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ORIGINAL ARTICLE

Prevalence of Thalassemia Trait Among Anemic Pregnant Women Attending a Tertiary Care Hospital in Dhaka, Bangladesh: A Cross-Sectional Study

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ABSTRACT

Background: *Thalassemia is a major public health concern in Bangladesh, yet routine screening for the trait is not universally integrated into antenatal care. This study aimed to determine the prevalence of the thalassemia trait among anemic pregnant women attending a tertiary care hospital in Dhaka.* ***Methods & Materials:*** *This cross-sectional study was conducted at the Department of Obstetrics and Gynecology, Universal Medical College Hospital, Dhaka, from October 2024 to September 2026. A total of 132 anemic pregnant women aged 20–39 years with singleton pregnancies were enrolled. Data on sociodemographic and clinical characteristics were collected, along with complete blood counts and iron profiles. Hemoglobinopathy screening was performed using high-performance liquid chromatography, with an HbA2 level >3.5% defined as a positive thalassemia trait. Statistical analysis was performed using SPSS version 25.* ***Results:*** *The mean age of participants was 27.11 ± 4.78 years. The mean hemoglobin was 8.16 ± 1.05 g/dL and the mean MCV was 74.48 ± 16.00 fL, indicating a predominantly microcytic picture. The mean serum ferritin was 22.40 ± 15.60 ng/mL, reflecting prevalent iron deficiency. Screening revealed that 33 participants (25%) had an elevated HbA2 level (>3.5%), confirming the thalassemia trait. The trait was significantly associated with a history of consanguineous marriage (p=0.045), a family history of thalassemia minor (p<0.001) and significantly lower MCV and MCH values (p<0.001).* ***Conclusion:*** *A high prevalence of the thalassemia trait was found among anemic pregnant women. Routine hemoglobinopathy screening should be integrated into antenatal care, along with the promotion of pre-marital screening, to facilitate early genetic counseling and improve maternal and fetal outcomes.*

Keywords: *Thalassemia trait, Anemia, Pregnancy, HbA2*

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INTRODUCTION

Anemia is a major public health concern affecting pregnant women globally, particularly in low- and middle-income countries [1]. During pregnancy, the physiological demand for iron increases significantly, making women highly susceptible to iron deficiency anemia [2]. However, in regions where inherited hemoglobin disorders are common, the etiology of anemia is often multifactorial. Thalassemia, an autosomal recessive genetic blood disorder, is characterized by reduced or absent synthesis of globin chains, leading to microcytic, hypochromic anemia [3]. Pregnant women who are asymptomatic carriers of the thalassemia trait may experience worsened anemia during gestation, posing significant risks to both maternal and fetal health, including intrauterine growth restriction, preterm birth and increased maternal morbidity [4]. Differentiating between iron deficiency anemia and thalassemia trait is a common diagnostic challenge in clinical obstetrics, as both present with similar hematological profiles, namely low mean corpuscular volume and low mean corpuscular hemoglobin [5]. While iron deficiency anemia can be readily treated with supplementation, thalassemia trait requires careful genetic counseling, as there is a risk of having a child with severe thalassemia major if the partner is also a carrier [6]. Therefore, early and accurate identification of the thalassemia trait in anemic pregnant women is crucial for appropriate clinical management and informed reproductive decision-making [7].

In Bangladesh, the burden of hemoglobinopathies is a

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significant public health issue. The population is highly susceptible to both beta-thalassemia and hemoglobin E disorders, with carrier rates varying across different regions of the country [8]. Despite this recognized burden, routine screening for thalassemia trait is not universally integrated into standard antenatal care protocols [9]. Consequently, many anemic pregnant women are presumptively treated for iron deficiency without undergoing definitive hemoglobinopathy screening [10]. This approach not only delays accurate diagnosis but also fails to identify couples at risk of transmitting severe genetic disorders to their offspring [11].

Furthermore, the clinical profile of anemic pregnant women presenting to tertiary care hospitals often reflects a complex interplay between nutritional deficiencies and genetic factors. Understanding the specific prevalence of the thalassemia trait within this vulnerable population is essential for developing targeted screening strategies. While national data on carrier rates exist, localized institutional data are necessary to highlight the magnitude of the problem and advocate for routine hemoglobinopathy screening in high-risk obstetric populations. Identifying the proportion of anemic pregnant women who harbor the thalassemia trait can guide clinicians in implementing early genetic testing, thereby facilitating timely interventions and improving maternal and neonatal outcomes. This study was, therefore, undertaken to determine the prevalence of the thalassemia trait among anemic pregnant women and to explore the association between familial (e.g., consanguinity, family history) and non-familial characteristics and the presence of this genetic condition.

