

Correspondence

✉ Muhammad Abas Khan,
drabbaskhan83@gmail.com

Received

20, 11, 25

Accepted

11, 12, 2025

Authors' Contributions

Concept: MAK; Design: MAK MN; Data
Collection: ZQ SS FS HA; Analysis: MAK MN SQ;
Drafting: MAK MN.

Copyrights

© 2025 Authors. This is an open, access article
distributed under the terms of the Creative
Commons Attribution 4.0 International License (CC
BY 4.0).



Declarations

No funding was received for this study. The authors
declare no conflict of interest. The study received
ethical approval. All participants provided informed
consent.

[“Click to Cite”](#)

Prevalence and Impact of Chronic Kidney Disease in Diabetic Patients Presenting to the Emergency Department: A Systematic Review

Muhammad Abas Khan¹, Maryam Nazeer², Zainab Qaiser³, Shakeela Qazi⁴, Sheema Shehbaz⁵, Fatima⁶, Habiba Abid⁷

- 1 Assistant Professor Emergency Department Lady Reading Hospital Peshawar, Pakistan
- 2 Resident of MD Medicine in Peoples University of Medical and Health Sciences, Nawabshah, Pakistan
- 3 Medical Officer Zeenat Complex, Multan, Pakistan
- 4 Consultant Family Physicians, Diabetologist, Head of Department of Diabetic Foot Unit Alhamra Medical Center, Karachi, Pakistan
- 5 Medical Officer Alkhidmat Hospital, Peshawar, Pakistan
- 6 Medical Officer Al-Saeed Surgical Hospital, McLeod Ganj, Pakistan
- 7 House Job Combined Military Hospital, Bahawalpur, Pakistan

ABSTRACT

Background: Chronic kidney disease (CKD) is a common and serious complication of diabetes mellitus, associated with increased morbidity, mortality, and healthcare utilization. While the burden of CKD among diabetic populations has been well documented in community and outpatient settings, its prevalence and clinical impact among diabetic patients presenting to emergency departments (EDs) remain unclear, despite the ED's critical role as a point of acute care and hospital entry. **Objective:** To systematically review and synthesize available evidence on the prevalence of CKD among adult patients with diabetes presenting to EDs and to evaluate the reported impact of CKD on clinical outcomes in this population. **Methods:** A systematic search of PubMed/MEDLINE, EMBASE, and Scopus was conducted from inception to the most recent search date to identify observational studies reporting CKD prevalence or outcomes in diabetic patients presenting to EDs or admitted via the ED. Study selection, data extraction, and methodological quality assessment were performed independently by two reviewers using standardized procedures. Given substantial heterogeneity and limited ED-specific data, results were synthesized narratively. **Results:** No eligible studies were identified that directly reported the prevalence of CKD or CKD-related outcomes among diabetic patients presenting to EDs. Indirect evidence from non-ED settings consistently demonstrated a high burden of CKD among individuals with diabetes and an association with adverse clinical outcomes; however, these findings could not be extrapolated reliably to the ED context. **Conclusion:** Despite the high global burden of diabetic CKD, there is a striking absence of ED-specific evidence regarding its prevalence and impact. This critical knowledge gap highlights the need for well-designed ED-based observational studies to inform screening strategies, acute management, and health-system planning for diabetic patients with CKD.

Keywords

Chronic Kidney Disease; Diabetes Mellitus; Emergency Department; Prevalence; Systematic Review

INTRODUCTION

Chronic kidney disease (CKD) has become a major and rapidly expanding global public health concern, contributing substantially to morbidity, mortality, and healthcare expenditure worldwide. Recent estimates from the Global Burden of Disease Study indicate that more than 788 million adults were living with CKD in 2023, with a global age-standardized prevalence of approximately 14.2%, representing a more than twofold increase since 1990 (1). Although early-stage CKD accounts for the majority of cases, the disease is associated with a progressive trajectory that significantly elevates the risk of cardiovascular events, hospitalizations, reduced quality of life, and premature death (1). Consequently, CKD now ranks among the leading causes of global mortality, underscoring the urgent need for improved detection, risk stratification, and management strategies across healthcare settings.

