# Estimation of Serum Uric Acid in Type II Diabetic Patients and Relationship with Anemia

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## Abstract
Diabetes mellitus (DM) is a metabolic condition that results in hyperglycemia, as well as abnormalities in the metabolism of carbohydrates, proteins, and fats. Serum uric acid (SUA) concentrations in diabetic anemic and non-diabetic subjects were measured in this research. According to the findings of this research, anemic diabetics had higher levels of serum uric acid and plasma glucose. In both the anemic and non-anemic diabetes groups, the Hb concentration and RBC count decreased. Patients with diabetes who have anemia are more likely to suffer from complications such as cardiovascular disease, inflammation, obesity, and long-term renal disease, all of which may worsen their already precarious health.

Keyword: Anemia, DM, Uric acid.

## 1. Introduction

An abnormality in insulin synthesis or activity may cause diabetes mellitus (DM), a metabolic disorder that affects the metabolism of protein, carbohydrate and fat. Hyperglycemia and the excretion of urine glucose are signs of DM [1].

Diabetes mellitus type II is considered a heterogeneous disorder, it is characterized by the resistance of insulin secretory defects with varying degrees, followed by secreted reduction of insulin from the pancreas (dysfunction of pancreatic beta-cell) [2]. Diabetes Type II is the wide prevalent form of diabetes, typically appearing in a person older than 40 years old, characterized by resistance of insulin and/or defect of the secretory cell of insulin [3].

Chronic diabetes is correlated with damage and failure of organs, especially the kidneys, eyes and cardiovascular system. Patients with diabetes mellitus type II are twice more likely to be anemic than non-diabetics [4].

With the progression of the illness and the development of concurrent conditions, such as cardiovascular disease (CVD), inflammation, obesity and chronic kidney disease (CKD), anemia has a passive impact on the health of diabetic patients [5].

In some cases, diabetes is associated with anemia due to its adverse effects on the organs and metabolic pathways [6]. Such iron deficiency anemia results in a reduced number of red blood cells (RBCs) due to the body does not have sufficient iron to produce them [7].

Uric acid (UA) in the blood is the final product of metabolic purine nucleotides, its excessive production and low excretion contribute to hyperuricemia. The increases in the blood uric acid concentration can result gout and are associated with other medical conditions, such as diabetes [8]. Serum uric acid (SUA) has been linked to hypertension, cardiovascular, dyslipidemia, and renal illness in epidemiological studies [9, 10].

There have previously been conflicting findings on the relationship between high SUA and diabetes [11, 12], whereas other research has shown a favourable link[13, 14] or the other way around [14]. In healthy people, SUA has been shown a positive relationship with blood glucose [15]. It has been shown that SUA and type II diabetes are linked, according to a meta-analysis [16]. In another case, there was no clear relationship between SUA and glycemic state [11, 12].

The link between SUA levels and blood glucose concentrations in healthy persons has been studied in just a few of research. There are several risk factors for cardiovascular disease that are linked to elevated levels of uric acid, hence it is critical to determine the exact SUA value in diabetic, prediabetic, and healthy persons.

As hyperuricemia is common, it is vital to investigate its impact on a wide range of disorders. The relationship between hyperuricemia and its comorbidities has been studied extensively [17]. Both hyperuricemia and anemia share comorbidities such as chronic kidney disease and cardiovascular disease [18].

Gout and anemia seem to be linked in very few studies. It was shown that people with anemia had double the chance of developing gout compared to those who did not have anemia, even after adjusting for blood urate levels and renal function [19].

## 2. Methodology

### 2.1. Study subjects

A cross-sectional study was conducted in Al-Najaf Al-Ashraf province, Iraq. The total number of participants in the research was 150, with an age range of (32-60) years, divided as follows:

First group: 50 patients with T2DM (25 men and 25 women), were diagnosed with diabetes based on the American diabetes association (ADA) criteria [20].

Second group: include 60 patients with T2DM & anemia (27 men and 33 women), they were diagnosed as anemic according to the WHO reference values.

Third group: was the control group; involved 40 healthy individuals (20 men and 20 women) who had not suffered

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from any diseases that can be associated with the study.

### 2.2. Hematologic analysis

Hematological analysis was performed to evaluate the red blood cells (RBCs) and hemoglobin concentration (Hb) in the blood samples by an automated hematology analyzer (Sysmex kx 21, Japan).

### 2.3. Biochemical analysis

Commercially available kits were used to measure the glucose and uric acid levels in the serum of all of the patients and healthy controls (BIOLABO, Francia).

### 2.4. Statistical analysis

The results were statistically analysed using Spss (V. 20) to derive the mean and standard error (± SE). The Completely Randomized Design (CRD) was used to analyse the parameters and test the results using the Least Significant Differences (L.S.D) tests at a significant level (P <0.05) to show the significance of the results.

