

Original Article

Determinants and Consequences of Delayed Nephrology Referral in CKD Patients in Pakistan

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Received: 02 September 2026

Revised: 13 September 2026

Accepted: 20 September 2026

Published: 30 September 2026

HOW TO CITE

Arbab Muhammad Ali et al. 2026. Determinants and Consequences of Delayed Nephrology Referral in CKD Patients in Pakistan. Journal of Health, Wellness and Community Research. 4, 18 (Sep. 2026), 1–9. DOI: <https://doi.org/10.61919/7052rg62>

ARTICLE INFORMATION

Author Contributions	Concept: AMA, MIA; Design: AMA, MIA; Data Collection: AMA; Analysis: MIA, SA; Drafting: AMA, MIA, SA.
Ethical Approval	The study was approved by research ethical board of Lady Reading Hospital, Peshawar, Pakistan
Informed Consent	Written informed consent was obtained from all participants
Conflict of Interest	The authors declare no conflict of interest.
Funding	No external funding.
Data Availability	Available from the corresponding author on reasonable request.
AI Declaration	No generative AI was used for conceptualization, analysis, or content generation. AI use was limited to language refinement, and the authors remain fully responsible for the accuracy, originality, validity, and integrity of the manuscript's content.

ABSTRACT

Background: Timely nephrology referral is important for the evaluation and management of chronic kidney disease (CKD), yet delayed referral remains common in resource-limited settings. **Objective:** To identify demographic and clinical factors associated with delayed nephrology referral and examine referral timing in relation to renal and biochemical characteristics and the interval to dialysis initiation. **Methods:** This cross-sectional study included 179 adults with CKD evaluated at a tertiary nephrology unit in Peshawar, Pakistan, between December 2023 and March 2024. Patients were categorized as early (>6 months before dialysis), late (3–6 months), or ultra-late (<3 months) referrals. Demographic, socioeconomic, clinical, laboratory, and referral data were analyzed using descriptive statistics, group comparisons, and univariate logistic regression. **Results:** Of 179 patients, 60 (33.5%) were referred to early, 16 (8.9%) late, and 103 (57.5%) ultra-late. Late/ultra-late referral was associated with older age, male sex, rural residence, and impaired ambulation. Compared with early referral, late/ultra-late referral was characterized by higher serum creatinine, blood urea nitrogen, potassium, HbA1c and lower eGFR and sodium (all $p < 0.001$). Male sex (OR 2.63, 95% CI 1.36–5.07) and rural residence (OR 5.54, 95% CI 2.71–11.33) were associated with greater odds of delayed referral. **Conclusion:** Delayed nephrology referral was common and was associated with demographic disparities, poorer kidney function, and an adverse biochemical profile at specialist assessment. **Keywords:** Chronic Kidney Disease; Delayed Referral; Dialysis; Nephrology; Early Referral.

INTRODUCTION

Chronic kidney disease (CKD) is a major global health burden associated with high morbidity, mortality, and health care costs. The prevalence of CKD is increasing, particularly in South Asia, with diabetes and hypertension being the leading causes (1, 2). Epidemiological studies have demonstrated that CKD is a substantial global issue affecting both developing and industrialized nations (3). According to the Global Burden of Disease (GBD) study in 2019, approximately 697 million CKD cases were reported (4). Despite advancements and better quality of healthcare facilities, developing countries still face higher incidence and mortality resulting from CKD, which are about four times higher than those in the developed world (5). CKD is more common in Asian countries than in the rest of the world, with 9.07% in Malaysia (6); 10–19% in China (7); 20% in Pakistan, Bangladesh, and India (8–10); and 10–20% in Nepal (11).

Early referral of patients to nephrologists improves survival and slows disease progression; however, many patients are referred late when renal function is severely compromised (12). Nephrologists play a key role in slowing disease progression and preparing for kidney replacement. However, this depends on timely referral by primary care providers. Early referral is associated with improved clinical outcomes (13, 14). Early specialist treatment improves dialysis preparation and reduces death rates (15). The early referral of patients to nephrologists is linked to improved survival and reduced mortality (12).

