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Anaemia and Its Determinants among Pregnant Women Attending for Accessing Antenatal Care in Dhaka, Bangladesh

Shimlin Jahan Khanam[1], Md Awal Kabir[2*]

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ABSTRACT

Anaemia is a major cause of maternal mortality in low- and middle-income countries and Bangladesh. The primary objective of this study was to evaluate the prevalence of anemia and its contributing factors among pregnant women in Dhaka, Bangladesh. A total of 260 pregnant women were included in this study, recruited from two healthcare facilities in Dhaka. The primary outcome of interest was the presence or absence of anaemia (yes or no). The exposure variables encompassed various characteristics related to the women, their partners, and the community. To investigate the associations between the outcome and exposure variables, multivariate logistic regression techniques were employed. The findings revealed that two-thirds of the pregnant women in the study were anemic. Notable socio-demographic determinants of anaemia included women aged between 21 and 30 years, unemployment, residing in households with lower wealth, and not taking iron supplements during the current pregnancy. Additionally, a history of previous abortions was identified as a risk factor for anaemia during pregnancy. The prevalence of anaemia among pregnant women in Bangladesh is notably high. There is a pressing need for improvements in the provision of antenatal care and other healthcare services to address this issue effectively.

INTRODUCTION

Anaemia, characterized by low concentrations of hemoglobin, is a significant global health concern, particularly among pregnant women. In 2019, the global prevalence of anaemia in this population was estimated to be 38% (Stevens *et al.*, 2013). Anaemia during pregnancy is associated with a heightened risk of various complications, including prolonged labor (IPHN, 2007), maternal mortality (Brabin *et al.*, 2001 & Black *et al.*, 2008), preterm birth (Black *et al.*, 2008), low birth weight (Rahman *et al.*, 2016), stillbirths (IPHN, 2007), and neonatal mortality (Brabin *et al.*, 2001) among offspring. Globally, an alarming 47%-53% of pregnant women experience complications related to anaemia, such as the risk of premature birth and having a low-birth-weight baby (Stephen *et al.*, 2018). Given these adverse outcomes, anaemia during pregnancy demands serious attention on a global scale.

The causes of anaemia during pregnancy are multifactorial, encompassing factors such as substandard diets, poor hygiene practices (Ahmed *et al.*, 2016), inadequate consumption of fish, meat (Hyder *et al.*, 2004), and vegetables, low B12 intake (Kalaivani, K, 2009), heightened iron requirements during pregnancy, iron deficiency (Haidar, 2010), and the presence of infectious diseases like malaria, HIV, and helminth infestations (Pasricha *et al.*, 2008). Additional contributors include menstrual blood loss before pregnancy, insufficient iron intake, poor iron absorption from diets, and increased iron requirements during growth and menstruation (Ahmed *et al.*, 2012 & Ahmed, 2000). Furthermore, various socio-economic and biological factors elevate the risk of anaemia, including maternal illiteracy, spousal illiteracy, lower income, environmental factors (Ahmed *et al.*, 2003), domestic violence (Ackerson & Subramanian, 2008), inadequate healthcare practices, early marriage (IPHN, 2007), gestational age, gravida, short pregnancy intervals (Barooti *et al.*, 2010, Jamaiyah Haniff *et al.*, 2007, Noronha *et al.*, 2010), an increased number of children, the use of intra-uterine devices (IUDs), and residing in rural areas (Ackerson & Subramanian, 2008, Mitra *et al.*, 2012). Additionally, chronic diseases and genetic disorders such as haemoglobinopathies and thalassemia can contribute to anaemia (Ahmed *et al.*, 2016).Notably, the prevalence of anaemia during pregnancy varies between low-income and high-income countries, with 56% of pregnant women suffering from anaemia in low-income nations compared to 18% in high-income countries (Mason & Gillespie, 2001). In the Southeast Asia region, the World Health Organization (WHO) reports that, on average, 65% of pregnant women are anaemic (De Benoist *et al.*, 2008). Bangladesh, a low-income country, faced a substantial burden of anaemia among pregnant women, with 3.2 million cases in 2018 (IPHN, 2007). Recent years may have seen fluctuations in the prevalence of anaemia among pregnant women in Bangladesh, necessitating investigation. According to the recent data in Bangladesh, 49% of ever-married women aged 15-49 years were anaemic. In urban areas, the prevalence stood at 41%, while in rural areas, the exact figure remains to be determined (UNICEF BBo, 2004). To combat this issue, Bangladesh has set a target to reduce the anaemia rate among pregnant women by 25% by 2025.

