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▪ ORIGINAL RESEARCH

Anemia in Pregnancy and Its Association with Antenatal Care

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ABSTRACT

Background. Anemia in pregnancy is common in low- and middle-income countries and is usually due to iron deficiency. This study aimed to determine the prevalence of anemia and its association with antenatal care among pregnant women in Dhaka City, Bangladesh.

Methods. This was a cross-sectional study of 480 pregnant women in their third trimester. Anthropometric and biochemical data were collected to assess the nutritional and health status of the women. An interview schedule, a structured questionnaire, and medical reports were used to collect the necessary data, and SPSS was used for the analysis.

Results. Anemia was present in 59% of the participants, which is alarming. Overall, 34% of the women were mildly anemic, 19% were moderately anemic, and 6% were severely anemic. Almost all of the respondents had received antenatal care. In total, 45.6% of the participants visited antenatal clinics 4-6 times. The number of ANC visits was not associated with anemia (p-value = .179), but diet pattern and occupation were significantly associated with the presence of anemia (p-value < 0.05).

Conclusion. Pregnant women should attend antenatal care for health monitoring, take iron supplements, and maintain a balanced diet for a healthy pregnancy and to avoid anemia during gestation.

Keywords: Anemia; Iron deficiency; Antenatal care; Pregnancy

1. Introduction

Anemia during pregnancy is one of the major public health problems in both developing and developed countries [1]. The highest prevalence is in Sub-Saharan Africa (57%), and the second highest is in Southeast Asia (48%) [2]. In India, the prevalence of anemia in pregnancy is about 52.2%, and it is even higher among teenage mothers (61.5%) [3]. Other South Asian countries, such as Nepal, Bhutan, and Sri Lanka, have rates of 65%, 59%, and 60%, respectively [4]. In Bangladesh, three different surveys showed that anemia in pregnancy is highly prevalent, at 50%, 59%, and 63%. It is observed more often in rural areas than in urban areas of Bangladesh [5].

Anemia is defined as a low hemoglobin (Hb) concentration or a lower red blood cell count in an individual than the lower reference level for the individual's age, gender, physiological condition, and geographical location [6]. According to the World Health Organization, a pregnant woman is anemic if her Hb level is lower than 11 g/dL. Anemia in pregnancy is classified as mild (Hb level 10-10.9 g/dL), moderate (Hb level 7.0-9.9 g/dL), or severe (Hb level < 7.0 g/dL) [7].

The causes of anemia in pregnancy can be multiple, but the principal cause is an increased requirement for micronutrients that is not met. The micronutrients whose deficiency causes anemia include iron, vitamin A, vitamin B6, vitamin B12, and folic acid. Other causes of anemia include chronic illness, malaria, HIV, intestinal infection, and malabsorption [8]. Risk factors also include low socio-economic status, rural residence, late antenatal care,

unhealthy lifestyle, poor nutrition, short birth intervals, menstrual disorders, smoking, and alcohol consumption [9][10].

Antenatal care is a medical service that a pregnant woman receives until childbirth to ensure the wellbeing of herself and her unborn child. It includes health education, screening for and identification of various diseases, and monitoring of fetal growth [11]. Studies have shown that antenatal care during complicated pregnancy reduces the risk of maternal and neonatal mortality [12]. Pregnant women with anemia can also face other serious health issues, such as gestational hypertension, preeclampsia, preterm labor, gestational diabetes, placenta previa, miscarriage, and stillbirth [13-17].

The key variables considered here are anemia, pregnancy, and antenatal care, together with their interrelationship, poor outcomes, and risk factors [18].

Although many studies have been conducted in Bangladesh on anemia among women and children, a gap remains. The purpose of this study was therefore to determine whether the situation is any better in the capital of Bangladesh, where health facilities such as antenatal care are more available.

2. Materials and Methods

2.1. Type of study

This was a cross-sectional study conducted in Dhaka city. Data were collected at Azimpur Maternity Hospital, Mohammadpur Fertility Center, and Dhaka Medical College from January 2024 to January 2025.

2.2. Selection

Pregnant women in their third trimester who were receiving antenatal care were selected for the study. Convenience sampling was used. The selected women were aged 18-45 years. If any participant had been younger than 18 years, consent would have been obtained from her parents, and she could have been included only if a parent provided consent, per the research protocol; however, none of our participants was younger than 18 years.

