Frequency of Anemia in Type-I & type-II diabetes Mellitus Patients of Akhtar Saeed Trust Hospital

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Abstract

Objective: This study aimed to estimate the frequency of anemia and its association with type-I and type-II diabetes mellitus.

Material & Methods: In this cross-sectional study, the patients presented with type-I and type-II diabetes mellitus were enrolled. Samples were collected from the outdoor and indoor patients of Akhter Saeed Trust Hospital Lahore for a one-year duration. HbA1c was performed to confirm the control of diabetes mellitus, and CBC showed the presence of anemia. This study was conducted on patients of both genders and all age groups. Based on age, history, and therapy, type I and type II diabetes mellitus were classified. A chi-square test was performed to assess any significant correlation between diabetes mellitus and anemia in all age groups and both genders.

Results: This study was performed on 237 patients, 66.85 were female, and 33.2% were diabetic males. Among all diabetic patients, only 26.58 % were without anemia, and the remaining 73.42% developed any state of anemia among mild, moderate, or severe. The p-values show a significant association (p=0.001) between diabetes and anemia. It was also found that patients with good control of diabetes show good management of anemia in both types of diabetes, and with poor control, anemia development chances are high.

Conclusion: Anemia is associated with both type-I and type-II diabetes mellitus. The good control of diabetes mellitus is necessary for the management of anemia.

Keywords: Type-I diabetes mellitus, type-II diabetes mellitus, anemia, diabetic control

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Introduction

Diabetes mellitus (DM) refers to elevated blood sugar levels during periods of fasting or after meals. Sustained high blood sugar is a defining feature of DM, accompanied by damage and impaired function in organs such as the kidneys, nerves, heart, and blood vessels.[1] In 2011, the International Diabetes Federation reported that 366 million people worldwide were affected by DM, a number projected to increase to 552 million by 2030. The World Health Organization, in agreement with the American Diabetes Association and the Canadian Diabetes Association, established diagnostic criteria for DM in 2006. These criteria encompass a random plasma glucose level of 200 mg/dL (11.1 mmol/L), a 2-hour plasma glucose level of 200 mg/dL (11.1 mmol/L) following a 75 g glucose load, or a fasting plasma glucose level of 126 mg/dL (7.0 mmol/L) observed on two or more occasions.[2]

Anemia, a condition characterized by a deficiency in red blood cells or hemoglobin, can be intricately linked to both type-I and type-II DM. While the mechanisms and impacts might differ, the presence of anemia can

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further complicate the management and overall health of individuals with either type of diabetes. Type-I DM is an autoimmune disorder where the body's immune system attacks and destroys the insulin-producing cells in the pancreas. This results in a lack of insulin, which is essential for glucose uptake by cells.[3]

The association between type-I DM and anemia often revolves around a few key factors. The same autoimmune process that targets insulin-producing cells can also affect other cells and functions within the body. In some cases, it can reduce the production of red blood cells, resulting in anemia. People with type I DM might face challenges in managing their diet due to insulin dependence. This can sometimes lead to inadequate intake of essential nutrients like iron, vitamin B12, and folate, which are crucial for red blood cell production.[4] Such nutritional deficiencies can contribute to anemia. While kidney complications are more commonly associated with type II DM, individuals with type I DM can also experience kidney dysfunction. Kidney impairment can affect the production of erythropoietin, a hormone that stimulates red blood cell production. Reduced erythropoietin levels can lead to anemia.[5]