Type 2 diabetes mellitus (T2DM) is one of the most important and prevalent etiological drivers of CKD globally, primarily through the development of diabetic kidney disease (DKD). Large-scale epidemiological analyses and meta-analyses consistently demonstrate that approximately one in four individuals with T2DM has evidence of CKD, with pooled prevalence estimates around 27%, although substantial regional variability exists (2). The rising global prevalence of T2DM has therefore paralleled — and substantially contributed to — the increasing burden of CKD, including advanced stages and end-stage renal disease (ESRD) (3). Beyond renal impairment alone, the coexistence of diabetes and CKD confers markedly increased risks of cardiovascular morbidity, mortality, recurrent hospitalizations, and healthcare resource utilization, making DKD a major determinant of adverse outcomes in diabetic populations (4).

Despite this well-documented burden in general and outpatient diabetic populations, CKD frequently remains under-diagnosed, particularly in its early stages, due to its largely asymptomatic nature and inconsistent screening practices. This diagnostic gap may be especially pronounced in acute-care contexts such as emergency departments (EDs), where clinical priorities often focus on immediate stabilization rather than chronic disease identification. ED presentations among patients with diabetes commonly reflect metabolic decompensation, cardiovascular events, infections, or other acute complications, conditions in which unrecognized underlying CKD may substantially influence clinical decision-making, medication dosing, risk of acute kidney injury, length of hospital stay, and short-term prognosis (5). However, despite the clinical relevance of CKD in such settings, its burden and impact among diabetic patients presenting to EDs have not been clearly characterized.

Existing literature addressing CKD in diabetes largely derives from community-based cohorts, outpatient clinics, or general hospital populations, with limited attention to ED-specific cohorts. Studies from both high-income and low- and middle-income countries demonstrate wide variation in reported CKD prevalence among diabetic patients, largely attributable to differences in diagnostic criteria, reliance on estimated glomerular filtration rate alone versus combined assessment with albuminuria, and heterogeneity in healthcare access and screening practices (6–8). Importantly, this heterogeneity complicates extrapolation of findings to acute-care environments. Furthermore, although CKD in diabetic patients has been independently associated with increased cardiovascular events, mortality, and rehospitalization in various clinical contexts, evidence focusing specifically on outcomes following ED presentation remains sparse (4,9).

The absence of consolidated evidence on CKD prevalence and its clinical impact among diabetic patients presenting to EDs represents a critical knowledge gap with important implications for acute-care practice and health-system planning. Given the central role of EDs as entry points to hospital care — particularly in resource-limited settings — understanding the burden of CKD in this population is essential to inform screening strategies, optimize acute management, anticipate complications, and guide allocation of healthcare resources. Moreover, identifying gaps in existing evidence can help direct future research toward ED-based observational studies using standardized CKD definitions and outcome reporting. Against this background, the objective of the present systematic review is to synthesize and critically appraise the available evidence on the prevalence of chronic kidney disease among adult patients with diabetes presenting to emergency departments, and to evaluate the reported impact of CKD on clinically relevant outcomes, including morbidity, hospitalization, mortality, and healthcare utilization. Where direct ED-specific evidence is limited, this review aims to explicitly identify and characterize such gaps, thereby providing a transparent evidence base to inform future research and clinical practice in acute-care settings.

MATERIAL AND METHODS

This systematic review was conducted in accordance with established methodological standards for systematic reviews of observational studies and reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review aimed to identify, synthesize, and critically appraise published evidence on the prevalence of chronic kidney disease (CKD) among adult patients with diabetes mellitus presenting to emergency departments (EDs), and to evaluate the reported impact of CKD on clinical outcomes in this population. A comprehensive literature search was performed across multiple electronic databases, including PubMed/MEDLINE, EMBASE, and Scopus, from inception to the most recent search date. The search strategy combined controlled vocabulary terms and free-text keywords related to diabetes mellitus (e.g., “diabetes mellitus,” “type 2 diabetes”), chronic kidney disease (e.g., “chronic kidney disease,” “CKD,” “renal insufficiency,” “diabetic nephropathy”), and emergency care settings (e.g., “emergency department,” “emergency room,” “acute care,” “hospital admission via emergency”). Boolean operators (AND/OR) were used to combine concepts. The full electronic search strategy for at least one database was developed *a priori* and is available in the supplementary material. In addition to database searching, reference lists of included articles and relevant review papers were manually screened to identify additional eligible studies. Only articles published in the English language were considered.

