Research Article

iMedPub Journals
www.imedpub.com

Medical and Clinical Reviews
ISSN 2471-299X

2023
Vol.9 No.4:136

Prevalence of Anemia in Patients with Diabetes in a Diabetic Center Tertiary Hospital in Riyadh, Saudi Arabia

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Received date: November 07, 2023, Manuscript No. IPMCR-23-18105; **Editor assigned date:** November 10, 2023, PreQC No. IPMCR-23-18105 (PQ); **Reviewed date:** November 24, 2023, QC No. IPMCR-23-18105; **Revised date:** December 01, 2023, Manuscript No. IPMCR-23-18105 (R); **Published date:** December 08, 2023, DOI: 10.36648/2471-299X.9.4.136

Citation: Almudaimegh K, Darraj H, Aldawsari M, Alghamdi K (2023) Prevalence of Anemia in Patients with Diabetes in a Tertiary Hospital in Riyadh, Saudi Arabia. Med Clin Rev Vol.9 No.4: 136.

Abstract

Background: Type 2 diabetes is a syndromic disease associated with numerous pathological patients that varies among the patients. The present study has been designed to determine the prevalence of anemia in type 2 diabetes patients and to evaluate the risk of anemia according to patient glycemic control, age and gender.

Methods: The present study included a cohort of type 2 diabetes patients who attended Al Iman Hospital in Riyadh, Saudi Arabia, between September and November 2021. The patients were subdivided into groups according to gender, age and glycemic status. Glycated Hemoglobin (HbA1c) values and Hemoglobin (Hgb) levels were then evaluated in the included subjects. Threshold Hb levels of <13.0 g/dL were set for anemia in men and <12.0 g/dL in women.

Results: The prevalence of anemia is significantly greater in diabetic females (53.3%) than in diabetic males (42.4%) 1.36 (OR: -(2.0-0.71)). Smoker patients were 2.78 (CI: 1.16-6.68) times more likely to develop anemia than non-smoker patients.

Conclusion: The prevalence of anemia is significantly high in the diabetic population, with female preponderance. Compliance with diabetic medication, regular screening for anemia and creating awareness related to the risk of anemia and associated complications among diabetic patients can help reduce anemia prevalence in this particularly high-risk population.

Keywords: Diabetes; Hemoglobin; Anemia

Introduction

Diabetes mellitus is a leading cause of both morbidity and mortality across the globe [1]. Approximately 425 million people between the ages of 20 and 79 are affected by the 8.3% global prevalence of diabetes mellitus, 90% of which is type 2 diabetes mellitus. The number of cases is expected to increase to 642 million by 2040 [2].

Anemia is a common blood-related disorder that is defined by the World Health Organization (WHO) as Hemoglobin (Hgb) levels less than <12 g/dL for women and less than 13 g/dL for men [3]. Compared to people without diabetes, people with type 2 diabetes mellitus are twice as likely to be anemic [4]. Diabetes patients are thus at higher risk of anemia, which, like many other chronic disorders, goes undiagnosed. Numerous research studies have investigated the relationship between anemia and diabetes since it adds to the burden of microvascular problems in diabetic patients [5,6]. Bosman et al., identified anemia as a risk factor for cardiovascular and end-stage renal diseases in diabetic patients [7]. Factors suggested for the earlier onset of anemia in diabetic patients include erythropoietin release inhibition, drugs, systemic inflammation, severe symptomatic autonomic neuropathy, renal interstitial damage, altered iron metabolism and hyperglycemia [8]. Diabetes patients also have folate, cyanocobalamin and iron dietary deficits, which can cause various anemias. Metformin may prevent the body from absorbing cyanocobalamin, which can result in vitamin B12 deficient anemia [9,10]. Most people with type 2 diabetes are unaware of anemia since the two conditions overlap symptoms, such as pale complexion, numbness or coldness in the extremities, chest pain, shortness of breath and headache [10]. Therefore, diagnosing anemia in people with diabetes is crucial. We examined data from the Laboratory Information System (LIS) for adult patients who visited Al Iman Hospital, Riyadh, Saudi Arabia between September and November 2021 to determine the prevalence of anemia in patients with type 2 diabetes mellitus. Gender, age and HbA1c status were considered in the data analysis. Additionally, we wanted to determine if IDA appeared in low HbA1c patients with diabetes and investigate the impact that prevalent morbidity disorders played in IDA development.

