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ORIGINAL ARTICLE

Analysis of demographic and clinical characteristics of patients with chronic renal failure in Mosul City, Iraq

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ABSTRACT

Aim To assess demographic and clinical determinants of CKD among patients undergoing haemodialysis in Mosul, Iraq.

Methods A descriptive cross-sectional study was conducted at a public dialysis centre in Mosul between January and April 2024. A total of 89 patients with confirmed CKD were recruited using purposive sampling. Data were obtained through structured interviews and medical records, including demographic characteristics, etiological factors, CKD stage based on KDIGO criteria, and biochemical indicators (serum creatinine and blood urea nitrogen). Associations between CKD stage and demographic or clinical variables were assessed using chi-square tests. Multivariate logistic regression was applied to identify independent predictors of advanced CKD (stages 4–5), with results expressed as odds ratios and 95% confidence intervals.

Results Diabetes mellitus (27 %) and hypertension (23.6 %) were the leading aetiologies. End-stage kidney disease (ESRD) represented 48.3 % of cases. Male prevalence increased across CKD stages, from 44.4% in mild to 67.4% in ESRD (p = 0.031). Mean creatinine rose from 1.6 ± 0.3 mg/dL in mild CKD to 8.5 ± 2.3 mg/dL in ESRD, with corresponding blood urea nitrogen (BUN) increases from 22.5 ± 5.2 to 89.6 ± 15.1 mg/dL. Overall, 71.9% presented in severe or ESRD stages, reflecting late diagnosis. Multivariate analysis confirmed male sex as an independent predictor of advanced CKD (OR = 2.14; 95% CI: 1.05–4.36; p = 0.031).

Conclusion CKD in Mosul is characterized by late-stage presentation and predominance of metabolic aetiologies. Male sex emerged as an independent predictor of advanced CKD. These findings highlight the need for targeted screening, earlier detection, and improved nephrology services in post-conflict communities.

Keywords: chronic kidney disease, haemodialysis, diabetes mellitus, hypertension, kidney function

INTRODUCTION

Data from the Global Burden of Disease initiative indicate that chronic kidney disease (CKD) is a major global health concern, affecting more than 850 million people worldwide (1,2). The gradual nature of CKD progression together with delayed detection of its advanced stages leads to increased morbidity and mortality rates and economic burden especially in low-resource areas and post-conflict regions such as Iraq. CKD exists as a multifaceted clinical condition which combines renal dysfunction with cardiovascular diseases and systemic inflammatory processes and metabolic disorders (3,4).

The prevalence of CKD keeps increasing because of longer life expectancy and urbanization alongside the growing epidemics of diabetes mellitus and hypertension (5,6). The two factors together produce more than half of worldwide CKD cases through glomerular hyperfiltration and endothelial dysfunction and chronic oxidative stress mechanisms (7,8).

In this study, the term "late onset presentation" refers specifically to the first clinical presentation at an advanced CKD stage, often at the point when dialysis was already required. It does not denote the biological onset of the disease but rather the delayed entry of patients into nephrology care, a common scenario in resource-limited and post-conflict settings.

The worldwide understanding of this disease exists but there is limited research on CKD epidemiology and clinical features in Northern Iraq. Mosul, having experienced significant infrastructural degradation and health system disruptions post-conflict, remains underrepresented in nephrological research. Given these circumstances, this study aims to delineate the demographic, clinical determinants of CKD in Mosul, with particular emphasis on gender distribution, age-related susceptibility, disease staging.

By adopting a structured cross-sectional design, this study not only contributes to the local evidence base but also informs

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targeted strategies for early detection and prevention of renal deterioration in high-risk populations.

PATIENTS AND METHODS

Patients and study design

The present study employed a descriptive cross-sectional design and was carried out between January and April 2024 at a public dialysis facility in Mosul, Iraq. The centre serves a dicerse population representing various socioeconomic strata of the Nineveh Governorate. A total of 89 patients with confirmed CKD diagnosis undergoing haemodialysis were recruited. Due to constraints in population size and access, a purposive (non-probability) sampling technique was employed. The sample size was deemed adequate for descriptive and $\chi 2$ inferential analysis, based on feasibility and previous studies with similar population sizes (9).

