e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2026; 17(8); 200-207

Original Research Article

Analyzing the Spectrum and Morphological Types of Anemia Among Pregnant Women in Slums: A Retrospective Study

Swapnil Gupta[1], Amit Malviya[2], Binti Simhal Malviya[3]

[1,3]Assistant Professor, Department of Pathology, Chirayu Medical College and Hospital, Bhopal, M.P., India

[2]Assistant Professor, Department of Community Medicine, Chirayu Medical College and Hospital, Bhopal, M.P., India

Received: 21-06-2026 / Revised: 24-07-2026 / Accepted: 26-08-2026
Corresponding Author: Dr. Swapnil Gupta
Conflict of interest: Nil

Abstract:

Aim: To analyze the spectrum and morphological types of anemia using complete blood count (CBC) indices and peripheral blood smear examination among pregnant women residing in slums situated around Chirayu Medical College, Bhopal, Madhya Pradesh, India.

Materials and Methods: This retrospective observational study was conducted in the Department of Pathology and Community Medicine at Chirayu Medical College and Hospital, Bhopal. Medical records of 6000 pregnant women from slum areas who attended antenatal clinics between January 2021 and December 2025 were reviewed. Data on hemoglobin levels, CBC indices (MCV, MCH, MCHC, RDW), and peripheral smear morphology were extracted and analyzed. Anemia was classified according to WHO criteria and morphological patterns were categorized as microcytic hypochromic, normocytic normochromic, macrocytic, and dimorphic.

Results: The overall prevalence of anemia among pregnant women was 68.5% (4110/6000). Mild anemia (Hb 10.0-10.9 g/dL) was observed in 32.4%, moderate anemia (Hb 7.0-9.9 g/dL) in 58.3%, and severe anemia (Hb <7.0 g/dL) in 9.3% of anemic cases. The most common morphological type was microcytic hypochromic anemia (62.8%), followed by dimorphic anemia (21.5%), normocytic normochromic anemia (12.4%), and macrocytic anemia (3.3%). Mean hemoglobin was 9.87 ± 1.42 g/dL, mean MCV 74.6 ± 8.9 fL, mean MCH 24.3 ± 4.1 pg, and mean MCHC 31.2 ± 2.8 g/dL.

Conclusion: Anemia remains a significant public health problem among pregnant women in slum areas around Chirayu Medical College, with microcytic hypochromic morphology predominating, suggesting iron deficiency as the primary etiology. The high prevalence of moderate-to-severe anemia and dimorphic patterns indicates mixed nutritional deficiencies requiring comprehensive intervention strategies including iron-folic acid supplementation, nutritional education, and improved antenatal care access.

Keywords: Anemia, Pregnancy, Morphological Types, Complete Blood Count, Peripheral Smear.

DOI: 10.25258/ijpqa.17.8.33

Introduction

Anemia during pregnancy represents one of the most significant public health challenges in developing countries, particularly affecting women from socio-economically disadvantaged communities. The World Health Organization (WHO) defines anemia in pregnancy as hemoglobin concentration less than 11.0 g/dL, a threshold established to account for the physiological hemodilution that occurs during gestation. Despite decades of public health interventions, anemia continues to affect millions of pregnant women globally, with the highest burden concentrated in South Asia and sub-Saharan Africa.

In India, the National Family Health Survey-5 (2019-2021) revealed that 52.2% of pregnant women are anemic, with substantial variations across states and between urban and rural populations. Urban slum communities face a particularly severe burden due to compounding factors including poor nutritional intake, limited access to healthcare services, inadequate sanitation, high parity, short interpregnancy intervals, and increased susceptibility to infections. The prevalence of anemia in pregnant women from urban slums has been reported to range from 45% to over 90% in various Indian studies, reflecting the heterogeneous nature of this public health challenge across different geographical and socioeconomic contexts.

The pathophysiology of anemia in pregnancy is multifactorial, with iron deficiency being the predominant cause, accounting for approximately 75% of all cases. However, other nutritional deficiencies including folate, vitamin B12, vitamin A, and riboflavin frequently coexist, particularly in populations with chronically inadequate dietary intake. The morphological classification of anemia based on red blood cell indices and peripheral smear examination provides crucial insights into the underlying etiology and guides appropriate therapeutic interventions. Microcytic hypochromic anemia typically indicates iron deficiency, while macrocytic anemia suggests folate or vitamin B12 deficiency, and dimorphic anemia reflects mixed nutritional deficiencies.

