



A Cross-Sectional Study On Prevalence And Morphological Types Of Anemia Among Pregnant Women In Hoshiarpur District, Punjab (India)

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Abstract: Anemia is a deficiency in the quantity or quality of hemoglobin or red blood cells, which reduces the blood's oxygen-carrying capacity. Anaemia in pregnant women is a big cause of concern owing to its double effect on mothers and infants. It is a public health issue in underdeveloped nations and a significant contributor to maternal morbidity as well as foetal and neonatal problems. The present cross-sectional study assessed the status of anemia among pregnant women receiving antenatal care at Community Health Centre Bhunga, Hoshiarpur, Punjab, from February 2022 to Oct 2022. About 140 subjects were thoroughly investigated, and the information regarding their general profile, along with socioeconomic status, was collected through a structured questionnaire. Their blood samples were analysed to determine haemoglobin concentration and to identify the types of anaemia present. The results showed that 72.14% of the subjects had anemia, with 17.14% having mild anemia, 54.28% having moderate anemia, and 0.71% having severe anemia. The findings also indicated 72.14% occurrences of anemia, with the highest frequency in the age group less than 20 years across all analyzed age groups. The association between risk factors and the anemia prevalence was also examined.

Index Terms - Anemia Prevalence, Pregnant women, cross-sectional study, Hoshiarpur.

I. INTRODUCTION

Anemia during pregnancy is a widespread public health issue, affecting 30-50% of expectant mothers in many regions (Kibibi, 2024). The prevalence can be even higher in certain areas, with studies reporting up to 72% of mothers being anemic during at least one trimester of pregnancy (Viral & Rakeshbhai, 2022). Anemia in pregnancy is associated with numerous adverse outcomes for both mother and child. For mothers, it increases the risk of complications such as bleeding, preeclampsia, and difficult labor (Suryanarayana et al., 2017). For the foetus, anemia can lead to impaired growth, low birth weight, premature delivery, and birth asphyxia (Galaktionova et al., 2016; Suryanarayana et al., 2017). In severe cases, it can even result in maternal and foetal mortality (Edelson, 2023). Interestingly, the impact of anemia varies across trimesters. Anemia in the third trimester is particularly concerning, as it can be used as a preventable factor for infant low birth weight (Viral & Rakeshbhai, 2022). Additionally, anemia during pregnancy can have long-term effects on the child's development, potentially leading to psychomotor and speech delays (Lozoff et al., 2006; Radlowski and Johnson, 2013; Galaktionova et al., 2016).

In India, anemia is also a significant public health concern among pregnant women. States like Ladakh, Bihar, Gujarat, West Bengal, and Odisha show the highest prevalence (Dutta et al., 2023). According to the National Family Health Survey (NFHS-5) from 2019 to 2021, about 52% of pregnant women in India were found to have anemia (NFHS-5, 2022). This represents a slight increase from the previous survey (NFHS-4) conducted in 2015-16, which reported a prevalence of about 50.4%, indicating that the problem persists and is getting worse in some cases. In Punjab, the situation is similarly concerning, although the

prevalence of anemia is somewhat lower than the national average. NFHS-5 found that 40.6% of pregnant women in the state were affected, an increase from 37% in the previous survey (NFHS-4, 2016). This increase suggests a rising trend and can be related to factors such as nutritional deficiencies, limited access to quality healthcare, or gaps in public health awareness and interventions.

Therefore, the present study evaluated the current status and morphological types of anemia among pregnant women in the selected population and related possible causative factors responsible for the development of anemia among the selected physiological group between Feb-2022 to Oct-2022.

The present study has been accomplished with the following objectives:

1. To estimate the prevalence of anemia among pregnant women attending the ANC clinic at the secondary health care center, CHC Bhunga, Dist. Hoshiarpur, Punjab
2. To assess the epidemiological determinants of anemia in pregnancy
3. To determine the correlation of prevailing anemia cases with socio-demographic and nutritional status

I. RESEARCH METHODOLOGY

2.1 Study Area:

The present study was undertaken at Model Rural Health Research Unit Community Health Centre in Bhunga Block of District Hoshiarpur Punjab. Bhunga is one of the towns located 22 km to the north of the district headquarters in Hoshiarpur. It is a Block headquarter one of the 10 community development blocks of the district, located in the middle of the district, 156 Km from Chandigarh, the state capital. This center caters to primary healthcare services to the majority of the visitors from rural Hoshiarpur. During the study period, the total population of Bhunga block as per the records of NHM, was 158,019, comprising 81,256 males and 76,763 females (Table 1). The local languages spoken here are Punjabi and Hindi. The female population was 48.58%, and the literacy rate was 82.6%.

