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# Prevalence of chronic kidney disease and its risk factors among Type 2 diabetes patients in a tertiary care hospital

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## ABSTRACT

**Background:** An increased chance of developing chronic kidney disease (CKD), which has higher morbidity and mortality, exists among patients with Type 2 diabetes (T2D). **Aims and Objectives:** Our goal was to determine and classify the anthropometric, physiological, and demographic risk factors for CKD in individuals with T2D. **Materials and Methods:** A cross-sectional research study was conducted at a tertiary care hospital involving 218 participants. Data were collected on various parameters including age, gender, education level, employment status, height, weight, blood pressure, hemoglobin levels, and estimated glomerular filtration rates (eGFRs). Participants were selected based on specific inclusion and exclusion criteria, and rigorous statistical analyses were applied to the collected data. Using the SPSS program, we analyzed the data, and when the $P<0.05$, we declared the results statistically significant. **Results:** There were 218 people in the research, 58.3% of whom were male and 41.7% of whom were female. The mean age group was between 51 and 60 at 36.2%. The age group distribution among the patients showed significant value ($P<0.0001$). About 87.6% of the patients had normal weight. 49.5% were recorded in Stage 1 CKD. Fasting blood sugar has a negative correlation ($-182$) with glomerular filtration rate (GFR) and shows a significant result. The post-prandial blood sugar value is also statistically significant and negatively relates to GFR. In addition, random blood sugar and glycated hemoglobin also reported statistically significant values. **Conclusion:** In individuals with T2D, it was determined that significant risk factors for the onset of CKD include eGFR, age, and the duration of diabetes. Males had a considerably greater incidence of CAD, peripheral neuropathy, and diabetic foot.

**Key words:** Type 2 diabetes; Glomerular filtration rate; Chronic kidney disease; Cross-sectional study

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## INTRODUCTION

Chronic kidney disease (CKD) is characterized by a gradual decline in renal function over a period ranging from 3 months to several years. Various factors such as blunt force trauma, diabetes mellitus (DM), and high blood pressure can contribute to the onset of kidney impairment. When the kidneys suffer injury, their ability to filter blood and perform essential functions becomes compromised, leading to a decrease in glomerular filtration rate (GFR) and the presence of proteinuria.[1] The prevalence of DM has become a significant global concern in the 21st century. According to recent data from the International Diabetes Federation, approximately 366 million people worldwide were affected by diabetes in 2011. If current trends continue, it is estimated that by 2030, the number of individuals with diabetes could reach a staggering 552 million.[2] Diabetic nephropathy is a primary cause of

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CKD and end-stage renal disease (ESRD). The use of urine albumin for diagnosing CKD in diabetic patients has been established.[3] In 2017, DM was identified as a prevalent non-communicable disease, impacting approximately 451 million individuals globally and resulting in 5 million deaths. Projections suggest that the diabetic population could rise to 693 million by the year 2045.[4]

ESRD is becoming more common in Japan and globally. Multiple studies conducted over the last two decades have shown that the number of people in Europe and the US with ESRD who need dialysis or a transplant has grown by nearly 4 times.[3] The prevalence of renal illnesses, particularly ESRD and CKD, is rising in an aging country such as Japan.[5] The management of CKD patients has been a source of concern. Furthermore, there is a growing public demand for identifying CKD risk factors and developing CKD preventive methods.[3]

The Third National Health and Nutrition Examination Survey, conducted over a decade and involving a cohort of more than 15,000 participants, examined cumulative mortality based on diabetes and kidney disease status. This study emphasized that individuals with kidney disease comprised the majority of the increased mortality observed in those with Type 2 diabetes (T2D).[6] The prevalence of renal illness contributes significantly to the higher mortality rates in T2D patients. In addition, it is noteworthy that diabetics with CKD face an increased risk of death from any cause specifically from cardiovascular disease. Several factors such as age, sex, ethnicity, family medical history, elevated blood sugar levels, hypertension, and cardiovascular conditions can collectively increase the susceptibility to CKD.[7]

