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**Original Research Article**

# Evaluation of Some Blood and Biochemical Parameters for Patients with Diabetes

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**Abstract:** This study was conducted on patients with diabetes, in Samarra General Hospital. In this study, 50 blood samples were collected, 30 of which were taken from patients with diabetes, 20 of which were from non-diabetic people of both sexes, for ages (18_65) and for the period December 5, 2022 to the period is 1 February 2023. Blood was separated to obtain serum for biochemical analyses, and whole blood was sampled for CBC testing. The sugar test was conducted to ensure the presence of diabetes first, and the study confirmed that there was a significant increase in the patients compared to the control group, where the FBG test was conducted, and we note that there is a significant increase in the FBG test for patients with diabetes. A uric acid test was conducted, and the results showed a significant increase in patients compared to the control group, as the results of the analysis indicated that patients with diabetes appeared to have a significant increase in uric acid levels. The urea and creatinine test did not find a significant difference compared to the control group. As for the cbc test, the results for rbc, wbc, plt, hb, pcv showed no significant difference.

**Keywords:** Blood, physiology, human health.

## INTRODUCTION

Diabetes mellitus, more simply called diabetes, is occurs when raised levels of blood glucose occur a serious, long-term (or "chronic") condition that produces. Insulin is an essential hormone produced in the pancreas It allows glucose from the bloodstream to enter the body' cells where it is converted into energy or stored. Insulin also essential for the metabolism of protein and fat. A lack of insulin, or the inability of cells to respond to it, leads to high levels of blood glucose (hyperglycemia), which is the clinical indicator of diabetes.

**The aim of the Research**

1. Detection of people with diabetes
2. The effect of diabetes on hematological and chemical parameters in males.
3. The effect of diabetes on hematological and chemical parameters in females

**2-1 Pancreas Anatomy**

Healthy human adult in the normal, the pancreas weighs approximately 100 g, has a length of 14 to 25 cm (Longnecker and Gorelick, 2018), a volume of approximately (72.4 ± 25.8 cm3) (Saisho, Butler and other, 2007) and is both lobular and elongated in shape (Longnecker and Gorelick, 2018). Lying obliquely behind the posterior and upper abdominal wall, this highly parenchymatous organ is divided into five anatomical parts: the head, uncinate process (located in the ventral lobe of the head), neck, body and tail. The normal human pancreas grows until approximately age 30, with significant variability in adult pancreas weight or volume (Saisho, Butler and other, 2007).

**2-2 Pancreas Histology:**

The vast majority of pancreatic tissue is devoted to its exocrine function, in which digestive enzymes are produced and secreted via a complex ductal tree into the duodenum. The cells in the pancreas that produce these digestive enzymes are acinar cells, derived from the Latin word 'acinus', meaning grape, as they are cellular aggregates that form bundles akin to clusters of grapes (Williams, 2010). Acinar cells make up nearly 85% of the pancreas, are arranged in acini, and synthesise and secrete enzymes active in protein, fat and carbohydrate digestion, including trypsin, lipase and amylase (Matsuda, 2019). Each acinar bundle connects to the pancreatic duct system. Centroacinar cells represent the most peripheral duct system and partially cover the apical surface of the acinar cells.

**2-3 Pancreas Physiology:**

Pancreatic secretions occur at a low rate between meals (0.2–0.3 ml/min) and markedly increase during meals (4.0 ml/min) for a total daily volume of ~2.5 l (Pandol, 2010). Pancreatic fluid output is regulated by several hormones, as well as by the autonomic nervous system. As food enters the duodenum, enteroendocrine cells found in the mucosal lining release hormones (e.g., secretin, cholecystokinin) into the bloodstream that, in turn, stimulate the pancreas to produce and release large amounts of water, bicarbonate and digestive enzymes (e.g., amylase and lipase) and zymogens (e.g., trypsinogen, chymotrypsinogen, proelastase and procarboxypeptidase), which are inactive enzyme precursors that are activated by proteolytic enzymes once they are secreted.

**2-4 Diabetes Mellitus (DM)**

Is among the most common disorders affecting people of all ages across the globe from neonates to seniors (Marsh Z, Nguyen Y, other 2021). In addition to type 1 and II diabetes (T2DM), gestational diabetes mellitus (GDM) (Shen L, Sahota DS other 2022) and neonatal diabetes mellitus (NDM) are now more frequently reported (Beltrand J, Busiah K 2020).

