



Assessment of Glycaemic Control and Its Association with Renal Function Among Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study

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Abstract

Background: Type 2 diabetes mellitus is a major contributor to chronic kidney disease. Poor glycaemic control may be associated with deterioration in kidney function, although the relationship varies with diabetes duration, blood pressure, age, comorbidities, and treatment. Assessing glycaemic status alongside renal parameters may help identify patients who require closer clinical monitoring.

Aim: To assess glycaemic control and examine its association with renal function among adults with type 2 diabetes mellitus attending a tertiary care hospital.

Materials and Methods: A hospital-based cross-sectional study may be conducted among eligible adults with established type 2 diabetes mellitus. Relevant demographic and clinical information should be collected using a structured proforma. Glycaemic control should be assessed using glycated haemoglobin (HbA1c). Renal assessment should include serum creatinine, estimated glomerular filtration rate (eGFR), and urine albumin-to-creatinine ratio (UACR), where available. Associations between HbA1c and renal parameters should be analysed using appropriate statistical tests, with adjustment for relevant confounding variables where feasible. Ethical approval and informed consent should be obtained before recruitment.

Results: This section must be completed using the actual study findings. It should report the number of participants, HbA1c distribution, renal function measurements, prevalence of abnormal renal markers, and the strength and statistical significance of observed associations. No numerical results should be inserted until the data have been analysed.

Conclusion: The study may help clarify the relationship between glycaemic control and renal function in the local clinical population. The conclusions should be based on the observed findings and should not imply causation from a cross-sectional design.

Keywords: Type 2 diabetes mellitus; glycated haemoglobin; HbA1c; renal function; estimated glomerular filtration rate; albuminuria; diabetic kidney disease.

INTRODUCTION

Type 2 diabetes mellitus is a chronic metabolic disorder that can affect several organs, including the kidneys. Diabetic kidney disease is an important complication because kidney damage may progress silently before noticeable symptoms develop. Early identification of abnormal renal markers is therefore an important component of routine diabetes care.

Glycated haemoglobin (HbA1c) provides an estimate of average blood glucose over approximately two to three months. Although HbA1c is widely used to assess glycaemic control, its relationship with kidney function is not necessarily straightforward. Patients with similar HbA1c levels may have different renal outcomes because of differences in diabetes duration, hypertension, age, medication use, and other clinical factors.

Renal assessment should not rely on serum creatinine alone. Estimated glomerular filtration rate (eGFR) helps assess filtration function, while the urine albumin-to-creatinine ratio (UACR) helps identify kidney damage that may not be

apparent from eGFR. The 2024 Kidney Disease: Improving Global Outcomes (KDIGO) guideline emphasizes the combined assessment of filtration and albuminuria for evaluating chronic kidney disease.

Current diabetes guidance recommends assessment of both eGFR and UACR in people with type 2 diabetes. Studying their relationship with HbA1c in a hospital population may help describe the burden of abnormal renal markers and identify clinical characteristics associated with poorer kidney health.

However, a cross-sectional study can identify associations at a particular point in time; it cannot establish that poor glycaemic control caused renal impairment. This distinction should remain clear throughout the manuscript.

AIM AND OBJECTIVES

Aim: To assess glycaemic control and its association with renal function among patients with type 2 diabetes mellitus.

Primary objective

- To determine the association between HbA1c levels and eGFR among adults with type 2 diabetes mellitus.

Secondary objectives

- To assess the distribution of HbA1c levels in the study population.
- To determine the frequency of reduced eGFR and increased UACR, where measurements are available.
- To examine the relationship between HbA1c and serum creatinine.
- To explore associations between renal markers and clinical variables such as age, duration of diabetes, and blood pressure.

MATERIALS AND METHODS

The following is a proposed methodology. Replace the placeholders with your actual hospital details and approved study protocol.

