

# Anemia and It's Risk Factors among Patients with Type II Diabetes Mellitus, Alkhair Medical Center, Wad Medani, Gezira State, Sudan (2020)

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## Research Article

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# Abstract

**Background:** Anemia is one of the common complications of diabetes mellitus, and their risk in diabetic patients is estimated to be 2 – 3 times higher than that of patients without diabetes. Therefore, having a major impact on the overall health and survival of diabetes patients. Globally, the prevalence of concurrent anemia and diabetes mellitus ranges from 14 – 45% in various ethnic populations worldwide.

**Objectives:** The aim of this study was to determine the prevalence of anemia among type II diabetic patients.

**Methodology:** This is a cross-sectional laboratory-based study conducted in Alkhair Medical Center, Wad Medani, Gezira State, Sudan during March to December 2020 among 100 type II diabetic patients ((32 males and 68 females) their ages ranged between 30 and 90 years with mean (52.26 ± 13.58 years). Three ml of venous blood samples were collected from all participants in K<sub>3</sub>EDTA containers. A thin blood film was prepared and stained immediately. The RBCs parameters were performed using Sysmex XP-300 Automated Hematology Analyzer. SPSS computer program (v 25.0) was used for data analysis.

**Results:** The study results showed that the prevalence of anemia among patients with type 2 Diabetes Mellitus were 7 (7 %). 6 (85.7 %) patients had mild anemia, and one (14.3 %) had moderate anemia according to clinical degree of anemia based on hemoglobin level. 4 (57.14 %) patients had microcytic hypochromic anemia, and 2 (28.57 %) patients had normocytic normochromic anemia and one (14.29 %) patients had macrocytic anemia based on RBCs indices and morphology. The prevalence of anemia is more in female (7.35 %) than male (6.25 %).

**Conclusion:** The study concluded that anemia among patients with type II Diabetes Mellitus was 7 %, mostly mild and microcytic hypochromic anemia; so improve their nutrition status among diabetic patients may help in reducing the anemia during diabetes.

## Introduction:

Diabetes is a chronic disease that requires ongoing medical care and education to prevent acute complications and reduce the risk of long-term complications (1–2). The estimated prevalence of diabetes in urban areas of Sudan is 19% and rural areas is around 2.6% (3). Type 2 diabetes is a chronic disorder in which the cells' ability to release insulin deteriorates over time as a result of the patient's age and length of diabetes, finally failing to meet the body's needs (4), It is among the top 10 causes of death in adults and was estimated to have caused 4 million deaths globally in 2017 (5). Anemia is a condition in which the number of red cells (and consequently their oxygen – carrying capacity) is insufficient to meet the body physiologic needs. It is a global public health issue that affects both developing and industrialized countries, having significant implications for human health, as well as social and economic development. It happens at all phases of life and affects nearly two billion (27%) people worldwide headache (6).

Anemia is a common and often neglected of untreated complication and poor controlled diabetes mellitus which may have a negative consequence on the development and progression of other diabetes-related macrovascular and microvascular complications which can further enhance anemia progression, making the vicious cycle however (7). The majority of hematological abnormalities in people with diabetes are caused by secondary illness problems, e.g. renal failure (8). Diabetic patients are thought to have a two to three times higher risk of anemia than non-diabetic patients. Globally, the prevalence of concurrent anemia and diabetes mellitus (both type 1 and type 2) ranges from 14–45% in various ethnic populations worldwide. The magnitude of anemia among T2DM patients varies among studies and regions, ranging from 7.7% in the United States of America (USA) to 67% in India (6).

Anemia in diabetes is caused by a variety of factors, including kidney disease, nutritional deficiencies, inflammation, concurrent autoimmune diseases, advanced age, lower BMI, longer duration of diabetes, peripheral vascular disease, specific medications, and hormonal changes (6). Several studies have found that anemia in T2DM patients is significantly related to sex, age, marital status, educational status, BMI, hypertension, hematological diseases, glycemic control, gastrointestinal disorders, and chronic kidney disease. Diabetes duration and microvascular complications like diabetic nephropathy, neuropathy, and retinopathy have all been found to be significantly associated with anemia in T2DM patients. Despite these facts, anemia in T2DM remains undiagnosed and untreated in 25% of diabetic patients because the symptoms are similar, including lethargy, pale skin, chest pain, irritability, numbness/coldness in the hands and feet, tachycardia, shortness of breath, and headache (6). Anemia in T2DM patients is a strong and independent predictor of diabetes-related macrovascular and microvascular complications, according to growing evidence (7).