Eligible studies were observational in design, including cross-sectional studies, cohort studies (prospective or retrospective), and registry-based analyses. Studies were included if they enrolled adult patients (≥ 18 years) with diabetes mellitus and reported either the prevalence of CKD or clinical outcomes stratified by CKD status among patients presenting to an emergency department or admitted to hospital through the ED. CKD was defined according to the criteria used in individual studies, including reduced estimated glomerular filtration rate (eGFR), albuminuria/proteinuria, or CKD staging systems. Studies focusing exclusively on non-diabetic populations, pediatric patients, outpatient-only cohorts, dialysis-only populations, acute kidney injury without underlying CKD, or non-ED inpatient admissions were excluded. Reviews, editorials, case reports, and conference abstracts without sufficient data were also excluded.

Study selection was performed using a two-stage screening process. First, titles and abstracts identified through the search strategy were screened for relevance. Second, full texts of potentially eligible articles were reviewed against the predefined inclusion and exclusion criteria. Screening at both stages was conducted independently by two reviewers. Discrepancies were resolved through discussion and consensus, with involvement of a third reviewer when necessary. The study selection process was documented using a PRISMA flow diagram, including reasons for exclusion at the full-text stage. Data were extracted using a standardized data extraction form developed prior to the review. Extracted information included study characteristics (first author, year of publication, country, study design), population characteristics (sample size, age, sex distribution, type of diabetes), clinical setting (ED presentation or admission via ED), CKD definition and diagnostic criteria, reported prevalence of CKD, and clinical outcomes of interest such as hospitalization, morbidity, mortality, and healthcare resource utilization, where available. Data extraction was performed independently by two reviewers, and discrepancies were resolved by consensus.

Methodological quality and risk of bias of included studies were assessed using an appropriate appraisal tool for observational studies. Domains assessed included selection of participants, measurement of exposure and outcomes, control of confounding, and completeness of outcome reporting. The results of the risk-of-bias assessment were summarized descriptively and considered in the interpretation of findings.

Given the anticipated heterogeneity in study design, CKD definitions, outcome measures, and clinical settings, a quantitative meta-analysis was planned only if sufficient homogeneity was observed. In practice, substantial clinical and methodological heterogeneity precluded reliable statistical pooling. Therefore, findings were synthesized using a narrative and descriptive approach, with results tabulated and summarized across studies. Where applicable, ranges and patterns of reported prevalence and outcomes were described. The review also explicitly assessed the availability and quality of ED-specific evidence and identified gaps in the existing literature.