The widespread distribution of CKD and growing evidence supporting effective interventions to slow its progression highlights the need for greater attention to CKD. Developing and executing practical, results-oriented action plans for CKD prevention, detection, and management are essential to ensure timely referral to specialized care (16). Evidence shows that timely referral leads to better dialysis preparation, reduced hospitalization, and an improved quality of life. However, in resource-limited settings, such as Pakistan, referral practices are inconsistent, and patients often receive nephrology care at advanced disease stages. This study aimed to identify the factors associated with early versus late referrals in patients with CKD and assess the impact of referral timing on clinical outcomes, particularly the time to dialysis initiation.

MATERIALS AND METHODS

This cross-sectional study examined nephrology referral patterns and their associations with demographic, socioeconomic, and clinical characteristics among adults with chronic kidney disease (CKD) attending a tertiary nephrology unit in Peshawar, Pakistan, between December 2023 and March 2024. The study population comprised patients aged >18 years with stage 3–5 CKD who were referred to a nephrologist during the study period. Patients with acute kidney injury, reversible kidney disease, or unwillingness to participate were excluded. Participants were informed about the study's purpose, procedures, and confidentiality arrangements, and written informed consent was obtained before participation.

Referral timing was categorized according to the interval between nephrology referral and dialysis initiation. Early referral was defined as an interval exceeding six months, late referral as an interval of three to six months, and ultra-late referral as an interval of less than three months (17). The three categories were used to describe participant characteristics and referral patterns. For the two-group laboratory comparisons and logistic regression analyses, the late and ultra-late categories were combined and compared with the early-referral category. The principal analytical outcome was combined late or ultra-late referral. Additional assessments described eGFR at referral, laboratory characteristics, and the referral-to-dialysis interval. Because this interval also determined referral classification, its distribution across referral categories was interpreted descriptively.

Sample-size planning used the single-population-proportion approach described by Daniel, with a 95% confidence level and an absolute margin of error of 5% (18). The anticipated CKD prevalence was 12.5%, based on the previously cited community-based study from Karachi (9). The study included 179 participants.

Data were collected using a structured 25-item questionnaire (20), covering demographic, socioeconomic, clinical, and referral-related information, supplemented by review of patients' medical records. Recorded characteristics included age, sex, urban or rural residence, educational attainment, employment status, CKD stage, recorded cause of CKD, and ambulation status. Clinical information included hypertension and diabetes mellitus. Laboratory measurements comprised estimated glomerular filtration rate (eGFR), serum creatinine, blood urea nitrogen, hemoglobin, serum sodium, potassium, calcium, albumin, parathyroid hormone, and glycated hemoglobin. Referral information, the recorded interval between referral and dialysis initiation, and relevant laboratory values were obtained from the available clinical records.

Statistical analysis was performed using IBM SPSS Statistics version 22. Categorical variables were summarized as frequencies and percentages, and continuous variables were summarized using means and standard deviations. Group comparisons used chi-square tests for categorical variables and analysis of variance for continuous variables, as appropriate. Referral-to-dialysis intervals were examined across demographic and clinical categories, including age, residence, employment, education, CKD stage, recorded etiology, and ambulation status. Laboratory characteristics were compared between the early-referral and combined late/ultra-late-referral groups.

Univariate binary logistic regression was used to examine associations between individual demographic or clinical characteristics and late/ultra-late referral. Findings were expressed as crude odds ratios with 95% confidence intervals. In the reported demographic comparisons, patients aged <30 years, female participants, and urban residents served as the reference categories for age, sex, and residence, respectively. These analyses estimated unadjusted associations rather than effects independent of other participant characteristics. Statistical significance was defined as $p < 0.05$.

Ethical approval was obtained from MTI-Lady Reading Hospital, Peshawar, Pakistan. Participation was voluntary, and written informed consent was obtained from all participants. Collected data were anonymized and stored securely, with access restricted to the research team.

RESULTS

Among the 179 patients with CKD, 60 (33.5%) were referred early, 16 (8.9%) were referred late, and 103 (57.5%) were referred at an ultra-late stage. Referral category differed across age ($p = 0.006$), sex ($p = 0.013$), residence ($p < 0.001$), employment status ($p = 0.001$), educational status ($p < 0.001$), CKD stage ($p < 0.001$), underlying cause of CKD ($p < 0.001$), and ambulation status ($p < 0.001$), whereas smoking status did not differ across referral categories ($p = 0.886$). All patients in the ultra-late group had stage 5 CKD, compared with 16.7% of the early-referral group. Rural residence was also concentrated in the ultra-late group, accounting for 68.0% of these patients compared with 21.7% of those referred early.