Table 1. Population of Study area (Block Bhunga, District Hoshiarpur, Punjab)

Census Parameter	Census Data
Total population	158,019
Females Population%	48.58%
Total literacy rate %	76%
Female literacy rate%	89.65%
Schedule tribe population%	0%
Schedule cast population%	19.9%
Working Population%	80.1%
Child (0-6) Population%	10%

2.2 Sample Size and Sampling Technique:

A total of 140 pregnant women aged between 18 and 40 gave written consent and willingly participated in the present study. The sample size for this precision-based study was calculated based on the confidence interval. From the literature, the prevalence of anaemia among pregnant women in the chosen study area was reported around 64%. The sample size for our study was determined by taking the most likely prevalence of anemia at 50% with a 95% confidence level and a 95% confidence interval. The final sample size was determined to be 140 after rounding off the figure and accounting for a 20% attrition rate. The schematic workplan of the study is presented in figure 1.

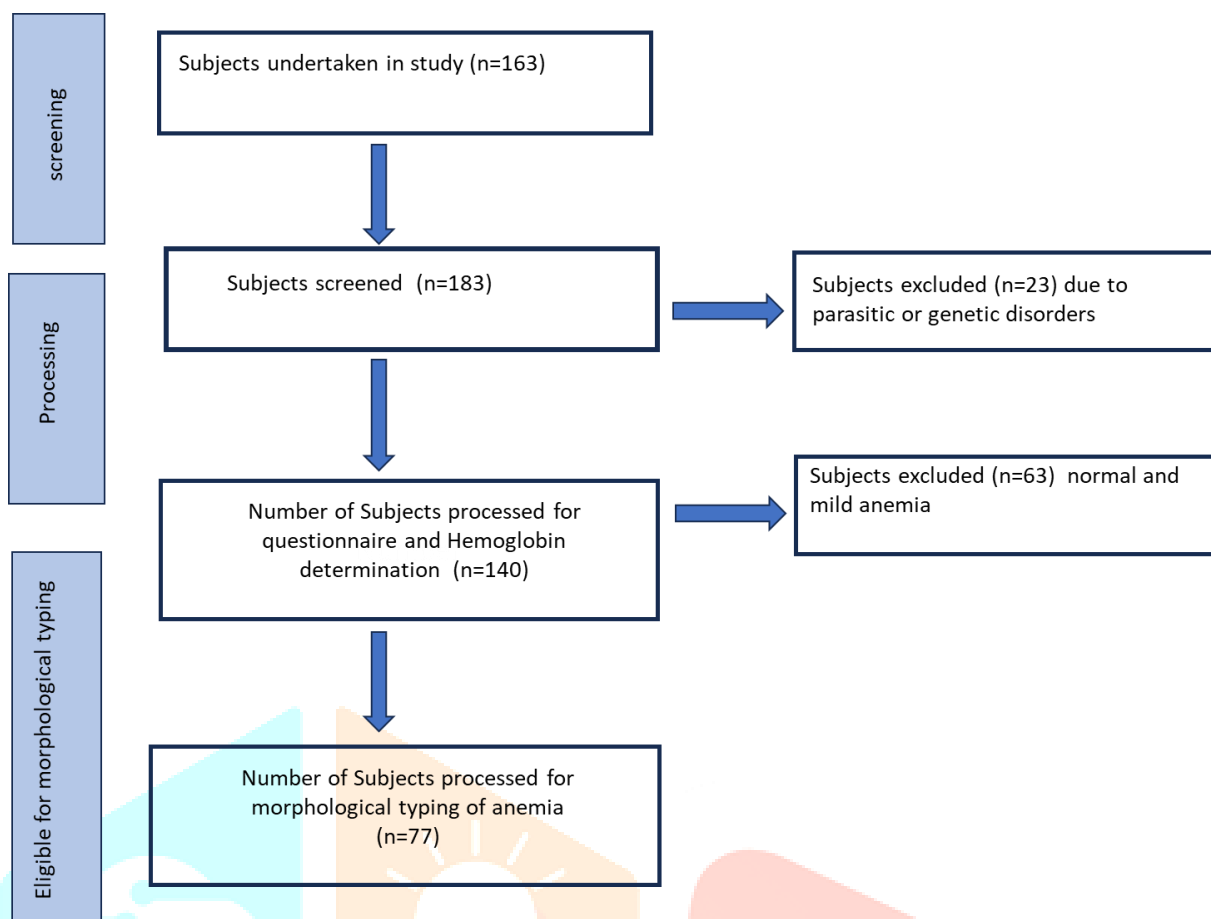


Figure 1: Schematic work plan of the study

A simple random sampling method was used to enrol the participants attending the OPD antenatal clinic at CHC Bhunga. The average daily attendance of the ANC clinic was 10 pregnant women, of whom 4 were selected randomly on each working day out of all pregnant women attending the ANC clinic on that day.

The socio-demographic and basic information of the participants regarding various parameters such as age, occupation, antenatal care visits, iron folic acid receiving and compliance was collected by using a pre-tested semi-structured questionnaire prepared by consulting the research team at MRHRU Bhunga and CHC Bhunga. Anthropometric measurements like height and weight were done as per the WHO norms. Body mass index (BMI) was an important anthropometric indicator for this study group.

Under the supervision of a trained and experienced laboratory technician, Two-milliliter of capillary blood samples were collected in EDTA-coated EDTA blood collection tubes/purple-top vacutainer tubes through venipuncture from the antecubital vein using sterilized needles and disposable plastic syringes. The concentration of hemoglobin was measured by Sahli's method. The result was expressed as hemoglobin content in gm/dL.

