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Prevalence of Anemia among Patients with Type II Diabetes Mellitus, Alkhair Medical Center, Wad Medani, Gezira State, Sudan (2020)

Khalid Abdelsamea Mohamedahmed (Corresponding Author)
Department of Hematology, Faculty of Medical Laboratory Sciences, University of Gezira, Wad Medani, Sudan
Department of Immunology, Faculty of Medical Laboratory Sciences, University of Gezira, Wad Medani, Sudan
Email: khalid.gu89@gmail.com

Rumisa Mobashar Mohammed
Department of Hematology, Faculty of Medical Laboratory Sciences, University of Gezira, Wad Medani, Sudan

Albadawi Abdebagi Talha
Department of Clinical Laboratory Sciences, Jouf University, Saudi Arabia

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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 K3EDTA 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 anima during diabetes.

Keywords: Anemia; Type II DM; RBCs parameters; Sudan.

1. 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% to 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].

In addition to kidney disease, nutritional deficiencies, inflammation, concomitant autoimmune diseases, advanced age, lower BMI, longer duration of diabetes, peripheral vascular disease, specific medications, and hormonal changes all contribute to anemia in diabetes [6]. Various studies revealed the development of anemia in

T2DM patients is significantly associated with sex, age, marital status, educational status, BMI, hypertension, hematological diseases, glycemic control, gastrointestinal disorders, and chronic kidney diseases. The duration of diabetes and microvascular complications of diabetes such as diabetic nephropathy, neuropathy and retinopathy have all found to be significantly associated with anemia in T2DM patients. Despite all these facts, anemia inT2DM remains unrecognized and untreated in 25% of the diabetic patients because both share similar symptoms such as lethargy, pale skin, chest pain, irritability, numbness/coldness in the hands and feet, tachycardia, shortness of breath and headache [6]. Growing evidence indicates that anemia in T2DM patients is a strong and independent indicator of increased risk for diabetes-related macrovascular and microvascular complications [7].

Tests can be helpful for screening to identify risk factors for disease and to detect occult disease in asymptomatic persons. Identification of risk factors may allow early intervention to prevent disease occurrence, and early detection of occult disease may reduce disease morbidity and mortality through early treatment [9].

The evaluation of the patient with anemia requires a careful history and physical examination, A routine complete blood count (CBC) is required as part of the evaluation and includes the hemoglobin, hematocrit, and red cell indices: the mean cell volume (MCV), mean cell hemoglobin (MCH), and mean concentration of hemoglobin per volume of red cells (MCHC). The reticulocyte count and iron supply tests, such as serum iron, total iron-binding capacity (TIBC; an indirect indicator of transferrin level), and serum ferritin, provide further useful information [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.

2. 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. Ethical permission was obtained from Alkhair Medical Center, Wad Medani, Gezira State. Informed consent was written from each participant.

A 2 ml venous blood sample was collected by clean venipuncture technique in K_2EDTA 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].

3. Results

100 Sudanese (32% males, 68% females) confirmed type II diabetic patients (mean age 52.26 ± 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

Factors	Type IIDM (N = 100)
Age (years)	52.26 ± 13.58
Age group (years)	
Less than 40 years	27 (27 %)
41 – 50 years	25 (25 %)
51 – 60 years	24 (24 %)
61 – 70 years	15 (15 %)
71 – 80 years	7 (7 %)
More than 40 years	2 (2 %)
Gender	
Male	32 (32 %)
Female	68 (68 %)
Occupation	
Unworked	66 (66 %)
Public working	20 (20 %)
Private working	14 (14 %)

Educational level	
Illiterate	13 (13 %)
Primary level	33 (33 %)
Secondary level	36 (36 %)
Graduate level	16 (16 %)
Postgraduate level	2 (2 %)
Economical status	
Low	7 (7 %)
Medium	68 (68 %)
High	25 (25 %)
Disease duration	
Less than 5 years	41 (41 %)
5 – 10 years	27 (27 %)
11 – 15 years	19 (19 %)
16 – 20 years	8 (8 %)
More than 20 years	5 (5 %)

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

Table-2. Mean and SD of RBCs parameters

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

The prevalence of anemia among patients with type 2 Diabetes Mellitus was 7% (Figure 1). 6 (85.7%) patients had mild anemia, and 1 (14.3%) had moderate anemia according to clinical types of anemia (Figure 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 (Figure 3).

