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Prevalence of anemia among patients with diabetes mellitus attending a tertiary care center in Nepal: A Descriptive Cross-sectional Study

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Abstract

Background: Anemia is a common yet often underdiagnosed complication in individuals with diabetes mellitus (DM), associated with increased risk of microvascular and macrovascular complications. Despite the growing burden of diabetes in Nepal, limited data exist on the prevalence of anemia in this population. This study aimed to determine the prevalence of anemia among patients with DM and explore its association with glycemic control and other clinical parameters. **Methods:**A descriptive cross-sectional study was conducted from April to October 2024 at Nepal Medical College Teaching Hospital. A total of 373 diabetic patients were enrolled using convenient sampling. Hemoglobin levels were assessed to diagnose anemia based on WHO criteria (<13 g/dL in males, <12 g/dL in females). Data on glycemic control (HbA1c), duration of diabetes, BMI, comorbidities, and treatment regimens were collected. Statistical analyses included chi-square tests, Mann-Whitney U tests, Kruskal-Wallis tests, and Spearman correlation. **Results:**Anemia was present in 123 (33%) of the 373 patients. Among anemic individuals, 67% had uncontrolled DM (HbA1c >7%). No significant association was found between anemia severity and glycemic control ($p = 0.22$). Anemia was significantly associated with gender ($p = 0.001$), BMI ($p = 0.001$), hypertension ($p < 0.001$), and thyroid dysfunction ($p = 0.006$), but not with dyslipidemia ($p = 0.062$). Duration of diabetes showed a significant association with glycemic control ($p = 0.009$) but not with anemia severity. Patients receiving oral hypoglycemic agents had significantly higher anemia severity compared to those on insulin therapy ($p < 0.05$). **Conclusion:**Anemia is a common comorbidity in diabetic patients in Nepal, especially among females and those with hypertension or thyroid dysfunction. Routine screening for anemia in diabetic patients is recommended to enable timely management.

Key words: Diabetes mellitus, anemia, glycemic control, Nepal, comorbidities, hemoglobin, prevalence

Introduction

Diabetes Mellitus (DM) is a globally prevalent metabolic disorder characterized by chronic hyperglycemia that affects nearly every organ system.[1,2] One of its commonly overlooked complications is anemia, which may accelerate the progression of microvascular and macrovascular complications such as diabetic retinopathy, nephropathy, and neuropathy.[3-5] The World Health Organization (WHO) defines anemia as a hemoglobin level less than 13 g/dL in men and less than 12 g/dL in women.[4] Anemia remains underdiagnosed and undertreated in diabetic populations despite its known impact on clinical outcomes.

The etiology of anemia in DM is multifactorial and includes chronic inflammation, nutritional deficiencies, nephropathy, and adverse effects of medications. Hyperglycemia leads to increased inflammatory cytokines such as IL-6 and TNF-α, which inhibit erythropoiesis. Longstanding and poorly controlled diabetes intensifies this inflammatory response. Other contributing mechanisms include impaired

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erythropoietin production, renal interstitial damage, and altered iron metabolism. Given these diverse mechanisms, anemia can manifest early in the disease course and may remain undetected.[6-12]

In Nepal, limited studies have evaluated the burden of anemia among individuals with diabetes. Understanding this association is crucial, given the high prevalence of both conditions. This study aims to determine the prevalence of anemia in diabetic patients attending a tertiary care center in Nepal and to explore its association with demographic, clinical, and treatment-related factors.

Materials and Methods

This study was a hospital based cross-sectional study,carried out fromApril, 2024 to October, 2024 (6 Months) inPatient with diabetes visiting the outpatient and inpatient department of internal medicine in Nepal Medical College Teaching Hospital NMCTH, Attarkhel, Gokarneshwor Municipality-8, Kathmandu. The with ethical clearance taken from Nepal Medical College- Institutional Review Committee NMC-IRC(refno)Convenient sampling method was employed with self-made questionnaires and data was filled up in proforma along detailed history was taken from the patients.Sample size was calculated using the formula $n = Z^2pq/E^2$ with a reference prevalence of 41.86% from a previous study.[13] The minimum required sample was 373. Diagnosed diabetic patients (on oral agents, insulin, or both)≥ 18 years were included in the study.Exclusion criteria were patients with gestational diabetes, chronic diseases (e.g., COPD, CKD), thyroid disorders, known blood disorders, gastrointestinal bleeding, or recent surgery. Anemia was defined per WHO criteria. Data were collected via structured proforma and included demographic data, hemoglobin levels, HbA1c, BMI, comorbidities, and treatment details. Anemic diabetic patients (n = 123) were further analyzed.An HBA1c level of >7% to >8% has been used as an indicator of uncontrolled hyperglycemia in patients with DM. So , HBA1c <7 were taken as controlled DM and HBA1c≥ 7 were taken as Uncontolled DM.3