A complete blood count was performed using a fully automated Hematology analyzer (Meryl AQ-200) available at MRHRU Bhunga. A Giemsa-stained thin blood film was examined through the cytology of peripheral blood cells smeared to determine the blood cell morphology. The PBF slides were prepared only for moderate and severe anaemia patients.

Other hematological parameters, including mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were assessed to determine the type of anaemia. Results of haematocrit (HCT/PCV) were expressed in terms of percentage, mean corpuscular volume (MCV) was expressed in femtoliter (fL), mean corpuscular haemoglobin (MCH) was expressed in picogram (pg), mean corpuscular haemoglobin concentration (MCHC) was expressed in g/dL and RBC distribution width (RDW) was expressed in terms of percentage.

Statistical analyses were done by percentages and proportions, Mean and Standard Deviation (S.D), Chi-square test. Haemoglobin estimation was done by Sahli's method & anaemia was graded according to WHO criteria into the following grades:

Mild: Hemoglobin 10.0 g/dL to lower limit of normal.

Moderate: Hemoglobin 8.0 to 10.0 g/dL.

Severe: Hemoglobin 6.5 to 7.9 g/dL

Life-threatening: Hemoglobin less than 6.5 g/dL.

Inclusion Criteria:

1. Pregnant women of all age groups attending ANC clinic at CHC Bhunga during the study period between February 2022 and October 2022.
2. Those pregnant women who agreed to participate in the study and gave informed written consent for participation in the study.

Exclusion criteria:

1. Those pregnant women who did not agree to participate in the study and have not given in informed written consent.
2. Those who had a chronic illness or any current acute illness (such as fever or infection)

IV. RESULTS AND DISCUSSION

A total of 140 pregnant women enrolled in the study completed it and responded well to the data and blood sample collection. The prevalence of anaemia was 72.14%, with 24 cases of mild anaemia (23.76%), 76 cases of moderate anaemia (75.24%), and 1 case of severe anaemia (0.99%). The mean age of pregnant women was 25.76 years and most of these women were Hindus, belonging to the scheduled cast (72.43%) and lower middle class (88.57%). 85% of women had educational status up to the secondary grade, whereas 6.4% were illiterate and 22.85% were up to primary level educated. The general profile of other studied parameters, along with mean values of the subjects under observation, are presented in table 2, while the socio-demographic parameters affecting the anaemia status during pregnancy are presented in table 3.