This study exclusively included chronic haemodialysis patients who had already progressed to end-stage kidney disease or were in advanced CKD stages requiring dialysis. Therefore, the findings should be interpreted within the context of a haemodialysis population rather than the general CKD spectrum. Patients with earlier stages of CKD who were not receiving dialysis were not part of the sampling frame, and the study does not attempt to generalize beyond the haemodialysis cohort.

When a patient were determined to have renal disease and more than one cause was documented in the medical records, the patient was classified based on the principal clinical diagnosis made by the patient's treating nephrologist. Thus, the categories of cause for renal disease presented in this article are the primary cause or predominant cause of renal disease in each patient, as documented in the medical records. These categories of cause do not include all of the potential risk factors that could have caused the development of renal disease in any given patient.

The study was granted approval by the College of Nursing at University of Mosul under the approval number REC-NU2024-CKD-017. All patients and their legal guardians provided written informed consent for involvement in the study.

Methods

Inclusion criteria were as follows: patients aged ≥ 10 years, clinically diagnosed with CKD (based on estimated glomerular filtration rate (eGFR) < 90 mL/min/L73 m² for ≥ 3 months), and currently undergoing haemodialysis. Exclusion criteria included patients with acute kidney injury (AKI), incomplete medical records, or refusal to participate. Demographic and clinical data were gathered using structured interviews and patient records. Variables included: age, gender, disease aetiology, CKD stage based on GFR. The staging of CKD followed the Kidney Disease: Improving Global Outcomes (KDIGO) classification: stages 1–5, with end-stage renal disease (ESRD) as stage 5 (10).

In addition to demographic and etiological data, serum creatinine, blood urea nitrogen (BUN), and systolic/diastolic blood pressure were obtained from medical records for all participants. These biochemical parameters provided further insight into kidney function and cardiovascular risk.

Statistical analysis

Table distributions were provided for the categorical variables as frequency/percent and for the continuous variables as mean/SD. However, due to the de-identified nature of the dataset and the fact that no patient-level biochemical data were available for individual patients, the serum creatinine and blood urea nitrogen levels for the different CKD stages could not be compared using an inferential statistical test. Statistical analyses were interpreted using a significance threshold of $p < 0.05$. Alongside χ^2 tests, a multivariate logistic regression model was constructed to assess the independent association between demographic and clinical factors and advanced CKD stages (stages 4–5 vs. stages 1–3). Variables listed in the model were age, gender, diabetes, and hypertension. The results were expressed as odds ratios (OR) with corresponding 95% confidence intervals (CI), and a $p < 0.05$ was regarded as statistically significant.

Given the cross-sectional design, the logistic regression model does not infer temporal or causal dynamics. Instead, it identifies independent associations between patient characteristics and the likelihood of being in an advanced CKD category at the time of assessment. The model was therefore used for risk association, not prediction of the disease progression. In the assessment of the data, also the correlation of age with some characteristics of diseases has been examined. However, because the data provided are summed up by age groups and therefore were not single patient data, corresponding analyses which require single data, such as the Spearman rank correlation test, cannot be performed for statistical reasons.

RESULTS

A total of 89 patients were enrolled, with a clear male predominance representing 54 (60.7%) patients, whereas females accounted for 35 (39.3%) patients thus confirming the gender disparity noted in CKD prevalence within this cohort.

Prevalence of CKD is increasing with increasing age from early to late adulthood: the highest frequency was found in the 61–70-year age group, 25 (28.0 %), followed by the 41–50-year age group, 22 (24.7%) (Figure 1). Across all age groups studied, a significantly higher number of CKD cases was observed in males compared to females, particularly in the 41–70-year age group. The number of CKD cases in the 10–20-year and 71–80-year age groups was very small; therefore, most CKD cases occurred among middle-aged and older adults with late onset of the disease and slow progression, and possibly a delay in diagnosis of the disease in progress.