The inclusion of estimated GFR (eGFR) and urine albumin-to-creatinine ratio significantly improved the ability to predict cardiovascular events and mortality compared to established risk factors in a meta-analysis examining kidney disease indicators and their association with mortality and ESRD among people with diabetes.[8] Regular screening with urine albumin and serum creatinine levels aids in the early detection and implementation of crucial countermeasures to stop the further movement of renal debilitation toward end-stage renal sickness (stages 4 and 5). Early ID of renal impedance in the diabetic populace aids policymakers and health-care professionals in developing and implementing the appropriate screening standards and management regimens.[9] ESRD is brought on by diabetes in 9.1–29.9% of cases and by hypertension in 13–21% of patients in diverse developing nations. One-quarter of Africans have hypertension, and that is the primary reason South Africans on dialysis or a transplanted kidney have it in the first place. The widespread mortality and disability caused by CKD are largely attributable to a lack of knowledge about the condition among both the general population and medical professionals.[10] Chronic hyperglycemia is associated with complications in several body systems, including the eyes, nervous system, kidneys, heart, and blood vessels. Diabetes-related morbidity and death are primarily ascribed to its microvascular and macrovascular consequences. Intensive glycemic management lowers the chance of developing microvascular and macrovascular problems, according to a UK prospective study of T2D patients.[11]

Information on the frequency of complications associated with diabetes is crucial for modifying policies and practices in managing diabetic care. In devising effective strategies for preventing and treating this chronic and debilitating ailment, it will be essential to incorporate measures that reduce its impact on health-care resources and costs. A key component of this approach will involve screening for both macrovascular and microvascular complications, as this will enable the identification of the necessity for comprehensive assessment and screening protocols.[2] Most research on DPN prevalence and related factors has been done in Western nations. Asian people, mainly North Indian ones, have few statistics available. The North Indian population is a separate entity exposed to a distinctive risk profile for developing T2DM.

Even though few community-based researches are conducted in Southern India due to ethnic, cultural, anthropometric, and meteorological variations.[12] The objective of this study was to compile and arrange the anthropometric, physiological, and demographic risk factors associated with CKD. In addition, we aimed to establish connections between each risk factor, such as age, diabetes duration, glycated hemoglobin (HbA1c) levels, body mass index (BMI), and the occurrence of CKD in individuals with T2D. This study adds to a better knowledge of the incidence of CKD among people with DM and offers solid scientific grounding for the design of preventative interventions to reduce that prevalence.

### Aims and objectives

To estimate the prevalence of Chronic Kidney disease (CKD) among Type 2 Diabetes patients in a tertiary care hospital.

## MATERIALS AND METHODS

The General Medicine Division of Sri Lalithambigai Medical College and Hospital in Adayalampattu, Tamil Nadu, was

the site of a cross-sectional study that took place between October 2022 and October 2023. Following the established inclusion and exclusion criteria, a total of 218 individuals diagnosed with T2D were signed up for the review.

### Inclusion criteria

All patients aged >19 and permanent residents with T2D were included in the study.

### Exclusion criteria

Type-1 diabetes patients, type-2 diabetes patients with any other comorbidities, and patients who did not provide proper consent were not included in the study.

All the participants had to provide proper written consent before starting the research. After obtaining approval from the Ethics Committee, the research was carried out. Participants willingly provided written consent, allowing for the collection of sociodemographic, clinical, and anthropometric information. Height and weight measurements were taken and documented, and the BMI was calculated by dividing weight by the square of height (kg/m$^2$). Blood pressure was taken. Blood and urine samples were taken, and laboratory technicians did biochemical assays. Follow-up laboratory work included determinations of fasting blood sugar (FBS), 2-h post-prandial blood sugar (PPBS), HbA1c, and hemoglobin and serum creatinine concentrations. A fasting venous blood sample of 5 mL was taken to separate serum using a conventional venipuncture procedure. Serum lipid, serum phosphorous, and serum electrolyte levels were recorded. The techniques of enzymatic glucose oxidase, kinetic alkaline picrate, and enzymatic glutamate-dehydrogenase were used to assess serum glucose, creatinine, and urea levels, respectively. Urine albumin was measured, and albuminuria was characterized as the presence of albumin in the urine (from +1 to +4). The modification of diet in renal disease equation was adjusted so that it could be used to determine GFR. eGFR and albuminuria were used together to establish CKD as a diagnosis. When CKD was studied in relation to other indicators, only stages 3, 4, and 5 were viewed as symptomatic of the sickness, though arranges 1 and 2 were viewed as indicative of the absence of CKD. This classification aligns with the definition of CKD, which is characterized by a decrease in eGFR to under 60 mL/min.