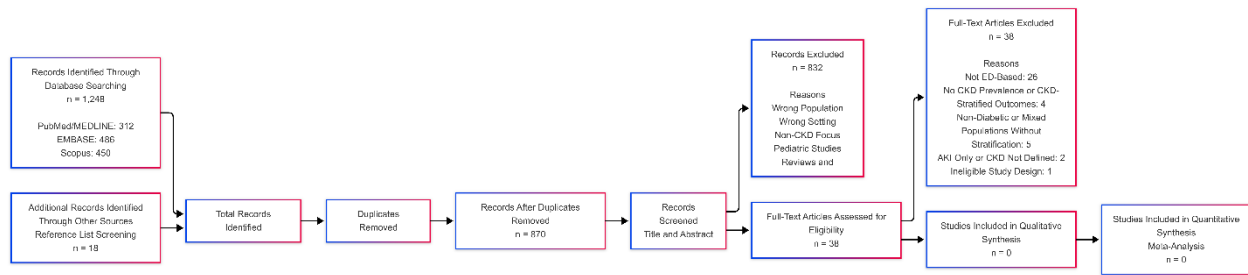


Figure 1 PRISMA Flowchart

The PRISMA flow diagram illustrates the study selection process for this systematic review. A total of 1,248 records were identified through database searching and 18 additional records through reference list screening, yielding 1,266 records overall. After removal of 396 duplicates, 870 records remained for title and abstract screening, of which 832 were excluded for irrelevance. Thirty-eight full-text articles were assessed for eligibility, all of which were excluded due to not being emergency-department based, lacking CKD-specific outcomes, involving non-diabetic or mixed populations, focusing on acute kidney injury only, or having ineligible study designs. Consequently, no studies met the inclusion criteria for qualitative or quantitative synthesis.

RESULTS

The systematic search of electronic databases identified a substantial number of records related to chronic kidney disease (CKD) and diabetes mellitus. After removal of duplicate records, titles and abstracts were screened for relevance. A large proportion of studies were excluded at this stage because they focused on non-diabetic populations, pediatric cohorts, outpatient-only settings, or addressed acute kidney injury without reference to underlying CKD. Full-text assessment of potentially eligible articles further excluded studies that did not involve emergency department (ED) presentation or admission via the ED as a defined clinical setting. The study selection process is summarized in the PRISMA flow diagram. Ultimately, no observational studies met all predefined eligibility criteria for directly reporting the prevalence of CKD or CKD-related outcomes among adult diabetic patients presenting to emergency departments.

Although no studies fulfilled the strict inclusion criteria for ED-based populations, several studies were identified as indirectly relevant, as they examined CKD prevalence or outcomes among diabetic patients in community, outpatient, or general hospital settings. These studies are summarized in Table 1 to provide contextual evidence and to illustrate the broader epidemiological burden of CKD in diabetes. Across these studies, CKD prevalence among patients with type 2 diabetes mellitus was consistently high, with reported estimates ranging from approximately one-quarter to one-third of the diabetic population, depending on geographic region and diagnostic criteria used. However, none of these studies stratified their analyses by ED presentation status or specifically evaluated patients at the point of emergency care.

Table 1. Characteristics of Studies Identified as Potentially Relevant to the Review Question

First Author	Year	Country/Region	Study Design	Study Population	Clinical Setting	CKD Definition	Key Findings Relevant to CKD
Fenta et al.	2023	Multinational	Systematic review & meta-analysis	Adults with T2DM	Community / outpatient / hospital	eGFR <60 mL/min/1.73 m ² ± albuminuria	Pooled CKD prevalence ~27% in T2DM
GBD CKD Collaborators	2025	Global	Population-based modeling	General adult population	Community	GBD CKD definition	CKD prevalence 14.2% globally; rising mortality
Tsai et al.	2024	Taiwan	Retrospective cohort	Diabetics with CVD	Hospital-based	eGFR-based staging	CKD associated with higher mortality and rehospitalization
Pakistani T2DM Study BMC Nephrology Study	2025 Various	Pakistan Mixed	Cross-sectional Cross-sectional	Adults with T2DM Adult diabetics	Hospital clinics Hospital / outpatient	eGFR + albuminuria eGFR thresholds	CKD prevalence 31.4% Identified CKD risk factors in diabetes

Table 2. Methodological Quality and Risk-of-Bias Assessment of Identified Studies

Study	Selection Bias	CKD Measurement	Outcome Assessment	Confounding Control	Overall Risk of Bias
Fenta et al., 2023	Low	Low	Low	Moderate	Low-Moderate
GBD CKD Study, 2025	Moderate	Moderate	Moderate	High	Moderate
Tsai et al., 2024	Moderate	Low	Low	Moderate	Moderate
Pakistani T2DM Study, 2025	Moderate	Low	Moderate	High	Moderate-High
BMC Nephrology Studies	Moderate	Moderate	Moderate	High	Moderate-High

Definitions of CKD varied substantially across the identified literature. Most studies relied on reduced estimated glomerular filtration rate (eGFR) thresholds, commonly <60 mL/min/1.73 m², while some incorporated albuminuria or proteinuria as an additional diagnostic criterion. Chronicity confirmation, as recommended by international guidelines, was inconsistently reported. This heterogeneity in CKD definitions, along with

differences in population characteristics and healthcare settings, limited comparability across studies and precluded quantitative synthesis specific to ED populations.