Type II DM is characterized by insulin resistance, where the body's cells become less responsive to insulin. This leads to elevated blood sugar levels. Anemia's association with type II DM is influenced by several factors. Many individuals with type II DM experience chronic low-grade inflammation. This inflammation can interfere with the body's ability to produce red blood cells, contributing to anemia.[6] Kidney complications are more prevalent in type II DM. The kidneys play a significant role in producing erythropoietin, which stimulates the bone marrow to create red blood cells. When kidney function is impaired, erythropoietin production decreases, leading to anemia. Some medications used to manage type II DM, such as metformin, can affect nutrient absorption and utilization. Prolonged use of these medications might contribute to nutritional deficiencies, further exacerbating anemia. Uncontrolled blood sugar levels can impact the health of blood vessels, leading to reduced oxygen supply to tissues and exacerbating anemia-related symptoms like fatigue and weakness.[7] Managing anemia in individuals with diabetes requires a comprehensive approach that addresses the specific factors at play. Regular monitoring of complete blood count (CBC), iron, vitamin B12, and folate levels is essential. Nutritional counseling, supplementation when necessary, and close collaboration with healthcare providers are crucial components of managing anemia in the context of diabetes.[8] In conclusion, anemia's association with both type-I and type-II DM highlights the complexity of these conditions. While the underlying mechanisms and risk factors might differ, anemia can significantly impact individuals with DM's health and quality of life. Understanding these connections and implementing appropriate management strategies can help mitigate the effects of anemia and contribute to more effective diabetes care.[9,10]

Given the high prevalence of DM in our region and the well-established association between DM and anemia, our study was designed with a dual purpose. We aimed to assess the frequency of anemia among diabetic patients while investigating the intricate relationship between these two conditions. Additionally, we sought to determine how anemia correlates with diabetic patients' varying levels of glycemic control, distinguishing between good and poor management. Our study's implications are far-reaching. By raising awareness about the importance of regular anemia screenings and proper management, we aim to empower diabetic patients to take charge of their health. Moreover, our findings shed light on the potential risk of anemia in well-controlled diabetic patients, as well as those struggling with their condition. Ultimately, this research contributes to a more comprehensive understanding of the intersection between diabetes and anemia. It equips healthcare providers and patients alike with essential insights, encouraging improved care practices. As the study outcomes emerge, we anticipate its pivotal role in driving awareness, refining healthcare strategies, and enhancing the overall well-being of individuals dealing with diabetes and its potential complications, including anemia.

Materials & Methods

The cross-sectional study was conducted in Akhter Saeed Trust Hospital Lahore from January 2022 to January 2023. All diabetic patients of the said duration were part of this study, and non-diabetic patients were excluded. 237 samples were collected from diabetic patients receiving therapy to control their diabetes. Patients with type-I and type-II DM were part of this study. Blood samples were collected in the ethylenediamine tetraacetic acid (EDTA) vacutainer to perform a CBC and hemoglobin A1C (HBA1c). CBC was performed on Sysmex XP-100. HbA1c was performed on an automated analyzer Audicom AC-600 based on ion exchange chromatography. A peripheral smear was performed on

all the samples to confirm the red blood cell morphology which was microcytic, macrocytic, or normocytic. The morphology was assessed to correlate it with hemoglobin concentration which was calculated previously using the hematology analyzer. The anemia (severe, moderate, or mild) was confirmed on the basis of hemoglobin concentration and correlation with RBC morphology. Patients with hemoglobin less than 7 g/dl were considered severe anemic, between 7-10 g/dl moderate, and more than 10 g/dl concluded as mild anemic. Patients with HBA1c of more than 5.5% were included in this study. Patient HBA1c values less than 7.0% were considered good control. If HbA1c was more significant than 7.0%, it showed poor control of diabetes. Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH) and Mean corpuscular hemoglobin concentration (MCHC) were also noted as evidence of anemia. Patients of both genders (male and female) of all ages were part of the study. Demographics, anemic, and diabetic status were noted in the already-designed data collection performance. To analyze the collected data, Statistical Package for the Social Sciences (SPSS) version 25.0 was used. Data was distributed into different age groups and genders. The frequency of type-I and type-II DM patients were also identified. A chi-square test was performed to assess the association between the different stages of anemia and type-I and type-II DM. The p-values were also calculated to assess the anemia and diabetic control.