## 3. Results

Results of table (1) were indicated a significant increase (P< 0.05) in the level of blood sugar (Glucose) in anemic diabetic group, where it was reached (230 ± 3.4 mg/dl) compared with the healthy control group that was (96.5 ± 1.5 mg/dl) and non- anemic diabetic group was (196.8 ± 1.8 mg/dl).

Table (1) also, referred that lower in red blood cells (RBCs) count of a diabetic group, were reached (4.8 ± 0.10) compare with a normal (healthy) group (5.2 ± 0.11); and a significant decrease (P< 0.05) in RBCs count of anemic diabetic group, that reached (3.6 ± 0.08), compare with non- anemic diabetic group (4.8 ± 0.10).

As well results have shown presence significantly decreased (P< 0.05) in the level of hemoglobin concentration (Hb) in anemic and non- anemic diabetic groups as it was reaching (9.7 ± 0.10 mg/dl) and (12.2 ± 0.16 mg/dl), respectively, compared with a normal (healthy) group, their hemoglobin concentration was (13.4 ± 0.14 mg/dl).

The serum uric acid levels of study groups in the table (1) referred to presence significantly increased (P< 0.05) in the levels of uric acid in anemic and non-anemic diabetic groups compared with a normal (healthy) group, where the level of uric acid was reaching (4.66 ± 0.13 mg/dl) in the diabetic group but not anemic while the normal (healthy) group was (4.45 ± 0.18 mg/dl).

As well, there was a significantly increased (P< 0.05) in the uric acid level of anemic diabetic group, their uric acid level was (5.89 ± 0.07 mg/dl) compare with non- anemic diabetic group and normal (healthy) group, that was (4.66 ± 0.13 mg/dl) and (4.45 ± 0.18 mg/dl), respectively.

**Table (1) Hematological and biochemical parameters in anemic and non- anemic diabetic groups**

| Groups Parameter | Normal control | Diabetic control | Anemic Diabetic |
|---|---|---|---|
| Glucose level mean ± S.E.M. | 96.5 ± 1.5 | 196.8 ± 1.8 | 230 ± 3.4 |
| RBCs Count (X*106) / µl mean ± S.E.M. | 5.2 ± 0.11 | 4.8 ± 0.10 | 3.6 ± 0.08 |
| Hb mean ± S.E.M. | 13.4 ± 0.14 | 12.2 ± 0.16 | 9.7 ± 0.10 |
| Uric acid level mean ± S.E.M. | 4.45 ± 0.18 | 4.66 ± 0.13 | 5.89 ± 0.07 |

## 4. scission

One of the most prevalent complications of long-term diseases, such as diabetes is anemia called chronic disease anemia [21]. Patients with type 2 diabetes are more likely to have anemia, which Andrews and Arredondo discovered when they examined the expression of genes involved in inflammation and the immunological response. The authors' findings show that diabetes individuals with anemia had higher levels of proinflammatory cytokine expression than diabetics alone.

Chronic inflammation in diabetes anemic patients is connected to high C-reactive protein levels, although iron levels in diabetic and anemic patients were low, showing that ferritin increases were tied to the chronic inflammatory process. Additionally, serum ferritin was shown to be connected with BMI, glucose levels, and insulin sensitivity, all of which were positively correlated [10].

Purine and monosodium urate crystals in their active state may have been degraded into uric acid as the ultimate outcome of the cellular catabolism of purine and urate crystals [22]. The NALP3 inflammasome is activated by these chemicals, which have previously been identified as danger signals [23]. Consequently, the pro-inflammatory cytokines that contribute to anemia patients' clinical profile should play a role in this pathway [24]. Anemia patients' prolonged hypoxia and inflammation lead to an increase in the activity of the purine pathway enzyme XO.

As uric acid levels rise, it might be a sign of worsening hemolytic anemia and hence a more severe clinical form of anemia. For diabetics, chronic kidney disease is a primary risk factor (CKD). It's interesting to note that Hb drops before the beginning of overt nephropathy in diabetics.

In our study, there was a significant negative correlation between Hb and serum uric acid (P < 0.05). This was in agreement with [25, 26]. Also, patients with anemic DM exhibited a significantly lower Hb than non-anemic DM; this was in line with [27]. As anemic or non-anemic DM, the RBC count of DM patients decreased significantly; this was consistent with previous findings [28, 29]. The adipocytokines like Adiponectin (ADPN) and leptin have an association with anemia in diabetic patients with renal failure. These adipocytokines were found to have a vital role in diabetes and represent a significant link between adipose tissue and insulin sensitivity, besides their role in hematopoiesis [30].

Studies were conducted by Aso et al. [31], and by Abashian et al. [32], in anemic and non-anemic women to clarify the association between plasma ADPN concentration with RBCs and Hb. Plasma ADPN levels were increased in anemic compared to non-anemic subjects and were negatively associated with RBCs and Hb. Some studies reported higher leptin and lower ADPN

levels in type2 diabetics, which worsen insulin sensitivity[33].

Other possibilities include less in the levels of erythropoietin (EPO) due to modification of the EPO receptors by glycation or damage to erythroid precursor cells by hyperglycemia [34].

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