The referral-to-dialysis interval varied significantly according to several demographic and clinical characteristics. The interval differed across age groups ($p = 0.032$), residence ($p < 0.001$), employment status ($p = 0.016$), educational status ($p < 0.001$), CKD stage ($p < 0.001$), underlying CKD cause ($p < 0.001$), and ambulation status ($p < 0.001$), but not by sex ($p = 0.652$). Rural patients had a longer mean referral-to-dialysis interval than urban patients (5.21 ± 1.86 vs 3.66 ± 0.78 months). The interval was longest among patients with stage 3 CKD (7.25 ± 0.71 months) and shortest among those with stage 5 disease (3.59 ± 0.64 months). As expected from the referral definitions, the interval declined across early, late, and ultra-late referral categories, from 7.41 ± 4.96 months to 4.55 ± 0.90 months and 2.94 ± 2.35 months, respectively ($p < 0.001$).

Table 1. Demographic and clinical characteristics according to nephrology referral category (N = 179)

Characteristic	Early referral (n = 60), n (%)	Late referral (n = 16), n (%)	Ultra-late referral (n = 103), n (%)	p-value
Age, years				0.006
<30	10 (16.7)	1 (6.3)	5 (4.9)	
31–40	11 (18.3)	1 (6.3)	7 (6.8)	
41–50	10 (16.7)	2 (12.5)	20 (19.4)	
51–60	9 (15.0)	1 (6.3)	32 (31.1)	
>60	20 (33.3)	11 (68.8)	39 (37.9)	
Sex				0.013
Female	42 (70.0)	8 (50.0)	48 (46.6)	
Male	18 (30.0)	8 (50.0)	55 (53.4)	
Residence				<0.001
Rural	13 (21.7)	2 (12.5)	70 (68.0)	
Urban	47 (78.3)	14 (87.5)	33 (32.0)	
Employment status				0.001
Businessman	5 (8.3)	0 (0.0)	21 (20.4)	
Government employee	2 (3.3)	2 (12.5)	5 (4.9)	
Housewife	29 (48.3)	4 (25.0)	43 (41.7)	
Private job	16 (26.7)	3 (18.8)	23 (22.3)	
Student	5 (8.3)	0 (0.0)	1 (1.0)	
Unemployed	3 (5.0)	7 (43.8)	10 (9.7)	
Education status				<0.001
Uneducated	7 (11.7)	1 (6.3)	95 (92.2)	
Primary	0 (0.0)	2 (12.5)	0 (0.0)	
Secondary	44 (73.3)	13 (81.3)	6 (5.8)	
Graduate	9 (15.0)	0 (0.0)	2 (1.9)	
CKD stage				<0.001
Stage 2	12 (20.0)	0 (0.0)	0 (0.0)	
Stage 3	19 (31.7)	0 (0.0)	0 (0.0)	

Stage 4	19 (31.7)	15 (93.8)	0 (0.0)	
Stage 5	10 (16.7)	1 (6.3)	103 (100.0)	
Cause of CKD				<0.001
Hypertension and diabetes mellitus	13 (21.7)	3 (18.8)	80 (77.7)	
Chronic glomerulonephritis	6 (10.0)	0 (0.0)	5 (4.9)	
Lupus nephritis	5 (8.3)	0 (0.0)	1 (1.0)	
Obstructive nephropathy	2 (3.3)	0 (0.0)	9 (8.7)	
Postnatal AKI progressed	7 (11.7)	2 (12.5)	2 (1.9)	
ADPKD	4 (6.7)	2 (12.5)	4 (3.9)	
NSAID abuse	6 (10.0)	6 (37.5)	2 (1.9)	
Unknown	17 (28.3)	3 (18.8)	9 (8.7)	
Ambulation status				<0.001
Normal	44 (73.3)	15 (93.8)	48 (46.6)	
Wheelchair user	12 (20.0)	1 (6.3)	50 (48.5)	
Bedridden	4 (6.7)	0 (0.0)	5 (4.9)	
Smoking status				0.886
Non-smoker	49 (81.7)	13 (81.3)	80 (77.7)	
Smoker	11 (18.3)	3 (18.8)	23 (22.3)	