**2-5 Type of Diabetes Mellitus (DM):**

**2-5-1 Type 1 Diabetes Mellitus**

Previously called insulin-dependent diabetes mellitus, this is the term used to describe the condition in patients for whom insulin therapy is essential because they are prone to develop ketoacidosis. It usually presents during childhood or adolescence. Most of these cases are due to immune-mediated processes and may be associated with other autoimmune disorders such as Addison's disease, vitiligo and Hashimoto's thyroiditis. It has been suggested that many cases follow a viral infection that has damaged the b-cells of the pancreatic islets. Individuals most at risk are those with human leucocyte antigen (HLA) types DR3 and DR4 of the major histocompatibility complex.

**2-5-2 Type 2 Diabetes Mellitus**

Previously called non-insulin-dependent diabetes mellitus, this is the most common variety worldwide (about 90 per cent of all diabetes mellitus cases). Patients are much less likely to develop ketoacidosis than those with type 1 diabetes, although insulin may sometimes be needed. Onset is most usual during adult life; there is a familial tendency and an association with obesity. There is a spectrum of disorders ranging from mainly insulin resistance with relative insulin deficiency to a predominantly secretory defect with insulin resistance.

**2-5-3 Gestational Diabetes Mellitus**

About 4–5 per cent of pregnancies are complicated by gestational diabetes mellitus (GDM). It is associated with increased fetal abnormalities, for example high birthweight, cardiac defects and polyhydramnios. In addition, birth complications, maternal hypertension and the need for caesarean section may occur. If maternal diet/lifestyle factors fail to restore glucose levels, insulin is usually required to try to reduce the risk of these complications.

**2-5-4 Neonatal Diabetes**

Diabetes occurring under 6 months of age is termed "neonatal" or "congenital" diabetes, and about 80–85% of cases can be found to have an underlying monogenic cause (Holt RIG, *et al*., 2021, De Franco E 2015– Timsit Timsit J, *et al*., 2016). Neonatal diabetes occurs much less often after 6 months of age, whereas autoimmune type 1 diabetes rarely occurs before 6 months of age. Neonatal diabetes can either be transient or permanent. Transient diabetes is most often due to overexpression of genes on chromosome 6q24, is recurrent in about half of cases, and may be treatable with medications other than insulin.

**2-6 Complications of Diabetes Include**

(Khatri, M. 2022) diabetic retinopathy (eye damage) neuropathy (nerve damage) nephropathy (kidney disease) cardiomyopathy (heart problems) gastroparesis**,** skin problems**,** etc (Khatri, M. 2022) (Scanlon, P. H., Wilkinson, C. P., 2009).

**2-7 Some of the Parameter that have Relation with Diabetes:**

**2-7-1 Insulin**

Insulin is an anabolic hormone that elicits metabolic effects throughout the body. In the pancreas, exocrine tissue known as the islets of Langerhans contain beta cells. Beta cells are responsible for insulin synthesis. By monitoring glucose levels, amino acids, keto acids, and fatty acids circulating within the plasma, beta cells regulate the production of insulin accordingly. Insulin's overall role is to control energy conservation and utilization during feeding and fasting states (Zhao L, other 2017) (Najjar SM, Perdomo G2019) (Slater T, Haywood NJ other 2019).

**2-7-1-1 Key Metabolic Process Definitions**

1 Gluconeogenesis: Synthesis of glucose using non-carbohydrate precursors.
2 Glycolysis: Degradation of glucose into pyruvic acid and energy for cell metabolism.
3 Glycogenesis: Synthesis of glycogen from glucose.
4 Glycogenolysis: Degradation of glycogen into glucose.
5 Lipogenesis: Conversion of acetyl-CoA into fatty acids and subsequent triglyceride synthesis.
6 Lipolysis: Degradation of lipids and triglycerides into free fatty acids.

**2-7-1-2 Clinical Significance of Insulin**

There is a group of metabolic diseases in which the body experiences chronic hyperglycemia. Type 1, insulin-dependent, diabetes mellitus is a condition in which the pancreas has low or absent insulin production. Type 2, insulin-independent, diabetes mellitus (DM) is a condition in which the body produces insulin, but it is not enough to effectively keep up with its glucose metabolic demands. This supply and demand mismatch leads to insulin resistance and abnormal glucose metabolism. In both type 1 and type 2 DM, glucose remains elevated in the bloodstream because its proper transport into cells and metabolism is not occurring normally. Type 2 DM has reached epidemic standards within the United States. This is of significant concern due to the vast complications caused by DM. These include neuropathy, renal failure, retinopathy, cardiovascular disease, and peripheral vascular disease. (Rinaldi *et al*., 2019) (Giugliano *et al*., 2019) (Demircik *et al*., 2019) (Eleftheriadou *et al*., 2019) (Kuzulugil *et al*., 2019).