Bar charts were used for the representation of all quantitative variables. Data that are categorical will be shown as frequencies and proportions. Descriptive analysis of the data was done with the help of mean and standard deviation. The statistical analysis employed linear regression as the method of choice. Data analysis was carried out using SPSS version 26 software, with the data transferred into a Microsoft Excel spreadsheet for analysis. The $P<0.05$ was considered statistically significant, and a longer duration of diabetes was seen between 6 and 10 in 113 patients.

## RESULTS

Most of the patients in the study were seen in the age group of 51–60 years, about 36.2%. The least number of patients was noted to be 3 (1.4%) between the age group of fewer than 30 years. Out of the total 218 patients included in the study, 127 (58.3%) were recorded to be male patients. 97 (44.5%) patients were smokers. Alcoholism was seen in 75 (34.4%) of the patients. After the BMI was measured, most patients had normal weight 191 (87.6%) of the total patients. In the fasting lipid profile (FLP), 24 (11.0%) patients were found to have dyslipidemia, and 194 (89.0%) were normal. Twenty-nine (13.3%) patients had Grade 1 left-ventricular diastolic dysfunction. However, the majority of them did not show any diastolic dysfunction. The majority of the members had a place with Stage 1 (49.5%), followed by Stage 2 (67%), Stage 3B (8.3%), Stage 3A (6.9%), and Stage 4 (4.6%) (Table 1).

FBS has a negative correlation (−182) with GFR and shows a significant result. The PPBs value is also statistically significant ($P=0.004$) and negatively relates to GFR. In addition, random blood sugar and HbA1C also reported statistically significant values, respectively ($P=0.023$ and 0.003) (Table 2).

The age group of 41–50 years was seen in the majority of 58.3% in stage 1 CKD compared to other stages. The age distribution among the CKD stages showed a significant difference. ($P<0.0001$). A majority of male patients were seen in Stage 1 (61). The gender distribution showed no significant difference in the CKD stages ($P=0.344$). The patients with smoking and alcohol consumption had no statistically significant value ($P=0.07$ and 0.151). The CKD stages in Grades 1, 2, and 3 left ventricular diastolic dysfunction showed significant differences ($P=0.002$). However, other parameters such as BMI, fundus examination, diabetes duration, FLP, and treatment measures were not statistically significant (Table 3).

## DISCUSSION

In general, CKD prevalence rises with age in both male and female patients. Elderly persons have a higher chance of developing CKD due to age-related renal abnormalities.