CKD, chronic kidney disease; ADPKD, autosomal dominant polycystic kidney disease; AKI, acute kidney injury; NSAID, non-steroidal anti-inflammatory drug. Group percentages were recalculated from the reported counts. Group comparisons were assessed using the Fisher–Freeman–Halton exact test with Monte Carlo estimation because several contingency-table cells were sparse.

Table 2. Referral-to-dialysis interval according to demographic and clinical characteristics

Characteristic	Referral-to-dialysis interval, months, mean ± SD	p-value
Age, years		0.032
<30	5.00 ± 1.86	
31–40	4.92 ± 1.94	
41–50	4.04 ± 1.29	
51–60	3.82 ± 1.17	
>60	4.55 ± 1.66	
Sex		0.652
Female	4.28 ± 1.50	
Male	4.40 ± 1.20	
Residence		<0.001
Rural	5.21 ± 1.86	
Urban	3.66 ± 0.78	
Employment status		0.016
Businessman	3.96 ± 1.36	
Government employee	4.63 ± 1.85	
Housewife	4.02 ± 1.25	
Private job	4.48 ± 1.66	
Student	5.67 ± 2.31	
Unemployed	5.25 ± 1.20	
Education status		<0.001
Uneducated	3.59 ± 0.66	
Primary	7.50 ± 0.71	
Secondary	6.18 ± 1.52	
Graduate	4.38 ± 2.00	
CKD stage		<0.001
Stage 2	5.43 ± 1.81	
Stage 3	7.25 ± 0.71	
Stage 4	6.82 ± 1.01	
Stage 5	3.59 ± 0.64	
Cause of CKD		<0.001
Hypertension and diabetes mellitus	3.73 ± 0.87	
Chronic glomerulonephritis	4.88 ± 1.81	
Lupus nephritis	4.50 ± 1.73	
Obstructive nephropathy	4.18 ± 1.54	
Postnatal AKI progressed	4.75 ± 1.67	
ADPKD	5.63 ± 2.33	
NSAID abuse	5.67 ± 1.92	

Unknown	7.25 ± 0.71	
Ambulation status		<0.001
Normal	4.98 ± 1.79	
Wheelchair user	3.59 ± 0.75	
Bedridden	3.88 ± 0.99	
Referral category		<0.001
Early referral	7.41 ± 4.96	
Late referral	4.55 ± 0.90	
Ultra-late referral	2.94 ± 2.35	

SD, standard deviation; CKD, chronic kidney disease; ADPKD, autosomal dominant polycystic kidney disease; AKI, acute kidney injury; NSAID, non-steroidal anti-inflammatory drug. Reported *p*-values were obtained using independent-samples *t*-test for two-group comparisons and one-way analysis of variance for comparisons involving more than two groups, as specified in the source analysis.

Table 3. Laboratory and clinical parameters in early versus late/ultra-late nephrology referral

Parameter	Early referral (n = 60), mean ± SD	Late/ultra-late referral (n = 119), mean ± SD	Mann–Whitney U	Z	p-value	Effect size r
Hemoglobin	8.91 ± 0.54	9.30 ± 1.44	3394.50	−0.554	0.580	0.041
Albumin	3.68 ± 0.33	3.73 ± 0.47	2753.50	−2.600	0.009	0.194
Serum creatinine	6.21 ± 2.95	8.14 ± 3.16	1751.00	−5.764	<0.001	0.431
Blood urea nitrogen	164.25 ± 88.74	225.27 ± 81.56	1659.50	−6.054	<0.001	0.452
eGFR	17.37 ± 7.82	13.23 ± 3.14	1776.00	−5.791	<0.001	0.433
Serum sodium	138.00 ± 3.41	136.69 ± 3.73	1926.00	−5.307	<0.001	0.397
Potassium	5.01 ± 0.58	5.69 ± 0.60	1534.00	−6.441	<0.001	0.481
Calcium	7.67 ± 0.63	7.68 ± 0.72	3378.50	−0.598	0.550	0.045
Parathyroid hormone	310.65 ± 168.42	344.94 ± 169.13	3007.50	−1.764	0.078	0.132
HbA1c	6.20 ± 1.50	8.07 ± 1.12	1688.00	−6.075	<0.001	0.454

SD, standard deviation; eGFR, estimated glomerular filtration rate; HbA1c, glycated hemoglobin. Effect size was calculated as $|r| = |Z|/\sqrt{N}$, with $N = 179$.