World Health Organization (WHO) criteria was used to define anemia as: Hgb concentration <13 g/dl for males and < 12 g/dl for females. It was further classified into mild anemia (female: 11–11.9 g/dl; male: 11–12.9 g/dl), moderate anemia (8–10.9 g/dl) and severe anemia (< 8 g/dl).4The BMI of the participants were classified as: underweight less than 18.5 kg/m2, normal (18.5–24.9 kg/m2), overweight (25–29.9 kg/m2), and obese (≥ 30 kg/m2).[14]
A structured proforma was used to collect sociodemographic and clinical information. Hemoglobin levels were used to define anemia per WHO criteria. Anemia severity was categorized as mild, moderate, or severe. BMI and HbA1c were recorded.Data were analyzed using SPSS version 26. Descriptive statistics, chi-square test, Mann-Whitney U test, Kruskal-Wallis test, and Spearman correlation were used as appropriate.

Results

Anemia was present in 123 (33%) of the 373 diabetic patients. The median age of anemic individuals was 62 years (IQR: 21), median BMI was 23 kg/m² (IQR: 5), median hemoglobin was 10 g/dL (IQR: 1.5), and median HbA1c was 8% (IQR: 2).

Among the anemic group, 83 (67%) had uncontrolled DM, and 40 (33%) had controlled DM. There were 59 males and 64 females; 42

males and 51 females had uncontrolled DM. BMI Distribution and Glycemic Control: BMI did not differ significantly between controlled and uncontrolled DM groups (Mann-Whitney U test, p > 0.05p > 0.05). Most patients were of normal BMI.

Table 1 : BMI Distribution among Anemic Diabetic Patients

BMI Category	Controlled DM (n=40)	Uncontrolled DM (n=83)	Total (n=123)
Underweight	0	3	3
Normal	25	54	79
Overweight	15	26	41

Age and Glycemic Control

There was no significant association between age group and glycemic control (Chi-square test, p = 0.28). HbA1c values were similar across age groups (Kruskal-Wallis test, p = 0.97). However, Hb levels significantly differed across age groups (Kruskal-Wallis test, p = 0.002).

Table 2 : Glycemic Control by Age Group

Age Group	Controlled DM	Uncontrolled DM	Total
20–40 years	4	6	10
40–60 years	19	29	48
>60 years	17	48	65

Duration of Diabetes and Glycemic Control

A significant association was found between DM duration and glycemic control (Chi-square test, p = 0.009). A moderate positive correlation was observed between DM duration and poorer glycemic control (Spearman's ρ = 0.274, p = 0.002).

Table 3 : Glycemic Control by Duration of Diabetes

DM Duration	Controlled DM	Uncontrolled DM	Total
<5 years	24	27	51
5–10 years	16	52	68
≥10 years	0	4	4

Anemia Severity and Glycemic Control

There was no statistically significant association between anemia severity and glycemic control (Chi-square test, p = 0.22). Hemoglobin levels did not significantly differ between the glycemic control groups (Mann-Whitney U test, p > 0.05).

Table 4 : Anemia Severity and Glycemic Control

Anemia Severity	Controlled DM	Uncontrolled DM	Total
Mild	28	46	74
Moderate	16	52	68
Severe	0	2	2

Correlations

Glycemic control and anemia severity: Weak, non-significant positive correlation (Spearman's ρ = 0.146, p = 0.108).Anemia and DM duration: Very weak, non-significant correlation (ρ = 0.058, p = 0.522).

Comorbidities in Anemic Patients

Among 123 anemic patients:69 (56%) had hypertension,20 (16%) had thyroid dysfunction and 97 (79%) had dyslipidemia.

Anemia showed significant associations with:Gender (Chi-square, p = 0.001; Fisher's exact test, p = 0.001),BMI (Spearman's ρ, p = 0.001),Hypertension (p < 0.001),Thyroid dysfunction (p = 0.006).No significant association was found with dyslipidemia (p = 0.062).