Tests can be useful for screening to identify disease risk factors and detecting occult disease in asymptomatic people. Early detection of occult disease may reduce disease morbidity and mortality through early treatment if risk factors are identified (9).

A thorough history and physical examination are required when evaluating a patient with anemia. As part of the evaluation, a routine complete blood count (CBC) is required, which includes hemoglobin, hematocrit, and red cell indices such as mean cell volume (MCV), mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC). Further useful information is provided by reticulocyte count and iron supply tests such as serum iron, total iron-binding capacity (TIBC; an indirect indicator of transferrin level), and serum ferritin (10).

The prevalence of diabetes mellitus and glycemic are increasing worldwide. The study, carried out in four states in Sudan, showed the prevalence of diabetes was 11.2% (11). The prevalence of un diagnosis diabetes mellitus in rural communities in River Nil State, north Sudan was 2.6% (12). Many diabetics suffer from vitamin shortages and nutritional deficiency, which can lead to anemia. Nutrient deficiencies can be caused by either not eating enough nutrient (because a person restricts his food choice, for example) or by the body inability to absorbs the nutrients that are eaten. Deficiencies in iron, vitamin B12

and folate can all cause anemia and anemia has a significant adverse effect on quality of life of diabetic patient and is associated with progressive of disease and can lead to more complications.

The aim of this study is to determine the prevalence of anemia among patients with type 2 diabetes mellitus, Alkhair Medical Center, Wad Medani, Gezira State, Sudan 2020.

## **Materials And Methods:**

The study was designed as cross-sectional laboratory-based study, carried out at Alkhair Medical Center, Gezira State, Sudan during period from March to September 2020. The samples were collected randomly from 100 patients with type 2 diabetes mellitus according to inclusion and exclusion criteria.

### **Ethical approval**

was obtained from the both Researches and Ethics Committees (REC) of Ministry of Health, Gezira State (No: 22-9-2022). Informed consent was written from each participant.

A 2 ml venous blood sample was collected by clean venipuncture technique in K<sub>2</sub>EDTA anticoagulant container from each participant (13). A thin blood film was prepared and stained immediately. The RBCs parameters (RBCs count, Hb, HCT, MCV, MCH, MCHC, RDW-CV, and RDW-SD) were measured using the Sysmex XP-300 automated Cell Counter (Sysmex, Kobe, Japan). The data were analyzed using statistical package for social sciences (SPSS) computer program (Version 25.0).

Anemia defined as a Hb below 10 g/dl. Clinical types of anemia defined as mild anemia (Hb between 10 g/dl and 10.9 g/dl), moderate anemia (Hb between 7 g/dl and 9.9 g/dl), and severe anemia (Hb below 7 g/dl) (14–15). Morphological types of anemia defined as Microcytic hypochromic anemia (MCV < 80fl, MCH < 27 pg), Normocytic normochromic anemia (MCV 80–95fl, MCH ≥ 27 pg), and Macrocytic anemia (MCV > 95fL) (14–16).

## **Results:**

100 Sudanese (32% males, 68% females) confirmed type II diabetic patients (mean age  $52.26 \pm 13.58$  years with age range from 30 to 90 years) were participated in this study (Table 1).

Table 1  
Demographic data of study participants.

<b>Factors</b>	<b>Type IIDM (N = 100)</b>
<b>Age (years)</b>	52.26 ± 13.58
<b>Age group (years)</b>	27 (27%)
Less than 40 years	25 (25%)
41–50 years	24 (24%)
51–60 years	15 (15%)
61–70 years	7 (7%)
71–80 years	2 (2%)
More than 40 years	
<b>Gender</b>	32 (32%)
Male	68 (68%)
Female	
<b>Occupation</b>	66 (66%)
Unworked	20 (20%)
Public working	14 (14%)
Private working	
<b>Educational level</b>	13 (13%)
Illiterate	33 (33%)
Primary level	36 (36%)
Secondary level	16 (16%)
Graduate level	2 (2%)
Postgraduate level	
<b>Economical status</b>	7 (7%)
Low	68 (68%)
Medium	25 (25%)
High	