Table 4. Factors associated with late/ultra-late nephrology referral

Predictor	Crude OR	95% CI	p-value
Age, years			
<30	1.00	Reference	
31–40	1.21	0.31–4.73	0.782
41–50	3.67	1.04–12.90	0.043
51–60	6.11	1.75–21.37	0.005
>60	4.17	1.34–12.99	0.014
Sex			
Female	1.00	Reference	
Male	2.63	1.36–5.07	0.004
Residence			
Urban	1.00	Reference	
Rural	5.54	2.71–11.33	<0.001
Employment status			
Businessman	1.00	Reference	
Government employee	0.83	0.13–5.30	0.847
Housewife	0.39	0.13–1.14	0.084
Private job	0.39	0.12–1.23	0.108
Student	0.05	0.00–0.50	0.011
Unemployed	1.35	0.28–6.47	0.708
Cause of CKD			
Hypertension and diabetes mellitus	1.00	Reference	
Chronic glomerulonephritis	0.13	0.03–0.49	0.003
Lupus nephritis	0.03	0.00–0.29	0.002
Obstructive nephropathy	0.70	0.14–3.63	0.676
Postnatal AKI progressed	0.09	0.02–0.35	0.001
ADPKD	0.23	0.06–0.95	0.042
NSAID abuse	0.21	0.06–0.70	0.011
Unknown	0.11	0.04–0.28	<0.001
Ambulation status			

Normal	1.00	Reference	
Wheelchair user	2.97	1.42–6.21	0.004
Bedridden	0.87	0.22–3.44	0.846
Clinical parameters			
Hemoglobin	1.30	1.003–1.736	0.047
Albumin	1.40	0.667–2.770	0.397
Serum creatinine	1.30	1.121–1.470	<0.001
Blood urea nitrogen	1.10	1.005–1.015	<0.001
eGFR	0.80	0.690–0.858	<0.001
Sodium	0.90	0.827–0.989	0.028
Potassium	8.50	4.082–17.815	<0.001
Calcium	1.00	0.657–1.615	0.898
Parathyroid hormone	1.00	0.999–1.003	0.203
HbA1c	2.40	1.869–3.043	<0.001

OR, odds ratio; CI, confidence interval; CKD, chronic kidney disease; ADPKD, autosomal dominant polycystic kidney disease; AKI, acute kidney injury; NSAID, non-steroidal anti-inflammatory drug; eGFR, estimated glomerular filtration rate; HbA1c, glycated hemoglobin. Outcome: late/ultra-late referral versus early referral. Categorical crude ORs were recalculated from the reported group counts; continuous-variable ORs and corresponding confidence intervals were retained from the reported univariate logistic regression. No adjusted regression estimates were available.

Compared with patients referred early, those in the combined late/ultra-late group had higher serum creatinine (8.14 ± 3.16 vs 6.21 ± 2.95 ; $p < 0.001$), blood urea nitrogen (225.27 ± 81.56 vs 164.25 ± 88.74 ; $p < 0.001$), potassium (5.69 ± 0.60 vs 5.01 ± 0.58 ; $p < 0.001$), and HbA1c (8.07 ± 1.12 vs 6.20 ± 1.50 ; $p < 0.001$), together with lower eGFR (13.23 ± 3.14 vs 17.37 ± 7.82 ; $p < 0.001$) and serum sodium (136.69 ± 3.73 vs 138.00 ± 3.41 ; $p < 0.001$). The largest rank-based effect sizes were observed for potassium ($|r| = 0.481$), HbA1c ($|r| = 0.454$), blood urea nitrogen ($|r| = 0.452$), eGFR ($|r| = 0.433$), and serum creatinine ($|r| = 0.431$). Albumin also differed statistically between groups ($p = 0.009$), although the corresponding effect size was smaller ($|r| = 0.194$). Hemoglobin, calcium, and parathyroid hormone did not differ significantly between the referral groups.

