



NUTRITIONAL FACTORS FOR SEVERITY AND PREVALENCE OF ANEMIA IN PREGNANCY IN A TERTIARY REFERRAL CENTRE

Community Medicine

Nishal Sharma	MD Student. Department Of Community Medicine, Vardhman Mahavir Medical College And Safdarjung Hospital, New Delhi, India.
Monika Gupta	MD Department Of Obstetrics And Gynecology, Vardhman Mahavir Medical College And Safdarjung Hospital, New Delhi, India.
Jugal Kishore	MD Department Of Community Medicine, Vardhman Mahavir Medical College And Safdarjung Hospital, New Delhi, India.
Himal Singla	MD Student Department Of Obstetrics And Gynecology, Vardhman Mahavir Medical College And Safdarjung Hospital, New Delhi, India.
Rohini Dayma	PhD Department Of Obstetrics And Gynecology, All India Institute Of Medical Sciences, New Delhi, India.
Sona Dharmendra	PhD Department Of Obstetrics And Gynecology, All India Institute Of Medical Sciences, New Delhi, India.
Jb Sharma*	MD FRCOG PhD, Department Of Obstetrics And Gynecology, All India Institute Of Medical Sciences, New Delhi, India. *Corresponding Author

ABSTRACT

Objective: To study the prevalence and severity of anemia and associated dietary factors per anemia in pregnancy. **Material and Methods:** It was a prospective cross sectional study on 430 pregnant women attending antenatal clinic in the second and third trimester of pregnancy of a tertiary referral public health hospital. A predesigned questionnaire proforma was filled with the relevant details of socio demographic profile and dietary factors for all participants. **Results:** The prevalence of anemia was found to be 48.84% (25.81% mild, 15.81% moderate, 6.98% severe). Anemia was more common in vegetarians and women consuming one or two meals a day. Most (87.90%) women were consuming inadequate calories per day with mean calories intake being significantly less in anemia group (1637 ± 298.3) than in normal Hb group (1982 ± 362.4) being least in severe anemia group (1331 ± 295.7). A total of 48.84% women were consuming inadequate proteins and anemia was more common in them. Mean protein intake was significantly less in anemia group (50.2 ± 5.1 gm/day) than in normal Hb group (68.4 ± 6.8 gm/day). Mean dietary iron intake was significantly less in the anemia group (21.1 ± 1.97 mg/day) than in the normal Hb group (33.2 ± 3.41 mg/day) with the difference being even more for the severe anemia group (14.8 ± 1.5 mg/day). There were 62 (14.41%) underweight women and anemia was more common in them. **Conclusion:** This study shows a high prevalence of anemia in pregnancy. With risk factors being inadequate calorie intake, inadequate protein intake, inadequate dietary iron intake, less than three meals per day, vegetarian diet and low body mass index.

KEYWORDS

Anemia, Calories Intake, Dietary Protein Intake, Dietary Iron Intake,

INTRODUCTION

As per World Health Organization (WHO) anemia is the most common disease affecting more than 1.5 billion people worldwide¹. Prevalence is very high in Africa and Asia^{1,2}. The highest prevalence of anemia is in 3 groups; children aged 2-5 years (46%), pregnant women (42%) and women of reproductive age group (30%). Iron deficiency anemia accounts for 50% of cases and is the most common cause of anemia.^{1,2} National Family Health Survey-5 (NFHS-5)³ observed a high prevalence of anemia (52.2%) during pregnancy in India in the year 2019-2021.

WHO has defined anemia as a condition in which the number of RBCs or Hb concentration is lower than normal^{4,5}. In pregnancy, a Hb concentration of less than 11 gm% or a hematocrit of less than 33% is taken as the definition of anemia^{1,2}. Anemia in pregnancy is a significant health problem globally with an overall prevalence of 38.2% women affected worldwide being much more in developing countries than in developed nations⁵. Most cases of anemia are due to nutritional deficiencies especially iron deficiency followed by folate and vitamin B₁₂ deficiency^{6,7}. Other causes of anemia in pregnancy can be hemoglobinopathies, infections and infestations especially hookworm infestation, malaria, chronic diseases like tuberculosis and rarely malignancy^{4,6,8}.

The major symptoms and signs of iron deficiency anemia in pregnancy are fatigue, low physical and mental capacity, vertigo, headache, leg cramps, cold intolerance, pallor, angular stomatitis and koilonychia^{2,4}. Anemia during pregnancy may be associated with poor maternal and perinatal outcome in the form of premature birth, fetal growth restriction, placental problems, decreased maternal reserves, cardiac stress and decreased breast milk production^{4, 6-8}. Hence timely diagnosis and effective treatment of anemia in pregnancy is crucial for optimum maternal and perinatal outcomes^{4,9-12}.