**Table 1: Factors associated with CKD**

| Patients characteristics | Count | Column n% |
|---|---|---|
| Age group | | |
| <30 | 3 | 1.4 |
| 31–40 | 46 | 21.1 |
| 41–50 | 60 | 27.5 |
| 51–60 | 79 | 36.2 |
| 61–70 | 18 | 8.3 |
| >71 | 12 | 5.5 |
| Gender | | |
| Female | 91 | 41.7 |
| Male | 127 | 58.3 |
| Smoking | | |
| No | 121 | 55.5 |
| Yes | 97 | 44.5 |
| Alcoholism | | |
| No | 143 | 65.6 |
| Yes | 75 | 34.4 |
| Body mass index kg/m$^2$ | | |
| Normal weight | 191 | 87.6 |
| Obese | 8 | 3.7 |
| Overweight | 14 | 6.4 |
| Underweight | 5 | 2.3 |
| Fasting lipid profile mg/dL | | |
| Dyslipidemia | 24 | 11.0 |
| Normal | 194 | 89.0 |
| LVDD | | |
| Nil | 176 | 80.7 |
| Grade 1 | 29 | 13.3 |
| Grade 2 | 11 | 5.0 |
| Grade1 | 1 | 0.5 |
| Grade2 | 1 | 0.5 |
| Urine albumin | | |
| 1+ | 16 | 7.3 |
| 2+ | 12 | 5.5 |
| 3+ | 6 | 2.8 |
| Nil | 184 | 84.4 |
| Fundus | | |
| DR | 36 | 16.5 |
| Normal | 182 | 83.5 |
| Diabetes duration | | |
| Newly diagnosed | 23 | 10.6 |
| <5 | 59 | 27.1 |
| 6–10 | 113 | 51.8 |
| >11 | 23 | 10.6 |
| Treatment | | |
| Lifestyle modifications | 8 | 3.7 |
| Lifestyle modifications+Monotherapy | 42 | 19.3 |
| Lifestyle modifications+Dual therapy | 101 | 46.3 |
| Lifestyle modifications+Triple therapy | 61 | 28.0 |
| Lifestyle modifications+Insulin therapy+OHA | 6 | 2.8 |
| Urine albumin | | |
| Nil | 184 | 84.4 |
| 1+ | 16 | 7.3 |
| 2+ | 12 | 5.5 |
| 3+ | 6 | 2.8 |
| CKD stages | | |
| Stage 1 | 108 | 49.5 |
| Stage 2 | 67 | 30.7 |
| Stage 3a | 15 | 6.9 |
| Stage 3b | 18 | 8.3 |
| Stage 4 | 10 | 4.6 |

CKD: Chronic kidney disease, LVDD: Left ventricular diastolic dysfunction

**Table 2: Distribution of abnormal variable frequency by group GFR**

| Patients characteristics | GFR |
|---|---|
| Fasting blood sugar mg/dL | |
| Pearson correlation | −0.182** |
| Sig. (2-tailed) | 0.007 |
| Post-prandial blood sugar mg/dL | |
| Pearson correlation | −0.196** |
| Sig. (2-tailed) | 0.004 |
| Random blood sugar mg/dL | |
| Pearson correlation | −0.153* |
| Sig. (2-tailed) | 0.023 |
| Glycated hemoglobin % | |
| Pearson Correlation | −0.198** |
| Sig. (2-tailed) | 0.003 |

GFR: Glomerular filtration rate, *p<0.05, p<0.01

The frequency of elderly adults with CKD is anticipated to increase as the populace ages.[13] In the current study, the CKD prevalence was seen as major in males and the gar group 41–51. 81.6% of those with T2DM had CKD, according to one research. Few patients in the study were in stages 1 and 2, whereas most were in Stages 3, 4, and 5.[9] Research of a similar kind undertaken in Tanzania found that almost 66% of patients were grouped in Stages 1 and 2, whereas far smaller percentage (less than one-third) went into stages 3 and beyond.[14] However, in the current study, most patients were in stages 1 and 2. While T2DM problems take a few years to manifest, they are sometimes only discovered at diagnosis. As a result, the increased frequency of CKD in DM is explained by delayed hospital presentation. Hence, after receiving a T2DM diagnosis, the current guidelines advise at least yearly monitoring for potential nephropathy.[15] According to a recent study of the urban Chinese population, women over 40 had a substantially greater frequency of lowered eGFR than males of the same age, and both genders' total prevalence increased with age.[16]

A study showed females had greater levels of all metabolic markers than males, including BMI, FBS, PPBS, HBA1c, blood pressure, LDL, and TG levels. However, FBS, HBA1c, and systolic blood pressure showed significant differences.[2] Contrarily, vascular problems tended to be more common in males than women, with notable differences in cases of CAD, neuropathy in diabetic feet, and lower limb amputation. According to data from the World Health Organization, males are twice as likely as women to have CAD.[17] Males can more likely have independent risk factors such as amputation-causing peripheral neuropathy, diabetic foot, PVD, and cigarette usage.[18] Men are twice as likely as women to develop sensory neuropathy, the most prevalent neuropathy linked to amputation. In a research

