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Short communication

Evaluation of Diabetes mellitus type 2 effects on kidney function

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Abstract: Type 2 Diabetes mellitus contributes to the development or progression of many chronic and age-related pathological processes. One of the major risk factors for morbidity and mortality among patients with diabetes is renal and vascular disease as well as heart disease. Type 2 diabetes mellitus was associated with a significantly increased age of kidney disease with higher urea and creatinine levels. 76 Libyan subjects participated in the study. The subjects were divided into three categories. One group hosts diabetes case (n=40) while the other group serves as a control (n=12) and the other group has no type 2 diabetes mellitus but urea and creatinine levels are elevated (n=36). After oral informed consent of the study participants, 5 ml of venous blood was drawn under sterile conditions for whole blood analysis. Fasting blood sugar was analyzed. Urea and creatinine levels were compared between diabetic and non-diabetic patients. However, a statistical analysis was performed using IBM SPSS version 26 where the correlation between parameters was analyzed by an independent samples t-test. In this study, patients with type 2 diabetes mellitus caused a significant increase in urea and creatinine compared to the control group. The study indicated that type 2 diabetes mellitus increases the damage to the kidney function.

Introduction

Diabetes Mellitus (DM) is a group of metabolic diseases characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. DM is characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves. The most common is type 2 diabetes mellitus (T2DM), usually in adults, which occurs when the body becomes resistant to insulin or does not make enough insulin [1]. Worldwide, in the past three decades with changing in lifestyles and increasing obesity, the prevalence of DM has increased and the global prevalence of DM was 425 million in 2017. According to the International Diabetes Federation (IDF), in 2015, about 10.0% of the American population had DM. Of these, seven million were undiagnosed. With an increase in age, the prevalence of DM also increases. About 25.0% of the population above 65 years of age has DM [2]. The epidemiology of T2DM is affected by genetics and the environment. Genetic factors exert their effect following exposure to an environment characterized by sedentary behavior and high-calorie intake. T2DM is the most common

cause of diabetic kidney disease (DKD) and end-stage kidney disease (ESRD) worldwide [3]. In the United States, more than 40.0% of the 29 million individuals with T2DM have DKD [4]. The kidney is a vulnerable organ as well as the most important target of microvascular damage in diabetes mellitus type 1 (T1DM) and T2DM [5-7]. The first description of the association between diabetes and kidney damage in humans was in 1552 BC [8, 9]. DKD is a major long-term complication of T2DM and is the leading cause of CKD and ESKD [10]. Among patients with T2DM, chronic kidney disease is the only complication for which the incidence has not decreased despite improvement in diabetes control over the last 20 years [11]. T1DM (insulin-dependent diabetes) is used to be called juvenile-onset diabetes because it often begins in childhood. Autoimmune reaction (the body attacks itself by mistake) that stops your body from making insulin. T2DM (non-insulin-dependent/adult-onset diabetes) is become more common in children and teens over the past 20 years, largely because more young people are overweight or obese. About 90.0% of people with DM have T2DM. This involves a more complex interplay between genetics and lifestyle. Globally, one in eleven adults have DM, and 90.0% have T2DM. Blood glucose levels above 180 mg/dL are often considered hyperglycemic, though because of the variety of mechanisms, there is no clear cutoff point. Patients experience osmotic diuresis due to saturation of the glucose transporters in the nephron at higher blood glucose levels. Although the effect is variable, serum glucose levels above 250 mg/dl are likely to cause symptoms of polyuria and polydipsia. Glycation leads to damage in small blood vessels in the retina, kidney, and peripheral nerves. T2DM is an insulin-resistance condition with associated beta-cell dysfunction. Initially, there is a compensatory increase in insulin secretion, which maintains glucose levels in the normal range. As the disease progresses, beta cells change, and insulin secretion is unable to maintain glucose homeostasis, producing hyperglycemia. Most of the patients with T2DM are obese or have higher body fat [12, 13]. The analysis of glycated hemoglobin (HbA1c) in blood provides evidence about an individual's average blood glucose levels during the previous two to three months, which is the predicted half-life of red blood cells [14]. Diagnosis of DM is through any of the hemoglobin A1c [HbA1c] level of 6.5% or higher, fasting blood sugar (FBS) level of 126 mg/dL (7.0 mol/L) or higher (no caloric intake for at least 8 hours), random blood sugar (RBS) 200 mg/dL or higher in a patient with symptoms of hyperglycemia. Diagnosis of nephropathy or impaired kidney function by creatinine is a commonly used as a measure of kidney function. The normal creatinine clearance test valve is 110-150 ml/min in males and in females it is 100-130 ml/min. Urea is the major nitrogenous end product of protein and amino acid catabolism, produced by the liver and distributed throughout the intracellular and extracellular fluid. In kidneys, urea is filtered out of the blood by glomeruli and is partially reabsorbed with water [15]. BUN level is higher than 100 mg/dl which points to severe kidney damage whereas decreased blood urea nitrogen (BUN) is observed in fluid excess [16]. A substantial proportion of individuals with DM will develop kidney disease owing to their disease and/or other co-morbidity, including hypertension and aging-related nephron loss. DKD is major long-term complication of T2DM and is the leading cause of CKD and ESKD [17]. In patients with T2DM, the prevalence of CKD is around 30.0-40.0%, mainly secondary to DKD [18]. The presence and severity of CKD: about half of all patients with T2DM and one-third with T1DM will develop CKD, which is clinically defined by the presence of impaired renal function elevated urinary albumin excretion, or both [19]. This study aims to give the paucity of data on DKD in Libyan patients with diabetes mellitus type 2.