Study design and setting

A hospital-based, cross-sectional observational study conducted in the Department of General Medicine at Gouri Devi institute of medical science over a period of Jun 2021 to April 2022

Study population

Adults with an established diagnosis of type 2 diabetes mellitus attending the outpatient department or medical wards during the study period.

Inclusion criteria

- Adults aged 18 years or older.
- Established diagnosis of type 2 diabetes mellitus.
- Willingness to participate and provision of informed consent.

Exclusion criteria

The protocol should specify relevant exclusions before recruitment. Depending on the research question, these may include acute kidney injury, current dialysis, pregnancy, or conditions that interfere substantially with HbA1c interpretation. Exclusions should be justified and not applied retrospectively to obtain preferred results.

Study variables and measurements

Variable	Proposed measurement
Glycaemic control	HbA1c (%)
Kidney filtration	Serum creatinine and eGFR
Kidney damage marker	UACR (mg/g or mg/mmol)
Demographic factors	Age and sex
Clinical factors	Diabetes duration, blood pressure, relevant comorbidities and medications

eGFR should be calculated using a validated equation appropriate to the study population and laboratory practice. Abnormal renal findings from a single measurement should not automatically be labelled chronic kidney disease, because chronicity generally needs to be established over time.

Statistical analysis

Data may be analysed using suitable statistical software. Continuous variables should be summarized as mean and standard deviation or median and interquartile range, depending on their distribution. Categorical variables should be presented as frequencies and percentages.

The relationship between HbA1c and eGFR can be examined using Pearson or Spearman correlation, as appropriate. Comparisons across prespecified HbA1c categories may be performed using suitable parametric or non-parametric tests.

Multivariable regression may be considered to account for confounding factors, including age, diabetes duration, blood pressure, and relevant medication use.

Report effect estimates, confidence intervals, and exact p-values where possible. Statistical significance should not be interpreted as proof of clinical importance.

RESULTS

Do not fill these tables with invented participant numbers or statistical results. They are templates for the actual analysis.

Table 1. Sociodemographic and clinical characteristics of participants

Characteristic	Result
Total participants	[N]
Mean age (years)	[Mean ± SD]
Duration of diabetes (years)	[Mean ± SD or median (IQR)]
HbA1c (%)	[Mean ± SD or median (IQR)]
Serum creatinine	[Appropriate summary]
eGFR (mL/min/1.73 m ²)	[Appropriate summary]
UACR	[Appropriate summary, if measured]

Table 2. Distribution of renal function according to HbA1c category

Renal parameter	HbA1c category	Number (%)
eGFR	Category defined in protocol	[N (%)]
eGFR	Other prespecified categories	[N (%)]
UACR	Normal or mildly increased	[N (%)]
UACR	Moderately or severely increased	[N (%)]

Note: Use clinically appropriate categories and report the definitions in the Methods section.

Table 3. Association between HbA1c and renal parameters

Renal parameter	Correlation coefficient	95% CI	p-value
eGFR	[r or ρ]	[CI]	[p]
Serum creatinine	[r or ρ]	[CI]	[p]
UACR	[r or ρ]	[CI]	[p]

DISCUSSION

Type 2 diabetes mellitus is an important risk factor for chronic kidney disease and contributes substantially to the burden of renal complications worldwide. Evaluating glycaemic control alongside renal function is clinically relevant because kidney impairment may develop gradually and remain asymptomatic during its early stages. The present study is designed to examine the association between HbA1c levels and renal parameters among patients with type 2 diabetes mellitus attending a healthcare facility.

HbA1c is an established indicator of average glycaemic exposure over the preceding two to three months. Persistently elevated blood glucose may contribute to renal injury through several mechanisms, including glomerular hyperfiltration, oxidative stress, endothelial dysfunction, and structural changes within the glomeruli. However, the development and progression of diabetic kidney disease are multifactorial. Age, duration of diabetes, hypertension, cardiovascular risk factors, and individual susceptibility may also influence renal outcomes. Therefore, the relationship between HbA1c and kidney function should be interpreted in the context of these additional clinical characteristics.

