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Prevalence of Anemia among type2 diabetic patients in Tarhuna. Libya

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انتشار فقر الدم بين مرضى السكري من النوع 2 في ترهونة. ليبيا

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Abstract
Anemia is a widespread health problem globally, particularly in resource-limited communities. It may occur as an independent condition or in association with chronic diseases such as type 2 diabetes mellitus. This study aimed to determine the prevalence of anemia among patients with type 2 diabetes who do not suffer from renal impairment and to investigate the factors that may contribute to its occurrence. The study included 100 participants, comprising 50 patients with type 2 diabetes (25 males and 25 females) attending Al-Safaa Clinic in Tarhuna between April 1 and July 31, 2023, and 50 healthy individuals from the local community matched for age and sex. Data were collected through a questionnaire covering demographic characteristics, duration of diabetes, type of treatment, and complications, in addition to laboratory tests including glycated hemoglobin (HbA1c) and complete blood count (CBC) for patients, and fasting blood sugar with CBC for the healthy group. Hemoglobin concentration was used as a diagnostic criterion for anemia (<13 g/100 ml in males and <12 g/100 ml in females), along with measurement of red blood cell indices to classify the type of anemia. The results showed that the prevalence of anemia was 26% among diabetic patients compared to 38% in healthy controls, with no statistically significant difference between the groups. Anemia was more prevalent in females than in males in both groups, with rates of 40% versus 12% in the diabetic group and 56% versus 20% in the control group. The most common type of anemia among diabetic patients was microcytic hypochromic anemia. Furthermore, no statistically significant association was observed between anemia and either the duration of diabetes or its complications. The study concluded that anemia is common in both diabetic patients and healthy individuals, with type 2 diabetes and its complications not contributing to an increased prevalence. Gender, however, plays an important role, as females were found to be more susceptible to anemia than males.

Keywords: Anemia, Diabetes mellitus, Malignancy, Bleeding, Erythropoietin.

الملخص

تُعَدّ الأنيميا (فقر الدم) من المشكلات الصحية الشائعة عالميًا، خصوصًا في المجتمعات محدودة الموارد، وقد تظهر كحالة مرضية مستقلة أو مرتبطة بأمراض مزمنة مثل داء السكري من النوع الثاني. هدفت هذه الدراسة إلى تحديد معدل انتشار فقر الدم بين مرضى السكري من النوع الثاني غير المصابين بقصور كلوي، واستقصاء العوامل التي قد تسهم في حدوثه. شملت الدراسة 100 مشارك، منهم 50 مريضًا بالسكري (25 رجلًا و25 امرأة) من مراجعي مصحة الصفاء بترهونة خلال الفترة من 1 إبريل إلى 31 يوليو 2023، و50 فردًا سليمًا من المجتمع المحلي متقاربين في العمر والجنس. جُمعت البيانات عبر استبيان تناول الخصائص الديموغرافية ومدة الإصابة بالسكري ونوع العلاج والمضاعفات، إضافة إلى إجراء تحاليل السكر التراكمي وفحص الدم الكامل للمرضى، وفحص السكر العادي والدم الكامل للأصحاء. اعتُمِد تركيز الهيموغلوبين معيارًا لتشخيص الأنيميا (أقل من 13 جم/100 مل للذكور وأقل من 12 جم/100 مل للإناث)، إلى جانب قياس حجم كريات الدم الحمراء وتركيز الهيموغلوبين داخلها لتحديد نوع الأنيميا. أظهرت النتائج أن نسبة الإصابة بفقر الدم بلغت 26% لدى مرضى السكري مقابل 38% لدى الأصحاء دون وجود فرق إحصائي دال، كما وُجد أن الإناث أكثر عرضة للإصابة من الذكور في كلا المجموعتين، حيث بلغت النسبة 40% مقابل 12% لدى مرضى السكري و56% مقابل 20% لدى الأصحاء. كما تبين أن أكثر أنواع الأنيميا شيوعًا بين مرضى السكري هو فقر الدم صغير الكريات ناقص الصباغ، في حين لم تُظهر الدراسة أي علاقة ذات دلالة إحصائية بين فقر الدم ومدة الإصابة بالسكري أو مضاعفاته. خلُصت الدراسة إلى أن فقر الدم يُعَدّ شائعًا سواء لدى مرضى السكري أو الأصحاء، وأن داء السكري ومضاعفاته لا يزيدان من معدل الإصابة به، بينما يلعب الجنس دورًا مؤثرًا في انتشاره، إذ كانت الإناث أكثر عرضة للإصابة مقارنة بالذكور..