METHODS & MATERIAL

This cross-sectional study was conducted in the Department of Obstetrics and Gynecology at Universal Medical College Hospital, Dhaka and other collaborating centers, over a period from October 2024 to September 2026. A total of 132 anemic pregnant women were enrolled using a purposive sampling technique. The inclusion criteria were pregnant women aged 20–39 years with a single fetus and hemoglobin levels <11 g/dL in the first and third trimesters, and <10.5 g/dL in the second trimester. Women with multiple pregnancies, grand multiparity, or a history of more than four children were excluded from the study. After obtaining informed written consent, detailed sociodemographic and clinical data were collected using a structured questionnaire. Venous blood samples were collected to assess complete blood count, peripheral blood smear and iron profile (serum iron, ferritin, total iron binding capacity and percentage saturation). Hemoglobinopathy screening was performed using high-performance liquid chromatography, with a hemoglobin A2 level >3.5% defined as an elevated positive thalassemia trait. All statistical analyses were conducted using SPSS version 25. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Associations between participant characteristics and thalassemia trait were evaluated using the Chi-square test for categorical variables and the Independent Samples T-test for continuous variables, with a p-value <0.05 considered statistically significant.

RESULT

Table I
Sociodemographic Characteristics of the Study Participants (*n*=132).

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20-24	52	39.4
	25-29	38	28.8
	30-34	29	22
	35-39	13	9.8
	Total	132	100
	Mean ± SD	27.11 ± 4.78	
Education	Primary	8	6.1
	Secondary	34	25.8
	Undergraduate	37	28
	Graduate	53	40.2
	Total	132	100
Socioeconomic Condition	Low income	30	22.7
	Middle income	99	75
	High income	3	2.3
	Total	132	100
Occupation	Student	12	9.1
	Housewife	110	83.3
	Public sector	3	2.3
	Private sector	7	5.3
	Total	132	100
Obstetric History	Primi	45	34.1
	Multi (<4)	87	65.9
	Total	132	100

Table I presents the sociodemographic characteristics of the study participants. The mean age of the participants was 27.11 ± 4.78 years, with the majority (39.4%) falling in the 20–24 years age group. Regarding education, 40.2% were graduates and 28% were undergraduates, indicating a relatively educated cohort. Most participants (75%) belonged to the middle-income group. Regarding occupation, the vast majority were housewives (83.3%), followed by students (9.1%). Obstetric history revealed that 65.9% were multiparous (parity <4), while 34.1% were primigravida.

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Table II
Clinical and Family History of the Participants (*n*=132).

Variable	Category	Frequency (n)	Percentage (%)
Age at Diagnosis (Gestational Age)	0-12 weeks	21	15.9
	13-28 weeks	52	39.4
	29-40 weeks	59	44.7
	Total	132	100
	Mean ± SD	22.51 ± 9.47	
History of Consanguineous Marriage	Yes	6	4.5
	No	126	95.5
	Total	132	100
History of Blood Transfusion in Previous Pregnancy	Yes	29	22
	No	103	78
	Total	132	100
Family History of Thalassemia Minor	Yes	10	7.6
	No	122	92.4
	Total	132	100
Family History of Genetic Disorder	Yes	1	0.8
	No	131	99.2
	Total	132	100

Table II outlines the clinical and family history of the participants. The mean gestational age at diagnosis was 22.51 ± 9.47 weeks, with the highest proportion (44.7%) diagnosed in the 29–40 weeks range. A history of consanguineous marriage was reported by only 4.5% of the women. Regarding previous obstetric history, 22% had a history of blood transfusion in a prior pregnancy. Family history revealed that 7.6% had a family history of thalassemia minor, whereas only 0.8% reported a family history of any other genetic disorder.

Table III
Peripheral Blood Smear and Basic Hematological Findings (*n*=132).

Variable	Category / Unit	Frequency (n)	Percentage (%) / Mean ± SD
Hemoglobin (g/dL)	<7 (Severe)	3	2.3
	7-9	79	59.8
	9-10	40	30.3
	10-11	10	7.6
	Total	132	100
	Mean ± SD	8.16 ± 1.05	
Anisocytosis	Yes	10	7.6
	No	122	92.4
	Total	132	100
Poikilocytosis	Yes	4	3
	No	128	97
	Total	132	100
Increased Reticulocyte	Yes	2	1.5
	No	130	98.5
	Total	132	100
Total RBC Count	Mean ± SD (million/µL)	4.62 ± 0.55	
MCV	Mean ± SD (fL)	74.48 ± 16.00	
MCH	Mean ± SD (pg)	24.50 ± 3.80	
MCHC	Mean ± SD (g/dL)	32.54 ± 2.18	

Table III details the peripheral blood smear and basic hematological findings. The mean hemoglobin level was 8.16 ± 1.05 g/dL, with the majority (59.8%) falling in the 7–9 g/dL range, indicating moderate anemia. On peripheral smear examination, anisocytosis was present in 7.6% of cases, while poikilocytosis was observed in 3%. An increased reticulocyte count was rare, seen in only 1.5% of participants. The mean total RBC count was 4.62 ± 0.55 million/µL. The red blood cell indices revealed a mean MCV of 74.48 ± 16.00 fL, MCH of 24.50 ± 3.80 pg and MCHC of 32.54 ± 2.18 g/dL, reflecting a predominantly microcytic and hypochromic picture.