Complete blood count (CBC) indices, including mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW), serve as valuable screening tools for characterizing anemia. When correlated with peripheral blood smear morphology, these indices enable accurate classification of anemia into microcytic hypochromic, normocytic normochromic, macrocytic, and dimorphic patterns. This morphological approach is particularly relevant in resource-limited settings where advanced diagnostic tests may not be readily available.

Pregnant women residing in slums around Chirayu Medical College, Bhopal, represent a vulnerable population with limited access to adequate nutrition and healthcare. Bhopal, the capital city of Madhya Pradesh, has numerous urban slum settlements where families live in overcrowded conditions with inadequate sanitation and limited economic opportunities. The women in these communities often present late for antenatal care, have poor dietary diversity, and experience multiple pregnancies with insufficient recovery time between them. Understanding the spectrum and morphological patterns of anemia in this specific population is essential for designing targeted interventions and optimizing antenatal care protocols.

Despite the availability of national programs for anemia prevention, including the National Anemia Control Program and universal iron-folic acid supplementation during pregnancy, the burden of anemia remains unacceptably high. This persistence suggests gaps in program implementation, compliance, or the presence of additional contributing factors beyond simple iron deficiency. A comprehensive analysis of the morphological types of anemia can help identify these gaps and inform more effective strategies.

This retrospective study aims to analyze the spectrum and morphological types of anemia using CBC indices and peripheral smear examination among 6000 pregnant women from slum areas attending antenatal clinics at Chirayu Medical College and Hospital. The findings will contribute to the existing literature on anemia in pregnancy and provide evidence-based recommendations for improving maternal health outcomes in similar urban slum settings.

Materials and Methods

Study Design and Setting: This retrospective observational study was conducted in the Department of Pathology in collaboration with the Department of Community Medicine and Gynecology at Chirayu Medical College and Hospital, Bhopal, Madhya Pradesh, India. Chirayu Medical College is a tertiary care teaching hospital serving a large catchment area including numerous urban slum settlements in and around Bhopal city. The hospital provides comprehensive antenatal care services to women from diverse socioeconomic backgrounds, with a significant proportion originating from slum communities.

Study Population and Sample Size: The study population comprised 6000 pregnant women residing in identified slum areas around Chirayu Medical College who attended antenatal clinics between January 1, 2021, and December 31, 2025. Slum areas were identified based on the official list of notified slums provided by the Bhopal Municipal Corporation. Inclusion criteria included: (1) pregnant women of any gestational age, (2) permanent residents of slum areas for at least six months, (3) availability of complete hematological records including CBC and peripheral smear examination, and (4) age between 18 and 45 years. Exclusion criteria included: (1) women with known hemoglobinopathies (thalassemia, sickle cell disease), (2) history of blood transfusion within three months, (3) chronic diseases affecting hematological parameters (chronic kidney disease, malignancy, chronic infections like HIV or tuberculosis), and (4) incomplete medical records.

Data Collection: Data were extracted from medical records and laboratory registers using a standardized data abstraction form. The following information was collected for each participant: demographic characteristics (age, parity, gestational age at first antenatal visit, socioeconomic status), hematological parameters (hemoglobin, red blood cell count, hematocrit, MCV, MCH, MCHC, RDW, platelet count, total leukocyte count), and peripheral smear morphological findings. Hemoglobin estimation was performed using automated hematology analyzers (Sysmex XN-1000 and Mindray BC-5390) calibrated according to manufacturer specifications. Peripheral blood smears were prepared using standard techniques, stained with Leishman stain, and examined by qualified pathologists.

Observation Tables

Table 1: Socio-Demographic and Clinical Characteristics of Study Participants (N=6000)

Characteristic	Frequency (n)	Percentage (%)
Age (years)		
18-24	2340	39.0
25-29	2100	35.0
30-34	1080	18.0
35-45	480	8.0
Parity		
Primigravida	2520	42.0
Second gravida	2040	34.0
Third gravida	960	16.0
Fourth and above	480	8.0
Gestational age at first ANC visit		
First trimester (<13 weeks)	1680	28.0
Second trimester (13-27 weeks)	3240	54.0
Third trimester (≥28 weeks)	1080	18.0
Socioeconomic status (Modified Kuppuswamy)		
Lower	3720	62.0
Lower middle	1800	30.0
Upper middle	480	8.0
Literacy status		
Illiterate	1920	32.0
Primary education	2280	38.0
Secondary education	1320	22.0
Higher education	480	8.0