Anemia Severity and Antidiabetic Medication

Anemia severity significantly varied across treatment groups (Chi-square and Kruskal-Wallis tests, p < 0.001). revealed:

Patients on oral hypoglycemic agents had more severe anemia than those on insulin (p < 0.05,Mann-Whitney U tests).No significant differences between oral and mixed therapy groups (p = 0.324) or oral and untreated groups (p = 0.409).

Table 5 : Antidiabetic Treatment and Anemia Severity

Treatment Type	Mild	Moderate	Severe	Total
Insulin only	21	0	0	21
Insulin + Oral	2	0	2	4
Oral only	46	44	0	90
No treatment	5	3	0	8
Total	74	47	2	123

Discussion

This study highlights the substantial burden of anemia among patients with diabetes mellitus (DM) attending a tertiary care center in Nepal, with a prevalence rate of 33%. This figure is in line with previous regional and global studies reporting anemia in 20–40% of individuals with diabetes, particularly among those with longstanding disease or complications such as nephropathy.[12,13,15-17]. The observed prevalence reinforces the recognition of anemia as a common yet underdiagnosed comorbidity in the diabetic population.

Despite the known impact of chronic hyperglycemia on erythropoiesis and systemic inflammation, our findings did not reveal a significant association between glycemic control and either the presence or severity of anemia. Hemoglobin levels and anemia severity were comparable between patients with controlled and uncontrolled DM. The lack of significant association between glycemic control and anemia suggests a multifactorial etiology. Chronic inflammation, renal insufficiency, and nutritional deficiencies likely play key roles. Duration of diabetes correlated with poor glycemic control but not directly with anemia, as reported in prior literature.[5-9]

A notable finding in this study was the significant association between diabetes duration and glycemic control, with poorer glycemic outcomes observed in those with longer disease duration. This likely reflects progressive β-cell dysfunction over time, reduced insulin sensitivity, and the accumulation of complications, which can indirectly contribute to anemia. [18,19] However, the direct relationship between DM duration and anemia was weak and statistically non-significant, suggesting a more complex interplay involving additional factors such as renal or cardiovascular comorbidities. Although age did not correlate with glycemic control, hemoglobin levels varied significantly across age groups, indicating that older individuals with diabetes may be more vulnerable to anemia. Age-related declines in renal function, marrow responsiveness, and cumulative exposure to chronic inflammation may explain this observation. Gender was another significant factor, with higher anemia prevalence in females, consistent with global data attributing this disparity to menstrual blood loss, nutritional deficiencies, and socio-cultural determinants of health.[12,20]

While BMI did not differ significantly between glycemic control groups, it showed a significant association with anemia. This finding may reflect nutritional status and inflammation-related anemia in both underweight and overweight individuals. [21,22] The role of BMI in anemia pathophysiology among diabetics remains understudied and warrants further exploration.

Comorbid conditions such as hypertension and thyroid dysfunction showed significant associations with anemia. Hypertension may impair renal perfusion and erythropoietin production, while hypothyroidism can suppress erythropoiesis, contributing to anemia. [23-26]These findings suggest that screening for anemia in diabetic patients should incorporate assessment of associated endocrine and cardiovascular disorders. Although dyslipidemia was highly prevalent in the study population, it did not show a significant association with anemia, implying a likely coexisting rather than causative role. [27] Anemia severity also varied significantly across antidiabetic treatment modalities. Patients receiving oral hypoglycemic agents had more severe anemia than those on insulin.

One plausible explanation is the long-term use of metformin, known to impair vitamin B12 absorption, potentially leading to macrocytic anemia. [28,29] Additionally, patients on insulin may be under more rigorous medical supervision and nutritional management, which could mitigate anemia risk. However, this association must be interpreted cautiously due to possible confounding factors such as disease severity and duration.

This study offers valuable insight into the epidemiology and clinical correlates of anemia in individuals with diabetes in Nepal. Nevertheless, several limitations must be acknowledged. The cross-sectional design precludes causal inference, and the lack of laboratory evaluation of renal function, iron status, or vitamin B12 levels limits our ability to determine specific etiologies. Furthermore, subgroup analyses may be constrained by small sample sizes, particularly among those with severe anemia or specific treatment regimens.

Conclusion

Anemia is a prevalent and clinically significant comorbidity among patients with diabetes mellitus in Nepal. While no direct association with glycemic control was observed, anemia was significantly associated with gender, BMI, hypertension, thyroid dysfunction, and treatment modality. Early identification and management are essential to improve overall outcomes. Routine hemoglobin monitoring should be integrated into diabetic care protocols

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