An important consideration is the choice of renal parameters. Serum creatinine is commonly used in clinical practice, but its concentration is influenced by factors such as muscle mass and age. The estimated glomerular filtration rate provides a more clinically useful estimate of filtration function, while the urine albumin-to-creatinine ratio helps identify albuminuria that may occur even when eGFR remains relatively preserved. The KDIGO 2024 guideline supports assessing both eGFR and albuminuria when evaluating chronic kidney disease. These measurements provide complementary information and can improve the identification of patients who may need further renal assessment. [1]

The association between glycaemic control and renal function should not be assumed to be uniform across all patients. Some individuals with elevated HbA1c may have preserved eGFR, whereas others may demonstrate renal impairment despite relatively satisfactory glycaemic control. Such differences may reflect the duration of diabetes, coexisting hypertension, previous glycaemic exposure, treatment history, or other causes of kidney disease. Furthermore, HbA1c may be less reliable in certain circumstances, including some anaemias, altered red-cell turnover, and advanced kidney disease. These factors should be considered when interpreting the study findings. [2,3]

The findings of this study should be compared with published evidence after the statistical analysis has been completed. If higher HbA1c is associated with lower eGFR or greater albuminuria, the discussion should report the magnitude and precision of the association and consider whether it remains after adjustment for relevant confounding variables. If no statistically significant association is observed, that finding should also be reported transparently. A lack of statistical

significance does not necessarily establish the absence of a clinically meaningful relationship, particularly when the sample size is limited.

The clinical relevance of this research lies in the combined assessment of glycaemic status and renal health. The American Diabetes Association recommends regular assessment of kidney function and albuminuria in people with type 2 diabetes. Identifying abnormal renal markers can support appropriate clinical follow-up, review of risk factors, and consideration of evidence-based kidney-protective management. Nevertheless, this cross-sectional study can describe associations at the time of assessment; it cannot determine whether poor glycaemic control preceded or caused renal impairment. [2]

Overall, this study can contribute useful information about glycaemic control and renal health in the population served by the participating institution. Its value will depend on the quality of the clinical measurements, adequate consideration of confounding variables, and cautious interpretation of the statistical findings.

Strengths and limitations

Strengths

The proposed study examines glycaemic control alongside clinically relevant indicators of renal function in patients with type 2 diabetes mellitus. The inclusion of HbA1c, serum creatinine, eGFR, and UACR, where available, would provide a more comprehensive assessment than reliance on a single renal marker. The hospital-based design may also help describe the clinical characteristics of patients receiving diabetes care in the study setting.

Limitations

The cross-sectional design limits the ability to establish temporal relationships or causality between glycaemic control and renal impairment. A single assessment of renal parameters cannot reliably establish chronic kidney disease without evidence of persistence over time. Hospital-based recruitment may limit the generalizability of the findings to the wider community. Other limitations may include a small sample size, incomplete UACR measurements, and residual confounding from factors such as hypertension, diabetes duration, medication use, and comorbid conditions. These limitations should be revised to reflect the study actually conducted.

CONCLUSION

The assessment of glycaemic control alongside renal function is an important component of the clinical evaluation of patients with type 2 diabetes mellitus. HbA1c provides information about recent glycaemic exposure, while eGFR and UACR offer complementary information regarding kidney filtration and renal damage.

The present study aims to clarify the relationship between glycaemic control and renal parameters in a hospital-based population. Its conclusions should be based on the observed data, including the strength of any association and the influence of relevant clinical confounders. Regardless of whether a statistically significant relationship is identified, the combined assessment of glycaemic status and renal markers may help inform appropriate monitoring and further clinical evaluation.

Longitudinal studies with repeated renal measurements and adequate follow-up would be useful to investigate whether glycaemic control predicts subsequent deterioration in kidney function.

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