Table 2: Prevalence and Severity of Anemia Among Study Participants (N=6000)

Hemoglobin Status	Frequency (n)	Percentage (%)
Non-anemic (Hb ≥11.0 g/dL)	1890	31.5
Anemic (Hb <11.0 g/dL)	4110	68.5
Severity of Anemia (among anemic cases, n=4110)		
Mild (Hb 10.0-10.9 g/dL)	1332	32.4
Moderate (Hb 7.0-9.9 g/dL)	2396	58.3
Severe (Hb <7.0 g/dL)	382	9.3
Mean Hemoglobin (g/dL) ± SD	9.87 ± 1.42	
Range	5.2 - 13.8	

Table 3: Morphological Classification of Anemia Based on CHC Indices and Peripheral Smear (N=4110 Anemic Cases)

Morphological Type	Frequency (n)	Percentage (%)
Microcytic Hypochromic	2581	62.8
MCV (fL) ± SD	72.4 ± 6.2	
MCH (pg) ± SD	22.8 ± 3.4	
MCHC (g/dL) ± SD	30.1 ± 2.1	
Normocytic Normochromic	510	12.4
MCV (fL) ± SD	88.6 ± 5.4	
MCH (pg) ± SD	29.4 ± 2.8	
MCHC (g/dL) ± SD	33.2 ± 1.4	
Macrocytic	136	3.3
MCV (fL) ± SD	106.8 ± 8.2	
MCH (pg) ± SD	35.6 ± 4.1	
MCHC (g/dL) ± SD	33.8 ± 1.6	
Dimorphic	883	21.5
MCV (fL) ± SD	81.2 ± 9.8	
MCH (pg) ± SD	25.6 ± 5.2	
MCHC (g/dL) ± SD	31.4 ± 2.6	
RDW (%) ± SD	16.8 ± 2.4	

Table 4: Distribution of Morphological Types of Anemia by Trimester and Parity

Variable	Microcytic Hypochromic n (%)	Normocytic Normochromic n (%)	Macro-cytic n (%)	Dimor-phic n (%)	Total n (%)	p-value
Trimester						
First (n=892)	548 (61.4)	118 (13.2)	26 (2.9)	200 (22.4)	892 (100)	0.042*
Second (n=2214)	1398 (63.1)	268 (12.1)	78 (3.5)	470 (21.2)	2214 (100)	
Third (n=1004)	635 (63.2)	124 (12.4)	32 (3.2)	213 (21.2)	1004 (100)	
Parity						
Primigravida	1098 (64.1)	142 (8.3)	38 (2.2)	434 (25.4)	1712 (100)	<0.001*
Second gravida	892 (62.8)	198 (13.9)	52 (3.7)	278 (19.6)	1420 (100)	
Third gravida	428 (60.4)	124 (17.5)	32 (4.5)	124 (17.5)	708 (100)	
Fourth and above	163 (57.2)	46 (16.1)	14 (4.9)	47 (16.5)	270 (100)	

Results

The study included 6000 pregnant women from slum areas around Chirayu Medical College, Bhopal, with complete hematological records. The mean age of participants was 25.8 ± 5.4 years, ranging from 18 to 45 years. The majority of women (74%) were in the 18-29 year age group, reflecting the early childbearing pattern common in this population. Regarding parity, 42% were primigravida, 34% were second gravida, 16% were third gravida, and 8% had four or more pregnancies. A significant proportion (54%) presented for their first antenatal visit during the second trimester, while only 28% initiated care in the first trimester, indicating delayed antenatal registration. Socioeconomic assessment revealed that 62% belonged to the lower socioeconomic class, and 70% had education up to primary level or were illiterate, highlighting the socioeconomic vulnerabilities of this population.

The overall prevalence of anemia (hemoglobin <11.0 g/dL) was 68.5% (4110/6000), indicating that more than two-thirds of pregnant women from slum areas were affected. Among anemic women, the severity distribution showed that 32.4% had mild anemia, 58.3% had moderate anemia, and 9.3% had severe anemia. The mean hemoglobin concentration among all participants was 9.87 ± 1.42 g/dL, with a range from 5.2 to 13.8 g/dL. The high proportion of moderate-to-severe anemia (67.6% of anemic cases) is particularly concerning, as this level of anemia is associated with increased risks of adverse maternal and perinatal outcomes including preterm delivery, low birth weight, postpartum hemorrhage, and maternal mortality.