Table 2: General profile of studied subjects

S.No.	Variable/ Characteristics	Minimum	Maximum	Mean	S.D
1	Age (years)	18	40	25.76	4.41
2	Gestational Age (Weeks)	04	38	16.79	9.62
3	Interval between previous and index pregnancy (years)	1.5	10	1.21	1.94
4	Weight (Kg)	36	85	57.64	9.16
5	Height (cm)	149	168	157.23	3.19
6	Haemoglobin (Hb)	6.4	12.5	9.83	0.85

Almost equal number of samples were obtained from women belonging to joint and nuclear families, but higher percentage (80%) of the women from the nuclear families were diagnosed with anaemia.

Besides the concerted efforts being made to prevent anaemia in Indian women, the prevalence of anaemia among the pregnant women included in this study was found to be significantly high, i.e 72.14%. The prevalence of anaemia in terms of severity has been categorized into mild, moderate, and severe anaemia by following the WHO guidelines for pregnant women (WHO, 2011). Results showed that 17.14% of participants had mild anaemia, 54.28% had moderate anaemia, and 0.71% had severe anaemia (Figure 2).

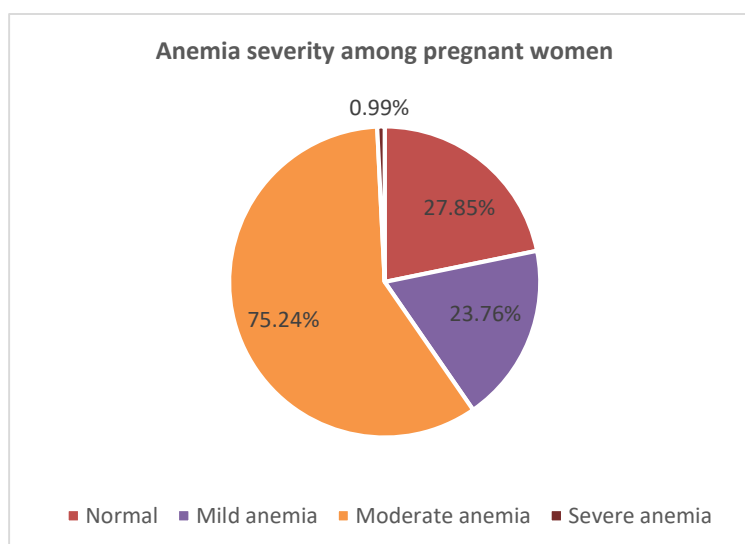


Figure 2: Percentage Severity of anaemia among pregnant women

Table 3: Prevalence of anaemia according to the socio-demographic status of participants

Particulars	Normal N=39 (27.85 %)	Anaemia N=101 (72.14%)	Mild N=24 (23.76%)	Moderate N=76 (75.24%)	Severe N=1 (0.99%)
Age					
<20 years	03 (21.42%)	11 (78.57%)	01 (9.09%)	10 (90.90%)	0 (0.00)
21-30 years	32 (29.36%)	77 (70.64%)	21 (27.27%)	55 (71.42%)	1 (1.3%)
31-40 years	04 (23.53%)	13 (76.47%)	2 (15.38%)	11 (84.61%)	0 (0.00)
Education status					
Illiterates	02 (22.22%)	07 (77.78%)	0 (0.00)	07 (77.78%)	0 (0.00)
Primary Education	10 (31.25%)	22 (68.75%)	05 (22.72%)	17 (77.27%)	0 (0.00)
Secondary Education/ 9-12 th	24 (30.76%)	54 (71.05%)	13 (24.07%)	40 (74.07%)	01(1.85%)
Under Graduate	01 (5.88%)	16 (94.12%)	04 (25.00%)	12 (75.00%)	0 (0.00)
Post Graduate	02 (50.00%)	02 (50.00%)	02 (100%)	0 (0.00)	0 (0.00)
Cast					
General	03 (15.79%)	16 (84.21%)	03 (18.75%)	13 (81.25%)	0 (0.00)
ST	01 (50.00%)	01 (50.00%)	0 (0.00)	01 (100.00%)	0 (0.00)
SC	30 (29.70%)	71 (70.29%)	16 (22.53%)	54 (76.06%)	01 1.41%)
OBC (Other Backward class)	04 (30.77%)	09 (69.23%)	03 (33.33%)	06 (66.67%)	0 (0.00)
Others	01 (20.00%)	04 (80.00%)	02 (50.00%)	02 (50.00%)	0 (0.00)
Type of family					
Joint	25 (35.71%)	45 (64.29%)	11 (24.44%)	34 (75.56%)	0 (0.00)
Nuclear	14 (20.00%)	56 (80.00%)	13 (23.21%)	42 (75.00%)	01(1.79%)
Parity					
Nulliparous	27 (30.00%)	63 (70.00%)	15 (23.80%)	48 (76.19%)	0 (0.00)
Uni	10 (27.03%)	27 (72.97%)	07 (25.93%)	19 (70.37%)	01(3.70%)
Di	01 (10.00%)	09 (90.00%)	02 (22.22%)	07 (77.77%)	0 (0.00)
Multi	01 (33.33%)	02 (66.66%)	0 (0.00)	02 (100.00%)	0 (0.00)
Duration of pregnancy					
<12 weeks	17 (25.76%)	49 (74.24%)	12 (24.49%)	37 (75.51%)	0 (0.00)
13-24 weeks	14 (35.00%)	26 (65.00%)	04 (15.38%)	22 (84.62%)	0 (0.00)
25 weeks and above	08 (23.53%)	26 (76.47%)	08 (30.77%)	17 (65.38%)	01(3.85%)
Birth interval					
0	27 (30.00%)	63 (70.00%)	15 (23.81%)	48 (76.19%)	0 (0.00)
<1 year	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
1-2 years	03 (20.00%)	12 (80.00%)	05 (41.67%)	07 (58.33%)	0 (0.00)

