

## Evaluation of Serum Glucose Concentrations, HbA1c, Urea, and Serum Creatinine in Individuals with Type 2 Diabetes in Samawah / Muthanna Governorate

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**Annotation:** This research was carried out between October 2023 and January 2024. A cross-sectional study took place at Samawah Teaching Hospital in Muthanna, Iraq. A total of 100 patient samples were chosen and categorized into four age groups: (less than 20, 20-40, 41-60, and more than 60). The impact of glycated was examined, focusing on their roles as screening tests and as the gold standard for evaluating glycemic control in individuals with diabetes and blood urea and creatinine levels were measured and compared with blood glucose concentrations. The results showed that blood sugar and HbA1c were high in all groups and there were significant differences between them in patients. Also, urea was high in all four groups, while creatinine was high in (G1) and (G3). The relationship between serum urea levels and blood glucose levels was found to be positive, with a correlation coefficient of  $r = +0.58$ . In contrast, when examining the correlation between serum creatinine levels and blood glucose in patients, a stronger positive correlation of  $r = +0.78$  was observed. This research intends to evaluate

the levels of blood sugar, HbA1c, urea and creatinine, while also comparing the values across a four study groups. Furthermore, the study aims to explore the correlation between urea and creatinine levels and blood glucose concentrations in individuals diagnosed with type 2 diabetes.

**Keywords:** HbA1c, urea, creatinine, glucose, correlation.

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## Introduction

One of the main unresolved health issues in the world today is type 2 diabetes mellitus, which increases the risk of several common and occasionally fatal illnesses like hypertension, stroke, coronary heart disease, kidney failure, and retinopathy(1,2). Diabetes is the term for an endocrine gland disorder that affects the Langerhans Island beta cells, resulting in a blood insulin shortage, this disease affects people of all ages and both sexes, with over seven hundred thousand new cases diagnosed globally each year(3). Diabetes mellitus rises the risk of cardiovascular disease by a factor of 2-3 across all levels of systolic blood pressure(4). Diabetes is a chronic illness that can be inherited or acquired, it is brought on by insufficient insulin production by the pancreas or by the body's developing resistance to the insulin that is produced (5). Hemoglobin A1c (HbA1c) measurements are now widely used in clinical practice guidelines for diabetes and are a key component of assessing glycemic control in patients with the disease, ever since the diabetes control and complications trial results were released in 1992 (6). Over the past years, clinical laboratories have performed a significant increase in the number of HbA1c tests, but few studies have looked into how the test is being used, there is disagreement over the ideal frequency of HbA1c measurement, but treatment goals based on HbA1c quantification have been established by the american diabetes association (ADA) and the canadian diabetes association (CDA) recommendations (7,8). A diverse range of long-term, degenerative metabolic diseases collectively known as diabetes mellitus (DM) are marked by persistent hyperglycemia, which is linked to altered protein, carbohydrate, and lipid metabolism due to deficiencies in insulin secretion, action (resistance observed in peripheral tissues) or both(9). The increased blood glucose concentration is primarily associated with insufficient or inefficient insulin synthesis within the body(10). Type 2 diabetes is brought on by insufficient insulin production by the pancreatic beta cells or by insulin resistance, it describes a state where the insulin receptors in peripheral tissues, such as muscles, liver, and fat, fail to react to normal levels of insulin (11). Type 2 diabetes is on the rise due to unhealthy lifestyles that include obesity (defined as having a body mass index of more than 30), stress and poor nutrition(12). The serum urea rise in patients with uncontrolled diabetes when blood sugar levels are high, and this is typically linked to kidney damage, blood urea levels can aid the timely identification and prevention of diabetic kidney disease (13). The glomerulus serves the function of filtering creatinine, which is excreted at a steady rate and exhibits a strong correlation with skeletal muscle. Additionally, a small amount of creatinine is released into the filtrate at the proximal convoluted tubules (14).

## Materials and Methods

From October 2023 to January 2024, a cross-sectional study was carried out at the Al Samawiya Teaching Hospital in Muthanna, Iraq.

Estimation of serum glucose concentration was estimated by enzymatic colorimetric method using a ready-made kit.

Estimation of cumulative blood sugar level HbA1c on TINIA (turbid metricinhibit for whole blood) immunosuppression turbidimetry. The method was performed according to the manufacturer's instructions (Elecsys Roche Cobas e 111). At Al Samawiya Teaching Hospital in Muthanna, venous blood (3 ml) was drawn. Part of the blood was placed in an EDTA tube, which is used for quantitative coloreimetric analysis of glycohemoglobin A1c in whole blood (HbA1c) measurement of blood urea and serum creatinine. A complete automatic clinical chemistry analyzer was employed to perform these measurements.

