e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(3); 1469-1473
Original Research Article

Relationship between Fasting Blood Glucose, Serum Urea, Serum Creatinine, and Duration of Diabetes in Type-2 Diabetic Patients

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Received: 25-01-2024 / Revised: 23-02-2024 / Accepted: 18-03-2024
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Conflict of interest: Nil

Abstract:

Background: T2DM leads to serious complications like metabolic and renal issues. Exploring the effect of diabetes duration on health markers is vital for better management and outcomes.

Methods: The study examined 200 T2DM adults, analyzing the relationship between diabetes duration and levels of fasting blood glucose, serum urea, and creatinine, adjusting for age and sex.

Results: There was a noticeable link between the duration of diabetes and greater amounts of fasting blood glucose, serum urea, and creatinine. This suggests a meaningful connection, even when considering other factors that could influence the results.

Conclusion: The results highlight a deterioration in metabolic control and kidney function over time in T2DM patients.

Recommendation: Early and continuous management of T2DM is crucial for controlling blood glucose and monitoring renal function to prevent severe complications.

Keywords: Type-2 Diabetes Mellitus, Fasting Blood Glucose, Serum Urea and Creatinine.

Introduction

The intricate interplay among fasting blood glucose, serum urea, and serum creatinine levels, alongside the duration of illness, presents a foundational understanding necessary for managing and mitigating the progression of Type-2 Diabetes Mellitus (T2DM). This form of diabetes, which represents a significant health challenge globally, is marked by the body's impaired response to insulin and insufficient insulin production, leading to elevated blood glucose levels. Chronic elevated glucose levels initiate a cascade of metabolic and physiological changes, especially affecting renal function, and precipitating diverse complications across the body systems [1,2].

Fasting blood glucose levels serve as a pivotal gauge for diabetes management, reflecting the body's ability to regulate glucose. Consistently elevated fasting glucose levels signal poor glycemic control, heightening the risk for diabetes-related complications, including but not limited to renal impairment, ocular issues, and neuropathy [3].

The assessment of serum urea and creatinine levels plays a vital role in evaluating kidney health. The kidneys, integral to filtering and excreting waste, eliminate substances like urea—arising from protein metabolism—and creatinine, a byproduct of muscle metabolism. Elevated levels of these substances may indicate renal dysfunction, a common sequelae of diabetes, which can progress to diabetic nephropathy and potentially, end-stage renal disease (ESRD) without timely intervention [4,5].

The duration of T2DM significantly influences the risk of developing diabetes-associated complications. With time, the likelihood of organ damage increases due to sustained hyperglycemia. Understanding the impact of diabetes duration on key markers such as fasting blood glucose, serum urea, and serum creatinine is essential for early identification and management of diabetic nephropathy and other complications [6,7].

The study underscores the necessity of comprehensive management strategies for T2DM, advocating for meticulous blood sugar control and routine monitoring of renal function markers. By elucidating the connections between diabetes duration and crucial biochemical markers, healthcare professionals can tailor treatments to preempt complications, thereby improving patient outcomes and quality of life for those with T2DM [8,9].

This research endeavors to elucidate the correlation between T2DM duration and specific biochemical markers in adults, including fasting blood glucose, serum urea, and serum creatinine levels. Its objective is to examine the influence of T2DM duration on metabolic control and renal function, contributing to a deeper understanding of T2DM progression and its renal implications. Through this investigation, the study aims to refine diabetes management strategies, emphasizing the early detection and vigilant monitoring of the disease to curb the onset of severe diabetic complications.

Material and Methodology

Study Design and Participant Selection

This study carefully selected 200 adult individuals who received a diagnosis of Type-2 Diabetes Mellitus (T2DM) between January and December 2020. The selection of participants was meticulously chosen to encompass adults aged 18 or above who had been dealing with a confirmed diagnosis of T2DM for at least one year, guaranteeing a concentration on the long-term impacts of the disease. Strict exclusion criteria were implemented to ensure that patients with Type-1 diabetes, expecting individuals, and those with acute renal failure or chronic kidney diseases not related to diabetes were not included. This approach was designed to reduce any potential bias and account for variables that could influence the study's results.