Materials and Methods

Study design

This cross-sectional study was designed to determine the prevalence of iron deficiency anemia among diabetic patients following up in Al Iman Hospital in Riyadh, Saudi Arabia, by analyzing their blood samples for Complete Blood Count (CBC)

and glycosylated Hemoglobin (HbA1c). Moreover, a questionnaire was designed to collect demographics, smoking, occupation and comorbidities. The survey was conducted by Al Iman Hospital in Riyadh, Saudi Arabia, between September and November 2021.

Study subjects

This cross-sectional study included 203 participants aged 20 to 85 selected at random. Patients with sickle cell anemia and thalassemia were excluded from the present investigation. Every patient was randomly assigned a questionnaire about their occupation, smoking habits, demographic information and cardiovascular comorbidities, such as obesity, dyslipidemia and hypertension. Participants were informed of the objectives of the study and the experimental procedure.

Data and samples collections

The questionnaire was designed to capture demographic and socioeconomic information about the participants, including their nationality (Saudi or non-Saudi), employment status (employed or unemployed) and smoking status (yes or no). According to WHO definitions, comorbidities include hypertension, obesity and dyslipidemia. Each patient had 3 ml of venous blood extracted and divided into two 1.5 ml K3EDTA containers. One was drawn for CBC measurement, while the other was for HbA1c measurement.

Hematological and biochemical parameters

Hemoglobin (Hb), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Volume (MCV) were measured utilizing the hematology analyzer BeckmanColter DxH900, whereas HbA1c was measured using the H-20 HbA1c analyzer.

Males with Hb levels below the cutoff value of 13.0 g/dl and females with Hb levels below 12.0 g/dl were considered anemic.

Statistical analysis

The study sample was characterized by demographic variables, including age, gender, anemia and HbA1c level, using descriptive analysis. Statistical analysis was conducted using version 20.0 of SPSS. The significance threshold was set at P 0.05.

Results

Table 1 summarizes the basic characteristics of diabetic patients included in the study. Out of 203, male patients accounted for 96 (47.3%), while 107 (52.7%) were female patients. Non-employed patients were 124 (61.1%), while Saudi patients constituted the majority (82.3%). The mean age of patients was 50.8 years with 14.2 SD. Smoker patients were 50 (24.6%), the prevalence of anemia based on the HbG classification of WHO was 42.4% for all patients, the prevalence among males was 30.2% and 53.3% among female patients.

Table 1: Basic characteristics of patients.

Variable	N=203
Gender	
Male	96 (47.3)
Female	107 (52.7)
Occupation	
Employed	79 (38.9)
Non employed	124 (61.1)
Nationality	
Saudi	167 (82.3)
Non-Saudi	36 (17.7)
Age	50.8 ±14.2
Smoking	
No	153 (75.4)
Yes	50 (24.6)
Anemia prevalence	
All	86 (42.4)
Male	29 (30.2)
Female	57 (53.3)
Rx	
NI	108 (53.2)
I	93 (45.8)
NE	2 (1.0)

HbG measures differences by gender were examined in **Table 2** using independent samples t-test. The overall mean of the parameter was 12.8 with 2.4 SD and the mean of HbG among male patients was 13.9 with 2.5 SD compared to 11.8 with 1.7 SD among female patients. The test result showed a significant difference (P<0.01). The results also revealed significant differences between male and female patients in the measures of MCV, MCH (P<0.01) and HbA1c (P<0.05).