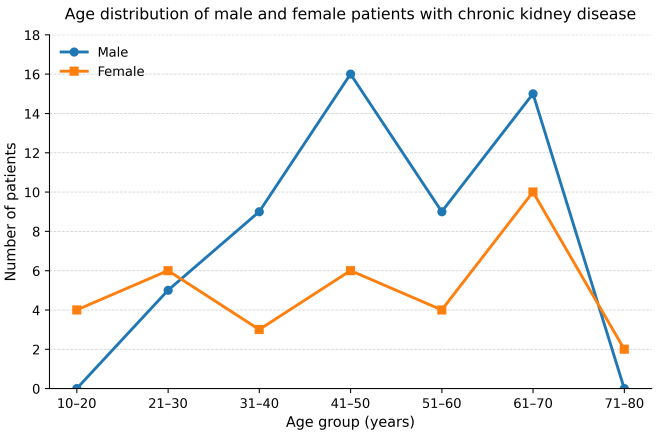

Figure 1. Chronic kidney disease by sex and age group
The numbers indicate individual patients within the respective age groups. No inferential statistical tests were performed because the data were already grouped by patient age categories and summarised as the number of male and female patients with CKD in each age group.

Table 1. Distribution of patients according to causes of the chronic kidney disease (CKD)

Causes of renal failure	No. (%) of patients
Diabetes	24 (27)
Hypertension	21 (23.6)
Urological cause	16 (18.0)
Glomerular disease	12 (13.5)
Inherited	9 (10.0)
Others*	7 (7.9)
Total	89

* Others: may include chronic infections, medication-induced kidney damage, or other rare conditions.

In terms of etiological distribution, diabetes mellitus emerged as the leading cause (27%), followed by hypertension (23.6%) and urological causes (18%). Less frequent aetiologies included glomerular diseases (13.5%), inherited conditions (10%), and other causes (7.9%) (Table 1). This etiological distribution highlights the predominance of metabolic disorders as the principal contributors to chronic kidney disease in the studied population.

Analysis of the severity of the disease among the patients with CKD showed that 43 (48.3%) had progressed to the end stage of kidney failure (ESRD), followed by 21 (23.6%), who were classified as severe cases. The patients with advanced stages of CKD were mostly males. Patients with diabetes and hypertension were found to be distributed unequally in the different stages of CKD. Patients with severe kidney failure showed increased levels of serum creatinine and blood urea (BUN) as the renal function continued to decline with the severity of the disease (Table 2).

Patients were categorized according to CKD stage as follows: mild (GFR 60–90 mL/min/1.73 m²), moderate (GFR 30–59 mL/min/1.73 m²), severe (GFR 15–29 mL/min/1.73 m²), and end-stage kidney disease (ESRD; GFR < 15 mL/min/1.73 m² or on dialysis). The majority of patients were in the ESRD stage, indicating late presentation to healthcare facilities (Figure 2).

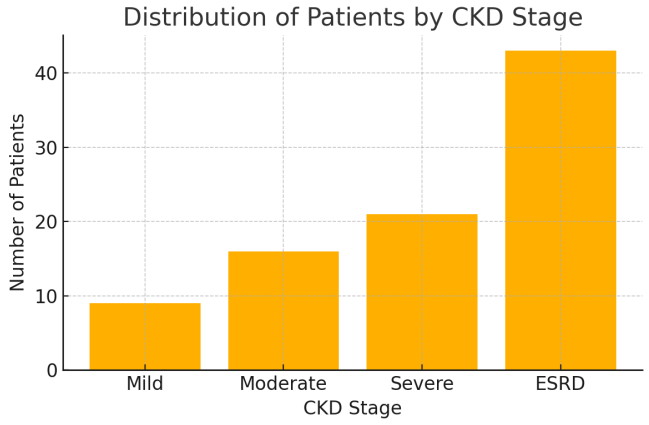

Figure 2. Distribution of patients according to chronic kidney disease (CKD) stages
ESRD, end-stage kidney disease

Mean serum creatinine and BUN levels increased progressively across stages, consistent with worsening renal function table (Table 3).