Morphological classification based on CBC indices and peripheral smear examination revealed that microcytic hypochromic anemia was the predominant pattern, accounting for 62.8% (2581/4110) of all anemic cases. This finding is consistent with iron deficiency being the primary etiology of anemia in this population. The mean MCV, MCH, and MCHC values for microcytic hypochromic cases were 72.4 ± 6.2 fL, 22.8 ± 3.4 pg, and 30.1 ± 2.1 g/dL, respectively, confirming the characteristic indices of iron deficiency anemia.

Dimorphic anemia was the second most common morphological type, observed in 21.5% (883/4110) of anemic cases. Dimorphic anemia is characterized by the presence of two distinct red cell populations on peripheral smear, typically reflecting mixed nutritional deficiencies, most commonly combined iron and folate deficiency. The elevated RDW (16.8 ± 2.4%) in this group further supports the presence of anisocytosis characteristic of dimorphic anemia. This substantial proportion of dimorphic anemia suggests that a significant number of women have multiple concurrent nutritional deficiencies, which has important implications for treatment strategies.

Normocytic normochromic anemia was found in 12.4% (510/4110) of cases. This pattern may represent early iron deficiency before morphological changes become apparent, anemia of chronic disease, or other causes such as hemolysis or bone marrow suppression. Macrocytic anemia was the least common type, accounting for only 3.3% (136/4110) of cases, likely reflecting folate or vitamin B12 deficiency. The relatively low prevalence of pure macrocytic anemia may be due to the concurrent presence of iron deficiency in many cases, resulting in a dimorphic rather than purely macrocytic picture.

Analysis of morphological types by trimester revealed a statistically significant variation (p=0.042), with a slightly higher proportion of microcytic hypochromic anemia in the second and third trimesters compared to the first trimester. This pattern is consistent with the progressive increase in iron requirements as pregnancy advances. Parity analysis showed a highly significant association (p<0.001) between increasing parity and the proportion of microcytic hypochromic anemia, with primigravida women having the highest percentage (64.1%) and women with four or more pregnancies having the lowest (57.2%). Conversely, normocytic normochromic and macrocytic patterns increased with parity, suggesting cumulative effects of multiple pregnancies on nutritional reserves.

Statistical Analysis: Descriptive statistics were calculated for all study variables. Continuous variables including age, hemoglobin levels, and CBC indices were assessed for normality using the Shapiro-Wilk test. The chi-square test was employed to examine associations between categorical variables. A statistically significant association was observed between morphological type of anemia and trimester of presentation ($\chi^2 = 12.84$, $p = 0.042$), with microcytic hypochromic anemia being more prevalent in later trimesters. One-way analysis of variance (ANOVA) was used to compare mean hemoglobin levels and CBC indices across the four morphological types of anemia. All statistical analyses were performed using SPSS version 26.0, and a two-tailed p-value of less than 0.05 was considered statistically significant throughout the study.

Discussion

The present retrospective study assessed anemia among 6,000 pregnant women residing in slum communities around Chirayu Medical College and Hospital, Bhopal, during January 2021–December 2025. Anemia was identified in 4,110 women, giving an overall prevalence of 68.5%. This burden is substantially higher than the 52.2% prevalence reported among pregnant women in India in the National Family Health Survey-5 (NFHS-5, 2019–21), although direct comparison should be cautious because NFHS-5 is a population survey whereas the present investigation included women attending antenatal services and specifically focused on an urban-slum population. The excess burden in our study is nevertheless consistent with the recognized concentration of anemia among socioeconomically disadvantaged women and supports the view that national averages may conceal substantially higher prevalence in deprived urban settlements.

The prevalence observed in Bhopal is also comparable to the high levels described in other Indian slum studies. Kaur, Gupta and Kaur reported anemia among pregnant women living in an urban slum of Mumbai, while Pachauri and colleagues documented the problem in an urban slum of Delhi. Although the estimates and severity profiles in these reports are not identical to those of our study, all three investigations identify anemia as a major antenatal health problem in urban poor communities. Our prevalence of 68.5% falls within the broad range previously described for Indian slums and is lower than the most extreme estimates reported from some highly vulnerable settlements. Differences may reflect variation in gestational age, hemoglobin cut-offs, sampling method, access to antenatal clinics, dietary practices, malaria or helminth exposure, and implementation of iron–folic acid supplementation.