Table 2: Blood parameters by gender.

Parameter	All	Male	Female	P value
HbG	12.8 ± 2.4	13.9 ± 2.5	11.8 ± 1.7	0.001
MCV	81.2 ± 8.5	83.7 ± 6.2	78.8 ± 9.7	0.001
MCH	26.6 ± 3.5	27.9 ± 2.8	25.5 ± 3.6	0.001
HbA1c	8.7 ±1.7	8.4 ± 1.4	8.9 ± 1.9	0.031

Table 3 and **Figure 1** summarize the correlation analysis between HbG and blood parameters, where a positive and significant correlation was identified between the outcome variable HbG and MCV and MCH. A non-significant inverse correlation was found between HbG and HbA1c.

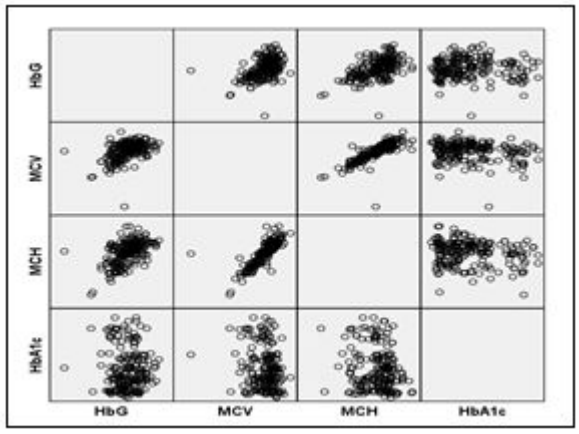

Figure 1: Correlation between HbG and parameters.

Table 3: Correlation between HbG and parameters.

Parameter	All	Male	Female
MCV	0.471*	0.343*	0.508*
MCH	0.547*	0.378*	0.600*
HbA1c	-0.015	0.059	0.066
Note: *Correlation significant at 1%.			

MCV, MCH and HbA1c differences by anemia status of patients are shown in **Table 4** and **Figure 2**. The mean of MCV among anemia patients was calculated at 77.1 with 8.6 SD compared to 84.1 with 7.2 SD among non-anemia patients; the test reported a significant difference (P<0.01). MCH mean measure among anemia patients was 24.5 with 3.5 SD, while it was 28.1 with 2.5 SD among non-anemia patients, with a significant difference found between the two groups (P<0.01). A non-significant difference was reported between anemia patients and non-anemia patients regarding HbA1c parameters.

Table 4: Parameters difference by anemia prevalence.

Parameter	Anemia	None	P value
MCV	77.1 ± 8.6	84.1 ± 7.2	0.001
MCH	24.5 ± 3.5	28.1 ± 2.5	0.001
HbA1c	8.6 ± 1.8	8.7 ± 1.6	0.453

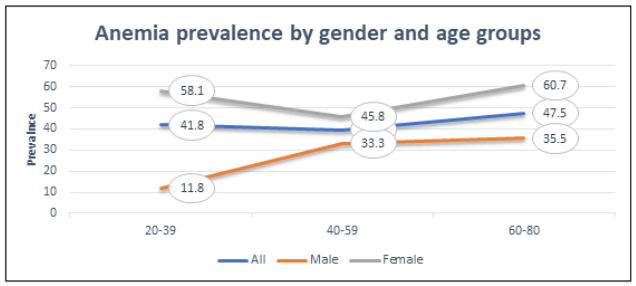

Figure 2: Anemia by gender and age group.

Multiple linear regression analysis results of HbG predictors are reported in **Table 5.** The overall model was statistically significant (P<0.01). The independent variables included in the regression model explained 40.0% of the variation in the outcome variable HbG, as indicated by the coefficient of determination R2 value. Three variables, MCH, HbA1c and sex of patients, were found to be significant predictors of the outcome variable of HbG, controlling for other variables included in the regression model. MCH coefficient (0.26, OR 013-0.39) indicated that one-unit increase in MCH is associated with a 26% increase in HbG, HbA1c regression coefficient of 0.16 (OR 0.01-0.31) is the rate of increase in HbG associated with one-unit increase in HbA1c. The mean difference in HbG measure between male and female patients was 1.36 (OR -(2.0-0.71)), considering the other independent variables included in the model.