Data Collection and Variables

The study focused on collecting a comprehensive set of variables, including patient demographics (such as age and sex), the duration of T2DM (measured in years), and key laboratory markers like fasting blood glucose levels (in mg/dL), serum urea (in mg/dL), and serum creatinine levels (in mg/dL). These particular variables were chosen for their relevance in evaluating the impact of T2DM duration on metabolic control and renal function—two pivotal factors in the holistic management of long-term diabetes.

Data gathering was conducted through a thorough review of electronic health records and laboratory reports. To ensure the integrity and consistency of laboratory measurements, all tests were performed in accordance with standardized procedures established by the hospital's laboratory. A meticulous review of patients' medical records was undertaken to extract the necessary information, with a dual-verification process by two independent researchers to guarantee the accuracy of data entry.

Participant Recruitment and Laboratory Procedures

The process for enrolling participants involved an initial screening of potential candidates based on their medical records, followed by the acquisition of informed consent from those who satisfied the inclusion criteria. In cases where recent laboratory results (from the last three months) were unavailable, participants were subjected to a fasting blood draw. This step was crucial to ensure the timeliness and relevance of the data collected for the study.

Statistical Analysis

Utilizing SPSS software (version 26.0), a comprehensive statistical analysis explored the relationship between Type-2 Diabetes Mellitus (T2DM) duration and key health markers, including fasting blood glucose, serum urea, and serum creatinine levels. Initial descriptive statistics provided an in-depth summary of participant demographics and lab results, setting the stage for further analysis. Pearson's correlation coefficient was applied to examine the associations between T2DM duration and the biochemical indicators, revealing significant relationships. To further refine these findings, multiple regression analysis was conducted, adjusting for potential confounders such as age and sex, ensuring a nuanced understanding of the data. The analysis confirmed significant associations across the studied variables, with a p-value threshold of less than 0.05, highlighting the impact of T2DM duration on metabolic and renal health markers. This methodological approach underscored the critical insights into the progression of T2DM and its implications, validating the importance of including T2DM duration in the disease's clinical management and research perspectives.

Result

In this detailed investigation aimed at understanding the relationship between the longevity of Type-2 Diabetes Mellitus (T2DM) and its impact on key physiological markers—fasting blood glucose, serum urea, and serum creatinine levels—a cohort of 200 adult T2DM patients was scrutinized. The demographic profile of the study participants included an average age of 55 years, with a variability of 10.2 years, and a gender split of 60% female (120 participants) and 40% male (80 participants), offering a rich demographic mix for analysis. The duration of diabetes among these individuals spanned from 1 to 20 years, with an average duration of 8 years, providing a comprehensive spectrum of disease longevity for examination.

The study meticulously measured the mean fasting blood glucose level across participants at 156 mg/dL, displaying a standard deviation of 45.6. Through Pearson correlation analysis, a moderate yet significant positive correlation was identified ($r = 0.45$, $p < 0.001$), indicating that an increase in the duration of T2DM is associated with heightened

fasting blood glucose levels. This relationship validates the notion that prolonged exposure to T2DM could exacerbate challenges in glucose regulation, underlining the necessity for intensified management efforts as the disease progresses.

In exploring renal health, the analysis reported an average serum urea level of 40 mg/dL (SD = 15.4), revealing a significant positive correlation ($r = 0.38$, $p < 0.001$) between the length of diabetes and serum urea levels. This trend points towards a degradation of renal function over time in individuals with extended T2DM history, as marked by increased serum urea levels.

Furthermore, the mean serum creatinine was recorded at 1.2 mg/dL (SD = 0.4), with findings demonstrating a positive correlation ($r = 0.30$, $p = 0.002$) between T2DM duration and serum creatinine levels. This correlation further supports the hypothesis that prolonged diabetes duration can lead to a progressive decline in kidney health, reflected by rising serum creatinine levels.

Adjusting for demographic variables such as age and sex, the multiple regression analysis solidified the significant impact of T2DM duration on elevated levels of fasting blood glucose ($\beta = 0.37$, $p < 0.001$), serum urea ($\beta = 0.29$, $p < 0.001$), and serum creatinine ($\beta = 0.25$, $p = 0.004$). These findings underscore that the correlations observed are not merely by-products of demographic characteristics but are significantly associated with the duration of T2DM.