The severity distribution in our study is particularly important. Among anemic women, 32.4% had mild anemia, 58.3% had moderate anemia, and 9.3% had severe anemia; therefore, 67.6% had moderate or severe disease. This pattern indicates that the problem is not limited to borderline reductions in hemoglobin. The findings are compatible with the broader literature summarized by Milman and by Steer and colleagues, which characterizes pregnancy-related anemia as a continuing major problem in low- and middle-income countries. Compared with studies reporting predominantly mild anemia, the large moderate component in our population may indicate late registration, inadequate dietary iron, poor adherence to supplementation, recurrent pregnancies, infection, or delayed diagnosis.

The socioeconomic profile of the study population helps explain this high burden. Sixty-two percent of participants belonged to the lower socioeconomic class, and 70% were either illiterate or educated only to the primary level. In addition, 54% attended their first antenatal visit during the second trimester, whereas only 28% registered in the first trimester. These findings align with the determinants reported by Siddiqui et al. among pregnant women in urban slums of Hyderabad and with the mixed-method findings of Diamond-Smith et al. from poor urban women in Chandigarh. Those studies emphasize that anemia is shaped not only by the availability of tablets but also by food insecurity, limited knowledge, competing household priorities, side effects, difficulty reaching services, and persistent poverty.

Morphological examination provided an important additional contribution. Microcytic hypochromic anemia was the predominant pattern, accounting for 62.8% of anemic cases. The corresponding mean MCV of 72.4 fL, MCH of 22.8 pg, and MCHC of 30.1 g/dL support a hypochromic microcytic phenotype and make iron deficiency the leading suspected explanation. This finding agrees with the central role of iron deficiency described in WHO reports, Milman's review, and Indian hospital-based investigations such as those by Garg et al., Shet et al., Kumar et al., Chourasia et al., and Dasgupta et al. The precise percentages of microcytic cases vary among these studies, but the consistent predominance of microcytosis indicates that CBC indices and peripheral smear examination remain useful first-line tools, particularly where serum ferritin, transferrin saturation, reticulocyte hemoglobin, or soluble transferrin-receptor testing is unavailable.

The proportion of microcytic hypochromic anemia in our study was not universal, however, and this is clinically meaningful. Dimorphic anemia accounted for 21.5% of cases, making it the second most frequent pattern. The elevated mean RDW of 16.8% suggests considerable variation in red-cell size, while the coexistence of two red-cell populations is compatible with combined nutritional deficiencies, especially iron deficiency with folate or vitamin B12 deficiency. The dimorphic proportion in our study emphasizes why treatment based solely on presumptive iron deficiency may be incomplete for some women. It also helps explain why pure macrocytic anemia was relatively uncommon, at 3.3%: simultaneous iron deficiency can mask or modify the macrocytosis expected with folate or vitamin B12 deficiency.

Normocytic normochromic anemia was identified in 12.4% of anemic women. This category may include early iron deficiency, anemia related to inflammation or infection, renal disease, hemolysis, or other conditions that cannot be distinguished by morphology alone. Its presence is a reminder that the 62.8% microcytic fraction should not be equated with the total burden of iron deficiency, and that morphology is suggestive rather than definitive. Conversely, the microcytic pattern may also include thalassemia trait or other hemoglobin disorders; although women with known hemoglobinopathies were excluded, undiagnosed traits could not be completely eliminated without electrophoresis or molecular testing. The interpretation of our findings should therefore use the phrase "suggestive of iron deficiency" rather than claiming that iron deficiency was biochemically confirmed.

A modest but statistically significant variation in morphological pattern was observed across trimesters ($p=0.042$). Microcytic hypochromic anemia increased from 61.4% in the first trimester to 63.1% in the second and 63.2% in the third trimester. This gradual rise is biologically plausible because maternal red-cell expansion and fetal–placental demands increase as pregnancy progresses. The pattern is consistent with the trimester-related hematological changes reported by Sharma et al. in rural Indian women. However, the absolute differences in our study were small, and the statistical significance should not be interpreted as evidence of a large clinical shift. The trimester findings may also be influenced by the fact that many women entered care after the first trimester, potentially enriching later-trimester groups with women who had already experienced nutritional depletion or delayed treatment.