A χ^2 test performed to assess associations between CKD stages and demographic variables found a notable link between male sex and advanced CKD stages ($p = 0.031$).

DISCUSSION

The present study provides important insights into the demographic and clinical characteristics of CKD in Mosul, highlighting patterns that are consistent with global epidemiological trends while reflecting distinct local features. The predominance of male patients corroborates findings from (9,11), who attributed male susceptibility to hormonal influences—particularly the profibrotic effect of testosterone—and lifestyle behaviours such as higher rates of smoking and occupational exposures.

It is important to emphasize that the present sample represents a dialysis-dependent CKD population, in which metabolic aetiologies and late clinical presentation are expected to dominate. As such, the stage distribution reflects the characteristics of patients already receiving renal replacement therapy rather than the natural spectrum of CKD in the community.

Furthermore, the peak prevalence in the 61–70-year age group aligns with studies demonstrating age as an independence risk factor for CKD progression, likely due to cumulative vascular insults, chronic hyperglycaemia, and declining nephron reserve (12,13). Conversely, the markedly low prevalence among patients older than 70 might be attributed not merely to biological survival bias but also to underdiagnosis and limited access to healthcare among the elderly, particularly in conflict-affected areas.

Diabetes and hypertension, jointly accounting for over half of the CKD cases, reinforce the established paradigm of metabolic-driven nephropathy in developing regions. This finding echoes the observations of (14,15), who emphasized the interplay between persistent hyperglycaemia, glomerular hyperfiltration, and microvascular damage. Moreover, the presence of urological and inherited causes, though less frequent, underlines the heterogeneity of CKD aetiology in this population, necessitating a tailored diagnostic approach.

Chronic kidney disease is a multi-factorial disease with diabetes and hypertension being the most common causes. In this study it was not possible to separate the additional coexisting causes from the principal cause documented in the patients' medical records. The values for serum creatinine and blood urea nitrogen for the different CKD stages, however, continuously and steadily decline with increasing degrees of kidney damage, as would be expected. These values correlate with the clinical classification of kidney damage.

The alarmingly high proportion of ESRD cases (48.3%) suggests systemic inadequacies in early detection and primary care, compounded by socioeconomic barriers and health literacy deficits. Such late presentations underscore an urgent need for community-based screening programs and reinforced nephrology services, as advocated by the KDIGO conference consensus (16,17).

The proportion of ESRD cases in our cohort (48.3%) is notably higher than regional reports from Jordan (32.5%) and Turkey (28.9%) (18), suggesting a more severe late presentation trend in Mosul. This disparity may be attributed to post-conflict healthcare disruption and limited access to nephrology services. Our study identified male sex as an independent predictor of advanced CKD, which is consistent with the outcome of the Chronic Renal Insufficiency Cohort study (19) that reported a higher progression risk in men after adjustment for comorbidities.

Although male sex appeared statistically associated with advanced CKD stages in this cohort, this association should be

Table 2. Distribution of patients according to chronic kidney disease (CKD) stage and associated categorical variables

CKD Stage	No.(%) of patients	Male	Female	Diabetes	Hypertension
Mild (GFR 60–90)	9 (10.1)	4 (44.4)	5 (55.6)	2 (22.2)	3 (33.3)
Moderate (GFR 30–59)	16 (18.0)	8 (50.0)	8 (50.0)	4 (31.3)	4 (25.0)
Severe (GFR 15–29)	21 (23.6)	13 (61.9)	8 (38.1)	6 (28.6)	7 (33.3)
ESRD (<15 or dialysis)	43 (48.3)	29 (67.4)	14 (32.6)	11 (25.6)	12 (27.9)

ESRD, end-stage kidney disease.