The prevalence of anemia during pregnancy is about 14% in developed countries but is very high being 51% in developing countries varying from 65-75% in India^{1,5}. However, recent NFHS-5 observed the prevalence of anemia to be 57% in women between the ages of 15 and 49 years as compared to 53% in 2015-2016 and 52.2% in pregnant women as compared to 50.4% in 2015-2016³. This is despite Anemia Mukht Bharat Programme which focuses on prophylactic iron and folic acid supplements, identification of anemia cases and their referral and treatment apart from improving nutrition¹³.

The commonest etiology of anemia in pregnancy is iron deficiency being responsible for 50-60% of cases^{4,5}. Iron deficiency is usually multifactorial and may include reduced iron availability due to insufficient dietary iron intake or poor absorption and or increased losses from vomiting or blood loss further compounded by increased iron demands during pregnancy^{4,11,14}. Hence, it is usually challenging for pregnant women to maintain adequate iron stores during pregnancy without iron supplements which is recommended for all pregnant women, especially in developing countries like India where the prevalence of anemia in pregnancy is more than 40% making it a major public health problem^{1,4,5}.

Iron supplementation is safe and cost effective treatment for the prevention and treatment of iron deficiency and iron deficiency anemia in pregnancy^{4,12}. Oral iron is the commonest firstline treatment modality but may be associated with gastrointestinal side effects like constipation and abdominal pain causing poor compliance^{4,11}. Parenteral iron in the form of intravenous iron sucrose or ferric carboxy maltose is given for severe iron deficiency anemia in patients unable to tolerate oral iron and if the gestation is advanced^{4,9-11}.

The severity of anemia in pregnancy is graded by WHO as mild if (Hb is 9-11 gm/dl), moderate if (Hb is between 9-11 gm/dl), severe (Hb 4-7 gm/dl) and very severe or decompensated (Hb is <4 gm/dl)^{1,4,5}.

This current study was carried out to observe the prevalence and severity of anemia (as per WHO classification) and various determinants especially dietary factors causing anemia during the second and third trimester of pregnancy.

MATERIALS AND METHODS

It was a prospective cross-sectional study on 430 pregnant women in their second and third trimester of pregnancy attending antenatal clinic of Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi. The study was conducted on women fulfilling inclusion criteria from January 2023 to September 2023 to find the prevalence and severity of anemia in them and various dietary factors affecting the Hb levels.

Sample Size: It was calculated taking the prevalence of anemia in pregnancy in Delhi as 42% as per NFHS-5³ and taking about a 10 percent non response rate the sample size was 411. It was rounded to 430.

Exclusion Criteria

1. Patients with history of comorbidities like HIV infection, diabetes mellitus, tuberculosis, liver disease, renal disease and malignancy were excluded.
2. Patients with obstetric complications like threatened abortion and antepartum hemorrhage leading to blood loss were also excluded.

Sampling Technique: The women attending antenatal clinic or admitted in obstetric ward of VMMC and Safdarjung Hospital in the second and third trimester of pregnancy fulfilling the inclusion criteria were randomly recruited into the study as shown in figure 1. Written informed consent was taken from all the participants in their language. They were interviewed as per a validated questionnaire (proforma). Clinical examination was done under the supervision of an obstetrician and Hb test (Hemocue test) and other investigations were performed as per hospital practice.

Study Tool:

1. **Proforma:** A preformed, pre tested, semi structured, self administered proforma was used with the following contents: -
 - a) Socio-demographic profile like age, parity, marital status, socioeconomic status, occupation
 - b) The details about the pregnancy and dietary intake using 24 hour recall method were used to obtain nutritional information.

Statistical Analysis

Data was computerized using an Excel spreadsheet and the authenticity of the data was verified. Statistical analysis was carried out using STATA version 18.0 statistical software. Categorical data was presented as frequency and percentage values. The prevalence of anemia was calculated as per the Indian standard and the association between anemia and socio demographic characteristics and dietary habits were tested using the Chi square/Fisher's exact test as appropriate. Skewed data was presented as median and inter-quartile range values and compared using Mann Whitney U test or Kruskal Wallis test as appropriate. For all the statistical tests, a two sided probability of $p < 0.05$ was considered for statistical significance.