Figure-1. Prevalence of anemia among study population

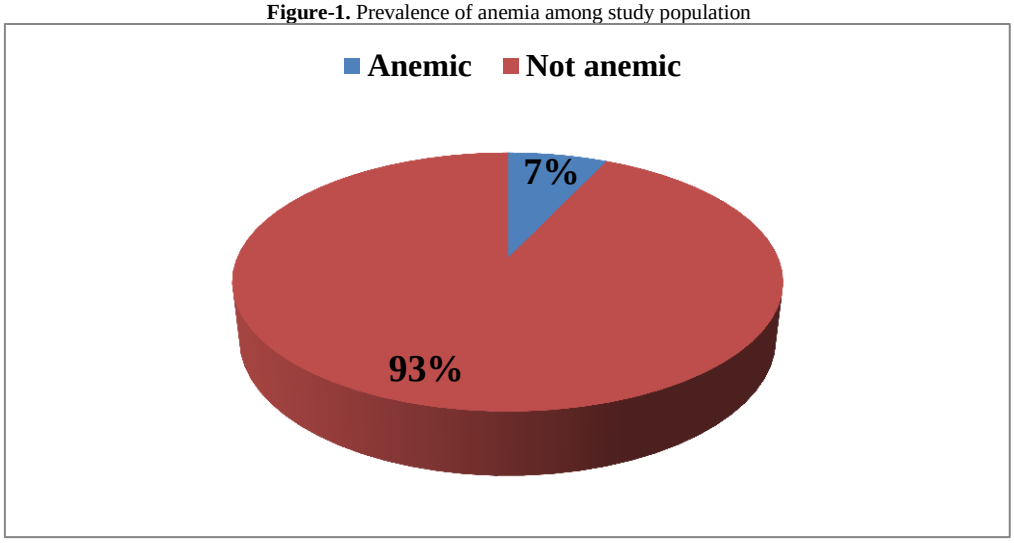


Figure-2. Prevalence of clinical types of anemia among anemic patients

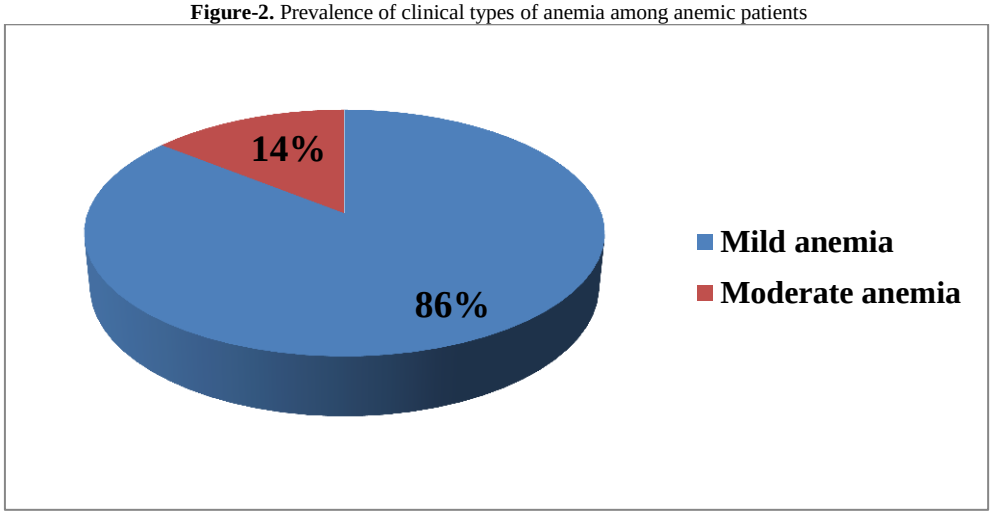
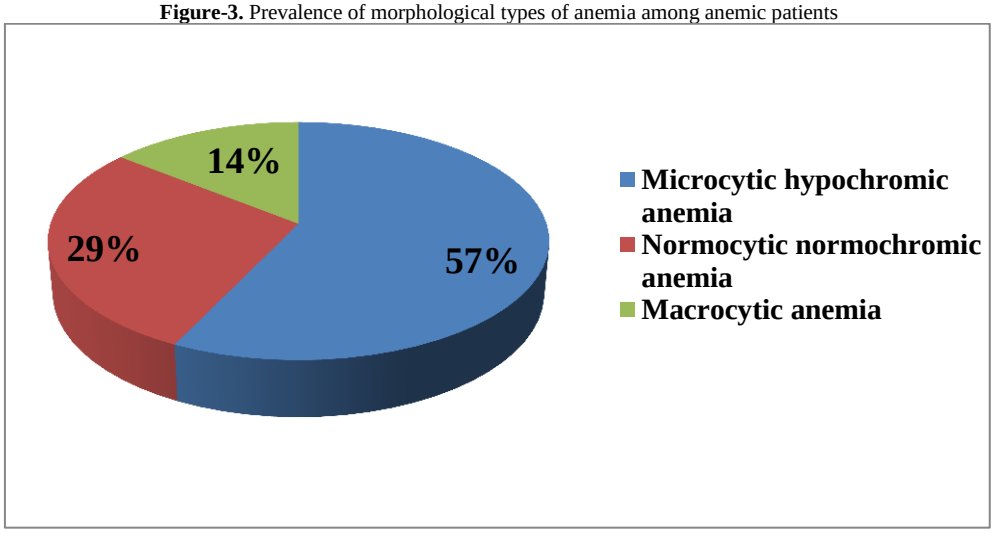


Figure-3. Prevalence of morphological types of anemia among anemic patients



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

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

4. 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 [1]. 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].