Materials and methods

A case-control study was conducted from March to July 2022. 76 Libyan subjects participated in the study. The subjects were divided into three categories. One group hosts diabetes case (n=40)

while the other group serves as a control (n=12) and the other group has no T2DM but urea and creatinine levels are elevated (n=36). After oral informed consent of the study participants. 5 ml of venous blood was drawn under sterile conditions for whole blood analysis. These data were collected from randomized patients with T2DM. Random samples of different ages have T2DM, with any concomitant diseases which can alter kidney function and patients with renal failure were excluded from the study. Methods of diagnosis consist of the glucose test mainly FBS. The kidney function tests which include creatinine/urea. After blood collection, centrifugation was done using Hettich Centrifuge Rotofix 32A at a speed 3000 per 3 min. The serum from all samples was transferred to the cuvette racks of COBAS INTEGRA 400 plus, automated pipetting processes were done for glucose and kidney functions test procedure by device measurement of FBS, kidney function tests (creatinine, and urea), which were performed using kits COBAS INTEGRA 400 plus Device.

Results

A total of 76 participants of the population were enrolled in this study as shown in **Table 1** and **Figure 1** (Males 37) 49.0% and (females 39) 51.0%. 40 patients diagnosed with T2DM with a duration greater than five years and 36 individuals as the control group were selected to perform this study. The age ranges between 23 and 73 years. Among the patients group, 22 patients were males and 18 patients were females, on the other hand, 15 of the control group were males and 21 were females. Furthermore, the levels of urea, creatinine and glucose were estimated in T2DM patients and the in the control group.

Table 1: Gender distribution of the participants

Gender	Number	Percentage
Male	37	49
Female	39	51
Total	76	100

Among 76 diabetic patients, 36 patients were abnormal FBS level, 55 patients were abnormal level of urea, and six patients were of abnormal creatinine level. This is according to the normal range approved by the manufacturers of the material used to investigate the test as shown in **Table 2**.

Table 2: Abnormal cases of diabetics according to the range

Test	Normal range	Abnormal cases
FBS	**70 → 130**	**36**
Urea	**5 → 20**	**55**
Creatinine	**0.6 → 1.2**	**06**