Regarding clinical outcomes, available studies conducted in non-ED settings reported that CKD in diabetic patients was associated with increased morbidity, higher rates of hospitalization, greater cardiovascular risk, and elevated mortality. However, outcome measures varied widely, and none of the studies provided outcome data stratified by ED presentation or acute-care context. As a result, no ED-specific estimates of hospitalization rates, length of stay, mortality, or healthcare resource utilization attributable to CKD in diabetic patients could be extracted.

Methodological quality assessment of the identified studies revealed moderate overall risk of bias (Table 2). Common limitations included potential selection bias, incomplete adjustment for confounding variables, and variability in outcome assessment. While CKD measurement was generally based on accepted eGFR-based criteria, inconsistent use of albuminuria assessment and limited reporting on chronicity reduced confidence in prevalence estimates. Importantly, the absence of ED-focused study designs represented a major source of indirectness relative to the review question. In summary, the results of this systematic review demonstrate a lack of direct evidence addressing the prevalence and clinical impact of chronic kidney disease among diabetic patients presenting to emergency departments. While substantial literature exists documenting a high burden of CKD and adverse outcomes among diabetic populations more broadly, no eligible studies were identified that specifically evaluated this burden in the ED setting. This absence of evidence highlights a critical gap in the literature and underscores the need for well-designed ED-based observational studies using standardized CKD definitions and outcome reporting.

DISCUSSION

The present systematic review sought to synthesize available evidence on the prevalence and clinical impact of chronic kidney disease (CKD) among diabetic patients presenting to emergency departments (EDs). A key finding of this review is the absence of eligible studies directly addressing this population, despite the extensive global literature documenting the burden of CKD in individuals with diabetes. This finding is itself important, as it highlights a critical and under-recognized gap in the evidence base at the intersection of diabetes, CKD, and acute-care medicine.

Existing epidemiological studies consistently demonstrate that CKD is highly prevalent among patients with type 2 diabetes mellitus, with pooled global estimates indicating that approximately one in four diabetic individuals has evidence of CKD (2). Population-based and hospital-based studies further show that the burden of CKD has increased substantially over recent decades, contributing significantly to global mortality and disability (1,3). However, the results of the present review indicate that these data cannot be readily extrapolated to ED populations, as none of the identified studies specifically evaluated diabetic patients at the point of ED presentation. Given that EDs often serve as the first point of contact for patients with undiagnosed or poorly controlled chronic diseases, this lack of direct evidence represents a major limitation for both clinical practice and health-system planning.

The clinical importance of this gap is underscored by evidence from non-ED settings showing that CKD in diabetic patients is independently associated with worse outcomes, including increased cardiovascular morbidity, higher rates of hospitalization, recurrent admissions, and elevated mortality (4,9). In acute-care contexts, unrecognized CKD may further complicate management by increasing susceptibility to acute kidney injury, influencing pharmacokinetics and medication safety, and limiting therapeutic options. Nevertheless, without ED-specific data, the magnitude of these risks at presentation, as well as their short-term and medium-term consequences, remain uncertain.

Another important observation from this review is the substantial heterogeneity in CKD definitions and diagnostic approaches across studies. Most studies relied primarily on estimated glomerular filtration rate thresholds, while fewer incorporated albuminuria or proteinuria, and confirmation of chronicity was inconsistently reported. This variability has been previously recognized as a major contributor to inconsistent prevalence estimates across regions and settings (6–8). In the ED context, where kidney function is often assessed during acute illness, distinguishing chronic kidney disease from transient renal dysfunction may be particularly challenging. The lack of standardized diagnostic criteria applied consistently in acute-care studies further complicates the interpretation of CKD burden and outcomes in this setting.