In univariate analyses, older age was associated with greater odds of late/ultra-late referral. Relative to patients younger than 30 years, the crude odds were higher among those aged 41–50 years (OR 3.67, 95% CI 1.04–12.90), 51–60 years (OR 6.11, 95% CI 1.75–21.37), and >60 years (OR 4.17, 95% CI 1.34–12.99). Male sex was associated with higher odds of late/ultra-late referral (OR 2.63, 95% CI 1.36–5.07). Rural residence was likewise associated with higher crude odds compared with urban residence (OR 5.54, 95% CI 2.71–11.33). Wheelchair users had greater odds than independently ambulant patients (OR 2.97, 95% CI 1.42–6.21).

Among the clinical parameters evaluated in the reported univariate models, serum creatinine (OR 1.30, 95% CI 1.121–1.470), blood urea nitrogen (OR 1.10, 95% CI 1.005–1.015), potassium (OR 8.50, 95% CI 4.082–17.815), and HbA1c (OR 2.40, 95% CI 1.869–3.043) were associated with increased odds of late/ultra-late referral. In contrast, higher eGFR (OR 0.80, 95% CI 0.690–0.858) and serum sodium (OR 0.90, 95% CI 0.827–0.989) were associated with lower odds. These estimates represent unadjusted associations because no multivariable-adjusted model was reported.

DISCUSSION

The present study identified a substantial burden of delayed nephrology referral among patients with chronic kidney disease, with approximately two-thirds of the study population referred either late or ultra-late. Delayed referral was associated with several demographic and clinical characteristics, including older age, male sex, rural residence, impaired ambulation, lower kidney function, and adverse biochemical profiles. Patients who referred late or ultra-late had higher serum creatinine, blood urea nitrogen, potassium, and HbA1c levels and lower eGFR and serum sodium levels than patients referred earlier. These findings indicate that delayed access to nephrology care in this population was associated with more advanced clinical and biochemical manifestations of kidney disease at specialist assessment, although the cross-sectional design does not establish that delayed referral itself caused these abnormalities.

Literature indicates that patients with glomerular nephritis are usually referred early because they are primarily treated in the nephrology department (20–22). Similarly, early referrals of patients with diabetes are highly recommended and encouraged by nephrologists in clinical practice to slow the progression of kidney disease and improve survival (23–25). Other studies have also reported that patients with diabetes should be referred to

nephrologists three or four months before initiating dialysis (17, 26-28). However, the results of this study showed that patients with diabetes and hypertension were referred late to nephrologists compared to those with other primary causes of kidney disease, which is inconsistent with the recommended clinical practice. The late referral of these patients may be attributed to the lack of knowledge of the benefits of early referral and optimum referral times among physicians (25, 29), as a referral time of 12 months is insufficient to adequately care for diabetic kidney disease patients or to prevent or delay renal complications of diabetes mellitus among these patients. Hence, it is recommended that these patients be referred as early as possible to prevent the progression of the disease into end-stage renal disease, subsequently improve survival (12).

The study also reported that patients with ultralate referrals and CKD stage-5 had a significantly shorter time to initiate dialysis compared to patients who were referred early to nephrologists. This may be explained, these patients had end-stage renal disease, necessitating immediate dialysis to improve survival (12). These findings are consistent with the existing literature, which indicates that delayed referrals often occur because of late diagnosis, limited access to early nephrology care, or under-recognition of CKD symptoms in primary care settings, especially in high-risk groups such as older patients, males, or those with comorbidities such as hypertension and diabetes (12, 19, 30).