الكلمات الدالة: فقر الدم، داء السكري، الأورام الخبيثة، النزيف، إريثروبويتين.

Introduction

Anemia is a common health condition, it occurs when the patients are not having enough healthy red blood cells or hemoglobin concentration , a hemoglobin is the protein found in red blood cells, that combines oxygen , carrying it from lungs to all organs in the body. anemia is a problem with high prevalence, affecting about 30 % of the global population and approximately 3 million people in the United States[(1)].

Anemia is defined as men with hemoglobin level of < 13 gram per 100 milliliter, non-pregnant women with <12 gram per deciliter and pregnant women with <11 gram per 100 milliliter.[(2)]

Anemia affects approximately 27% of the population in the world or approximately 1.93 billion people worlds widely[(3)].

Nutritional deficiencies, such as iron, folic acid and vitamin B12 deficiencies are important causes of the anemia, other causes include infectious diseases such as malaria and hook worms' infestations . In addition, chronic illnesses like malignancies, kidney diseases and endocrine disorders. Iron deficiency anemia contributes to approximately 50% of anemia cases of the world.[(4)]Gastro intestinal bleeding, menstruation, reduced intake and absorption of iron are considered the most common causes of iron deficiency anemia.[(5)] There are many types of anemia , such as iron deficiency anemia, megaloblastic anemia, sickle cell anemia, hemolytic anemia and thalessemias . persons with anemia complain of many symptoms including tiredness, shortness of breathing, generalized weakness, dizziness, palpitation and pallor of skin. To diagnose anemia, complete blood analysis (CBC) should be done. other investigations such as stool analysis, peripheral blood films, gastro intestinal endoscopy and bone marrow aspiration sometimes are needed for determination of underlying causes.[(6)].

Diabetes mellitus is a chronic long-term disease, affecting most organs of the body .it can affect people of different ages, from neonatal ages to old ages, it's due to insulin deficiency or the

body does not use insulin properly(insulin resistance), leading to hyperglycemia, over the time having consistently hyperglycemia can lead to many health problems, for example heart, eyes and kidney diseases[7]. There are two main types of diabetes, type 1 diabetes or insulin dependent diabetes mellitus (IDDM) , and type 2 diabetes or non-insulin dependent diabetes mellitus (NIDDM) , but there are other rare types such as neonatal diabetes and auto immune diabetes and diabetes occurring during pregnancy, which is called gestational diabetes, poly urea, excessive thirst, weight loss and generalized weakness are the most common clinical features of diabetes, in addition to clinical features, there are some laboratory tests used in diagnosis of diabetes such fasting and random blood sugar , glycosylated hemoglobin (HbA1c) and urine test for presence of glucose.

Treatment of diabetes mellitus includes non-medical and medical treatments, the non-medical treatments include life style changes such as weight reduction, exercise and low carbohydrate diets.

The medical treatment includes oral hypoglycemic agents and insulin therapy. the diabetes mellitus if not diagnosed and treated early, it can lead to severe and life-threatening complications, hypoglycemia is one of the severe and fatal acute complications, if not discovered and treated promptly can lead to death. Hypertension, ischemic heart diseases, diabetic retinopathy, diabetic nephropathy and diabetic neuropathy are the major chronic long term complications of diabetes mellitus, many previous studies carried out before found that anemia is more common in diabetic patients than those non diabetics ,the patients with type 2 diabetes mellitus are twice more likely to prone to anemia than the patients without diabetes mellitus[8], anemia is unrecognized in 25% of diabetic patients[9], although diabetic patients with renal impairment have increased risk of developing anemia[10],nutritional deficiencies such as iron, vitamin B12, and folic acid which may cause different types of anemia, metformin drug , which was using as first line treatment of diabetes, it may impair the absorption of vitamin B12 resulting in vitamin B12 deficiency[11]. Further ,more, there is increasing evidence that anemia in type 2 diabetic patients is strongly correlated to the increased risk of development of macro vascular and micro vascular complications of diabetes mellitus.[12]

Many studies were conducted on prevalence of anemia in diabetic patients with renal impairment but there are few studies demonstrating possible association between prevalence of anemia in diabetics and other possible factors such as sex , age and blood pressure, we aimed in this study to determine the prevalence, types and some risk factors of anemia among type 2 diabetic patients in Tarhuna.