**Table 3: Distribution of CKD stages**

| Patients characteristics | CKD stages | | | | | | | | | | P-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage 1 | | Stage 2 | | Stage 3a | | Stage 3b | | Stage 4 | | |
| | Count | Row n% | Count | Row n% | Count | Row n% | Count | Row n% | Count | Row n% | |
| Age group | | | | | | | | | | | |
| <30 | 3 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | <0.0001 |
| 31–40 | 36 | 78.3 | 8 | 17.4 | 2 | 4.3 | 0 | 0.0 | 0 | 0.0 | |
| 41–50 | 35 | 58.3 | 15 | 25.0 | 2 | 3.3 | 6 | 10.0 | 2 | 3.3 | |
| 51–60 | 29 | 36.7 | 32 | 40.5 | 4 | 5.1 | 9 | 11.4 | 5 | 6.3 | |
| 61–70 | 5 | 27.8 | 8 | 44.4 | 2 | 11.1 | 2 | 11.1 | 1 | 5.6 | |
| >71 | 0 | 0.0 | 4 | 33.3 | 5 | 41.7 | 1 | 8.3 | 2 | 16.7 | |
| Gender | | | | | | | | | | | |
| Female | 47 | 51.6 | 28 | 30.8 | 7 | 7.7 | 8 | 8.8 | 1 | 1.1 | 0.344 |
| Male | 61 | 48.0 | 39 | 30.7 | 8 | 6.3 | 10 | 7.9 | 9 | 7.1 | |
| Smoking | | | | | | | | | | | |
| No | 57 | 47.1 | 39 | 32.2 | 11 | 9.1 | 12 | 9.9 | 2 | 1.7 | 0.076 |
| Yes | 51 | 52.6 | 28 | 28.9 | 4 | 4.1 | 6 | 6.2 | 8 | 8.2 | |
| Alcoholism | | | | | | | | | | | |
| No | 67 | 46.9 | 49 | 34.3 | 12 | 8.4 | 11 | 7.7 | 4 | 2.8 | 0.151 |
| Yes | 41 | 54.7 | 18 | 24.0 | 3 | 4.0 | 7 | 9.3 | 6 | 8.0 | |
| Body mass index kg/m$^2$ | | | | | | | | | | | |
| Normal weight | 96 | 50.3 | 56 | 29.3 | 14 | 7.3 | 16 | 8.4 | 9 | 4.7 | 0.836 |
| Obese | 3 | 37.5 | 3 | 37.5 | 1 | 12.5 | 1 | 12.5 | 0 | 0.0 | |
| Overweight | 6 | 42.9 | 7 | 50.0 | 0 | 0.0 | 0 | 0.0 | 1 | 7.1 | |
| Underweight | 3 | 60.0 | 1 | 20.0 | 0 | 0.0 | 1 | 20.0 | 0 | 0.0 | |
| Fasting lipid profile mg/dL | | | | | | | | | | | |
| Dyslipidemia | 10 | 41.7 | 8 | 33.3 | 2 | 8.3 | 2 | 8.3 | 2 | 8.3 | 0.861 |
| Normal | 98 | 50.5 | 59 | 30.4 | 13 | 6.7 | 16 | 8.2 | 8 | 4.1 | |
| LVDD | | | | | | | | | | | |
| | 84 | 47.7 | 55 | 31.3 | 10 | 5.7 | 18 | 10.2 | 9 | 5.1 | 0.002 |
| Grade 1 | 14 | 48.3 | 10 | 34.5 | 5 | 17.2 | 0 | 0.0 | 0 | 0.0 | |
| Grade 2 | 9 | 81.8 | 2 | 18.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | |
| Grade 1 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | |
| Grade 2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 100.0 | |
| Fundus | | | | | | | | | | | |
| DR | 14 | 38.9 | 11 | 30.6 | 2 | 5.6 | 6 | 16.7 | 3 | 8.3 | 0.191 |
| Normal | 94 | 51.6 | 56 | 30.8 | 13 | 7.1 | 12 | 6.6 | 7 | 3.8 | |
| Diabetes duration | | | | | | | | | | | |
| Newly diagnosed | 16 | 69.6 | 6 | 26.1 | 1 | 4.3 | 0 | 0.0 | 0 | 0.0 | 0.042 |
| <5 | 34 | 57.6 | 19 | 32.2 | 2 | 3.4 | 2 | 3.4 | 2 | 3.4 | |
| 6–10 | 49 | 43.4 | 38 | 33.6 | 10 | 8.8 | 11 | 9.7 | 5 | 4.4 | |
| >11 | 9 | 39.1 | 4 | 17.4 | 2 | 8.7 | 5 | 21.7 | 3 | 13.0 | |
| Treatment | | | | | | | | | | | |
| Lifestyle modifications | 5 | 62.5 | 2 | 25.0 | 1 | 12.5 | 0 | 0.0 | 0 | 0.0 | 0.156 |
| Lifestyle modifications+Monotherapy | 26 | 61.9 | 14 | 33.3 | 1 | 2.4 | 1 | 2.4 | 0 | 0.0 | |
| Lifestyle modifications+Dual therapy | 54 | 53.5 | 29 | 28.7 | 6 | 5.9 | 6 | 5.9 | 6 | 5.9 | |
| Lifestyle modifications+Triple therapy | 20 | 32.8 | 21 | 34.4 | 6 | 9.8 | 10 | 16.4 | 4 | 6.6 | |
| Lifestyle modifications+Insulin therapy+OHA | 3 | 50.0 | 1 | 16.7 | 1 | 16.7 | 1 | 16.7 | 0 | 0.0 | |