Factors	Type IIDM (N = 100)
<b>Disease duration</b>	41 (41%)
Less than 5 years	27 (27%)
5–10 years	19 (19%)
11–15 years	8 (8%)
16–20 years	5 (5%)
More than 20 years	

The means of RBCs parameters (RBCs count, Hb, HCT, MCV, MCH, MCHC, RDW-SD, and RDW-CV) were  $4.48 \pm 0.46 \times 10^{12}/L$ ,  $13.86 \pm 1.42$  g/dl,  $41.44 \pm 4.39\%$ ,  $85.60 \pm 5.75$  fl,  $28.68 \pm 1.80$  p.g,  $33.40 \pm 0.89$  g/dl,  $42.05 \pm 3.06$  fl, and  $12.29 \pm 0.84\%$  respectively) (Table 2).

Table 2  
Mean and SD of RBCs parameters.

	RBCs × 10 <sup>12</sup> /L	Hb g/dl	HCT %	MCV fL	MCH pg	MCHC g/dL	RDW-SD fL	RDW-CV %
<b>Mean</b>	4.84	13.86	41.44	85.60	28.68	33.40	42.05	12.29
<b>SD</b>	0.46	1.42	4.39	5.75	1.80	0.89	3.06	0.84
<b>Minimum</b>	3	10	29	66	24	32	35.4	10.7
<b>Maximum</b>	6	17	52	97	33	36	57.7	15.8

The prevalence of anemia among patients with type 2 Diabetes Mellitus was 7% (Fig. 1). 6 (85.7%) patients had mild anemia, and 1 (14.3%) had moderate anemia according to clinical types of anemia (Fig. 2). 4 (57.14%) patients had microcytic hypochromic anemia, 2 (28.57%) patients had normocytic normochromic anemia and 1 (14.29%) had macrocytic anemia according to morphological types of anemia (Fig. 3).

The prevalence of anemia is more in female (7.35%) than male (6.25%) and is more in population of age group between 30–40 years (14.8%) and with duration of Diabetes Mellitus was less than 5 years (9.75%) (Table 3)

Table 3  
distribution of anemia among demographic data.

<b>Factors</b>	<b>Anemic patients (N = 7)</b>
<b>Age group (years)</b>	4 (14.8%)
Less than 40 years	3 (12.5%)
51–60 years	
<b>Gender</b>	2 (6.3%)
Male	5 (7.4%)
Female	
<b>Occupation</b>	3 (4.5%)
Unworked	3 (15%)
Public working	1 (7.1%)
Private working	
<b>Educational level</b>	1 (3%)
Primary	2 (5.5%)
Secondary	3 (18.8%)
Graduate	1 (50%)
Postgraduate	
<b>Economical status</b>	1 (14.3%)
Low	5 (71.4%)
Medium	1 (14.3%)
High	
<b>Disease duration</b>	4 (9.8%)
Less than 5 years	1 (3.7%)
5–10 years	1 (5.3%)
11–15 years	1 (12.5%)
16–20 years	

## Discussion:

Diabetes is a chronic disease that requires ongoing medical care and education to prevent acute complications and reduce the risk of long-term complications (2). Anemia is the most common blood

disorder and common finding in patients with diabetes (17). This is a cross-sectional laboratory based study conducted from March 2020 to January 2021. The aim of the study was to determine the prevalence of anemia among patients with type 2 diabetes mellitus at Alkhair Medical Center, Wad Medani, Gezira state, Sudan. Also, the study was evaluated the effects of numbers of risk factors on patients with diabetes mellitus included gender, age, occupation, duration of DM, nutritional status, physical activity, education level and economic status.

A total of 100 DM patients were participated in this study from Wad Medani city according to inclusion and exclusion criteria.

The study results showed that the prevalence of anemia in DM patients were 7%. This prevalence (7%) is two times lower than the prevalence in the studies done in Kuwait (18), Nigeria (17), and India (19). Also lower three times than the prevalence in the different studies done in Eastern Ethiopia (6–7), Australia (20), Iran (21), and China (22). Moreover, lower four times than the prevalence in the previous studies done in Kuwait (23), Egypt (24), and Brazil (25). These differences suggested due to differences in the geographical area, ethnicity, duration of DM, and age of the study participants (26–27).