Material and methods

This study was a case- control study, included 50 cases of type 2 diabetes mellitus (25 males and 25 females), matched with 50 healthy(not diabetic) cases(25 males and25 females). For age and sex. Any cases with renal impairment (high blood urea >80 mg l dl and high serum creatinine level >1.5 mg \ dl) were excluded.

Socio-demographic data were obtained from diabetic and control cases, for diabetic cases, history, duration and complications of diabetes were included in questions of the questionnaire. A complete blood count (CBC), fasting blood sugar(FBS) laboratory tests taken from both diabetic patients and controls. The criterion of anemia diagnosis was any male with hemoglobin value < **13 gram| 100 milliliter** or any female with hemoglobin value < **12 gram|100 millimeter** were considered **anemic**[9]

For determination of the types of anemia**, the following criteria were used, Normal mean corpuscular volume (MCV)** is 80-100 aflon(fl), so MCV value of < 80 fl is considered

Microcytic anemia, the value between 80-100 fl is **Normocytic anemia** and the value of >100 fl is **Macrocytic anemia,** normal mean corpuscular hemoglobin concentration (MCHC) is 32-36 picogram (pg), so MCHC value of < 32pg is considered **Hypochromatic anemia,** value between 32-36 pg is **Normochromic anemia** and value of > 32pg is **Hyperchromic anemia[2].** Data were collected and analyzed using statistical package for social sciences (**SPSS)** version **16**, P value <0.05 is considered significant.

Results:

Age and gender of study groups:

This study was a case control study involved 50 diabetic cases (25 males and 25 females) and 50 healthy (non diabetic) controls (25 males and 25 females).the age of diabetic cases ranged between 30 yrs to79 yrs and in controls, it is ranged between 30 yrs to 78 yrs, the mean age for diabetic cases and controls were 51.3 yrs(+\-) 1.8 and 49.8 yrs(+\-) 1.86 respectively.

prevalence of anemia among diabetic cases and control cases.

26% of diabetic cases had anemia, where as 38% of control (not diabetic) cases had anemia, so anemia was more prevalent in control(non diabetic) group than diabetic group, the relation was not significant (p value=0.089)

the prevalence of anemia was more prevalent in females in both groups 40% versus 12% and 56% versus 20% in diabetic group and control group respectively. The relation was significant (p value=0.002).

Table (1) prevalence of anemia among diabetic cases and control cases.

Parameter	**Diabetic cases**		**Control cases**	
	Male	Female	Male	Female
Anemia	3 case(12%)	10 cases(40%)	5cases(20%)	14cases(56%)
No anemia	22 cases(88%)	15 cases(60%)	20 cases(80%)	11cases(44%)

Table 2. Statistical correlation between anemia and diabetes mellitus.

		presence of anemia	**diabetes mellitus**
presence of anemia	Pearson Correlation	1	-.137-
	Sig. (1-tailed)		.089
	N	100	99
diabetes mellitus	Pearson Correlation	-.137-	1
	Sig. (1-tailed)	.089	
	N	99	99

Table 3.statistical correlation between prevalence of anemia and sex (gender) of cases.

		presence of anemia	sex of cases
presence of anemia	Pearson Correlation	1	-.289**
	Sig. (1-tailed)		.002
	N	100	100
sex of cases	Pearson Correlation	-.289**	1
	Sig. (1-tailed)	.002	
	N	100	100

MCV and MCHC for diabetic cases with anemia.

The most common type of anemia in both groups was microcytic hypochromic anemia, where MCV value < 80 fl in 69.2% and 63.1% in cases of anemia in both groups (diabetics and controls) respectively. in addition, MCHC value < 32pg in 61.5% and 47.4% in anemic cases of diabetic group and controls respectively,

Table 5. Values of MCV and MCHC for diabetic cases and controls with anemia.