2.3. Sample size

The sample size was calculated using the formula of Kish Leslie, also known as the single population proportion formula [19]. The formula is:

$n = z^2\ pq/d^2$

Here, n = sample size

z = z-score for the desired confidence level

p = true population prevalence of the disease

q = complement of p

d = margin of error

A 50% prevalence of anemia in pregnancy was assumed, and a 0.05 margin of error was used. Thus, the ideal sample size for the study was 380 pregnant women [20], but the sample size was increased to 480 women. We used convenience sampling to select the 480 women who fulfilled the inclusion criteria. Data from 160 participants were collected at each hospital.

2.4. Data collection method

After the study purpose was explained, all necessary data were collected from the women who fulfilled the inclusion criteria. A structured questionnaire developed by the researchers and an interview schedule were used for face-to-face interviews. Meat and fish intake was assessed by two questions: whether it was taken daily (yes/no), which was used in the chi-square analysis in Table 3, and the weekly frequency of intake, which is reported in Table 4.

Anthropometric measurements were taken using a weight machine and a height scale. The World Health Organization Body Mass Index chart was used to assess the nutritional status of the participants. The biochemical data, such as blood hemoglobin levels in each trimester, were obtained from the latest medical records of the respondents at the hospitals. The Hb levels of the first and second trimesters were measured retrospectively from the previous medical records of each participant.

Hemoglobin measurements for the first, second, and third trimesters were obtained from participants' medical records at Azimpur Maternity Hospital, Mohammadpur Fertility Center, and Dhaka Medical College. Hb levels were collected retrospectively during the 10^{th} and 20^{th} weeks, and the latest Hb level was taken as the third-trimester measurement. Missing measurements, where present, were handled using available-case analysis for the relevant variables. There were no missing values for Hb levels in any trimester, but there were some missing values for RBS, FBS, TG, cholesterol, and systolic and diastolic blood pressure. The laboratory methods in all the health care centers were consistent.

2.5. Data analysis

All the data were entered into a computer after collection, and IBM SPSS Statistics was used to analyze and compile them. The primary outcome was the presence of anemia among pregnant women and its severity. The primary exposure was the number of antenatal clinic visits, and the secondary exposures were dietary intake, iron-folate supplementation, occupation, and pregnancy trimester.

2.6. Ethical approval

Ethical approval was obtained from the ethical committee of Govt. College of Applied Human Science before the research was conducted, and informed consent was obtained from the participants.

3. Results

Table 1 shows the mean values (mean ± standard deviation) of anthropometric variables, such as height, weight, and BMI, and of biochemical variables, including blood pressure, blood sugar, and hemoglobin level. Comparing the mean hemoglobin levels of the three trimesters, the hemoglobin level was lowest among pregnant women during the second trimester (mean 9.8048 ± 1.38371 g/dL) and improved in the third trimester. The table also shows the total cholesterol and triglyceride levels of the women. The other biochemical measurements in the table are also important, as diabetes, hypertension, obesity, and hyperlipidemia are also prevalent in pregnant women. The units of the biochemical data in the table are the same as those in the hospital medical records. The number of observations varied across biochemical variables because some measurements were unavailable for certain participants. Analyses of these variables were conducted using the available observations for each variable; the missing data were excluded, and the corresponding sample size is reported in Table 1.

Table 2 presents the socio-demographic information of the study population, such as age group, occupation, and monthly family income. According to Table 2, most of the pregnant women were young, and they were either students or housewives, which suggests that they were living a sedentary lifestyle during their pregnancy. The majority of the pregnant women (40%) were from middle-class families. Figure 1 shows the number of antenatal clinic visits and the stage of anemia among the study population. It shows that 283 (59%) of the total study population were anemic, which indicates a high prevalence of anemia during pregnancy. The anemic women were given intravenous iron supplements, and some received blood transfusions. They were also counseled about their dietary habits and provided with iron-folate supplements by the hospitals. Although 46% of the pregnant women visited the ANCs 4-6 times and 37% visited more than six times, this did not have a significant effect on their hemoglobin levels. In total, 447 (93%) of the 480 pregnant women took iron-folate supplements, and 33 women did not. Table 3 shows the association between antenatal clinic visits and stage of anemia, occupation, and iron-folate tablet intake. The results show that the stage or presence of anemia was not associated with the number of antenatal clinic visits (p-value = .179). However, visit frequency alone does not measure the timing or quality of care, anemia screening, iron–folate counselling, or supplement adherence. Likewise, iron-folate intake was not

significantly associated with the presence of anemia (p-value = .365). An association was found between the presence of anemia and the occupation of pregnant women (p-value = .025). There was also a significant association between meat and fish intake and the presence of anemia (p-value = .046). The participants were asked about the frequency of meat and fish intake.