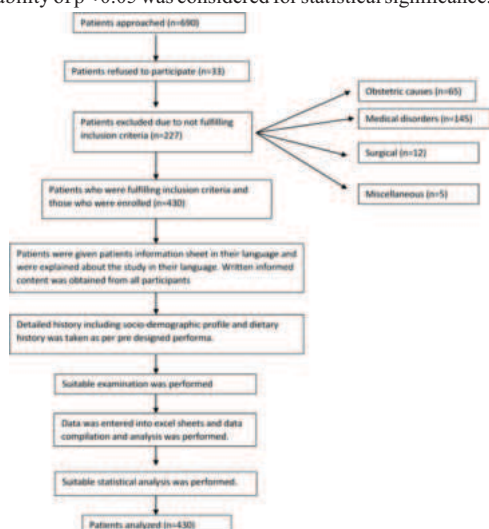


Figure 1: Flow chart of patients' enrolment from antenatal clinic and methodology used

RESULTS

The characteristics of prevalence and severity of anemia are shown in Table 1. The mean age was 26.5+4.5 years while the mean parity was 1.8. Out of total 430 women, anemia was seen in 210 women with a prevalence of 48.84% being mild in 25.81%, moderate in 15.81%, severe in 6.98% and very severe in 1(0.24%).

Table 1: Prevalence and severity of anemia in pregnancy and socio-demographic characteristics

	Number	Percentage out of total	Percentage out of Anemia	Range	Mean	SD
Normal Hb	220	51.16%		7-17	13.2	2.8
Anemia	210	48.84%		5-14	8.5	1.8
Mild	111	25.81%	52.86%	6-14	9.6	1.9
Moderate	68	15.81%	32.38%	5-13	7.2	1.6
Severe	30	6.98%	14.29%	5-12	6.4	1.3
Very severe	1	0.24%	0.47%	-	-	-
Total(n=430)				5-17	11.7	2.2
Age(years)	-	-	-	18-43	26.5±4.5	-
Parity	-	-	-	0 to 5	1.8	-
BMI (Kg/m ²)	-	-	-	16-35	22.5± 4.5	-

Dietary habits of patients and meal frequency and their relationship to the prevalence and severity of anemia are shown in Table 2. There were 49.3% vegetarians in the study with a higher prevalence of anemia in them ($p=0.04$) while prevalence was lesser in non-vegetarian patients. Severe anemia was even more common in vegetarian patients ($p=0.01$).

Table 2: Dietary habits of patients

	Normal (n=220)	Mild (n=111)	Moderate (n=68)	Severe (n=31)	Anemia (n=210)	Total (n=430)	P value	Significance
	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)		
Vegetarian	96(43.64)	59(53.1)	38(55.88)	19(61.29)	116(55.24)	212(49.3)	0.04	S
Non-Vegetarian	124(56.36)	52(46.8)	30(44.12)	12(38.71)	94(44.76)	218(50.7)	0.04	S
Distribution of patients as per eating habits (meals per day)								
1 Meal/Day	0	0	0	2	2(0.95%)	2(0.47%)	0.02	S
2 Meal/Day	4(1.81)	2(1.80)	6(8.82)	27(87.09)	35(16.66)	39(9.07)	0.01	S
3 Meal/Day	53(24.09)	35(31.53)	48(70.58)	2(6.45)	85(40.47)	138(32.09)	0.02	S
4 Meal/Day	126(57.27)	72(64.86)	12(17.64)	0	84(40)	210(48.84)	0.01	S
≥5 Meal/Day	37(16.81)	2(1.80)	2(2.94)	0	4(1.90)	41(9.52)	0.01	S
Total	220	111	68	31	210	430		

Most women were having either three meals a day (138, 32.09%) or four meals a day (210, 48.84%). Anemia was less common in them ($p=0.02$ and 0.015). Only two (0.47%) women were having only 1 meal a day and both were severely anemic while 39(9.07%) women were having 2 meals a day with anemia being much more common in them ($p=0.01$). Hence a meal frequency of less than three meals a day was a risk factor for anemia especially severe anemia.

Distribution of patients as per calorie intake is shown in Table 3. Mean calorie intake was significantly less in the anemia group (1637 ± 298.3) than in normal Hb group (1982 ± 362.4) ($p=0.02$). The difference was even more significant in severe anemia group (1331 ± 295.7) ($p=0.01$). Anemia was significantly more common in women consuming less than 1800 calories per day while it was less common in women consuming more than 2600 calories per day. Only 52(12.09%) women were consuming adequate calories and most of them were having normal Hb. A total of 378(87.90%) women were consuming inadequate calories, and anemia was more common in them.