Parameter	MCV			MCHC		
	<80fl	80-100fl	>100fl	<32pg	32-36pg	>36pg
Diabetics with anemia	9 cases 69.2%	4 cases 30.8%	0 0%	8 cases 61.5%	5 cases 38.5%	0 0%
Controls with anemia	12 cases 63.2%	5 cases 26.3%	2 cases 10.5%	9 cases 47.4%	7 cases 36.8%	3 cases 15.8%

Treatment modalities of diabetes mellitus:

44% of type 2 diabetic cases on oral hypoglycemic tablets such as Glibenclamide and metformin. Where, as 36% were on insulin injections and 20% on both treatments (oral tablets and insulin).

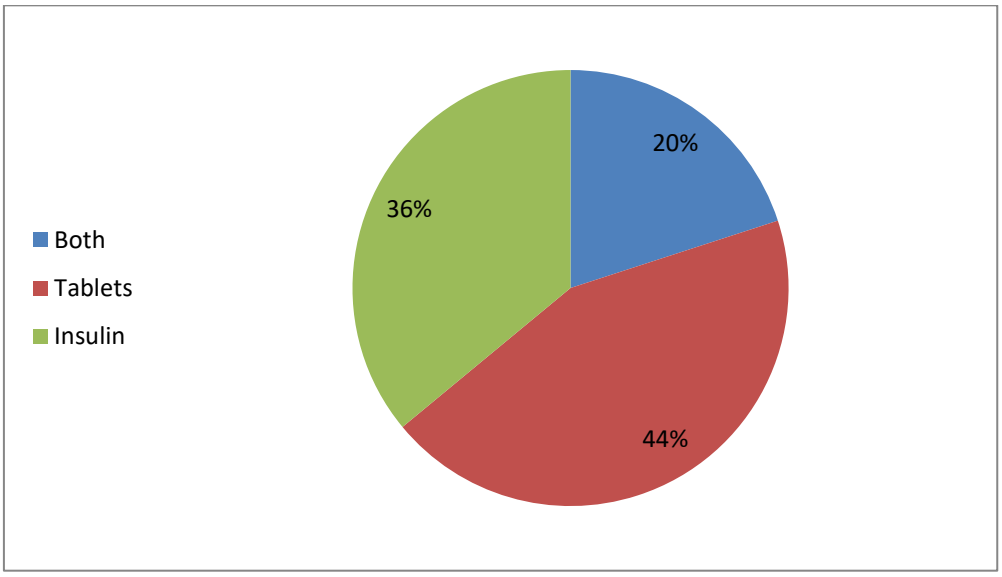

Figure (1): treatment modalities of diabetic cases**.**

Complications of diabetes mellitus in diabetic cases.

60% of diabetic cases reported in questionnaire development of some complications, such as hypertension, diabetic retinopathy and diabetic foot the correlation between anemia in type 2 diabetic cases and complications of diabetes was not significant **(p value=0.37).**

Table 6. complication of diabetes in diabetic cases.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	complications	30	60.0	60.0	60.0
	No complications	20	40.0	40.0	100.0
	Total	50	50.0	100.0	

Table 7. Statistica correlations between anemia and complications of diabetes.

		presence of anemia	complication of diabetes
presence of anemia	Pearson Correlation	1	-.046-
	Sig. (1-tailed)		.377
	N	100	50
complication of diabetes	Pearson Correlation	-.046-	1
	Sig. (1-tailed)	.377	
	N	50	50

Control of diabetes mellitus in diabetic cases.

52% of diabetic cases had good control of diabetes (average HbA1C<7%) and 48% of diabetic cases had bad control of diabetes (average HbA1c > 7%)**,** further, more, the relation between anemia in diabetics and its duration was not significant **(p value=0.316)**