Results

A total of 237 samples were included in the study, 66.2% (n=157) were females, and 33.8% (n=80) were males. All diabetic patients were divided into four age groups, patients with ages less than and equal to 18 years, 19-40 years, 41-60 years, and > 60 years. It was found that 06(2.53%), 45(18.98%), 128(54.00%), and 58 (24.47%) of patients were included in the first, second, third, and fourth age groups respectively. Table 1 shows the frequency of anemia among different age groups.

Table 1: *Mild, moderate, and severe anemia in different age groups*

Age groups n (%)	Mild anemia	Moderate anemia	Severe anemia	No anemia
≤ 18 Years	03 (50.00%)	0%	0%	03 (50.00%)
19-40 Years	10 (22.22%)	23 (51.11%)	09 (20.00%)	03 (6.66%)
41-60 Years	27 (21.09%)	54 (42.18%)	32 (25.00%)	15 (11.71%)
>60 Years	15 (25.86%)	27 (46.55%)	10 (17.24%)	06 (10.34%)

In both genders (male and female), 19 (23.75%) of males develop mild, 30 (37.50%) moderate, and 11 (13.75%) severe anemia. Similarly, among females, 32 (20.38%), 71 (45.22%), and 11 (7.00%) developed mild, moderate, and severe anemia. The overall frequency of mild, moderate and severe anemia were 51 (21.51%), 101 (42.61%), and 22 (9.28%) respectively. Table 2 shows the percentiles of mild, moderate, and severe anemia in both genders. The frequency of type-I and type-II diabetes mellitus was 12.23% (n=29), and 87.76% (n=208) respectively. In Table 3 percentile of mild, moderate, and severe anemia is reported in type-I and type-II diabetic patients, showing that 09 (31.03%) and 71 (45.22%) of patients developed moderate anemia respectively, which is the highest among all. Table 4 represents anemia in diabetic patients with good or poor control. The chi-square test showed a significant association (p=0.001) between anemia, and control status of diabetes.

Table 2: *Percentages of mild, moderate, and severe anemia in males and females*

Types of anemia	Male	Female
Mild	19 (23.75%)	32 (20.38%)
Moderate	30 (37.50%)	71 (45.22%)
Severe	11 (13.75%)	11 (7.00%)
No Anemia	20 (25.00%)	43 (27.38%)

Table 3: *Mild, moderate, and severe anemia in type-I & type-II diabetes mellitus*

Types of anemia	Type-I diabetes mellitus n=29	Type-II diabetes mellitus n=208
Mild	06 (20.68%)	52 (25.00%)
Moderate	09 (31.03%)	97 (46.63%)
Severe	03 (10.34%)	49 (23.55%)
No Anemia	11 (37.93%)	10 (4.80%)

Table 4: *Association of anemic patients with good and poor diabetic control*

Types of anemia	Good control	Poor control	Chi-square P-value
Mild	49 (96.07%)	02 (3.92%)	
Moderate	25 (24.75%)	76 (75.24%)	0.001*
Severe	0%	22 (100.0%)	

*P<0.05 is considered significant.

Discussion

In our study, a total of 237 DM patients with all age groups were included, and they were also assessed for excellent and poor diabetic control and association with the development of anemia. There was a significant relationship between anemia and control of DM. It was assessed that patients with type-I and type-II DM are more likely to develop anemia, especially when diabetes is under poor management. Anemia is a common complication in type-II DM patients, impacting diabetes-related complications. However, little is known about anemia prevalence and factors in type-II DM patients in specific regions like Debre Berhan Referral Hospital in North-East Ethiopia. This study addresses the gap by assessing anemia prevalence and determinants among 249 type-II DM patients at Debre Berhan Referral Hospital. The findings reveal a 20.1% anemia prevalence, associating anemia with factors including age (>60 years), poor glycemic control, reduced eGFR, longer diabetes duration (>10 years), and diabetic complications. These insights underscore the importance of anemia screening, tailored interventions, and improved patient care within the type-II DM population, leading to better outcomes.[8]