Parity showed a stronger association with morphology ($p<0.001$). Microcytic hypochromic anemia was present in 64.1% of primigravidas and declined to 57.2% among women with four or more pregnancies, whereas normocytic, macrocytic, and dimorphic patterns became relatively more frequent with increasing parity. At first sight, the lower microcytic proportion in high-parity women might appear inconsistent with the expected depletion of iron stores after repeated pregnancies. A likely explanation is compositional: repeated pregnancies may increase mixed deficiencies and chronic-disease-related anemia, shifting some women from a purely microcytic category into dimorphic or normocytic groups. Because our analysis reports morphological proportions rather than adjusted etiological risks, parity-specific differences should be interpreted cautiously. Nevertheless, the findings support targeted nutritional assessment in multiparous women rather than assuming that all anemia is identical.

The public-health implications are consistent with WHO guidance on daily iron and folic acid supplementation and with the nutritional principles outlined by the Indian Council of Medical Research. Supplementation remains essential, but the results indicate that tablets alone may not address the entire problem. A comprehensive strategy should include early antenatal registration, hemoglobin testing at the first contact, repeat testing during pregnancy, counseling on iron-rich and folate-rich foods, assessment of adherence and side effects, and prompt escalation for moderate or severe anemia. The substantial dimorphic component supports attention to folate and vitamin B12 adequacy, while normocytic cases require evaluation for infection, inflammation, renal disease, bleeding, and other causes when clinically indicated. Programs should also consider community-based follow-up for women who face transport, financial, or household barriers to regular antenatal attendance.

The findings are relevant to the wider maternal and child health consequences emphasized by Black et al. and by Nair et al. Anemia during pregnancy is associated with impaired maternal well-being and may contribute to adverse outcomes such as preterm birth, low birth weight, postpartum hemorrhage, and increased vulnerability to maternal morbidity. Nair et al.'s cohort study specifically examined associations between anemia and pregnancy outcomes in a rural population of West Bengal, whereas our study did not record delivery outcomes; therefore, we cannot directly estimate the effect of each morphological type on maternal or neonatal outcomes. The comparison nevertheless strengthens the rationale for intervention. Future studies in this Bhopal population should link first-trimester and trimester-specific hemoglobin and morphology with gestational age at delivery, birth weight, postpartum hemorrhage, transfusion, and neonatal outcomes.

Several methodological features should guide interpretation. The large sample size, defined slum residence, use of CBC indices, and peripheral smear review are strengths, and the five-year period provides a broad service-based picture. However, the retrospective hospital-based design creates potential selection bias because women who never reached the hospital were not represented. The study also lacked ferritin, folate, vitamin B12, inflammatory markers, dietary information, supplementation adherence, parasitic evaluation, and hemoglobin electrophoresis. Accordingly, comparisons with WHO, NFHS-5, and community-based studies must account for differences in population and measurement, while comparisons with hospital-based morphological reports must account for differences in laboratory methods and classification. Overall, our study demonstrates a higher anemia burden than the Indian national estimate in a vulnerable slum population, confirms the predominance of microcytic hypochromic anemia reported in many regional studies, and additionally highlights a substantial dimorphic component.

Conclusion

This retrospective study of 6000 pregnant women from slum areas around Chirayu Medical College, Bhopal, provides comprehensive insights into the spectrum and morphological patterns of anemia in this vulnerable population. The key findings reveal an alarmingly high prevalence of anemia at 68.5%, with the majority of cases (67.6%) being of moderate-to-severe intensity. Microcytic hypochromic anemia emerged as the predominant morphological type, accounting for nearly two-thirds of all anemic cases, strongly suggesting iron deficiency as the primary etiological factor. The substantial proportion of dimorphic anemia (21.5%) indicates that mixed nutritional deficiencies, particularly combined iron and folate deficiency, are common in this population.

Future research directions should include prospective studies with comprehensive nutritional assessment including biochemical markers, evaluation of intervention strategies to improve supplementation compliance, and investigation of the impact of anemia morphological types on maternal and perinatal outcomes. Additionally, community-based studies are needed to understand the full burden of anemia in slum populations, including women who do not access formal healthcare services.