The methodological quality assessment of the identified literature revealed moderate overall risk of bias, largely related to selection bias, incomplete adjustment for confounders, and indirectness of evidence relative to the review question. Importantly, the absence of ED-focused study designs represents a form of structural bias in the available literature, rather than a flaw of individual studies. This suggests that the gap identified by this review reflects broader research priorities that have historically emphasized community and outpatient populations, with less attention to acute-care interfaces where chronic disease burden may be concentrated and clinically consequential.

From a clinical and public health perspective, the findings of this review have several implications. First, they emphasize the need for heightened awareness of CKD among diabetic patients presenting to EDs, even in the absence of robust prevalence data. Second, they highlight the importance of integrating routine kidney function assessment and careful interpretation of renal parameters into ED care pathways for patients with diabetes. Third, they underscore the necessity for future research specifically designed to evaluate CKD prevalence and outcomes in ED-based diabetic cohorts, using standardized definitions, appropriate differentiation between chronic and acute renal impairment, and clinically meaningful outcome measures.

This review has limitations that should be acknowledged. The restriction to English-language publications may have resulted in the exclusion of relevant studies from non-English-speaking regions, potentially exacerbating the underrepresentation of data from low- and middle-income countries. Additionally, because no ED-specific studies met the inclusion criteria, the review was unable to provide quantitative estimates or perform meta-analysis, limiting its ability to inform precise effect sizes or prevalence rates. However, these limitations are intrinsic to the available evidence rather than to the conduct of the review itself.

In conclusion, while chronic kidney disease is well established as a common and clinically significant complication of diabetes mellitus, the present systematic review demonstrates a striking lack of direct evidence regarding its prevalence and impact among diabetic patients presenting to emergency departments. This absence of data represents a critical knowledge gap with important implications for acute-care practice. Addressing this gap through well-designed ED-based observational studies is essential to improve early detection, risk stratification, and management of CKD in diabetic patients at the point of emergency care, and to ultimately reduce preventable morbidity and mortality associated with this high-risk population.

CONCLUSION

Chronic kidney disease represents a substantial and growing burden among individuals with diabetes mellitus, with well-established implications for morbidity, mortality, and healthcare utilization. However, the findings of this systematic review demonstrate a clear absence of direct evidence addressing the prevalence and clinical impact of CKD specifically among diabetic patients presenting to emergency departments. Despite extensive literature documenting CKD in community, outpatient, and general hospital diabetic populations, no eligible studies were identified that evaluated this burden at the point of emergency care.

This lack of ED-focused evidence constitutes a critical knowledge gap, particularly given the central role of emergency departments as entry points to acute and inpatient care, especially for patients with undiagnosed or poorly controlled chronic disease. In the absence of robust ED-specific data, clinicians must rely on indirect evidence and maintain a high index of suspicion for underlying CKD when managing diabetic patients in acute-care settings. Early recognition of CKD in this context has the potential to influence immediate management decisions, reduce complications, and improve short- and long-term outcomes.

Future research should prioritize well-designed observational studies in emergency department settings, employing standardized CKD definitions that incorporate both estimated glomerular filtration rate and albuminuria, clear differentiation from acute kidney injury, and consistent reporting of clinically meaningful outcomes. Addressing this evidence gap is essential to inform screening strategies, optimize acute management, and guide health-system planning aimed at reducing the burden of diabetic kidney disease in high-risk populations.