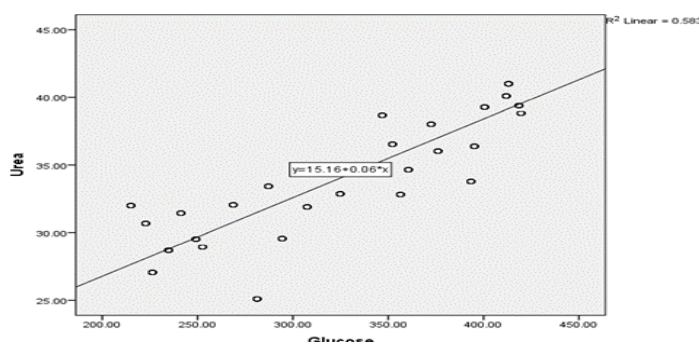
## Results

One hundred patient samples were organized into four distinct age classifications (less than 20, 20-40, 41-60, and more than 60) according to their age. 62 were woman and 38 were mans, show that there are some significant differences between groups , and no significant difference between others. There is a notable disparity in HbA1c levels among patients with type 2 diabetes when comparing groups (G1) to groups (G2, G3, G4). A noteworthy distinction is also observed when contrasting groups (G2) and (G4). There is no significant difference between (G3) when compared with (G4). Table (1) presents this information. The table shows significant differences in glucose levels in type 2 diabetes patients' blood between groups (G1) and groups (G2, G3, G4). There is also a significant difference when comparing (G2) and groups (G3, G4). A comparison between (G3) and (G4) reveals no notable differences. Along with the same prior findings and groupings, the table also demonstrates statistically significant variations in the blood urea levels of type 2 diabetic patients. While the results showed that creatinine in the blood of type 2 diabetes patients showed only a significant difference between (G1) and (G3).

**Table (1): Displays the levels of patients with type 2 diabetes's HbA1c, glucose, urea, and creatinine.**

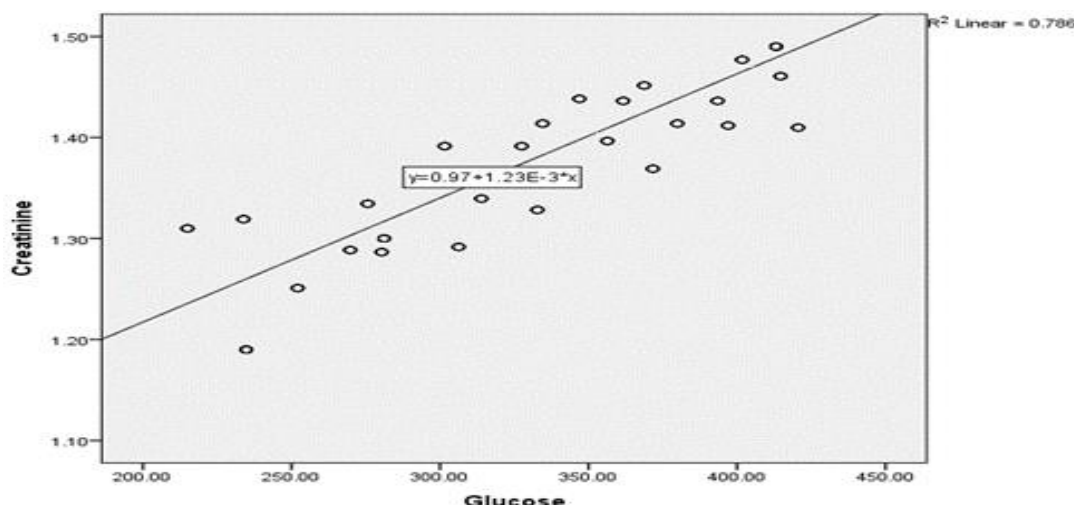
Groups	HbA1c Mean $\pm$ SD	Glucose Mean $\pm$ SD	Urea Mean $\pm$ SD	Creatinine Mean $\pm$ SD
(G1)	11.7 $\pm$ 0.3 <sup>a</sup>	413.1 $\pm$ 17.2 <sup>a</sup>	41 $\pm$ 0.6 <sup>a</sup>	1.49 $\pm$ 0.04 <sup>a</sup>
(G2)	9.5 $\pm$ 2.7 <sup>a,b</sup>	281.2 $\pm$ 11.4 <sup>a,b</sup>	25.1 $\pm$ 0.2 <sup>a,b</sup>	1.30 $\pm$ 0.2
(G3)	8.8 $\pm$ 2.4 <sup>a</sup>	234.8 $\pm$ 10.8 <sup>a</sup>	28.7 $\pm$ 0.1 <sup>a</sup>	1.19 $\pm$ 0.1 <sup>a</sup>
(G4)	8.3 $\pm$ 3.4 <sup>a,b</sup>	215 $\pm$ 15.3 <sup>a,b</sup>	32 $\pm$ 0.4 <sup>a,b</sup>	1.31 $\pm$ 0.16
LSD	0.8	56.5	5.1	0.27