5. 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 anima during diabetes.

Competing interests

The authors have declared that no competing interests exist.

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References

[1] Almakey, E. A., Makeen, A. M., Saeed, O. K., and Mohamedahmed, K. A., 2021. "Association between adiponectin and insulin resistance among sudanese males with type 2 diabetes mellitus." *Chinese J. Med. Res.*, vol. 4, pp. 34-37.

[2] Kawthalkar, S. M., 2010. *Essential of clinical pathology*. 1st ed. India: Jaypee Brothers Medical Publishers.

[3] Ibrahim, R. E., Ibrahim, S. E., Abdalsamea, K., Haj Alzebar, A. B., Babiker, A. M., and Nour, B. Y., 2021. "Evaluation of common coagulation tests in type 2 diabetic patients and association with diabetic pre-cardiovascular complications, gezira state–sudan, 2020-2021." *Asian Hematology Research Journal*, vol. 5, pp. 1-6.

[4] Bishop, M. L., Fody, E. P., and Schoeff, L. E., 2013. *Clinical chemistry*. 7th ed. Philadelphia: Wolter Kluwer.

[5] Ibrahim, R. E., Ibrahim, S. H. E., Mohamedahmed, K. A., Haj Alzebar, A. A. B., Mohamed, R. A. A., and Babiker, A. M., 2022. "The frequency of rs1799889 in plasminogen activator inhibitor type -1 gene in sudanese type 2 diabetic patients, gezira state, sudan, 2020-2021." *Open Journal of Applied Sciences*, vol. 12, pp. 165-174.

[6] Bekele, A., Roba, K. T., Egata, G., and Gebremichael, B., 2019. "Anemia and associated factor among type2 diabetes mellitus patients attending public hospitals in harari region, Eastern Ethiopia." *Plos One*, vol. 14, p. e0225725.

[7] Taderegew, M. M., Gebremariam, T., Tareke, A. A., and Woldeamanuel, G. G., 2020. "Anemia and associated factor among type 2 diabetes mellitus patients attending debre berhan referral hospital, north-east ethiopia: A cross-sectional study." *J. Blood Med.*, vol. 11, pp. 47–58.

[8] Provan, D., Singer, C. R. J., Baglin, T., and Lilleyman, J., 2004. *Oxford hand book of clinical haematology*. 2nd ed. New York: Oxford University Press.

[9] Nicoll, D., Mcphee, S. J., Pignone, M., and Chou, T. M., 2001. *Detmer wm. Pocket guide to diagnostic tests*. 3rd ed. USA: McGraw –Hill companies.

[10] Wiener, C., Fauci, A. S., Braunwald, E., Kasper, D. L., Hauser, S. L., and Longo, D. L., 2008. *Harrison's principles of internal medicine, self-assessment and board review*. USA: McGraw. Hill.

[11] Abdalla, E. A. M. and Ahmed, R. F., 2017. "Epidemiology of diabetes among adults in Jabra area "block 14" in Khartoum state – Sudan: community base study." *IJCMPH*, vol. 4, pp. 1863-1869.

[12] Noor, S. K. M., Bushara, S. O. E., Sulaiman, A. A., Elmadhoun, W. M. Y., and Ahmed, M. H., 2015. "Undiagnosed diabetes mellitus in rural communities in Sudan: prevalence and risk factors." *East Mediterr Health J.*, vol. 21, pp. 164-70.

[13] Bain, B. J., Bates, I., Laffan, M. A., and Lewis, S. M., 2017. *Dacie and lewis practical haematology*. 12 ed. London: Elsevier Ltd.

[14] Paul, D., Paul, S., Adaduzzaman, M., Juliana, F. M., and Hossain, M. S., 2017. "Prevalence of type 2 diabetes mellitus in patient with anemia in bangladeshi population - a case control study." *Int. J. Health Sci. Res.*, vol. 7, pp. 121-125.

[15] World Health Organization, 2018. *11th World malaria report*. WHO in Geneva.