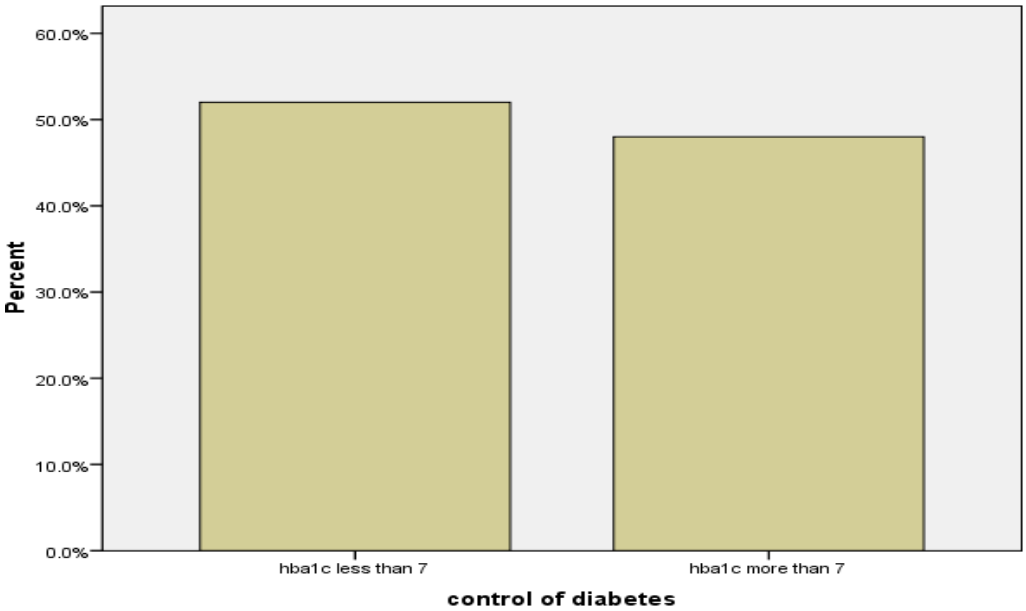

Figure 2. control of diabetes in diabetic cases.

Table 9. Statistical correlation between anemia and control of diabetes.

		presence of anemia	control of diabetes
presence of anemia	Pearson Correlation	1	-.069-
	Sig. (1-tailed)		.316
	N	100	50
control of diabetes	Pearson Correlation	-.069-	1
	Sig. (1-tailed)	.316	
	N	50	50

Duration of diabetes in diabetic cases.

70% of diabetic cases were of <10 years duration and 30% of diabetic cases were of > 10 years duration, there is no correlation between anemia in type 2 diabetic cases and its duration. **(p value=0.471)**

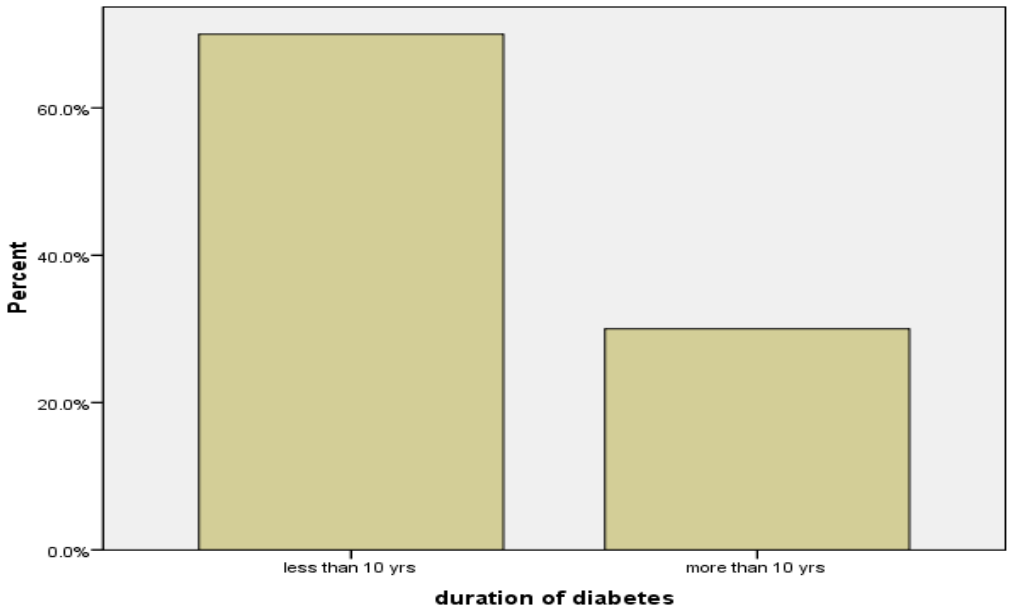

Figure 3. duration of diabetes in diabetic cases.

Table 11. Statistical correlations between anemia and duration of diabetes

		presence of anemia	duration of diabetes
presence of anemia	Pearson Correlation	1	-.010-
	Sig. (1-tailed)		.473
	N	100	50
duration of diabetes	Pearson Correlation	-.010-	1
	Sig. (1-tailed)	.473	
	N	50	50

Descriptive statistics of some variables.