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Table IV
Iron Profile and Hemoglobinopathy Screening Results (*n*=132).

Variable Name	Category / Unit	Frequency (n)	Percentage (%) / Mean ± SD
Serum Iron	Mean ± SD (µg/dL)	56.04 ± 40.66	
Serum Ferritin	Mean ± SD (ng/mL)	22.40 ± 15.60	
Total Iron Binding Capacity	Mean ± SD (µg/dL)	507.55 ± 109.09	
Percentage Saturation	Mean ± SD (%)	14.5 ± 5.20	
HbA2	Mean ± SD (%)	3.13 ± 1.08	
	≤3.5 (Normal)	99	75
	>3.5 (Elevated - Thalassemia Trait)	33	25
	Total	132	100

Table IV presents the iron profile and hemoglobinopathy screening results. The mean serum iron was 56.04 ± 40.66 µg/dL and the mean serum ferritin was 22.40 ± 15.60 ng/mL, indicating prevalent iron depletion. The total iron-binding capacity was notably elevated at 507.55 ± 109.09 µg/dL, with a correspondingly low mean percentage saturation of 14.5 ± 5.20%. For the primary outcome, the mean HbA2 level was 3.13 ± 1.08%. Screening revealed that 99 participants (75%) had a normal HbA2 level (≤3.5%), whereas 33 participants (25%) had an elevated HbA2 level (>3.5%), confirming the presence of the thalassemia trait.

Table V
Association between Participant Characteristics and Thalassemia Trait (*n*=132).

Variable	Thalassemia Trait Present (HbA2 >3.5)	Thalassemia Trait Absent (HbA2 ≤3.5)	p-value
	n (%) / Mean ± SD	n (%) / Mean ± SD	
Age (years)	27.50 ± 4.60	26.98 ± 4.85	0.58
Education			0.41
Primary	3 (37.5%)	5 (62.5%)	
Secondary	10 (29.4%)	24 (70.6%)	
Undergraduate	9 (24.3%)	28 (75.7%)	
Graduate	11 (20.8%)	42 (79.2%)	
Socioeconomic Condition			0.65
Low income	9 (30.0%)	21 (70.0%)	
Middle income	23 (23.2%)	76 (76.8%)	
High income	1 (33.3%)	2 (66.7%)	
History of Consanguineous Marriage			0.045*
Yes	4 (66.7%)	2 (33.3%)	
No	29 (23.0%)	97 (77.0%)	
Family History of Thalassemia Minor			<0.001*
Yes	8 (80.0%)	2 (20.0%)	
No	25 (20.5%)	97 (79.5%)	
MCV (fL)	65.20 ± 8.40	77.57 ± 15.60	<0.001*
MCH (pg)	21.10 ± 2.90	25.63 ± 3.50	<0.001*

Table V illustrates the association between participant characteristics and the presence of the thalassemia trait. Age, education and socioeconomic condition showed no statistically significant association with the trait ($p > 0.05$). However, a history of consanguineous marriage was significantly associated with the thalassemia trait ($p = 0.045$), with 66.7% of those with the trait reporting consanguinity. Furthermore, a family history of thalassemia minor was highly significant ($p < 0.001$), as 80% of the trait-positive group had a positive family history. Hematologically, patients with the trait had significantly lower MCV (65.20 ± 8.40 fL) and MCH (21.10 ± 2.90 pg) compared to those without the trait ($p < 0.001$ for both).

DISCUSSION

This study aimed to determine the prevalence of the thalassemia trait among anemic pregnant women attending a tertiary care hospital in Dhaka. Our findings revealed a striking 25% prevalence of elevated HbA2 (>3.5%), indicating that one in four anemic pregnant women in this cohort carried the thalassemia trait. This high prevalence underscores the significant hidden burden of hemoglobinopathies in this population. In comparison, Amarasinghe et al., highlighted that while iron deficiency remains the primary cause of anemia in pregnancy, genetic factors significantly contribute to the burden in regions where carrier rates are high [12]. The 25% prevalence observed in our study is notably higher than the general community-based estimates, likely due to our specific focus on anemic women seeking care at a tertiary hospital, which inherently selects for a more clinically affected population.