Table 5: Predictors of HbG.

Variable	β	P value	95% CI of β
MCV	0.03	0.24	-0.1
MCH	0.26	0.001	0.13-0.39
HbA1c	0.16	0.049	0.01-0.31
Age	-0.01	0.576	-0.05
Sex	-1.36	0.001	-1.29
Occupation	-0.31	0.353	-1.32
Nationality	0.22	0.525	-1.39
Smoking	-0.01	0.977	-1.38
Note: F=16.15 (P < 0.01); R^2=0.400.			

Adjusted OR of anemia prevalence among patients was calculated using the binary logistic regression model in **Table 6**. The dependent variable was HbG, classified into two categories based on the criteria of WHO of men and women. The overall model was found to be significant (P<0.01). Independent variables included in the model accounted for 31.4% of the variation in the outcome variable classification. MCV, MCH, Sex and smoking status of patients were significant variables of HbG

classification in anemia and non-anemia patients. The OR of MCV and MCH showed a positive association as an increase in the two parameters was associated with increasing the likelihood of anemia. The OR of the sex variable (3.56, CI 1.63-7.79) indicated that female patients were 3.56 times more likely to have anemia than male patients. Smoker patients were 2.78 (CI 1.16-6.68) times more likely to develop anemia than non-smoker patients.

Table 6: Adjusted OR of anemia prevalence.

Variable	OR	P value	95% CI of OR
MCV	1.09	0.05	1.00-1.19
MCH	0.67	0.001	0.53-0.85
HbA1c	0.97	0.743	0.82-1.15
Age	1.01	0.52	0.98-1.03
Sex	3.56	0.001	1.63-7.79
Occupation	1.25	0.596	0.55-2.84
Nationality	1.31	0.513	0.58-2.98
Smoking	2.78	0.022	1.16-6.68
Note: χ^2=54.42 (P<0.01); Nagelkerke R^2=0.314			

Discussion

Anemia is twice as prevalent in type 2 diabetes patients as in non-diabetic individuals. Bosman et al. [7] have linked anemia to end-stage renal disease and cardiovascular disease in people with diabetes. Keane et al., also demonstrated that people with diabetes with reduced HbG levels are more likely to be hospitalized and die young [11]. Despite this, 25% of people with diabetes are unaware that they have anemia [12]. This study assessed the risk of anemia based on gender, age, glycemic control and the prevalence of anemia in diabetic participants.

Also, a problem in developed nations is this type of anemia. This disparity may be attributable to differences in sociodemographic characteristics, chronic disease complexity and nutritional management knowledge.

In our study, the prevalence of anemia among diabetic patients was 42.4%; this is higher than the prevalence of 29% reported by Engidaw et al., [5] but lower than the prevalence of 55.5% at a primary health center affiliated with King Faisal University in Al Ahsa, Saudi Arabia [13].

We discovered that female diabetics were more likely than male diabetics to develop anemia. Alsayegh et al., found that the prevalence of diabetes in females was 35.8% compared to 21.3% in males [14]. This result is consistent with their findings.

The limitations of this study, particularly the fact that it was conducted at a single institution may, however, limit its applicability.

Conclusion

This prospective observational study found that smokers and diabetics had a significantly increased risk of developing anemia. The increased risk of anemia associated with these sub-groups should be brought to the attention of medical professionals, who should then make the appropriate vitamin and iron supplementation recommendations. When someone is diagnosed with diabetes, they must be told about the risk of anemia and other complications associated with their disease.

Author Contributions

All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no competing interests.

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