**2-7-2 Urea and Creatinine:**

In diabetic nephropathy, bio-markers viz. serum urea and creatinine are known to be raised with hyperglycemia in uncontrolled diabetics and usually correlate with severity of kidney damage. Measurement of serum urea and creatinine are easily available tests for this purpose which can assist in detection and prevention diabetic kidney disease at an early stage and can limit the progression to end stage renal disease (ESRD). (Shlomo and Polonsky *et al*., 2011) (Zimmet and Alberti *et al*., 2001) Creatinine is the breakdown product of creatinine phosphate is released from skeletal muscle at a steady rate. Serum creatinine correlates quite well with the percent of the body that is skeletalmuscle. It is filtered by the glomerulus, and a small amount is also secreted into the glomerular filtrate by the proximal tubule (hence at low GFR's, the usual reciprocal relationship breaks down and creatinine tends to underestimate how low the GFR has gotten) (Schrier 1993) (Anjaneyulu and Chopra 2004).

**2-7-3 Uric Acid:**

Serum uric acid (SUA) is the end product of the metabolism of purine nucleotides It is mainly synthesized in the liver, intestine, kidneys, muscles, and vascular endothelium and eliminated by the kidneys and intestines (Karwur and Pujiastuti, 2017). It exhibits the properties of pro-oxidants and antioxidants. It is responsible for two-thirds of the total antioxidant capacity of plasma. A growing number of epidemiological studies have shown that SUA is a risk factor for diabetes (Krishnan and Pandya *et al*., 2012) (Lou and Qin *et al*., 2020). In adult men and postmenopausal women, normal serum uric acid level ranges between 3.5 and 7 mg/dL. However in reproductive-age women, the levels of serum uric acid are slightly lower than those in men and postmenopausal women (normal level < 6.0 mg/dL) (Liu and Wang *et al*., 2021). An increased glomerular filtration rate and high estrogen levels in premenopausal women are generally related to their lower levels of serum uric acid (Niyonzima and Dusabimana, 2021). It is a significant indicator of insulin resistance, responsible for the development of a metabolic syndrome and type II diabetes mellitus in the future (Şahin Aker and Yüce *et al*., 2016).

**2-7-4 Complete Blood Count CBC:**

Uncontrolled DM is associated with multiple disorders including metabolic, cellular, and blood disturbances leading to vascular complications (Agu Diabetes mellitus 2018). Type 2 diabetes (T2DM) is a part of the metabolic syndrome that comprises dyslipidemia, obesity, hypertension, and changes in hematological parameters (Karaman and Ozturk, 2009). Hematological changes encountered in T2DM patients include changes in the function, structure, and metabolism of red blood cells (RBCs), white blood cells (WBCs), platelet (PLT) and the coagulation systems (Karaman and Ozturk, 2018). These changes may manifest as immunological and coagulation problems, and anemia characterized by a decrease in the RBC count, hemoglobin (Hgb) and hematocrit (Hct) level as compared to non-diabetic individuals

(Waggiallah and Alzohairy, 2011). Anemia is a common hematological change in patients with T2DM and often unrecognized, and estimates of its prevalence vary widely (Gauci and Hunter, 2017) (Feteh and Choukem *et al*., 2016).

## 3-METHODS AND MATERIALS

### 3-1 Study Samples

The current study was conducted in Samarra General Hospital / Salah El-Din Governorate, for the period from December 5, 2022 to February 1, 2023. The study included follow-up (50) samples distributed from both sexes. Their ages are (18- 65). Into two groups as follows:

- **Control Group:**

The study included healthy, normal people as a comparison group (control group), and their number was 10 males, 10 females, ages 18-65 from Samarra General Hospital.

- **Patients Group:**

In this study, 30 blood samples were collected distributed from both sexes, and the study samples were for people with diabetes, whose ages ranged from 18-65 years, in Samarra General Hospital and some external laboratories.

### 3-2 Blood Collection and Storage:

Sample collection 5 (ml) of venous blood was drawn, and 2.5 (ml) of blood was placed in a test tube containing an anticoagulant (Ethylene diaminetetra acetic acid). For the purpose of calculating the number of red blood cells and the quantitative and differential number of white blood cells. He also placed 2.5 ml of blood in a tube A non-anticoagulant test to separate blood serum by centrifugation using a centrifuge for the purpose of measuring urea concentration And creatinine concentration and uric acid concentration in serum. The serum is separated from the cells using an automatic pipette and then stored at a temperature of -20 until the required tests are performed.