Table 3. Renal biochemical parameters according to chronic kidney disease (CKD) stage

CKD stage	Mean ± SD	
	Creatinine (mg/dL)	BUN (mg/dL)
Mild	1.6 ± 0.3	22.5 ± 5.2
Moderate	2.5 ± 0.6	32.1 ± 6.8
Severe	4.1 ± 1.2	52.7 ± 10.4
ESRD	8.5 ± 2.3	89.6 ± 15.1

BUN, blood urea nitrogen; ESRD, end-stage kidney disease.
Inferential comparisons were not performed because individual patient-level biochemical measurements were unavailable for re-analysis.

interpreted cautiously. The finding likely reflects sample composition within a haemodialysis-dependent population rather than a true biological predisposition. The study does not evaluate hormonal, behavioural or environmental mediators directly; therefore, no causal inference regarding gender-related susceptibility can be made. Larger population-based studies are needed to determine whether this pattern persists beyond the haemodialysis setting.

Since the study design is observational and cross-sectional, the relationships identified represent associations rather than temporal or causal pathways. The study does not track disease progression over time nor does it evaluate longitudinal risk trajectories. Therefore, interpretations must remain descriptive, focusing on patterns present at the time of the data collection.

Finally, environmental and occupational exposures—though not directly assessed in this study—are hypothesized contributors, especially in Mosul, where post-conflict infrastructural degradation and heavy metal contamination may exacerbate renal vulnerability. Future studies integrating environmental biomarkers and broader socio and behavioural variables are warranted to elucidate these dimensions further.

Despite providing valuable insights into CKD epidemiology in Mosul, this analysis has numerous limitations. The comparatively small sample size and single-centre design limit the generalizability of the findings; however, the sample size reflects the actual patient population accessible during the study period in a post-conflict setting, where healthcare approach and patient registration are limited. The purposive sampling approach may have introduced choosing bias. The cross-sectional design precludes creating causal association among risk factors and disease progression. Additionally, although key biochemical parameters (creatinine, BUN, blood pressure) were included, other laboratory measures such as proteinuria, lipid profile, and inflammatory biomarkers were not assessed. Future multicentre, longitudinal studies incorporating environmental exposure assessment, larger cohorts, and broader biochemical profiling are recommended. Because individual patient ages at the time of data collection were unavailable, correlation analyses (Spearman's rank correlation) between age and the respective clinical variables could not be performed. Thus, any comments regarding age related issues would be purely descriptive and should not be taken as evidence for a statistical correlation. In the majority of cases the different causes of a patient's CKD had not been documented in the patients' medical records in a consistent manner. Patients were therefore classified on the basis of the main diagnosis for which they were being treated for their CKD, i.e., the main cause of the renal disease may have been underestimated.

This cross-sectional assessment of haemodialysis patients in Mosul reveals a predominance of metabolic aetiologies and a high rate of late-stage presentation, reflecting structural gaps in early detection and referral pathways. While male sex was statistically associated with advanced CKD stages, this relationship may be influenced by sampling characteristics and should not be interpreted as evidence of inherent biological risk. Strengthening community-level screening, improving health literacy, and expanding nephrology services are essential steps towards the reduction of late presentation in post-conflict regions.

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CONFLICTS OF INTEREST

None to declare.

ETHICS STATEMENT

The study protocol was reviewed and approved by the Collegiate Committee for Medical Research Etics of the Collage of Nursing, University of Mosul (approval number: 26/26).

DATA AVAILABILITY STATEMENT

Data is not publicly available but is available in the Dialysis Unit at Al-Salam Teaching Hospital in Mosul.

AUTHOR CONTRIBUTIONS (CRediT)

Conceptualization: F.M.G.; **Data curation:** F.M.G.; **Formal analysis:** D.A.-N.; **Investigation:** F.M.G.; **Methodology:** F.M.G.; **Validation:** F.M.G., D.A.-N.; **Visualization:** F.M.G., D.A.-N.; **Writing – original draft:** F.M.G.; **Writing – review & editing:** F.M.G., D.A.-N. All authors have read and agreed to the published version of the manuscript.

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