Bangladesh's national health service offers free antenatal

[1] Department of Population Science, Jatiya Kabi Kazi Nazrul Islam University, Mymensingh, Bangladesh
[2] Department of Social Work, Pabna University of Science and Technology, Pabna, Bangladesh
[*] Corresponding author's e-mail: shimlinjahan2208@gmail.com

care, which includes iron supplementation with folic acid tablets from the second trimester to 45 days post-delivery, deworming after the first trimester, and food fortification programs (Mitra *et al.*, 2012). Multiple strategies for anaemia prevention and control exist, divided into two categories: population-based strategies and targeted strategies for high-risk groups. The latter encompasses micronutrient supplementation, dietary enhancement, parasitic disease control, family planning and safe motherhood practices, as well as food fortification (IPHN, 2007). To adhere to WHO recommendations for antenatal care, pregnant women in Bangladesh are advised to attend at least four visits, with the first visit scheduled for the first trimester (8–12 weeks), the second in the second trimester (24–26 weeks), and the third and fourth in the third trimester (visit 3 at 32 weeks and visit 4 at 36–38 weeks) (Jo *et al.*, 2019 & WHO, 2016).

While several studies on anaemia in Bangladesh have provided valuable insights, there remain gaps in our understanding, particularly with regard to anemia risk factors. To address these gaps, this study aims to assess the prevalence of anemia and explore its associated determinants among pregnant women attending ANC clinics in Bangladesh. In doing so, we contribute to a more comprehensive understanding of anemia in this population, with a focus on factors that have not been adequately addressed in previous research.

METHODOLOGY

Study Design and Setting

This study, employing a cross-sectional design, was conducted in 2022. To ensure a diverse representation of socio-economic levels, two tertiary hospitals in the capital city of Dhaka were selected using purposive sampling. The chosen hospitals included Dhaka Medical College Hospital (a government hospital) and Salauddin Specialized Hospital (a private hospital).

Participants

Eligible participants were pregnant women between the ages of 15 to 49 years, irrespective of their current trimester, who were receiving antenatal care at these hospitals. Inclusion criteria included the presence of a recorded hemoglobin level from the same day of the antenatal care visit. Participants were required to show their health records confirming this. Pregnant women who did not provide consent or lacked recorded hemoglobin levels from the same day were excluded. Convenience sampling was employed to recruit participants, and the first author, SJK, approached eligible individuals upon their arrival at the antenatal care center. Informed consent was obtained, and participants were free to withdraw from the study at any point. A total of 260 consenting pregnant women participated.

Sample Size Determination

To determine the sample size, assuming a prevalence of anaemia at 50% among pregnant women and a 5% margin of error, a total sample of 384 pregnant women was initially required. The formula used for sample size calculation was as follows:

$n = (z^2 * p * q) / d\text{^}2 = [(1.96)^2 * 0.5 * 0.5] / (0.05)^2 = 384.16 \approx 384$

However, due to time constraints and budget limitations, a sample size of 260 was selected to achieve the study's objectives.

Dependent Variable

The dependent variable in this study was anaemia, assessed through hemoglobin levels extracted from participants' health records. Hemoglobin levels were recorded on the same day as the antenatal care visit. Due to potential variations in hemoglobin levels during pregnancy, trimester-specific cutoff points for anemia were not available. Therefore, World Health Organization (WHO) cutoffs for pregnant women were used. Hemoglobin levels of 11.0g/dl or higher were considered non-anaemic, 10.0-10.9 g/dl as mild anaemia, 7.0-9.9 g/dl as moderate anaemia, and less than 7.0 g/dl as severe anaemia.

Independent Variables

Independent variables included socio-demographic characteristics (age, age at marriage, education, religion, marital status, occupation), maternal factors (gravida, parity, history of pregnancy termination), current pregnancy information (trimester, history of pregnancy termination, iron and folate supplementation), health-seeking behavior (antenatal care visits, any illness during current pregnancy), maternal anthropometry (height, weight), dietary information (meal frequency, nutrition knowledge, awareness of anaemia causes and consequences), and household-level factors (access to safe water, sanitation). Additionally, questions related to physical exercise, access to safe water and sanitation, sleep habits, and smoking habits were asked.

Statistical Analysis

Descriptive statistics were used to characterize the study participants, and Pearson's Chi-square test was employed to assess associations between socio-demographic variables and anaemia status. Bivariate logistic regression models were used to identify factors associated with anaemia, and a final multivariate logistic regression model was employed. Results were reported as odds ratios with their corresponding 95% confidence intervals. A p-value of <0.05 was considered statistically significant, and there were no missing values in the dataset.