## 4-RESULTS AND DISCUSSION

### 4-1 Sugar

The results showed in figure (2) that there was a significant increase in sugar test in the group of patient males (162.6±32.8) compared to the group of control males (92.3±12.0) as well as a significant increase among the patient females (176.4±39.0) compared to control females (107.1±10.6).In this study increases of the FBS with the diabetes. Increased fasting blood glucose concentration (hyperglycemia) is an indicator of a higher risk to diabetes. An individual's fasting blood plasma glucose (FPG) may be in the normal range because the individual is not diabetic or because of effective treatment with glucose-lowering medication in diabetics. Mean FPG at the national level is used as a proxy for both promotion of healthy diets and behaviours and, treatment of diabetes (WHO 2016). The increased FBS level in diabetics promotes lipid peroxidation through stimulation of non-enzymatic glycation of proteins and formation of advanced glycated end-products (Suryawanshi NP, other, 2006).

**Table 1: The Sugar level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| Sugar | 92.3±12.0 | 162.6±32.8 | 107.1±10.6 | 176.4±39.0 |

### 4-2 Urea

The results showed in Figure (3) that there was no significant difference in the urea test between male patients (39.7±12.2) compared to the male control (35.9±10.2), as well as the absence of a significant difference in female patients (38.6±11.5) compared to the female control (32.1±11.7).

**Table 2: The Urea level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| Urea | 35.9±10.2 | 39.7±12.2 | 32.1±11.7 | 38.6±11.5 |

### 4-3 Uric acid

The results showed in Figure (4) that there was significant increase in the Uric acid test between male patients (7.65±1.02) compared to the male control (4.91±1.43), as well as the of a significant increase the female patients (6.48±1.51) compared to the female control (4.04±1.30). In this study, an increase in Uric acid was found in patients with diabetes, more clinical trials demonstrated uric acid was significantly associated with diabetes. For example, Bombelli *et*

*al*., (M. Bombelli, other, 2018 M. Bombelli) (T. Anothaisintawee, other 2017) randomly selected 3,200 northern Italian residents between the ages of 25 and 74 and found that increased uric acid resulted in an increased risk of impaired fasting glucose (IFG), and people with higher median UA levels may also develop metabolic syndrome and diabetes. In women, serum uric acid (SUA) levels in the normal range were associated with an increased risk of new- onset diabetes compared with women with low-normal values (M. Shani, other, 2016).

**Table 3: The Uric acid level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| Uric acid | 4.91±1.43 | 7.65±1.02 | 4.04±1.30 | 6.48±1.51 |

**4-4 Creatinine**

The results showed in Figure (5)that there was no significant difference in the Creatinine test between male patients (0.800±0.257) compared to the male control (0.765±0.277), as well as the absence of a significant difference in female patients (0.913±0.320) compared to the female control (0.840±0.263).

**Table 4: The Creatinine level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| Creatinine | 0.765±0.277 | 0.800±0.257 | 0.840±0.263 | 0.913±0.320 |

**4-5 RBC**

The results showed in Figure (6)that there was no significant difference in the RBC test between male patients (4.56±1.15) compared to the male control (5.094±0.660), as well as the absence of a significant difference in female patients (4.388±0.311) compared to the female control (4.406±0.473).

**Table 5: The RBC level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| RBC | 5.094±0.660 | 4.56±1.15 | 4.406±0.473 | 4.388±0.311 |

**4-6 WBC**

The results showed in Figure (7)that there was no significant difference in the WBC test between male patients (9.81±2.61) compared to the male control (9.05±2.87), as well as the absence of a significant difference in female patients (9.10±3.70) compared to the female control (9.82±3.90).

**Table 6: The WBC level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| WBC | 9.05±2.87 | 9.81±2.61 | 9.82±3.90 | 9.10±3.70 |

**4-7 Plt**

The results showed Figure (8) that there was no significant difference in the Plt test between male patients (249.9±77.9) compared to the male control (260.4±45.0), as well as the absence of a significant difference in female patients (286.3±62.8) compared to the female control (279.4±34.2).

**Table 7: The Plt level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| Plt | 260.4±45.0 | 249.9±77.9 | 279.4±34.2 | 286.3±62.8 |

**4-8 PCV**

The results showed in Figure (9) that there was no significant difference in the PCV test between male patients (40.56±4.39) compared to the male control (39.89±5.79), as well as the absence of a significant difference in female patients (36.09±4.73) compared to the female control (36.45±4.19).

**Table 8: The PCV level of diabetic patients compared with the control group**

| Groups / Tests | Male | | Female | |
|---|---|---|---|---|
| | control | Patients | control | Patients |
| PCV | 39.89±5.79 | 40.56±4.39 | 36.45±4.19 | 36.09±4.73 |

# CONCLUSIONS

1. The level of FBS (i.e. the level of sugar in the blood) increased in both patients with diabetes in both males and females.
2. The study indicates that the levels of Uric acid terrier are associated with diabetes, as the patients with diabetes showed a significant increase in the results of Uric acid.

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