According to clinical grading based on Hb level, 6 (85.7%) had mild anemia, 1 (14.3%) had moderate anemia. This finding similar to study done in Ethiopia (7) that reported the mild anemia account for 84% compared to 16% moderate anemia. According to morphology of RBCs based on RBCs indices, four (57.14%) had Microcytic hypochromic anemia, 2 (28.57%) had Normocytic normochromic anemia and 1 (14.29%) had Macrocytic anemia. This finding consistence with study conducted in India, which showed a higher rate of the microcytic hypochromic type of anemia (28). This study deviates from several studies reported Normocytic normochromic blood picture was the most common morphological types of anemia (7, 29–32). This finding suggested the anemia related mainly to iron deficiency anemia.

The study results showed that the prevalence of anemia is more in females (7.35%) than males (6.25%) and is more in population of age group between 30–40 years (14.8%) and with duration of Diabetes Mellitus were Less than 5 years (9.75%). This result agrees with study done in Kuwait (18) and Nigeria (17), and disagrees with study done by in Eastern Ethiopia (6).

## **Conclusion:**

The study concluded that anemia among patients with type II Diabetes Mellitus was 7%, mostly mild anemia and microcytic hypochromic anemia; so improve their nutrition status among diabetic patients may help in reducing the anemia during diabetes.

## **Declarations:**

**Ethical approval and consent to participate:**



Ethical approval was obtained from the Researches and Ethics Committees (REC) of Ministry of Health, Gezira State (No: 22-9-2022). We confirm that all methods were carried out in accordance with relevant guidelines and regulations of Helsinki declaration. Written informed consent was obtained from each patients.

**Consent of publication:**

Not applicable.

**Availability of data and materials:**

All relevant data are within the paper and its supporting information files.

**Competing interests:**

The authors have declared that no competing interests exist.

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**Authors' contributions:**

KAM, RMM, and AAT wrote the main manuscript. KAM prepared figures. All authors reviewed the manuscript.

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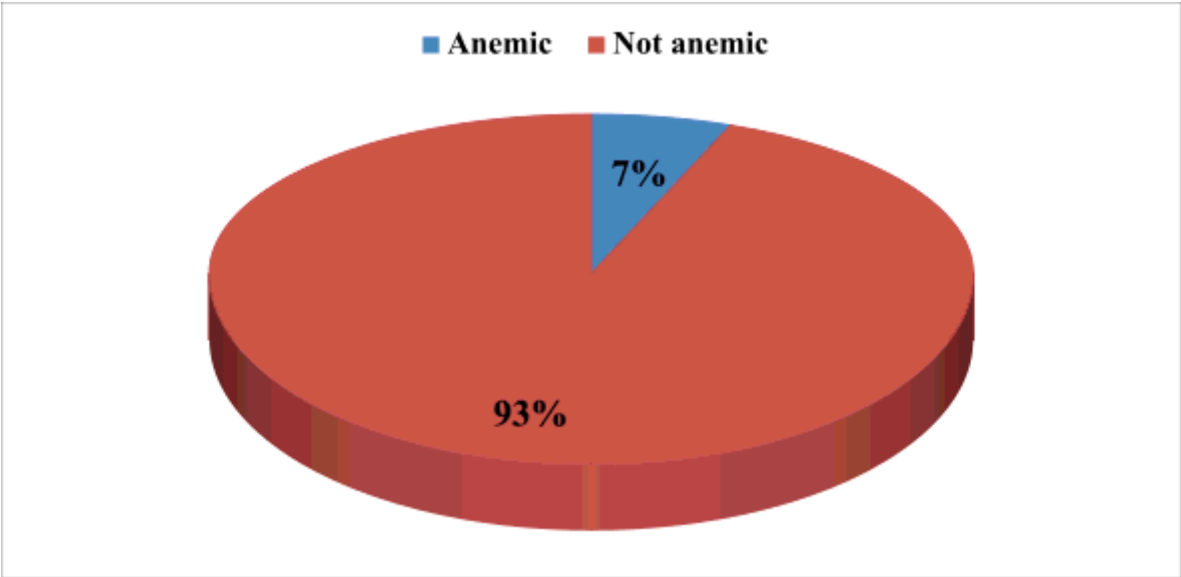
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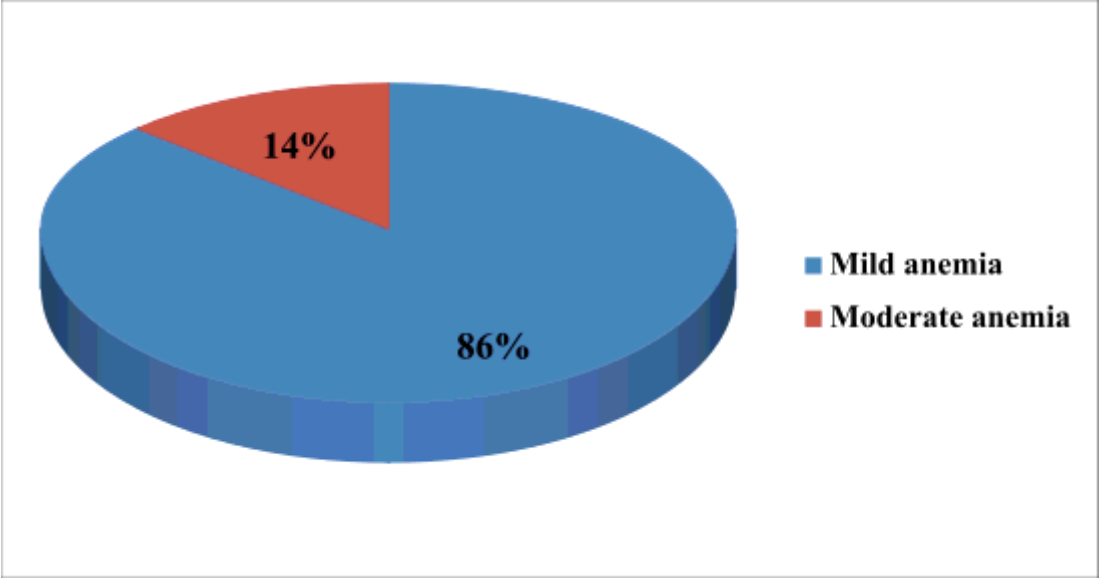
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## Figures