[16] Hoffbrand, A. V., Moss, P. A. H., and Pettit, J. A., 2006. *Essential haematology*. 5th ed. Oxford, UK.: Blackwell Publishing.

[17] Adejumo, B. I., Dimkpa, U., Ewenighi, C. O., Onifade, A. A., Mokogwu, A. T., and Erhabor, T. A., 2012. "Incidence and risk of anemia in type 2 diabetic patients in the absence of renal impairment." *Journal of Health*, vol. 4, pp. 304-308.

[18] AlDallal, S. M. and Jena, N., 2018. "Prevalence of anemia in type 2 diabetic patients." *J. Hematol.*, vol. 7, pp. 57-61.

[19] Ranil, P. K., Raman, R., Rachepalli, S. R., Pal, S. S., Kulothungan, V., and Lakshmipathy, P., 2010. "Anemia and diabetic retinopathy in type 2 diabetes mellitus." *J. Assoc. Physicians India*, vol. 58, pp. 91-94.

[20] Thomas, M. C., Cooper, M. E., Tsalamandris, C., MacIsaac, R., and Jerums, G., 2005. "Anemia with impaired erythropoietin response in diabetic patients." *Arch. Intern. Med.*, vol. 165, pp. 466–469.

[21] Bonakdaran, S., Gharebaghi, M., and Vahedian, M., 2011. "Prevalence of anemia in type 2 diabetes and role of renal involvement." *Saudi J. Kidney Dis. Transpl*, vol. 22, pp. 286-290.

[22] He, B. B., Xu, M., Wei, L., Gu, Y. J., Han, J. F., and Liu, Y. X., 2015. "Relationship between anemia and chronic complications in Chinese patients with type 2 diabetes mellitus." *Arch. Iran Med.*, vol. 18, p. 277.

[23] Samuel, T. R., Tejaswi, N., Kumar, P. N., Prudhvi, K., Sravan, N. S., and Govardhin, B., 2018. "Clinical significance of screening for anaemia in diabetic patients." *Artic. Int. J. Pharm. Sci. Rev. Res.*, vol. 48, pp. 20–24.

[24] Fayed, H. M., Elsaied, A. R., Alsenbesy, M. A., and Moubark, I. A., 2013. "Proportion of anemia in type 2 diabetic patients in qena governorate Case-Control Study: clinical correlates and prognostic significance." *Int. J. of Diabet Res.*, vol. 2, pp. 64–75.

[25] Barbieri, J., Fontela, P. C., Winkelmann, E. R., Zimmermann, C. E. P., Sandri, Y. P., and Mallet, E. K. V., 2015. *Anemia in patients with type 2 diabetes mellitus*. Anemia, pp. 1–7.

[26] Ahmed, A. T., Go, A. S., Warton, E. M., Parker, M. M., and Karter, A. J., 2010. "Ethnic differences in anemia among patients with diabetes mellitus: the Diabetes Study of Northern California (DISTANCE)." *Am. J. Hematol*, vol. 85, pp. 57–61.

[27] Antwi-Bafour, S., Hammond, S., Adjei, J. K., Kyeremeh, R., Martin-Odoom, A., and Ekem, I., 2016. "A case-control study of prevalence of anemia among patients with type 2 diabetes." *J. Med. Case Rep.*, vol. 10, p. 110.

[28] Kaushik, D., Parashar, R., and Malik, P. K., 2018. "Study of anaemia in type 2 diabetes mellitus." *Int. J. Res. Med. Sci.*, vol. 6, pp. 1529–1533.

[29] Abdulqadir, A. H. and Polus, R. K., 2014. "Prevalence of anemia of chronic disease and iron deficiency anemia among adult diabetic patients in Erbil City." *Zanco J. Med. Sci.*, vol. 18, pp. 674-679.

[30] Chen, C. X. R., Li, Y. C., Chan, S. L., and Chan, K. H., 2013. "Anaemia and type 2 diabetes: implications from a retrospectively studied primary care case series." *Hong Kong Med. J.*, vol. 19, pp. 214–221.

[31] Idris, I., Tohid, H., Muhammad, N. A., Rashid, M. R. A., Ahad, A. M., and Ali, N., 2018. "Anaemia among primary care patients with type 2 diabetes mellitus (T2DM) and chronic kidney disease (CKD): a multicentred cross-sectional study." *BMJ Open*, vol. 8, pp. 1-9.

[32] Karan, B., Krishna, B., Kumar, A. P., Faiyaz, A., Shruti, S., Abhisek, K., Baruah, K., and Kumar, A. P., 2016. "Study of anaemia in type II diabetes mellitus in relation to glycemic control." *Int. Arch. Biomed Clin. Res.*, vol. 2, pp. 29-33.