demographic and clinical disparities between anaemic and non-anaemic pregnant women.

DISCUSSION

The findings of this study indicate that anaemia among pregnant women is influenced by multiple demographic and clinical factors. Scientifically, the high prevalence of anaemia in younger women, particularly those under 20, can be attributed to their increased nutritional demands during growth and pregnancy, coupled with potential dietary deficiencies. A lower BMI among anaemic women suggests undernutrition, which exacerbates the risk of anaemia. The significant proportion of anaemic women with lower education levels highlights the potential lack of awareness about proper nutrition and healthcare practices, indicating a need for targeted educational interventions. Urban residence being more common among anaemic women suggests possible dietary differences or access issues to iron-rich foods, despite better overall healthcare access compared to rural areas.

Epidemiologically, the higher incidence of anaemia in the second trimester may be due to increased iron requirements as the pregnancy progresses, which are often unmet without supplementation. The study underscores the importance of regular antenatal care (ANC) visits, which were fewer among anaemic women, suggesting that consistent monitoring and early intervention can mitigate the risk of anaemia. The data align with broader epidemiological trends that link socioeconomic factors, nutritional status, and healthcare access to anaemia prevalence in pregnant women. This reinforces the need for comprehensive public health strategies addressing these determinants to improve maternal health outcomes.

From the study findings, it is evident that the prevalence and severity of anaemia among pregnant women are influenced by a variety of factors. This aligns with Shaan et al. (2018), who also identified age, BMI, and education as significant determinants of anaemia in antenatal women. Our findings show a higher prevalence of anaemia in younger women, under 20 years of age, consistent with Shaan et al.'s observation of increased risk among younger age groups.[11] Moreover, the lower BMI observed in anaemic women in our study parallels the nutritional deficiencies highlighted by Akinbami et al. (2013) in their assessment of pregnant women in Lagos.[12] Both studies underline the importance of adequate nutrition and prenatal care in mitigating anaemia.[12]

Our findings also show significant disparities in educational status and antenatal care visits between anaemic and non-anaemic women. This is consistent with the conclusions of Elgari et al. (2013) and Trivedi et al. (2016), who found that lower education levels and fewer ANC visits were associated with higher anaemia rates.[13, 14] Elgari's study, conducted in Sudan, and Trivedi's research in India, both emphasize the critical role of education and regular medical check-ups in preventing anaemia.[13, 14] Furthermore, our study's observation of significant differences in hematological parameters like MCH and platelet count between trimesters mirrors the findings of Ahenkorah et al. (2018) in Ghana, reinforcing the notion that ongoing monitoring and tailored interventions are essential for improving maternal health outcomes.[15]

The demographic and clinical characteristics of the participants, including age, BMI, and gestational age, reflect a diverse population, suggesting that the results may be applicable to a broad range of pregnant women. However, it's crucial to note that the study is limited to a specific geographic area and healthcare setting, which could impact

the applicability of the findings to different populations or regions. The high rate of iron and folic acid supplementation in the study cohort also means that the results may not be representative of populations with lower supplementation rates or different dietary habits.

One of the primary limitations of this study is the cross-sectional design, which restricts the ability to infer causal relationships between the observed variables and anaemia outcomes. Additionally, the reliance on self-reported data for certain variables, such as educational status and ANC visits, introduces the potential for recall bias. The sample size, while substantial, may still be insufficient to detect smaller differences between subgroups, and the exclusion of women with certain pre-existing conditions could limit the generalisability of the findings. Future studies could benefit from a longitudinal design, larger sample sizes, and the inclusion of more diverse populations to enhance the robustness and applicability of the results.

CONCLUSION

In conclusion, our study highlights significant demographic and clinical factors associated with anaemia in pregnant women. The findings underscore the high prevalence of anaemia among younger women, those with lower BMI, and those with lower educational attainment. The disparities in antenatal care visits between anaemic and non-anaemic women emphasize the importance of consistent prenatal monitoring and interventions. Our data reinforce the need for targeted public health strategies to address nutritional deficiencies and improve healthcare access, particularly for vulnerable populations. Further research with larger, more diverse cohorts is essential to deepen our understanding of these associations and develop effective interventions to reduce anaemia's impact on maternal and foetal health.

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