The insights gleaned from this study shed light on the critical linkage between T2DM duration and an escalation in markers indicative of compromised metabolic control and renal function. By illustrating these associations, the research underscores the progressive detrimental effects of T2DM on the body and reinforces the imperative for prompt, continuous diabetes care. The study's outcomes enrich our understanding of T2DM's pathophysiological development and highlight the paramount importance of comprehensive, anticipatory medical strategies to mitigate the adverse outcomes associated with this chronic condition.

Table 1: Demographic and Clinical Characteristics of Participants (N=200)

Characteristic	Total (N=200)	Male (n=120)	Female (n=80)	p-value
Age (years)				
- Mean (SD)	58.5 (±11.2)	59.3 (±10.8)	57.4 (±11.8)	0.28
- Range	35-80	35-80	36-79	
Duration of Diabetes (years)				
- Mean (SD)	10.2 (±5.8)	11.1 (±6.0)	8.9 (±5.3)	0.03*
- Range	1-25	1-25	2-24	
Fasting Blood Glucose (mg/dL)				
- Mean (SD)	152.3 (±45.2)	158.7 (±48.3)	143.1 (±39.5)	0.02*
Serum Urea (mg/dL)				
- Mean (SD)	39.8 (±12.6)	42.2 (±13.4)	36.1 (±10.8)	0.01*
Serum Creatinine (mg/dL)				
- Mean (SD)	1.2 (±0.4)	1.3 (±0.5)	1.1 (±0.3)	0.04

Discussion

The connection between the duration of Type-2 Diabetes Mellitus (T2DM) and alterations in biochemical markers underscores the metabolic and renal complications associated with this chronic ailment. Notably, research involving 200 adults with T2DM highlighted a direct link between the length of diabetes and key metabolic indicators, demonstrating a moderate positive correlation with fasting blood glucose and a significant relationship with serum urea and creatinine levels. These findings underline the importance of early detection and consistent management of diabetes to mitigate the risks associated with prolonged disease duration, pointing towards the aggravation of metabolic imbalances and the gradual deterioration of kidney function as the disease progresses [8,9].

A comparative study further validated these observations, contrasting 50 T2DM patients with 50 age and sex-matched healthy individuals, revealed marked increases in fasting blood glucose, serum urea, and creatinine levels, reinforcing the connection between diabetes duration and renal impairment. [10-12] The emphasis on rigorous glycemic control is highlighted as a crucial preventive measure against kidney damage, advocating for advanced monitoring and management to preserve renal health in diabetic patients [13].

Research conducted at the Clinical Analysis Laboratory of Kwame Nkrumah University of Science and Technology in Kumasi, Ghana, focused on the renal function dynamics within the diabetic population. The study identified a higher average duration of disease in female patients, and a clear correlation between age and plasma

creatinine levels in diabetics, suggesting a gender-specific vulnerability and the impact of age on kidney function. It also observed significant relationships among female patients between fasting blood glucose and metabolic end products, and between BMI with uric acid, and fasting blood glucose, indicating signs of renal dysfunction when compared to non-diabetic counterparts. This research accentuates the necessity for diligent kidney function monitoring in diabetic individuals to enable timely medical intervention [14].

Supplementary research exploring the interplay between urea, creatinine, and glucose levels in diabetics versus non-diabetics highlighted substantial links between increased urea levels and elevated blood sugar levels among diabetic subjects. This association suggests a potential for renal compromise, positioning elevated urea and creatinine levels as key indicators for assessing renal health in diabetics. Such insights reinforce the importance of serum urea and creatinine measurements not just for diagnosing diabetic nephropathy but also for improving patient management through early detection and intervention strategies [15].

Conclusion

The findings from recent studies elucidate a compelling association between the prolonged duration of Type-2 Diabetes Mellitus (T2DM) and escalations in critical health indicators such as fasting blood glucose, serum urea, and serum creatinine levels among patients. This relationship delineates a concerning trajectory: with the advancement of T2DM over time, there's a marked propensity for the decline in both metabolic regulation and kidney function. Such insights accentuate the crucial need for early detection and vigilant management of T2DM, aiming to mitigate its cumulative adverse effects on the body's systems. Emphasizing the importance of regular health assessments and prompt medical actions, these findings advocate for a proactive stance toward managing T2DM. This strategic focus not only endeavors to maintain stability in these essential health parameters but also seeks to improve life quality for individuals grappling with T2DM, highlighting the imperative of comprehensive and coordinated care approaches in effectively tackling the disease's progression.

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