2.5-3 years	03 (20.00%)	12 (80.00%)	0 (0.00)	11 (91.67%)	01(8.33%)
3.5 or above	06 (30.00%)	14 (70.00%)	4 (28.57%)	10 (71.43%)	0 (0.00)
Body Mass Index					
<18.5	03 (25.00%)	09 (75.00%)	03 (33.33%)	06 (66.67%)	0 (0.00)
18.5-24.9	26 (31.70%)	56 (68.30%)	14 (25.00%)	41 (73.21%)	01(1.79%)
25-29.9	10 (22.73%)	34 (77.27%)	07 (20.59%)	27 (79.41%)	0 (0.00)
>30 or above	0 (0.00)	02(100.00%)	0 (0.00)	02 (100.00%)	0 (0.00)

The findings of our study are comparable to other studies previously carried out in rural India. A study carried out in 2010 by Viveki et al. reported 82.9% of anaemia prevalence among the group of pregnant women enrolled from urban wards following 3 months of pregnancy (Viveki et al., 2012). They reported 50.4% of participants with a moderate degree of anaemia, which is almost similar to our findings i.e., 54.28%. Another similar study carried out among pregnant women in Aurangabad city of India reported the prevalence of moderate anaemia up to 54.54% (Lokare et al., 2012). The high prevalence of anaemia among pregnant women in the Bhunga block of Hoshiarpur district is also consistent with the findings from other studies conducted in rural India (Mangla & Singla, 2016). Overall, studies published between 2011 and 2020 have provided an estimated prevalence of anemia that is slightly greater than that of prior research (68.0% and 60.3%) and indicated that the prevalence of anemia has not decreased even after the implementation of suitable interventional programs like the National Iron Plus Initiative (NIPI) and Weekly Iron and Folic Acid Supplementation (WIFS). Only 12% of adolescents (10–19 years old) with anemia were estimated to have iron insufficiency by the Comprehensive National Nutritional Survey (CNNS 2016–2018).

With respect to the socioeconomic stratification of studied participants, it was 71% and 72% among Hindu and Sikh communities respectively and 70%, 72% and 84% among participants belonging to Scheduled cast, Backward and others, respectively. Prevalence in the lower income class has been found to be 64%, whereas in other classes, jointly it was reported to be 75%

The age of a pregnant woman plays a crucial role in her susceptibility to anemia. Adolescent pregnancies, which are particularly common in certain regions of India, are associated with an increased risk of anemia due to the mother's own ongoing growth and nutritional needs (Chakarborty et al, 2023; Intan et al., 2020). Considering age groups categorized into three groups, the anaemia prevalence was found across all age groups and was observed to be maximum as 78.57% in the age group less than 20 years, followed by 76.47% in the age group of 31–40 years, respectively. The results are presented in Table 4 and Figure 3.