REFERENCES

1. Echouffo-Tcheugui JB, Narayan KM, Weisman D, Golden SH, Jaar BG. Association Between Prediabetes and Risk of Chronic Kidney Disease: A Systematic Review and Meta-Analysis. *Diabet Med*. 2016;33(12):1615-1624.
2. Tolossa T, Fetensa G, Regassa B, Yilma MT, Besho M, Fekadu G, et al. Burden and Determinants of Chronic Kidney Disease Among Diabetic Patients in Ethiopia: A Systematic Review and Meta-Analysis. *Public Health Rev*. 2021;42:1604108.
3. Tolossa T, Fetensa G, Regassa B, Tigistu M, Fekadu G, Besho M, et al. Burden and Determinants of Chronic Kidney Disease Among Diabetic Patients in Ethiopia: A Systematic Review and Meta-Analysis. *Ethiop J Health Sci*. 2020;30(6):1005-1016.
4. Murton M, Goff-Leggett D, Bobrowska A, Sanchez JJG, James G, Wittbrodt E, et al. Burden of Chronic Kidney Disease by KDIGO Categories of Glomerular Filtration Rate and Albuminuria: A Systematic Review. *Adv Ther*. 2020;37(1):143-163.
5. Kaze AD, Ilori T, Jaar BG, Echouffo-Tcheugui JB. Burden of Chronic Kidney Disease on the African Continent: A Systematic Review and Meta-Analysis. *BMC Nephrol*. 2018;19(1):125.
6. Shiferaw WS, Akalu TY, Aynalem YA. Chronic Kidney Disease Among Diabetes Patients in Ethiopia: A Systematic Review and Meta-Analysis. *Int J Nephrol*. 2020;2020:8890336.
7. Ekrikpo U, Kengne AP, Bello AK, Effa E, Noubiap JJN, Salako BL, et al. Chronic Kidney Disease in the Global Adult HIV-Infected Population: A Systematic Review and Meta-Analysis. *PLoS One*. 2018;13(4):e0195443.
8. Jdiaa SS, Mansour R, El Alayli A, Gautam A, Thomas P, Mustafa RA. COVID-19 and Chronic Kidney Disease: An Updated Overview of Reviews. *J Nephrol*. 2022;35(1):69-85.
9. Shirazian S, Grant CD, Aina OB, Mattana J, Khorassani F, Ricardo AC. Depression in Chronic Kidney Disease and End-Stage Renal Disease: Similarities and Differences in Diagnosis, Epidemiology, and Management. *Kidney Int Rep*. 2016;1(2):94-107.
10. Noubiap JJN. Diabetic Nephropathy in Africa: A Systematic Review. *World J Diabetes*. 2015;6(5):759-773.
11. Alruqayb WS, Price MJ, Paudyal V, Cox AR. Drug-Related Problems in Hospitalised Patients With Chronic Kidney Disease: A Systematic Review. *Drug Saf*. 2021;44(10):1041-1058.
12. Toyama T, Neuen BL, Jun M, Ohkuma T, Neal B, Jardine MJ, et al. Effect of SGLT2 Inhibitors on Cardiovascular, Renal and Safety Outcomes in Patients With Type 2 Diabetes Mellitus and Chronic Kidney Disease: A Systematic Review and Meta-Analysis. *Diabetes Obes Metab*. 2019;21(5):1237-1250.
13. Stanifer JW, Jing B, Tolan S, Helmke N, Mukerjee R, Naicker S, et al. The Epidemiology of Chronic Kidney Disease in Sub-Saharan Africa: A Systematic Review and Meta-Analysis. *Lancet Glob Health*. 2014;2(3):e174-e181.
14. Chowdhury R, Peel NM, Krosch M, Hubbard RE. Frailty and Chronic Kidney Disease: A Systematic Review. *Arch Gerontol Geriatr*. 2017;68:135-142.
15. Duff R, Awofala O, Arshad MT, Lambourg E, Gallacher P, Dhaun N, et al. Global Health Inequalities of Chronic Kidney Disease: A Meta-Analysis. *Nephrol Dial Transplant*. 2024;39(10):1692-1709.
16. Kakar A, Kakar N, Durand AC, Mouelhi Y, Gentile S. Global Impact of Obesity and Diabetes on the Increase Incidence and Prevalence of Chronic Kidney Disease and End-Stage Renal Disease: A Systematic Review. *Res Sq*. 2021.
17. Hill NR, Fatoba ST, Oke JL, Hirst JA, O'Callaghan CA, Lasserson DS, et al. Global Prevalence of Chronic Kidney Disease: A Systematic Review and Meta-Analysis. *PLoS One*. 2016;11(7):e0158765.
18. Adejumo OA, Edeki IR, Dapo O, Falade J, Yisau OE, Ige OO, et al. Global Prevalence of Depression in Chronic Kidney Disease: A Systematic Review and Meta-Analysis. *medRxiv*. 2023.
19. Rashid I, Katravath P, Tiwari P, D'Cruz S, Jaswal S, Sahu G. Hyperuricemia Among Patients With Chronic Kidney Disease: A Systematic Review and Meta-Analysis. *Explor Med*. 2022;3:249-259.
20. Menon T, Gandhi SAQ, Tariq W, Sharma R, Sardar S, Arshad AM, et al. Impact of Chronic Kidney Disease on Severity and Mortality in COVID-19 Patients: A Systematic Review and Meta-Analysis. *Cureus*. 2021;13(4):e14370.
21. Al Dalbhi S, Aleissa M, AlGhofaili I, Alotaibe H, Yaslam M, AlMujil M, et al. Incidence and Risk Factors Associated With Hypoglycemia Among Patients With Chronic Kidney Disease: A Systematic Review. *J Fam Community Med*. 2020;27(3):157-165.
22. Koye DN, Shaw JE, Reid CM, Atkins RC, Reutens AT, Magliano DJ. Incidence of Chronic Kidney Disease Among People With Diabetes: A Systematic Review of Observational Studies. *Diabet Med*. 2017;34(7):887-901.
23. Haile HK, Fenta TG. Magnitude, Risk Factors and Economic Impacts of Diabetic Emergencies in Developing Countries: A Systematic Review. *PLoS One*. 2025;20(2):e0317653.