Table 1. Mean values of anthropometric and biochemical variables among study participants (N = 480 unless otherwise noted).

Variable	N	Mean	Std. Deviation
Height (m)	480	1.5437	0.04957
Weight (kg)	480	65.80	6.65146
BMI of Participants (kg/m^2)	480	27.67	2.99139
Hb Level in 1st Trimester (g/dL)	480	10.4656	1.48074
Hb Level in 2nd Trimester (g/dL)	480	9.8048	1.38371
Hb Level in 3rd Trimester (g/dL)	480	10.0880	1.51480
Random Blood Sugar (mmol/L)	408	6.0480	1.46920
Fasting Blood Sugar (mmol/L)	388	5.4072	0.77018
Systolic Blood Pressure (mmHg)	476	121.5966	10.53511
Diastolic Blood Pressure (mmHg)	476	78.1933	8.79934
TG (mg/dL)	420	190.8748	39.3439
Total Cholesterol (mg/dL)	296	95.3298	25.70

Table 2. Age, occupation, and monthly family income of the study participants.

Age of Participants	N	%
18-20 Years	84	17.5%
21-25 Years	108	22.5%
26-30 Years	173	36.0%
31-35 Years	109	22.7%
36-45 Years	6	1.3%
Total	480	100%
Occupation	**N**	**%**
Daily Labourer	8	1.6%
Desk Job	115	24.0%
Garments Worker	50	10.4%
Housewife/ Student	307	64.0%
Total	480	100%

Age of Participants	N	%
Monthly Family Income	**N**	**%**
10,000-30,000 BDT	142	29.6%
30,000-50,000 BDT	192	40.0%
>50,000 BDT	146	30.4%
Total	480	100%