II. Table 3: Anaemia Prevalence across different age groups

Age Group	Normal	Mild anaemia	Moderate anaemia	Severe Anaemia	Chi Square (X ²) Value	P Value
> 20 years	3(21.4%)	1(7.1%)	10(71.4%)	0	3.48	0.747
21-30 years	32(29.6%)	21(19.3%)	55(50.4%)	1(0.9%)		
31-40 years	4(23.5%)	2(11.8%)	11(64.7%)	0		

Degrees of freedom = 6, N= 140

The higher moderate anemia prevalence (71.4%) in the first group, i.e., the age group less than 20 years, is usually due to insufficient iron stores resulting from poor nutrition, rapid growth during adolescence, and possibly heavier menstrual bleeding. These factors can be made worse by the increased iron demands of pregnancy. The study is also in compliance with another cross-sectional study conducted by Dhillon et al., in 2020 on 34 adolescent girls studying in the government Higher Secondary School, Hari ke Pattan, from Tarantaran District, Punjab. They have reported about 100% anemia prevalence among this age group with mild, moderate, and severe anemia in 28, 59, and 13%, respectively (Dhillon et al., 2021). The moderate anemia prevalence in the higher age group between 31 and 40 years was also significantly high (64.7%). This is probably because pregnant women between the ages of 31 and 40 years often have higher parity (number of prior pregnancies), resulting in increased iron demands from multiple pregnancies. The potential nutritional deficiencies from inadequate iron intake and occasionally shorter intervals between pregnancies may further deplete iron stores in their body, leading to anaemia. In the present study, age showed no statistically significant association with anemia prevalence as demonstrated by the high p-value.

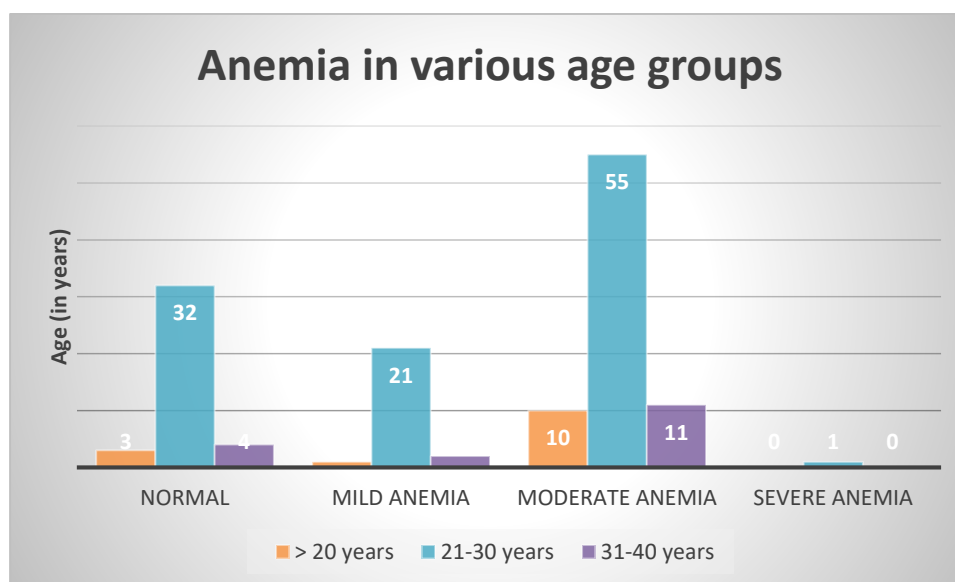


Figure 3: Distribution of anemia prevalence in different age groups

The impact of anaemia also varies across trimesters. Anaemia in the third trimester is particularly concerning, as it can be used as a preventable factor for an infant's low birth weight (Viral & Rakeshbhai, 2022). In our study almost a similar percentage 74.24% and 76.47% of women suffered from anaemia in their first and third trimesters, whereas 25.74% each were observed anemic in their second and third trimesters, respectively. About 50% of the pregnant women population (17 women out of 34) had moderate anaemia in their third trimester and were advised to have iron iron-rich diet.