These included the mean, standard deviation, minimum and maximum values of some variables, such as glycosated hemoglobin, MCV, MCHC, FBS, RBCS count and serum creatinine, as illustrated in table 5.

Table 12. Descriptive Statistics of some variables.

Parameter	N	Minimum	Maximum	Mean	Std. Deviation
average HBA1c(%)	50	4.60	11.00	7.4880	1.64300
hemoglobin concentration(g\dl)	100	7.60	17.30	12.9880	1.99607
RBC count (million\mm^3)	100	2.30	7.10	4.7165	.81681
MCV value (fl)	100	51.00	117.00	79.3500	9.23271
MCHC value(pg)	100	21.00	49.40	32.8550	4.56545
FBS value(mg\dl)	100	66.00	250.00	157.002	49.65274
creatinine value (mg\dl)	50	0.30	2.20	1.0852	.46696

Discussion:

Anemia is a common health problem, it occurs as an isolated condition or as a sequence of other diseases, one of these diseases is diabetes mellitus, prevalence of anemia was twice more in diabetic patients than healthy(not diabetic) people, there is also strong evidence that anemia increases the morbidity of diabetic patients, diabetic patients with renal impairment are more prone to develop anemia, which is documented by many other previous studies, which could be related to erythropoietin deficiency in those group of patients, our study included 100 participants (50 diabetic cases and 50 controls),50 type 2 diabetic patients without renal impairment, so any diabetic cases with renal impairment were excluded.

In our study , the prevalence of anemia among type 2 diabetics was 26% and 38% in controls (not diabetic), the anemia was more prevalent in females than males in both groups, 40% versus 12% and 56% versus 20% in diabetics and controls respectively.

Our study showed that presence of anemia was not different between those patients with complications, long duration and bad controls of diabetes and those with no complications, short duration and good control of diabetes.

In Brack- Libya, Ahlam Enwais and et al[13] conducted cross sectional study, included 198 diabetic patients, 83 males and 115 females, in this study, the overall prevalence of anemia among diabetics was 10.1%, 4.5% in males and 5.5% in females, which is lower than our results, but consistent with our study in anemia was more prevalent in females than males, in this study the most common type of anemia was microcytic hypochromic, which is also consistent with our study.

Salma M Alldallal, etal[14].2018, conducted the study in Kuwait, the prevalence of anemia among type 2 diabetic patients was 29.7%, the prevalence was more in females than males, 38.5% and 21.6% respectively, which is consistent with our results, the prevalence was more in poorly controlled diabetic patients, which is inconsistent with results of our study.

Another case control study carried out by **Samuel Antiwi and et al[15],** included 100 cases (50 diabetics and 50 controls), the prevalence of anemia in diabetic cases was 84.8%, which is higher than our result, this study found that the prevalence of anemia was more in female patients, which is consistent with our study , this study found positive correlation between bad

control and complications of diabetes and occurrence of anemia, which is inconsistent with results of our study.

In Ethiopia[16], there is another cross sectional study involved 249 type 2 diabetes mellitus, the prevalence of anemia in type 2 diabetes mellitus patients was 20.1%, which is near with results of our study, this study showed that the prevalence of anemia was more common in patients with bad control and complications, which is not consistent with our results, in addition this study found a correlation between anemia and duration of diabetes, which is inconsistent with our study.

Sharif A and et al[17] conducted study involved 200 type 2 diabetics, the prevalence of anemia among diabetics in this study was 63%, its more prevalent in females than males, which is consistent with our study.

In Sri lanka, study conducted by Sawandika and et al[18], the prevalence of anemia among type 2 diabetic patients was 31.3%, it was more in females than males 65.8% versus 34.2%, this study found significant correlation between prevalence of anemia in diabetics and complications, durations and poor glycemic control of diabetes, which is inconsistent with results of our study.

Conclusion:

Anemia was a common condition in both groups(type 2 diabetics and healthy(non diabetic) controls), it was more prevalent in healthy controls than diabetic cases, so type 2 diabetic patients without renal impairment did not have an increased risk for developing anemia, more than healthy (not diabetic) people. The most common type of anemia in both groups was Microcytic Hypochromic Anemia, female gender is associated with increased risk to develop anemia

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