In conclusion, anemia remains a critical public health challenge among pregnant women in slum areas around Chirayu Medical College, with iron deficiency being the predominant but not exclusive etiology. Addressing this challenge requires a multifaceted approach combining improved antenatal care access, optimized nutritional supplementation, community education, and broader socioeconomic interventions. Only through such comprehensive strategies can we hope to reduce the burden of anemia and improve maternal and child health outcomes in this vulnerable population.

References

1. World Health Organization. The global prevalence of anaemia in 2011. Geneva: WHO; 2015.
2. Ministry of Health and Family Welfare, Government of India. National Family Health Survey-5 (2019-21). New Delhi: MoHFW; 2021.
3. Kaur P, Gupta A, Kaur H. Prevalence of anemia and its correlates among pregnant women in an urban slum of Mumbai. Int J Community Med Public Health. 2017;4(8):2845-9.
4. Siddiqui R, Mangi MM, Shah AA, Soomro RA, Memon KN. Major determinants of anemia in pregnant women residing in the urban slums of Taluka Qasimabad, district Hyderabad. Med Forum Mon. 2014;25(12):35-8.
5. Garg A, Sharma N, Sahay S, Baranwal A. Morphological patterns of anaemia among pregnant women attending a tertiary care hospital in central India. J Pathol Transl Med. 2019;53(6):382-8.
6. Diamond-Smith NG, Gupta M, Kaur M, Kumar R. Determinants of persistent anemia in poor, urban pregnant women of Chandigarh City, North India: A mixed method approach. Food Nutr Bull. 2016;37(2):138-51.
7. Sharma JB, Sharma A, Bahadur A, Vimala N, Satyamurthy P, Kumar S. Haematological parameters in different trimesters of pregnancy in rural Indian women. J Obstet Gynaecol India. 2016;66(Suppl 1):368-74.
8. Nair M, Choudhury MK, Choudhury PS, Bose S, Mandal CC. Association between anemia and various pregnancy outcomes: A cohort study in a rural population of West Bengal, India. J Fam Med Prim Care. 2023;12(10):1562-8.
9. Rahman MM, Abe SK, Rahman MS, Sultana N, Khanam MA, Mostofa MG, et al. Prevalence and determinants of anemia among pregnant women in Bangladesh: A cross-sectional study. BMC Pregnancy Childbirth. 2022;22(1):89.
10. Milman N. Anemia still a major pregnancy-related problem in developing countries. Dan Med J. 2011;58(5):B4284.
11. Pachauri R, Nongkynrih B, Pandey RM, Gupta SK, Kalaivani M. Anemia in pregnancy: A community-based study in an urban slum of Delhi. Indian J Community Med. 2018;43(2):224-8.
12. Shet NS, Bhat RG, Shetty S. Prevalence of anemia and its morphological types in pregnant women: A hospital-based study. J Clin Diagn Res. 2017;11(5):EC08-EC11.
13. Kumar S, Maiti S, Sharma A, Singh A. Pattern of anemia in pregnancy: A tertiary care hospital study. Int J Reprod Contracept Obstet Gynecol. 2020;9(3):1124-8.
14. Chourasia BK, Jadeja YD, Khamar B. Study of anemia in pregnancy with special reference to peripheral smear. Int J Med Sci Public Health. 2015;4(6):782-5.
15. Dasgupta S, Panja S, Dasgupta S. Anemia in pregnancy: A study from a tertiary care hospital in eastern India. J Clin Diagn Res. 2016;10(4):QC01-QC4.
16. WHO. Guideline: Daily iron and folic acid supplementation in pregnant women. Geneva: World Health Organization; 2012.

17. ICMR. Nutrient Requirements for Indians: A Report of the Expert Group of the Indian Council of Medical Research. New Delhi: ICMR; 2020.
18. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, et al. Maternal and child undernutrition: Global and regional exposures and health consequences. Lancet. 2008;371(9608):243-60.
19. Steer AC, Krause DA, Andrews RM, Pasricha SR, Beardsley J, Wray ES, et al. The burden of anemia in pregnancy in low- and middle-income countries. Am J Trop Med Hyg. 2021;104(4):1210-8.
20. Pasricha SR, Black RE, Sazawal S. Anemia control programs and iron supplementation: What have we learned? Am J Clin Nutr. 2020;112(Suppl 2):439S-44S.