CKD: Chronic kidney disease, LVDD: Left ventricular diastolic dysfunction

population, this gender-based propensity was also seen.[2] In a study, a lower hemoglobin level was discovered to be related to CKD. Paleness is pervasive in CKD and can both reason and result from CKD.[19] Recent research demonstrates a linear association between CKD eGFR and hemoglobin decrease. This emphasizes the need to check hemoglobin levels during follow-up visits for diabetes patients so that the condition can be detected early and treated effectively.[9]

Identifying the risk factors related to the improvement of miniature and macrovascular angiopathy is fundamental for decreasing the effect of unexpected problems. Past examinations have shown that the risk of developing angiopathy depends on a number of factors, including age, diabetes duration, and the age at which diabetes is first diagnosed. In individuals recently diagnosed with diabetes, findings from the UK prospective diabetes study indicate that the prevalence of myocardial infarction rises

with age, whereas neither retinopathy nor nephropathy exhibit a similar trend.[2] Furthermore, although HbA1c measures short-term blood glucose management, the correlation between the two variables was negative but not statistically significant. According to a recent study, higher HbA1c was not linked to an increased risk of death or ESRD in a population with established CKD. Instead, intensive blood glucose control was likely caused by impaired drug clearance, an impaired counter-regulatory response, and an increased co-morbidity burden.[20]

### Limitations of the study

The study explored risk factors for chronic kidney disease (CKD) in type 2 diabetes (T2D) patients. While it identified links between factors like age, diabetes duration, and kidney function, the design limitations are important. Relying on a single point in time (cross-sectional) and potentially a limited sample from one center can restrict generalizability. Additionally, factors like ethnicity and socioeconomic status, which can influence CKD, might not have been considered.

## CONCLUSION

The current study presents reliable and contemporary epidemiological data demonstrating an inverse relationship between GFR and age and duration of diabetes while demonstrating a correlation between GFR and BMI among T2D patients. This study shows that age and the length of diabetes are important factors that are linked to deteriorating renal function in T2D patients in India. It is important to highlight the proper steps to strengthen medical therapy, lifestyle changes to manage modifiable risk factors, and frequent screening to identify new problems to reduce morbidity and mortality.

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**Authors Contribution:**
**NMRB-** Manuscript preparation and performed the procedure; **SSST-** Editing manuscript; **VMS-** Protocol review and review manuscript; **VC-** Literature review, data collection, and data analysis.

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