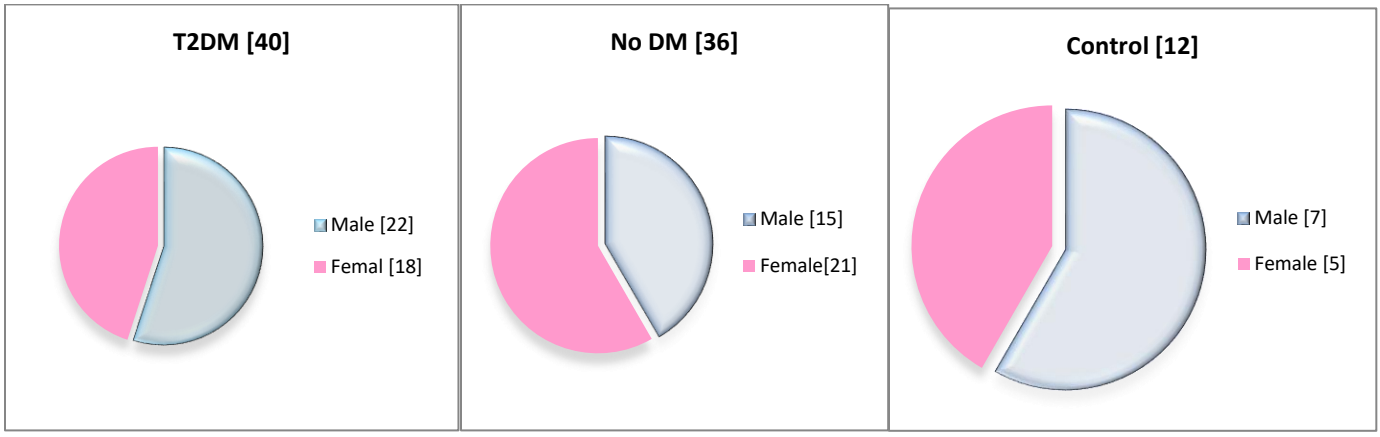

Figure 1: Distribution of the participants according to gender

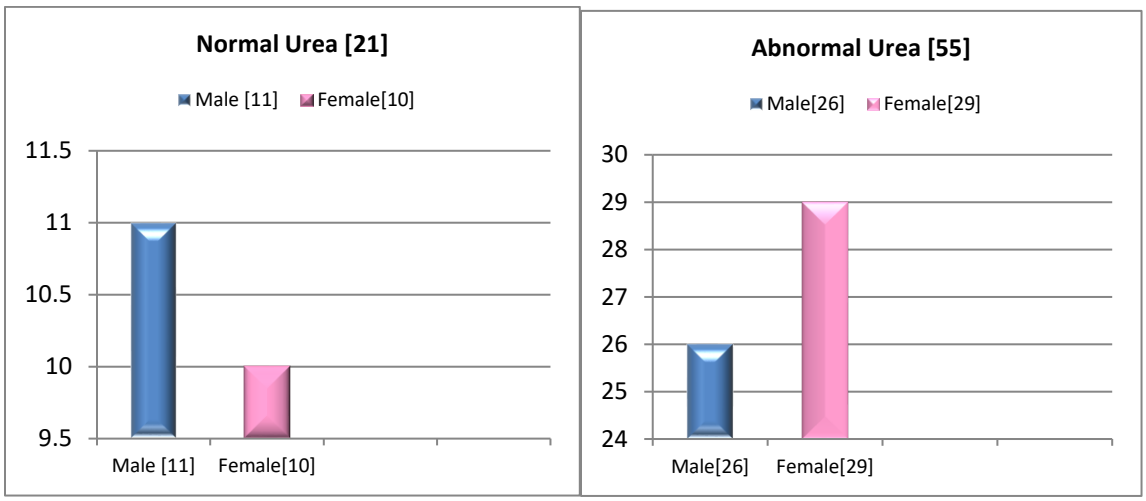

Figure 3: Urea levels in the participants

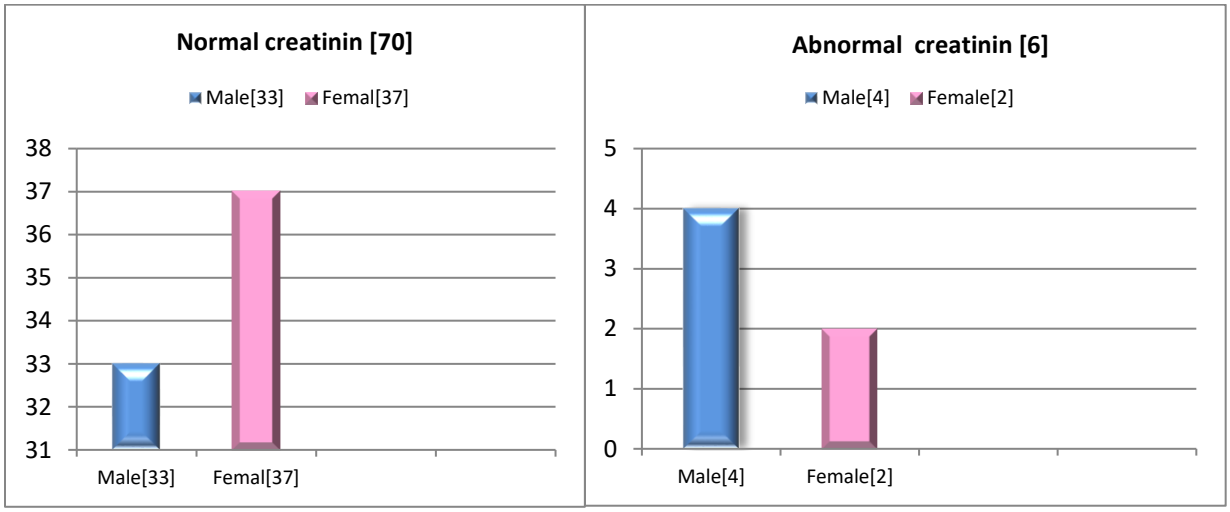

Figure 4: Classification of creatinine results

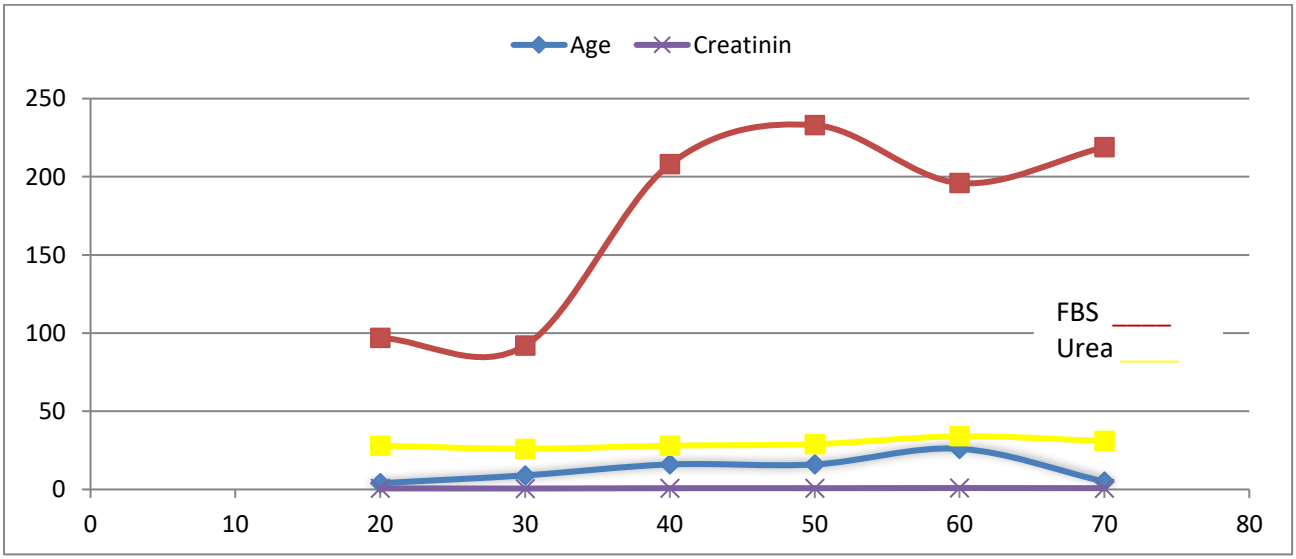

Figure 5: Age groups and the levels of blood glucose, urea and creatinine

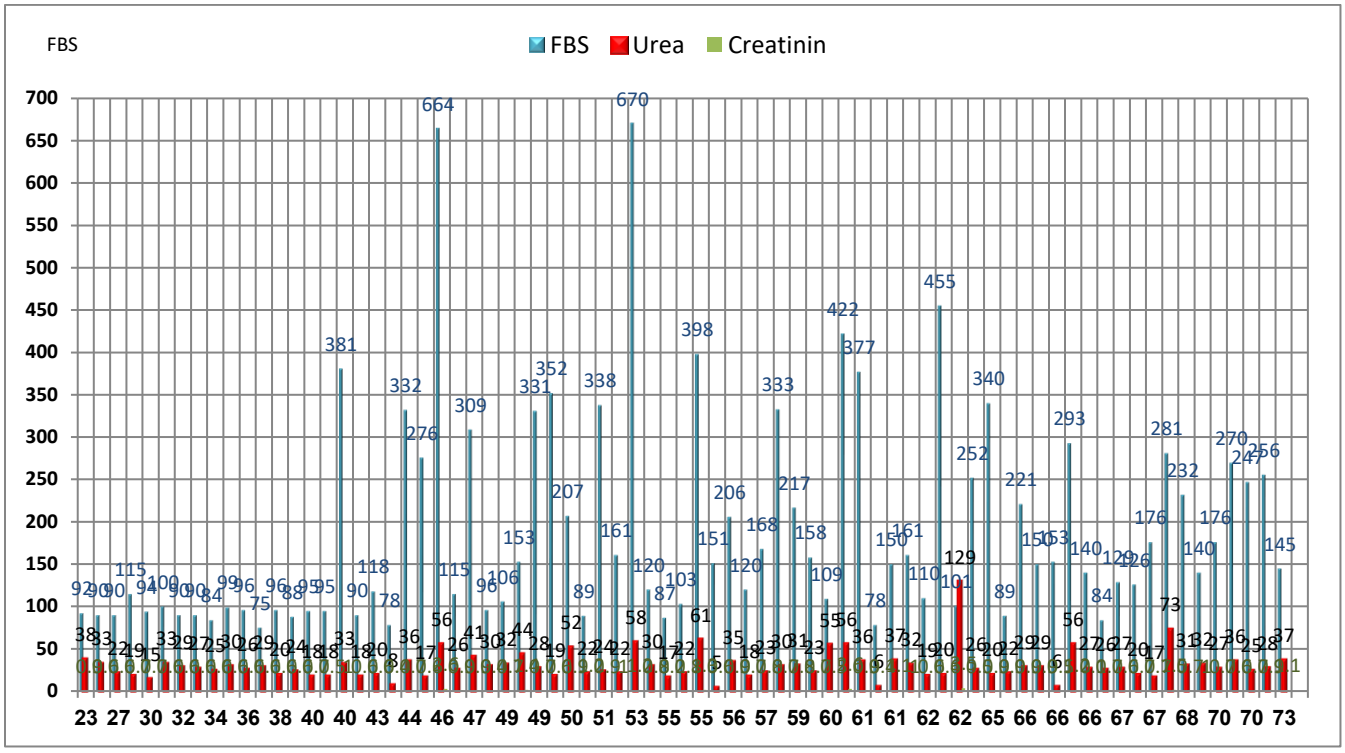

Figure 6: The levels of FBS, urea and creatinine with participant's age

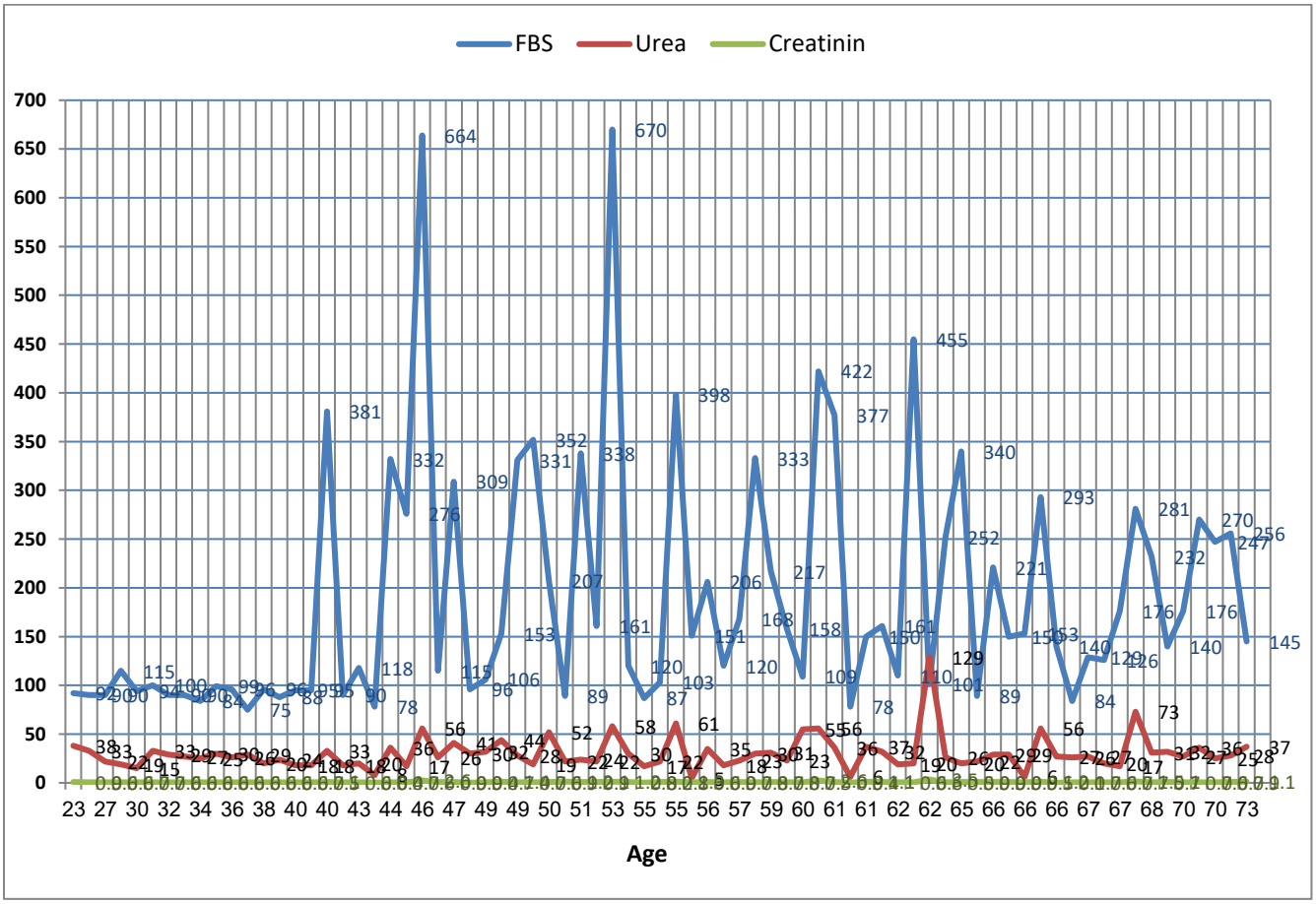

Figure 7: FBS, urea and creatinine levels with age of the participants

Discussion

The blood samples of the participants were prepared at the Diabetes and Endocrinology Hospital with an official document from the Faculty of Medical Technology, University of Tripoli, in a period estimated at months. Samples were randomly distributed to diabetics and healthy subjects who performed fasting tests on glucose, urea and creatinine levels. The results were consistent with different