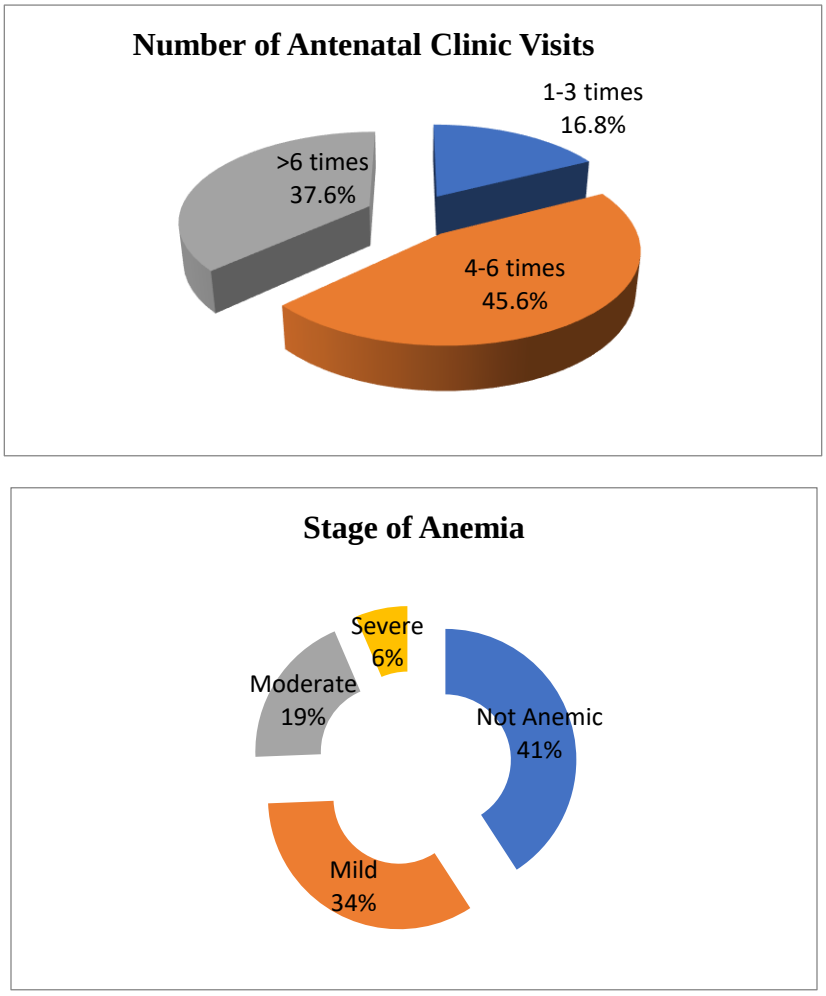


Figure 1. Distribution of pregnant women by number of antenatal clinic visits and stage of anemia (N = 480).

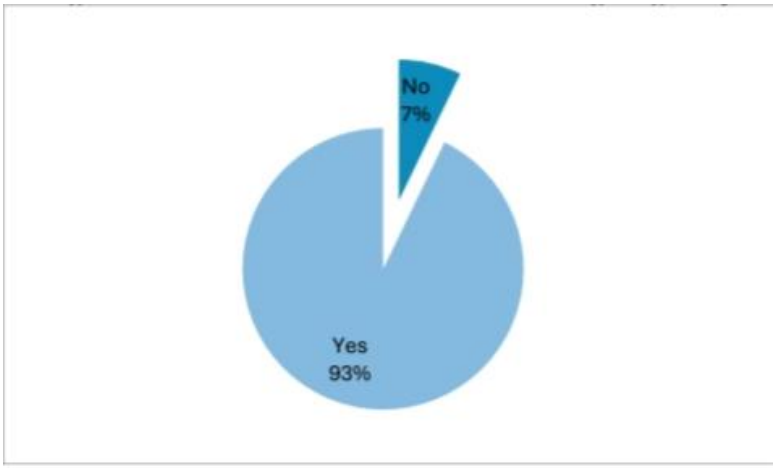


Figure 2. Iron-folate supplement intake among study participants (N = 480).

Table 3. Chi-square analyses of the association between presence of anemia and number of antenatal clinic visits, iron-folate tablet intake, occupation, and meat/fish intake.

(Number of Antenatal Clinic Visits and Presence of Anemia)	**Value**	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-square	4.906[a]	3	.179
Likelihood Ratio	5.413	3	.144
N of Valid Cases	480		

Antenatal clinic visits: 2 cells (25%) have an expected count of less than 5. The minimum expected count is 0.41.

(Iron Folate-tablet Intake and Presence of Anemia)	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-square	0.820[a]	1	.365
Likelihood Ratio	0.878	1	.349
N of Valid Cases	480		

Iron-folate tablet intake: 0 cells (0%) have an expected count of less than 5. The minimum expected count is 13.5.

(Occupation and Presence of Anemia)	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-square	9.325[a]	3	.025
Likelihood Ratio	11.428	3	.010
N of Valid Cases	480		

Occupation: 2 cells (25%) have an expected count of less than 5. The minimum expected count is 0.82.

(Daily Intake of Meat and Fish and presence of Anemia)	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.970[a]	1	.046
Likelihood Ratio	4.118	1	.042
N of Valid Cases	480		

Meat/fish intake: 0 cells (0%) have an expected count of less than 5. The minimum expected count is 13.87.

Table 4. Distribution of study participants by weekly intake of meat/fish, egg/milk, and fruits/vegetables.

Frequency	N (Meat and Fish)	%	N(Egg and milk)	%	N (Fruits and Vegetables)	%
Once	0	0.0	8	1.7	4	0.8
2-3 Times	10	2.1	134	27.9	111	23.1
4-5 times	121	25.2	165	34.4	238	49.6
Daily	349	72.7	173	36.0	127	26.5
Total	480	100	480	100	480	100

Table 4 shows the dietary habits of the pregnant women. The intake of meat and fish seems satisfactory: 72.7% of women took meat and fish daily, which is necessary in the last trimester due to high fetal growth. On the other hand, 36% of women had eggs and milk daily, although daily intake of milk and eggs is also essential, as they are high-protein foods. In addition, 127 of the 480 women had fruits and vegetables daily. Pregnant women should be more careful about their dietary habits. Meat and fish intake was considered as a single exposure; similarly, fruits and vegetables, and eggs and milk, were each counted as single exposures. This study also focused on poor pregnancy outcomes, such as stillbirth and miscarriage. Overall, 7.2% of the participants had experienced stillbirth, and 24% of the women had a history of miscarriage in their previous pregnancies.