A significant positive correlation was observed between serum urea levels and blood sugar levels, indicated by an "r value" of 0.58. The graphs below feature a line of best fit characterized by an increasing curve, thereby illustrating a positive relationship between these two variables (Figures 1).



**Figure 1: Scatter plot illustrating the correlation between blood sugar levels and serum urea levels in individuals with type 2 diabetes. The "r" value is 0.58, indicating a strong correlation.**

On the other hand, a significant positive correlation was noted between serum creatinine levels and blood glucose, indicated by an "r value" of 0.78. The line of best fit depicted in the graphs below demonstrates an upward trend, thereby illustrating the positive relationship between these two variables. (Figure 2)



**Figure 2: Scatter plot illustrating the correlation between blood sugar levels and serum creatinine levels in individuals with type 2 diabetes. The "r" value is 0.78, indicating a strong correlation.**

The study found that the percentage of urea was high in (G3 24%), followed by (G1, G4 16%), and the lowest percentage in (G2 12%). As for the percentage of creatinine, it was high in (G3 44%), followed by (G1 36%) and (G2 28%), and the lowest percentage was in (G4 20%), had raised values as represented in Table (2).

**Table (2): The percentages of urea and serum creatinine in diabetics**

Groups	Age categories	Number of patients (n=100)		Raised blood urea	Raised serum creatinine
		Man	Woman		
G1	< 20	8	17	4(16%)	9(36%)
G2	20-40	7	18	3(12%)	7(28%)
G3	41 - 60	11	14	6(24%)	11(44%)
G4	> 60	12	13	4(16%)	5 (20%)
total		38	62	17	32

## Discussion

The HbA1c test is utilized to assess the average glycemic control over the past 8 to 12 weeks; this test is recognized as the gold standard for measuring chronic glycemia(15). The findings presented in Table 1 indicated a notable impact of age on HbA1C levels, resulting in enhanced diagnostic efficiency for HbA1C. This correlation arises from the physiological decrease in the number of red blood cells (RBCs) as individuals age (16). This results in a reduction of bone marrow production, particularly among the elderly, as well as a decline in kidney function(17). The findings presented in Table 1 indicate an increase in HbA1C levels and blood glucose. This phenomenon can be attributed to several factors, including a decline in the functionality of pancreatic islets, reduced tissue sensitivity to insulin, diminished activity of insulin receptors, and a general decrease in glucose consumption within muscle tissues(18,19).

Research findings indicated that individuals with type 2 diabetes mellitus exhibited elevated levels of plasma creatinine, and urea concentrations, these results are consistent with what was indicated by (20, 21,22). It is our belief that inadequately managed blood sugar levels can result in

heightened blood urea levels, thereby increasing the likelihood of kidney disease in diabetic patients, this agrees with the results of previous study (23).

Elevated concentrations of urea and creatinine in individuals with type 2 diabetes may result from hyperfiltration, causing alterations in both micro and macrovascular structures, subsequently leading to an increase in renal filtration inhibitors, these results are consistent with what was indicated by (24). The rise in urea and creatinine levels can be linked to elevated sugar levels resulting from a disturbance in insulin secretion, which aligns with the findings presented in (25). Elevated levels of creatinine can occur due to urinary retention, which may cause renal failure by disrupting the filtering capabilities of the renal glomeruli, these findings align with the indications presented in reference (26).

The results of our research were consistent with those of numerous other studies, demonstrating a significant correlation between blood sugar levels and both serum urea and serum creatinine levels. These findings corroborate the observations made in reference (27), findings revealed a marked correlation between serum urea and glucose levels in the bloodstream. The findings of our study revealed a positive correlation between serum creatinine and blood sugar levels. These results corroborate the observations noted in reference (28), which highlighted a significant positive association between blood creatinine concentrations and blood sugar levels.

### Conclusion:

There is a pressing need for prompt and effective diabetes care and monitoring in Iraq. The current management of diabetes in these patients is insufficient, as evidenced by alarmingly high rates of inadequate HbA1c control and suboptimal glycaemic regulation. There is a correlation between high blood sugar levels and urea and creatinine levels.

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