Table 3: Distributions of patients as per calories intake

Calories	Normal (n=210)	Mild (n=111)	Moderate (n=68)	Severe (n=31)	Anemia (n=210)	Total (n=430)	P value	Significance
	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)		
<1000	-	-	5(7.35)	9(29.03)	14(6.66)	14(3.25)	0.01	S
1001-1200	1(0.45)	-	9(13.23)	6(19.35)	15(7.14)	16(3.25)	0.01	S
1201-1400	2(0.90)	1(0.90)	9(13.23)	5(16.12)	15(7.14)	17(3.95)	0.01	S
1401-1600	5(2.27)	3(2.70)	11(16.17)	4(12.90)	18(8.57)	23(5.34)	0.04	S
1601-1800	12(5.45)	10(9.00)	9(13.23)	5(16.12)	24(11.42)	36(8.37)	0.04	S
1801-2000	30(13.63)	14(12.61)	7(10.29)	2(6.45)	23(10.95)	53(12.32)	0.07	NS
2001-2200	35(15.90)	13(11.71)	9(13.23)	-	22(10.47)	57(13.25)	0.06	NS
2201-2400	46(20.90)	28(25.22)	4(5.88)	-	32(15.23)	78(18.13)	0.06	NS
2401-2600	42(19.04)	33(29.72)	3(4.41)	-	36(17.14)	78(18.13)	0.12	NS
2601-2800	21(9.54)	5(4.50)	2(2.94)	-	7(3.33)	28(6.51)	0.03	S
2801-3000	19(8.63)	2(1.80)	-	-	2(0.95)	21(4.88)	0.01	S
>3000	7(3.18)	2(1.80)	-	-	2(0.95)	9(2.09)	0.04	S
Adequate	43(19.54)	8(7.20)	1(1.47)	0(0)	9(4.28)	52(12.09)	0.01	S
Inadequate	177(80.45)	103(92.79)	67(98.52)	31(100)	201(95.71)	378(87.90)	0.04	S
Total	220	111	68	31	210	430		
Calories Intake								
Range	1105-3157	1210-3097	910-2794	897-1995	897-3025	897-3157	-	
Mean	1982	1843	1639	1331	1637	1801	-	
S.D.	362.4	322.3	313.4	295.7	298.3	340.2	-	

P value: Normal vs anemia p=0.02(Significant)

Normal vs mild anemia p=0.125(Non-significant)

Normal vs moderate anemia p=0.03(Significant)

Normal vs severe anemia p=0.01(Significant)

Distribution of patients as per protein intake in grams per day is shown in Table 4. The mean protein intake was significantly lower in the anemia group (50.2 ± 5.1 gm/day) as compared to normal Hb group (68.4 ± 6.8 gm/day) ($p=0.015$). The difference was even more significant in the severe anemia group (38.5 ± 3.9 gm/day) ($p=0.001$). A total of 51.16% of women were consuming adequate protein and anemia was less common in them ($p=0.02$) while 48.84% of women were consuming inadequate protein and anemia was more common in them.

Table 4: Distribution of patients as per dietary protein intake (gm/day)

Protein	Normal (n=220)	Mild (n=111)	Moderate (n=68)	Severe (n=31)	Anemia (n=210)	Total (n=430)	p value	Significance
0-10	-	-	-	-	-	-	-	
10.1-20	-	-	-	4(12.90)	4(1.90)	4(0.93)	0.01	S
20.1-30	-	1(0.90)	2(2.94)	6(19.35)	9(4.28)	9(2.09)	0.01	S
30.1-40	5(2.27)	4(3.60)	14(20.58)	11(35.48)	29(13.80)	34(7.90)	0.01	S
40.1-50	12(5.45)	7(6.30)	13(19.11)	7(22.58)	27(12.85)	39(9.06)	0.04	S
50.1-60	18(8.18)	17(15.31)	11(16.17)	2(6.45)	30(14.28)	48(11.16)	0.04	S
60.1-70	38(17.27)	26(23.42)	8(11.76)	-	34(16.19)	72(16.74)	0.112	NS
70.1-80	63(28.63)	28(25.22)	11(16.17)	1(3.2)	40(19.04)	103(23.95)	0.04	S