RESULTS

A total of 260 pregnant women participated in this study, with the decision to conclude the study made due to resource constraints. Among the surveyed pregnant women, 48% were adolescents and young women aged 18 to 24 years, while 52.3% were adult women aged 25 to 37 years (Table 1). Regarding their educational background, less than a quarter (21.5%) of the pregnant women had completed higher secondary education or above, and 5.8% had no formal education. The majority of the participants

Table 1: Distribution of socio-demographic and maternal characteristics

Characteristics	Categories	N (%)
Age (years)	18-24	180 (47.7)
	25-37	80 (52.3)
Education	No education	15 (5.8)
	Primary	80 (30.8)
	Secondary	109 (41.9)
	Higher Secondary and above	56 (21.5)
Occupation	Home maker	206 (79.2)
	Service-holder	42 (16.2)
	Others	12 (4.6)
Monthly Income (Bangladesh Taka)	≤20000	56 (21.5)
	20001-30000	93 (35.8)
	30001-40000	76 (29.2)
	≥40001	35 (13.5)
Age at first pregnancy (years)	15-20 years	163 (62.7)
	21-25 years	63 (24.2)
	26-29 years	34 (13.1)
Total number of pregnancies	One	85 (32.7)
	Two	80 (30.8)
	Three	51 (19.6)
	Four and more	44 (16.9)
Pregnancy Trimester	1st trimester (0-13 weeks)	15 (5.8)
	2nd trimester (14-26 weeks)	79 (30.4)
	3rd trimester (27-40 weeks)	166 (63.8)
Ever terminated pregnancy	Yes	128 (49.2)
	No	132 (50.8)
Abortion History	Yes	80 (30.8)
	No	180 (69.2)

(79.2%) were homemakers, while 16.2% were employed in various services. For the age at which they experienced their first pregnancy, the majority (62.7%) were between 15 and 20 years old, with only 13% having their first pregnancy between 21 and 26 years of age. Approximately one-third of the women surveyed (32.7%) were experiencing pregnancy for the first time, while a similar proportion (30.8%) had a history of abortion among the total participants. Additional socio-demographic and maternal characteristics are presented in Table 1.

Nutritional Characteristics

Table 2 presents the nutritional characteristics of the pregnant women in the study. Among the total pregnant women, an overwhelming majority (97.3%) reported having three meals per day. Additionally, just over half of the participants (51.5%) reported taking or having taken iron or folate tablets during their pregnancy.

Table 3 provides insights into the prevalence of anaemia based on age groups. Among respondents aged 20 years or below, 43.8% had anaemia. Conversely, the highest

Table 2: Distribution of nutritional characteristics

Variables	Categories	N (%)
Meal frequency per day	Two Times	7 (2.7)
	Three times	253 (97.3)
Height (cm)	<150 cm	110 (42.3)
	≥150 cm	150 (57.7)
Weight gain (kg) self-reported	≤3	75 (28.8)
	4-6	157 (60.4)
	≥7	28 (10.8)

Taken of any iron or folate tablets during pregnancy	Yes	134 (51.5)
	No	126 (48.5)
Practice of breast-feeding	Ever breast-feeding	49 (18.8)
	Never breast-feeding	211(81.2)

prevalence of anaemia was observed among women aged 21-30 years (70.4%). In the oldest age group, aged 31-40 years, 56.3% had anaemia. These differences in anaemia prevalence by age were found to be statistically significant. Examining the prevalence of anaemia by age at marriage, it was found that among respondents married at the age of 18 years or below, 65.9% had anaemia. On the other hand, the highest prevalence of anaemia was observed among women married at the age of 19-24 years (72.9%). Among respondents married at the age of 25 years or above, 20% had anaemia. These differences in anaemia prevalence by age at marriage were statistically significant. Regarding employment status, 20% of employed respondents had anaemia, while the prevalence of anaemia among unemployed respondents was 71.8%. These differences in anaemia prevalence by occupation were statistically significant.

Wealth level also showed a significant association with anaemia prevalence. Among respondents with an upper level of wealth, 38.1% had anaemia, and those with a middle level of wealth had an anaemia prevalence of 11.9%. In contrast, a higher prevalence of anaemia (78.7%) was observed among respondents with a lower level of wealth.

These differences in anaemia prevalence by wealth were statistically significant. Furthermore, the study found that among respondents who did not take any iron or folate tablets, 84.9% had anaemia. Conversely, the prevalence of anaemia among respondents who took iron or folate tablets was 45.5%. These differences in anaemia prevalence by the use of iron or folate tablets were statistically significant. Finally, among respondents with a history of abortion, 91.3% had anaemia. On the other hand, the prevalence of anaemia among respondents without a history of abortion was 52.8%. These differences in anaemia prevalence by abortion history were statistically significant.