international studies such as in India, Jordan and Libya, that showed that high levels of creatinine in plasma and urea in diabetic patients may indicate a pre-renal problem [20, 21]. In this study, a higher serum creatinine level was observed in males than in females, which could be due to the storage of creatinine as a waste product in muscle mass and higher muscle mass in males as previously reported [20, 22]. Some previous prospective studies have examined associations between urea and creatinine concentrations and the incidence of T2DM [23]. Several studies have examined the association of serum urea with the risk of T2DM, thus, two of these reported a significant association between blood urea and diabetes [16-19]. Most of the previous studies that examined the relationship between creatinine and the incidence of T2DM were included [24]. The purpose of this study was to examine the associations of serum urea and creatinine levels on the incidence of T2DM in a prospective community-based cohort study of Libyan individuals aged 20 to 80 years old. This study was conducted on 40 diabetic patients and 36 healthy individuals. There was no significant difference between the age and gender of the participants from the two groups. Diabetic patients were confirmed by recording their detailed medical history and finally by estimating the FBS concentration. FBS concentration more than 120 mg/dl was considered as confirmation of DM FBS recording. The Pearson correlation coefficient of 0.95, which means that the relationship between diabetes and urea is a strong positive relationship. Pearson's correlation coefficient of 0.96, which means that the relationship between diabetes and creatinine is a strong positive correlation individuals with T2DM have a robust increase in urea test rate compared to individuals without diabetes, although there has been no significant finding of an association between T2DM and creatinine.

Conclusion: The findings of this study confirm that blood glucose levels significantly affect kidney function and diabetes mellitus has a role in raising kidney function. This supports the effect of blood sugar on kidney function.

Author contribution: BMR conceived and designed the study, and drafted the manuscript. AAA & ENZ, SYA collected the data, contributed in data analysis and performed the analysis and interpretation of the data. All the authors approved the final version of the manuscript and agreed to be accountable for its contents.
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Ethical issues: Including plagiarism, informed consent, data fabrication or falsification, and double publication or submission have completely been observed by authors.
Data availability statement: The raw data that support the findings of this article are available from the corresponding author upon reasonable request.
Author declarations: The authors confirm that all relevant ethical guidelines have been followed and any necessary IRB and/or ethics committee approvals have been obtained.

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