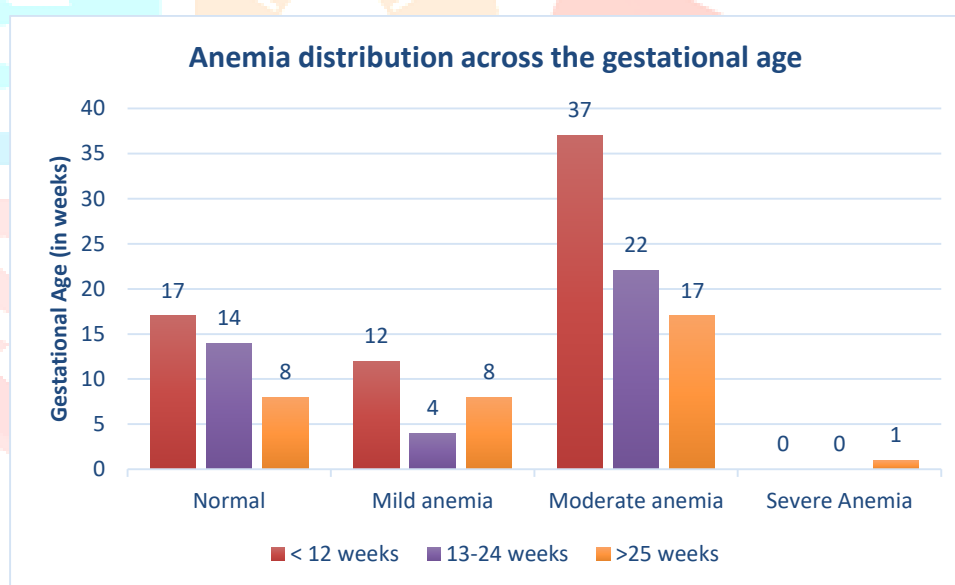


Figure 4: Anemia prevalence across gestational age groups (trimesters)

Dietary habits also play a crucial role. Vegetarian diets are usually poor in folate content. Women who consume predominantly a vegetarian diet or lack access to iron-rich food are more susceptible to anaemia during pregnancy (Cheema et al., 2016; Weldekidan et al, 2018). In our study, majority of women consuming fruits and green leafy vegetables daily and on alternate days were also observed anaemic as compared to those who consume fruits and vegetables occasionally. The findings suggest that a vegetarian diet involving fruits and vegetables is not enough to meet the increased iron requirements during pregnancy. As millets are more nutrient-rich, consuming millets instead of the more affordable refined wheat flour, rice, and maize is another better option for vegetarians to meet the growing iron requirements of pregnant women (Anitha et al., 2024; Saikat et al., 2024).

Family structure also influences the variety and nutritional quality of food available to pregnant women. Nuclear families tend to have a higher prevalence of anemia, potentially due to a lack of support. Family beliefs can sometimes hinder supplement intake, highlighting the need to involve family members (spouses, mothers-in-law) as supporters (Dutta et al., 2023). Diversified diets with a judicious choice from a variety of food groups provide the necessary nutrients. Joint families usually offer more diverse meal options, potentially reducing the risk of nutrient deficiencies leading to anemia. Our findings showed higher anemia

prevalence (80%) among the women from nuclear families as compared to the women from the joint family, which was around 64%. This could be due to the limited variety in the diet of the former group, which has led to insufficient nutrient intake.

Table 4: Relationship of Anaemia Prevalence with Nutritional Status

Consumption of green vegetables	Normal N=39 (27.85 %)	Anaemia N=101 (72.14%)	Mild N=24 (23.76%)	Moderate N=76 (75.24%)	Severe N=1 (0.99%)
Daily	05 (38.46%)	08 (61.54%)	04 (50%)	04 (50%)	0(0.00)
Alternate day	19(25%)	57(75%)	15(62.50)	41(53.95)	01(1.8%)
Once in a week	03(42.86%)	04(57.14%)	0(0.00)	04(100%)	0(0.00)
Twice in a week	12 (28.57%)	30(71.43%)	05(16.67)	25(83.33%)	0(0.00)
Once in a while	0(0.00)	02(100%)	0(0.00)	02(100%)	0(0.00)
Consumption of fruits					
Daily	25(64.10)	65(64.35)	21(87.50)	43(56.58)	01(100.00)
Alternate day	14(35.90)	34(33.66)	03(12.50)	31(40.79)	0(0.00)
Once in a week	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Twice in a week	0(0.00)	02(1.98)	0(0.00)	02(2.63)	0(0.00)
Once in a while	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)