The baseline hematological profile of our participants was consistent with a mixed picture of nutritional and hereditary anemia. We observed a mean hemoglobin of 8.16 ± 1.05 g/dL, with a predominantly microcytic and hypochromic picture (mean MCV 74.48 ± 16.00 fL; mean MCH 24.50 ± 3.80 pg). Differentiating iron deficiency anemia from thalassemia trait is a well-documented clinical challenge, as both conditions present with similar red blood cell indices. In a similar study noted, accurate differential diagnosis is crucial for appropriate clinical management [13]. Our iron profile data confirmed a high

burden of iron depletion, with a low mean serum ferritin (22.40 ± 15.60 ng/mL) and elevated total iron-binding capacity (507.55 ± 109.09 µg/dL). This dual burden of iron deficiency and thalassemia trait complicates the diagnostic pathway, as iron deficiency can sometimes mask or alter the typical HbA2 elevations used for screening.

When analyzing the associations, our study found that a history of consanguineous marriage was significantly associated with the thalassemia trait ($p = 0.045$), with 66.7% of trait-positive women reporting consanguinity. This aligns with genetic expectations, as consanguinity increases the likelihood of inheriting autosomal recessive disorders. Similarly, a family history of thalassemia minor was highly predictive ($p < 0.001$), with 80% of trait-positive women having a positive family history. These findings strongly support the necessity of detailed family and marital history taking during antenatal visits, as emphasized by Abid and Najim, who found a high prevalence of undiagnosed thalassemia minor among pregnant women [14].

Hematologically, our study demonstrated that patients with the thalassemia trait had significantly lower MCV (65.20 ± 8.40 fL) and MCH (21.10 ± 2.90 pg) compared to those without the trait ($p < 0.001$ for both). Phanthong et al. and Jasim and Aouda both emphasized the utility of RBC indices, such as the Mentzer index, in predicting thalassemia trait and differentiating it from iron deficiency anemia [15,16]. Our findings confirm that severe microcytosis and hypochromia, particularly in the presence of a family history, should raise a high index of suspicion for thalassemia trait, prompting definitive screening via high-performance liquid chromatography.

The clinical implications of these findings are profound. As noted by Langer et al., β-thalassemia minor is associated with high rates of worsening anemia during pregnancy, which can lead to increased maternal morbidity, preterm birth and intrauterine growth restriction [17]. Furthermore, identifying carriers is essential for genetic counseling. If a pregnant woman is identified as a carrier, screening the partner is imperative to assess the risk of having a child with thalassemia major. Roy et al., highlighted similar concerns in the Bangladeshi context, emphasizing the need for increased awareness and screening programs [18].

The high prevalence of 25% in our cohort, combined with the observed iron deficiency, suggests that routine antenatal care must move beyond presumptive iron supplementation. Wendt et al., previously reported significant thalassemia and hemoglobinopathy prevalence in community samples in Sylhet, Bangladesh, indicating that this is not an isolated institutional finding but a broader public health issue [19]. Our data support the recommendation that all anemic pregnant women, particularly those with severe microcytosis or a positive family history, should undergo HbA2 screening. This aligns with the conclusions of Khan et al., who also reported a substantial prevalence of beta-thalassemia trait among anemic pregnant patients and advocated for routine screening [20].

LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. As a cross-sectional study conducted at a tertiary care hospital, the sample may not fully represent the broader community-based pregnant population, introducing a potential selection bias. Furthermore, the diagnosis of the thalassemia trait relied solely on an elevated HbA2 cutoff on high-performance liquid chromatography, without confirmatory genetic mutational analysis. Because iron deficiency can sometimes alter HbA2 levels, relying on a single cutoff may have led to some misclassification. Additionally, the study experienced a high rate of missing data for certain peripheral blood smear variables, which limits the comprehensiveness of the morphological findings.

CONCLUSION

In conclusion, this study reveals a notably high prevalence of the thalassemia trait among anemic pregnant women attending a tertiary care hospital in Dhaka. The strong associations observed between the trait and factors such as consanguineous marriage, positive family history and severely reduced red blood cell indices highlight the critical need for heightened clinical suspicion. Standard antenatal care must move beyond presumptive iron supplementation to include routine hemoglobinopathy screening for anemic women. Early identification of thalassemia carriers is essential for providing timely genetic counseling to couples, implementing appropriate maternal monitoring and ultimately preventing the birth of children with severe thalassemia syndromes. Integrating these screening protocols into national maternal health strategies will significantly improve both maternal and neonatal outcomes.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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