80.1-90	33(15)	21(18.91)	8(11.76)	-	29(13.80)	62(14.41)	0.12	NS
90.1-100	36(16.36)	5(4.50)	1(1.47)	-	6(2.85)	42(9.76)	0.02	S
>100	15(6.81)	2(1.80)	-	-	2(0.95)	17(3.95)	0.01	S
Adequate	135(61.36)	53(47.74)	28(41.18)	4(12.90)	85(40.47)	220(51.16)	0.02	S
Inadequate	85(38.64)	58(52.25)	40(58.82)	27(87.10)	125(59.52)	210(48.84)	0.02	S
Total	220	111	68	31	210	430		
Dietary protein intake (in gm per day)								
Range	32-114	25-102	22-98	15.5-74	15.5-102	15.5-114	-	
Mean	68.4	60.3	48.3	38.5	50.2	58.91	-	
SD	6.8	6.1	4.7	3.9	5.1	5.9	-	

P value: Normal vs anemia p=0.015(Significant)

Normal vs mild anemia p=0.06(Non-significant)

Normal vs moderate anemia p=0.018(Significant)

Distribution of patients as per dietary iron intake is shown in Table 5. The mean dietary iron intake was significantly less in anemia group (21.1 ± 1.97 mg/day) as compared to normal Hb group (33.2 ± 3.41) ($p=0.015$). The mean dietary iron intake was less in the severe anemia group (14.8 ± 1.5 mg/day) ($p=0.001$). Anemia especially moderate and severe anemia was significantly more common in women consuming less than 30mg dietary iron per day. Majority of women (335,77.90%) were consuming inadequate dietary iron per day and anemia especially moderate and severe anemia was more common in them. Only 95(22.09%) women were taking adequate dietary iron per day and anemia was significantly less in them.

Table 5: Distribution of patients as per dietary iron intake in mg/day

Dietary Iron (mg)	Normal (n=220)	Mild (n=111)	Moderate (n=68)	Severe (n=31)	Anemia (n=210)	Total (n=430)	p value	Significance
<10mg	-	-	3(4.41)	7(22.58)	10(4.76)	10(2.32)	0.01	S
11-20	2(0.90)	7(6.30)	20(29.41)	11(35.48)	38(18.09)	40(9.30)	0.02	S
21-30	49(22.27)	20(18.01)	28(41.17)	10(32.25)	58(27.61)	107(24.88)	0.07	NS
31-40	75(34.09)	44(39.63)	16(23.52)	3(9.67)	63(30)	138(32.09)	0.04	S
41-50	79(35.90)	32(28.82)	1(1.47)	-	33(15.71)	112(26.04)	0.01	S
51-60	15(6.81)	8(7.20)	-	-	8(3.80)	23(5.34)	0.02	S
>60	-	-	-	-	-	-	-	
Adequate	65(29.55)	21(18.92)	9(13.23)	0	30(14.28)	95(22.09)	0.02	S
Inadequate	155(70.45)	90(81.08)	59(86.76)	31(100)	180(85.71)	335(77.90)	0.02	S
Total	220	111	68	31	210	430		
Dietary iron intakes (mg per day)								
Range	15-60	14-59	9-49	8-39	8-58	8-60		
Mean	33.2	26.3	20.9	14.8	21.1	23.24		
SD	3.41	2.7	2.2	1.5	1.97	2.54		

P value: Normal vs anemia p=0.015(Significant)

Normal vs mild anemia p=0.04(Significant)

Normal vs moderate anemia p=0.02(Significant)

Normal vs severe anemia p=0.001(Highly significant)

The distribution of patients as per body mass index (BMI) in Kg/m² is shown in Table 6. Majority of patients (328, 76.27%) had normal BMI. A total of 62(14.41%) patients were underweight and anemia was significantly more common in them ($p=0.01$). Severe anemia was most common in underweight patients. Overweight (6.51%) and obese (2.79%) patients had less prevalence of anemia. Hence, under nutrition was a risk factor for anemia while overweight and obesity were protective factors.