Table 4 reveals that respondents aged 20 or younger and those aged 21-30 face 3.53 and 8.44 times higher odds of experiencing anaemia compared to those aged 31-40,

Table 3: Factors associated with Anaemia in Dhaka, Bangladesh

Variables	**Categories**	**Anaemia, N (%)**		**Total (N)**	**Chi² test**
		Anaemic	**Not-Anaemic**		
Age in years	≤ 20	21 (43.8%)	27(56.3%)	48	p>0.002
	21-30	138(70.4%)	58(29.6%)	196	
	31-40	9 (56.3%)	7 (43.8%)	16	
	Total	168(64.6%)	92(35.4%)	260	
Age at marriage in years	≤ 18	85 (65.9%)	44(34.1%)	129	p>0.001
	19-24	78 (72.9%)	29(27.1%)	107	
	≥25	5 (20.8%)	19(79.2%)	24	
	Total	168(64.6%)	92(35.4%)	260	
Occupation	Unemployed	148(71.8%)	58(28.2%)	206	p>0.001
	Employed	20 (37.0%)	34(63.0%)	54	
	Total	168(64.6%)	92(35.4%)	260	
Wealth	Lower	155(78.7%)	42(21.3%)	197	p>0.001
	Middle	5 (11.9%)	37(88.1%)	42	
	Upper	8 (38.1%)	13(61.9%)	21	
	Total	168(64.6%)	92(35.4%)	260	
Taken of any iron or folate tablets	No	107(84.9%)	19(15.1%)	126	p>0.001
	Yes	61 (45.5%)	73(54.5%)	134	
	Total	168(64.6%)	92(35.4%)	260	
Having History of abortion	No	95 (52.8%)	85(47.2%)	180	p>0.001
	Yes	73 (91.3%)	7 (8.8%)	80	
	Total	168(64.6%)	92(35.4%)	260	

after adjusting for variables such as education, occupation, wealth, iron tablet usage, and abortion history. While the p-value for the age group 20 or younger is not statistically significant, the p-values for the age groups 21-30 and 31-40 are statistically significant.

Regarding education, respondents with formal education have 71.4% lower odds of developing anaemia compared to those without education, even after controlling for age, occupation, wealth, iron tablet usage, and abortion history. However, it's worth noting that the p-value for education is not statistically significant. Employment status also plays a significant role, with pregnant women who are employed having 80.3% lower odds of experiencing anaemia compared to their unemployed counterparts, even after adjusting for age, education, wealth, iron tablet usage, and abortion history. The p-value for employment status is statistically significant. Furthermore, wealth level is a critical factor. Respondents with a lower level of wealth face 4.33 times higher odds of developing anaemia compared to those with an upper level of wealth, and this difference is statistically significant. Conversely, participants with a middle level of wealth have 64.8% lower odds of experiencing anaemia after adjusting for age, education, occupation, iron tablet usage, and abortion history, although the p-value for this group is not statistically significant. Among pregnant women who have taken iron tablets, there is an 84.4% reduction in the odds of developing anaemia compared to those who have not taken iron tablets, even after controlling for age, education, occupation, wealth, and abortion history. The p-value for iron tablet usage is statistically significant. Finally, respondents with a history of abortion face 9.52 times higher odds of experiencing anaemia compared to those without a history of abortion, even after adjusting for age, education, occupation, wealth, and iron tablet usage. The p-value for abortion history is also statistically significant.

Table 4: Determinants of Anaemia among pregnant women

Variables	Categories	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age of the respondents	≤20	3.535	0.798 - 15.654	0.096
	21-30	8.442	2.359 -30.208	0.001
	31-40	Ref	Ref	0.002
Education	Has Education	0.286	0.053-1.538	0.145
	No Education	Ref	Ref	Ref
Occupation	Employed	0.197	0.081-0.480	0.001
	Unemployed	Ref	Ref	Ref
Wealth	Lower	4.328	1.213-15.439	0.024
	Middle	0.352	0.068-1.835	0.215
	Upper	Ref	Ref	0.001
Taken of Iron tablets	Yes	0.156	0.069-.350	0.001
	No	Ref	Ref	Ref
History of abortion	Yes	9.521	3.123-29.029	0.001
	No	Ref	Ref	Ref

DISCUSSION

In Bangladesh, anaemia poses a significant threat to maternal and child survival during pregnancy. This study highlights a high prevalence of anaemia among pregnant women in Dhaka city, reaching 64.6%. Typically, in developing countries, the prevalence of anaemia during pregnancy hovers around 56%, while the Bangladesh Demographic and Health Survey (BDHS) reports a prevalence rate of 50%. Geographical, socio-economic conditions, and methodological differences may contribute to this variation.