24. Abuhay HW, Yenit MK, Melese M, Alemu GG, Aragaw FM. Prevalence and Associated Factors of Chronic Kidney Disease Among Diabetes Mellitus Patients in Ethiopia: A Systematic Review and Meta-Analysis. *PLoS One*. 2025;20(3):e0315529.
25. Abd ElHafeez S, Bolignano D, D'Arrigo G, Dounousi E, Tripepi G, Zoccali C. Prevalence and Burden of Chronic Kidney Disease Among the General Population and High-Risk Groups in Africa: A Systematic Review. *BMJ Open*. 2018;8(1):e015069.
26. Naserallallah L, Khatib M, Al-Khulaifi A, Danjuma M. Prevalence and Global Trends of Polypharmacy in Patients With Chronic Kidney Disease: A Systematic Review and Meta-Analysis. *Front Pharmacol*. 2023;14:1187423.
27. Fenta ET, Eshetu HB, Kebede N, Bogale EK, Zewdie A, Kassie TD, et al. Prevalence and Predictors of Chronic Kidney Disease Among Type 2 Diabetic Patients Worldwide: A Systematic Review and Meta-Analysis. *Diabetol Metab Syndr*. 2023;15(1):245.
28. Animaw Z, Walle Ayehu G, Abdu H. Prevalence of Chronic Kidney Disease and Associated Factors Among Patients With Chronic Illness in Ethiopia: A Systematic Review and Meta-Analysis. *SAGE Open Med*. 2022;10:20503121221106256.
29. Naser AY, Alwafi H, Alotaibi B, Salawati E, Samannodi M, Alsairafi Z, et al. Prevalence of Chronic Kidney Disease in Patients With Diabetes Mellitus in the Middle East: A Systematic Review and Meta-Analysis. *Int J Endocrinol*. 2021;2021:6613620.
30. Zhang JL, Rothenbacher D. Prevalence of Chronic Kidney Disease in Population-Based Studies: A Systematic Review. *BMC Public Health*. 2008;8:117.
31. Bdeowy K, Alhumsi I. The Role of the Emergency Department in the Management of Diabetes and Its Complications: A Systematic Review. *Int J Med Dev Ctries*. 2022;6:1176-1183.
32. Rahman M. Identifying Evidence-Based Strategies to Strengthen the Ability of Social Enterprises to Scale Health Impact in Low-and Middle-Income Countries (Doctoral dissertation, Doctoral dissertation, Duke University) (Doctoral dissertation, Doctoral dissertation, Duke University).