The relationship between anemia in pregnant women and parity is complex and multifaceted. Women with higher parity (multiple pregnancies) tend to have a higher risk of anemia because each pregnancy depletes maternal iron stores, potentially leading to iron deficiency anemia in subsequent pregnancies. Also, women with higher parity often have shorter intervals between pregnancies that reduce the recovery time and result in insufficient replenishment of iron stores, which in turn increases the risk. No significant association between BMI and anemia burden in pregnant women has been observed. More than 67% of women had a normal BMI with mild and moderate anemia.

3.1 Morphological Typing of Anaemia:

The morphological analysis provided further insight into the types of anemia present. Out of 77 women with moderate and severe anaemia, were analysed for the morphological typing of anaemia. The majority of cases (68%) were diagnosed with microcytic hypochromic anemia, characterized by smaller-than-normal red blood cells (microcytic) with reduced hemoglobin content (hypochromic). The primary cause of this type of anemia is iron deficiency.

Poor dietary habits during pregnancy such as low intake of iron-rich foods, insufficient consumption of vitamin C (which enhances iron absorption), and reliance on monotonous or cereal-heavy diets, significantly increase the risk of iron deficiency anemia. Pregnant women have higher iron demands due to expanded blood volume and fetal development, and without adequate iron intake or bioavailability, iron-deficiency anemia is common in them.

Fatigue, weakness, pale skin, and shortness of breath were the common symptoms observed among them. The majority of the women suffering from microcytic hypochromic anemia were from economically poor sections of the society residing in the rural areas with low educational status. This finding aligns with existing literature emphasizing the importance of adequate iron intake during pregnancy to support increased blood volume and foetal development (Sharif et al., 2023). To prevent adverse outcomes, they were counselled to regularly monitor their hemoglobin levels and to take oral iron supplements. Macrocytic anemia was identified in 18.5% of the total cases. The primary cause of this type of anemia is vitamin B12 and folate deficiencies. Such deficiencies are particularly concerning given their potential impact on fetal development, including neural tube defects and other congenital disabilities. Normocytic anemia was identified in a very small proportion of cases (2%) and requires further investigations to identify potential underlying causes.

III. Conclusion:

The prevalence of anaemia in pregnant women in the chosen study area is significantly high, with 72% of women being found to be anemic, 59% of whom were higher secondary educated. The high prevalence of anemia among pregnant women in the Hoshiarpur district is consistent with the findings from other studies conducted in rural India (Mangla & Singla, 2016; NK et al., 2020). The maximum anemia prevalence was observed in women under 20 years of age. BMI showed no impact on anemia as the majority of the anemic women had normal BMI. Women from nuclear families were found to be the most affected by iron deficiency anemia as compared to women living in a joint family. Therefore, an inclusive multi-component approach is required to reduce the burden of anaemia and its consequences.

To improve maternal and foetal outcomes, effective interventions, such as iron and folic acid supplementation and community health initiatives, are essential. Furthermore, strengthening primary healthcare, enhancing education campaigns, and improving access to healthcare are vital strategies for reducing the burden of anemia in pregnancy and its associated complications. It is also important to reinforce the primary health system and emphasize prevention, early detection, and fast treatment of pregnant mothers with anemia. Hence, a more unified strategy should be introduced, informing and educating the public about the impact and advantages of iron and folic acid intake.

Limitations of the study:

This study was a part of Master's dissertation and completed in a 6-month duration in the Community Health Centre, Bhunga, Hoshiarpur district, Punjab, India. The number of subjects included in certain variable groups to study their association with anemia was relatively small to draw generalizations. Only 5 women were aware of government initiatives and regularly consumed folic acid and vitamin B12. Therefore, we did not investigate the serum ferritin levels and hence did not include them in the study. To improve the sample's representativeness and generalizations, this study can be used as a reference point to plan a multicentric study involving comprehensive sampling with a large sample size.

IV. ACKNOWLEDGMENT

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