The analysis demonstrates a significant association between various factors and anaemia. Current age, age at marriage, occupation, wealth, iron tablet intake, and history of abortion are all significantly linked to anaemia. Regarding the association between current maternal age and anaemia, the study finds that most anaemic mothers fall within the age group 21-30, which is consistent with previous research showing an increased risk of anaemia with late pregnancy. This correlation may be attributed to the general physical weakness associated with advanced maternal age and the higher likelihood of multigravidity, which can deplete maternal iron reserves and lead to blood loss during delivery (Ahmed, 2000). Early marriage is also significantly associated with anaemia, with a majority of anaemic mothers having married at age 18 or younger. Early marriage may impact anaemia due to the immaturity of girls, making it challenging for them to adapt to the physical changes of pregnancy (14). Additionally, neglect of nutrient-rich foods like meat, fish (De Benoist *et al.*, 2008), milk, and eggs, along with changes in lifestyle, can contribute to their declining health. Occupation and anaemia are interrelated, with a higher prevalence among unemployed pregnant women. Unemployed women often prioritize their family's nutrition over their own, leading to neglect of their own health. This may result in various

health issues and insufficient nutrition during pregnancy, contributing to anaemia. The increased prevalence of anaemia is closely linked to the lower economic and social status of women, particularly those who lack education and financial stability. This group faces challenges in accessing quality healthcare and proper nutrition, leading to malnourishment. Poor nutrition, chronic infections, and worm infestations further exacerbate their health issues. Additionally, the study finds that a significant portion of pregnant women had a low number of antenatal care visits, with 46.5% attending only one to three times. The relationship between wealth and anaemia is statistically significant, with most anaemic pregnant women belonging to the lower wealth quintile. Economic conditions influence respondents' food habits, antenatal care visits, and lifestyle choices. Women from lower wealth quintiles are more likely to experience anaemia than those from upper wealth quintiles (Jamaiyah Haniff *et al.*, 2007).

Although education is an important factor, the study does not find a statistically significant association between education and anaemia. While a higher percentage of participants without education experience anaemia compared to those with education, it suggests that education alone does not always guarantee better health outcomes. Maternal health practices, such as inadequate nutrition and limited access to healthcare services, can contribute to anaemia (14). The study also reveals that anaemia prevalence is higher among pregnant women who did not take iron or folate tablets. Iron tablets play a crucial role in addressing blood and iron deficiencies in the body, and this finding aligns with previous studies conducted in India (Noronha *et al.*, 2010), Pakistan (Mitra *et al.*, 2012), and Nepal, which highlight the lack of iron supplementation as a significant risk factor for anaemia during pregnancy. Furthermore, pregnant women with a history of abortion are more likely to experience anaemia. This is likely due to the blood loss associated with abortion (De Benoist *et al.*, 2008). Despite some limitations in the study, such as sample size and factors not considered in the model, it underscores the urgency of implementing interventions to reduce anaemia.

CONCLUSION

To achieve the Sustainable Development Goals targets for reducing preventable maternal and child mortality in Bangladesh, it is imperative to reduce the prevalence of anaemia among pregnant women. This necessitates the improvement of current healthcare coverage. Reproductive education and advice should be provided to all women of reproductive age to raise awareness. Both unemployed and employed women should be encouraged to maintain a healthy lifestyle. Access to healthy and diversified foods can help reduce anaemia prevalence during pregnancy. Mass media campaigns and community-based initiatives should be implemented to minimize the risk of maternal morbidity and mortality. Increasing women's participation in income-generating activities, promoting proper ANC visits, advocating for iron tablet supplementation, and ensuring a balanced diet during pregnancy are crucial steps to reduce anaemia occurrence.

List of Abbreviations

ANC: Antenatal care; BDHS: Bangladesh Demographic and Health Survey; BMI: Body Mass Index; Hb: Haemoglobin; HIV: Human Immunodeficiency Virus; IDA: Iron Deficiency Anaemia; IFA: Iron and Folic acid; LBW: Low Birth Weight; MCH: Maternal and Child Health; MMR: Maternal mortality rate; NMS: National Micronutrients Status Survey; NPNL: Non-pregnant and non-lactating; SPSS: Statistical Package for Social Sciences; WHO: World Health Organization.

Declaration of Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author's Contributions

Khanam SJ designed the study, performed the data analysis, and wrote the first draft of this manuscript. Kabir MA critically reviewed and edited the previous versions of this manuscript. All authors approved this final version of the manuscript.

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