4. Discussion

Our study was conducted to determine the actual prevalence of anemia among pregnant women in Dhaka city who were regularly using health facilities. We focused on various socioeconomic variables, which are given in Table 2. Another study, conducted in rural areas of China, found that most of the women depended on agriculture, unlike in this study. That study also found an association between occupation and the presence of anemia, as we did [21].

This study found that 93% of our total study population took iron-folate supplements during pregnancy. The women also had diverse food choices, as they included meat, fish, vegetables, fruits, milk, and eggs in their daily diet. A study in Ghana reported a similar result among pregnant women [20]. An interrelationship of anemia with supplementation and diet was found in this study; however, iron-folate supplement intake was not statistically significantly associated with the presence of anemia (p-value = .365). Meat and fish intake was associated with the presence of anemia among pregnant women (p-value = .046), and the occupation of the pregnant women was also associated with anemia (p-value = .025). Another study, conducted in Northern Tanzania, found that women had visited ANC only once to thrice, whereas the number of visits was higher in this study, as that study included pregnant women in their first trimester as well [22]. We also tried to determine the prevalence of different chronic diseases, such as diabetes, hypertension, thyroid problems, and asthma, and a recent history of infection during the time of our study. As anemia can be associated with these factors, other research has been done on them [23]. However, no significant association was found between the number of antenatal clinic visits and the presence and

stage of anemia among pregnant women. The number of ANC visits is not the only predictor of anemia during pregnancy.

4.1. Strengths and limitations

The key limitation of this study was that it included only women from Dhaka city and, owing to convenience sampling, the sample is not representative of the whole nation. Also, as a cross-sectional study, it cannot establish any causal relationship between anemia in pregnancy and its associated factors. The Hb levels of the 1st and 2nd trimesters of the participants were collected retrospectively, which limits comparability.

In summary, the findings of this study could not associate anemia with antenatal care during pregnancy. On the other hand, they highlight the importance of a balanced diet, iron tablets, and a healthy lifestyle to avoid infections. Occupation and physical activity are also essential factors that can affect pregnancy outcomes. Women in urban areas are also at risk, like rural women, despite living in a city full of facilities. The sample size of this study was smaller than ideal, as this research was part of an academic curriculum. Further research with a larger study population is suggested.

5. Conclusion

In conclusion, the study showed a satisfactory result regarding antenatal care, as all women received it during pregnancy. However, our study showed no significant association between the number of antenatal visits and anemia, although there are other factors associated with anemia during pregnancy. The timing and quality of care, anemia screening, iron–folate counselling, and adherence to supplementation were not measured in this study. Similarly, no significant association was found between iron-folate supplement intake and the presence of anemia. The importance of education, occupation, and other socio-demographic variables was highlighted. Moreover, besides routine check-ups, it is important to maintain a proper diet and take medication during pregnancy according to the woman's physical condition.

Abbreviations

ANC, antenatal care; BMI, body mass index; FBS, fasting blood sugar; Hb, hemoglobin; RBS, random blood sugar; SD, standard deviation; SPSS, Statistical Package for the Social Sciences; TG, triglyceride.

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Not applicable.

Author Contributions

Conceptualization, MS; Investigation, MM; Formal analysis, MM; Writing — original draft, MM; Supervision, MS. All authors have read and approved the final manuscript.

Consent to Participate

Informed consent was obtained from all the participants before data collection. No participant was below 18 years old; thus, parental consent was not required.

Consent for Publication

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability

Data are available from the corresponding author upon reasonable request.

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Appendix

Appendix. Cross-tabulation of iron-folate intake and presence of anemia.

Count

	Is the patient anemic?		
Iron-folate Intake	Yes	No	Total
Yes	261	186	447
No	22	11	33
Total	283	197	480