Table 6: Distribution of patients as per BMI (kg/m²)

BMI	Normal (n=220)	Mild (n=111)	Moderate (n=68)	Severe (n=31)	Anemia (n=210)	Total (n=430)	P value	Signifi cance
	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)		
Underweight	18(8.18)	18(16.21)	16(23.52)	10(32.25)	44(20.95)	62(14.41)	0.01	S
Normal	172(78.18)	87(78.37)	49(72.05)	20(64.51)	156(74.28)	328(76.27)	0.12	NS
Overweight	21(9.54)	4(3.60)	2(2.94)	1(3.22)	7(3.33)	28(6.51)	0.05	S
Obese	9(4.09)	2(1.80)	1(1.47)	-	3(1.42)	12(2.79)	0.04	S
Total	220	111	68	31	210	430		

DISCUSSION

The prevalence of anemia in the present study was found to be 48.84% with mild anemia being 25.81 % (52.86% of anemia cases), moderate anemia being 15.81 % (32.38% of anemia cases) 4 severe anemia being 6.98 % (14.29% of anemia cases) and very severe being only 1 case (0.24%). Overall global prevalence of anemia in pregnancy as per Stevens et al¹⁵ was 36% and was 5.7% in USA, but 75% in Africa and Asia as per WHO data¹. The prevalence was much higher in Africa varying from 24.2% to 50.8% in different studies¹⁶⁻²⁴. It was 18.9% in China (Wu et al)²⁵. Hence prevalence of anemia of 48.84% in present study was in range of various studies in Africa and other developing countries.

The prevalence varied from 28% to 90.5% in Southeast Asian countries²⁶⁻³⁰. Hence present prevalence of 48.84% was as per other studies in South East Asian countries. The prevalence of anemia in pregnancy in different parts of India in various Indian studies varied from 47.18% to 96.5%³¹⁻³⁶. There was higher prevalence in older studies and decreased overtime possibly due to better understanding and affluence with time. In spite of Anemia Mukht Bharat, the prevalence of anemia in pregnancy didn't decrease recently¹³. In fact, there was marginal rise in overall prevalence of anemia in pregnancy in India, from 50.1% in NFHS 4 (2016-2018) to 52% in NFHS 5 (2019-2021)³. The prevalence of anemia in pregnancy in National Capital Region, Delhi decreased from 46.1% in 2016 to 18 in NFHS 4 to 42.2% in 2019 to 2021 in NFHS 5. In the present study, the prevalence of anemia in pregnancy was 48.84% which was more than NFHS 5 of Delhi (42.2%). It could be due to study being done in tertiary referral public hospital of Delhi Safdarjung Hospital which caters to poor patients of Delhi. The prevalence may be lower in private hospitals catering to richer patients. In the present study, prevalence of anemia in pregnancy was 48.84% being mild in 25.81% (52.86% of anemia patients), moderate in 15.81 % (32.38% of anemia patients) and severe anemia being 6.98 % (14.29% of anemia patients) and with only 1 case (0.23%, 0.48% of anemia group) being very severe (decompensated) anemia. Other authors from India, Southeast Asia and Africa also observed mild and moderate anemia to be more common while severe anemia least common during pregnancy^{18,20,23,27,30,32}.

In the present study, anemia was significantly more common in vegetarian women and less common in non vegetarian women. Silubonde et al³⁷ from South Africa, Zhang et al³⁸ from China and Baig Ansari et al³⁰ from Pakistan observed low intake of eggs, red meat, beef and chicken as risk factors for anemia.

In the present study, one and two meals a day were a significant risk factor for anemia in pregnancy especially for moderate and severe anemia. Similarly lower average calorie intake, lower dietary protein intake and lower dietary iron intake were risk factors for anemia in the present study. Other authors have also observed under nutrition (less calories, protein, and iron intake) as risk factors for anemia and animal source food consumption as a protective factor against anemia in pregnancy^{19,38,41}. Mare et al⁴² also observed underweight as a risk factor for anemia in pregnancy. We also observed low BMI (underweight) as a risk factor for anemia in pregnancy.

Strength of this study

It was a prospective study and reasonably large sample of women in their second and third trimester of pregnancy in which nutritional factors were correlated with prevalence and severity of anemia. The study adds to the knowledge regarding dietary habits, calories, intake, protein intake, dietary iron intake, and body mass index in relation to

prevalence and severity of anemia. The study guides regarding recommendations to advise adequate dietary calories, protein and iron intake in pregnancy to decrease prevalence and severity of anemia.

Limitations

The limitations of the study are being hospital based study and may not be representative of true prevalence at the community level. Another limitation is dependence on dietary recall method with risk of recall bias. Also, it was a one-time cross sectional study with no data on follow up and maternal and perinatal outcome.

CONCLUSION

The study shows a high prevalence (48.84%) of anemia in pregnancy with risk factors being low BMI, less dietary calories, protein, iron intake. The findings have practical clinical implications for counselling patients to consume adequate calories, protein and iron to reduce prevalence of anemia in pregnancy.

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Conflict of interest: None

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