The objective of another study was to ascertain the prevalence of anemia among individuals with type-II DM patients and evaluate its correlation with gender, age, and glycemic control. The study encompassed patients attending the outpatient diabetic department of Amiri Hospital (Al-Asimah Capital area) from January 1, 2016, to December 31, 2017. Patients were categorized based on glycemic status and gender. The assessment involved analyzing both HbA1C values and hemoglobin levels. Anemia was defined by hemoglobin levels < 13.0 g/dL for men and < 12.0 g/dL for women. The results indicated a significantly higher prevalence of anemia in diabetic females (38.5%) compared to diabetic males (21.6%). Similarly, poorly controlled diabetics exhibited a higher prevalence of anemia (33.46%) compared to those with well-controlled glycemic status (27.9%) (P= <0.05). Notably, patients with anemia had an average age of 60.69 ± 0.198 years, whereas patients without anemia had an average age of 54.07 ± 0.121 years, revealing an increased risk of anemia with advancing age.[11]

A total of 5999 participants older than 40 years old from the general community were enrolled for the study. A total of 1414 participants were diagnosed with DM. To check for anemia, hemoglobin levels were measured. 12.3% of people had anemia (Hemoglobin: 12g/dl in women and 13g/dl in males). Anemia prevalence was higher in women than men between the ages of 40 and 49 years. The risk of developing diabetic retinopathy was twice higher in males with anemia than in women.[12] Although type II DM affects most study participants, anemia is a frequent complication. The prevalence and factors influencing anemia in type-I DM outpatients were examined. CBC was taken in addition to routine testing in patients with type-I DM at the Royal North Shore Hospital (n =135), the Royal Prince Alfred Hospital (n =42), and the Austin Medical Centre (n =135) in Sydney, Australia. 01 in 07 patients (14%) experienced anemia, which is more than six times more common in those with functioning kidneys. More than half (52%) of patients with macroalbuminuria developed anemia, compared to 24% of patients with microalbuminuria and less than 8% of patients with normoalbuminuria. Compared to diabetic patients with adequate renal function, diabetic patients with renal impairment had anemia more than six times as frequently. Anemia, a significant underappreciated burden, is frequently seen in type I DM patients.[13] The hundred children of six to seventeen years of age with type-I DM were included. Based on their clinical symptoms and eventually the discovery of islet cell autoantibodies, it was determined that all individuals had type-I DM. The patients were divided into four groups according to how long they had the disease: those with newly diagnosed type-I DM, those with the condition for one to three years, those with the condition for four to six years, and those with the condition for more than six years. The following parameters have been determined: red blood cells, hemoglobin, HbA1c, hematocrit, MCV, MCH, MCHC, and serum iron content. The levels of hematocrit, hemoglobin, red blood cells, and MCV are significantly lower in children when compared to children who have had type-I DM for a longer period. Statistical analysis showed inverse associations between the MCH concentration and children who have had type-I DM for more than a year.[14] In this study, it was found that patients with poor diabetic control are more prone to developing anemia and vice versa in patients with good control of diabetes. The cross-sectional study provides a snapshot of data at a specific point in time. It cannot establish causality or show how variables change over time. A larger sample size may provide more resilient results. Future studies may add risk factors and can be conducted for a longer period.

Conclusion

Diabetic patients of both types (I & II) are more likely to develop anemia in all age groups, especially when diabetes is not under control. The association between anemia and DM is not dependent on gender. Both genders have an equal chance of facing anemia due to many underlying factors.

Conflict of interest *None*

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Authors Contribution

AW, AFK: Conceptualization of Project
RA: Data Collection
A: Literature Search
FK: Statistical Analysis
NH: Drafting, Revision
ZY: Writing of Manuscript