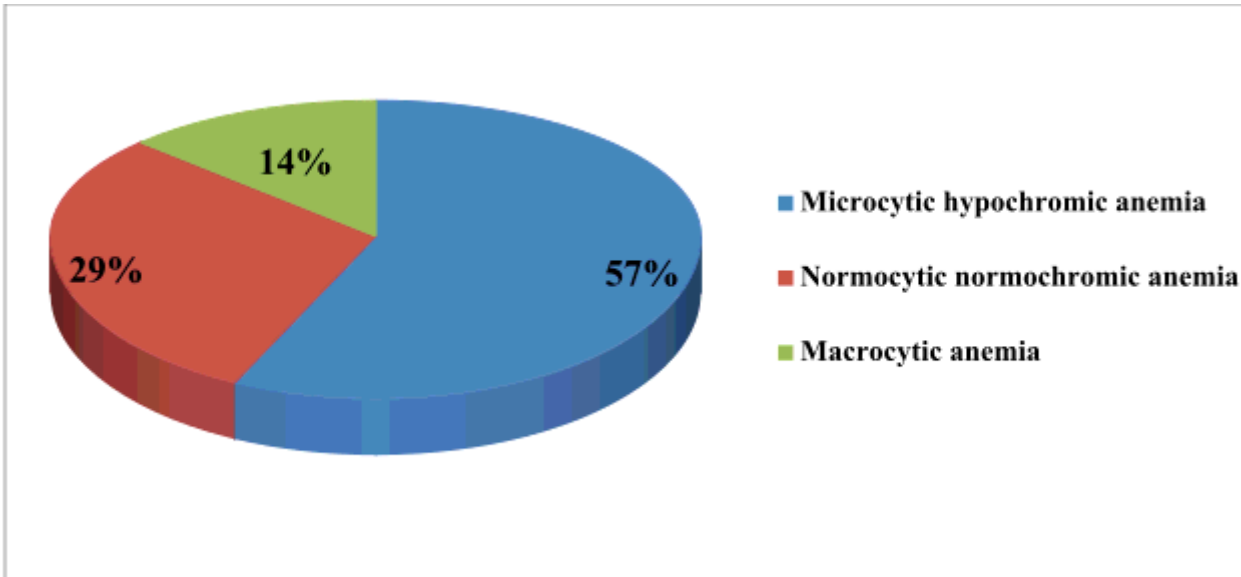
**Figure 1**

Prevalence of anemia among study population.



**Figure 2**

Prevalence of clinical types of anemia among anemic patients.



**Figure 3**

Prevalence of morphological types of anemia among anemic patients.