Similarly, 91.1% of the patients in our study were referred late to nephrologists, which is significantly higher than that in other similar studies. A study conducted in Korea reported that 37.6% of patients in the late referral group (19). Similarly, a meta-analysis (2025) reporting referral data of approximately 630,000 patients with CKD across 78 studies conducted between 1998 and 2019 reported a pooled late referral prevalence of 49% among CKD patients (31). This high prevalence may reflect patients presenting with end-stage renal disease, necessitating immediate dialysis alongside interventions to improve quality of life and survival. However, clinically, late referral contributes to increased mortality, higher healthcare costs, compromised quality of life, and exacerbated inequities, especially for high-risk patients such as older adults, males, and those with hypertension or diabetes (32).

Our findings align with international evidence that delayed nephrology referral contributes to worse outcomes. Several factors may explain late referral in this setting, including limited CKD awareness among primary care providers, inadequate early screening, and lack of standardized referral pathways. Importantly, Educational attainment and employment status were associated with referral timing, highlighting the role of health literacy and access barriers. These results emphasize the urgent need to improve CKD screening at the primary care level and to establish clear referral guidelines. Targeted training of non-nephrology physicians and the use of validated risk tools such as the Kidney Failure Risk Equation may help identify high-risk patients earlier. Policies addressing rural/urban disparities and socioeconomic barriers are equally important to ensure equitable access to specialist care. This study has several strengths, including evaluation of demographic, socioeconomic, renal, metabolic, and referral-related characteristics within the same patient population and examination of both categorical referral patterns and clinical laboratory parameters. The regression analysis also allowed estimation of crude associations between individual characteristics and delayed referral. Nevertheless, several limitations should be considered. The cross-sectional design precludes determination of temporal or causal relationships between referral timing and clinical status. The study was conducted in a single tertiary nephrology setting, which limits generalizability to other regions and levels of care in Pakistan. Referral categories were defined relative to dialysis initiation, making the referral-to-dialysis interval intrinsically related to the exposure classification. In addition, the reported regression analyses were univariable; therefore, observed associations may be affected by confounding among age, socioeconomic characteristics, CKD severity, underlying disease, and laboratory parameters. Some demographic and etiological categories contained relatively small numbers of participants, resulting in imprecise estimates with wide confidence intervals. Finally, the study did not report longitudinal outcomes after dialysis initiation, such as hospitalization, vascular-access preparation, mortality, or quality of life, so the consequences of delayed referral beyond the clinical status observed at assessment cannot be established from these data.

CONCLUSION

Late and ultra-late nephrology referral was common among the patients with CKD included in this study and was associated with older age, male sex, rural residence, impaired mobility, and a less favorable renal and metabolic profile. Patients who referred later had lower kidney function and several biochemical abnormalities indicative of more advanced clinical disease at specialist assessment. These findings support the importance of timely

recognition and referral of patients with progressive CKD while highlighting the need to address demographic and health-care access factors associated with delayed nephrology assessment.

REFERENCES

1. Somaili M, Darraj H, Abusageah F, Hakami F, Hakami KM, Zogel B, et al. Rate of vascular access preparation in hemodialysis patients and associated baseline characteristics in Jazan Region, Saudi Arabia: a multicentre study. *Open Med J*. 2024;11.
2. Okoro RN, Ummate I, Ohieku JD, Yakubu SI, Adibe MO, Okonta MJ. Kidney disease knowledge and its determinants among patients with chronic kidney disease. *J Patient Exp*. 2020;7(6):1303-1309.
3. Jurkovitz CT, Elliott D, Li S, Saab G, Bombback AS, Norris KC, et al. Physician utilization, risk-factor control, and CKD progression among participants in the Kidney Early Evaluation Program (KEEP). *Am J Kidney Dis*. 2012;59(3 Suppl 2).
4. Liu W, Zhou L, Yin W, Wang J, Zuo X. Global, regional, and national burden of chronic kidney disease attributable to high sodium intake from 1990 to 2019. *Front Nutr*. 2023;10.
5. Alemu H, Hailu W, Adane A. Prevalence of chronic kidney disease and associated factors among patients with diabetes in northwest Ethiopia: a hospital-based cross-sectional study. *Curr Ther Res Clin Exp*. 2020;92:100578.
6. Hooi LS, Ong LM, Ahmad G, Bavanandan S, Ahmad NA, Naidu BM, et al. A population-based study measuring the prevalence of chronic kidney disease among adults in West Malaysia. *Kidney Int*. 2013;84(5):1034-1040.
7. Zhang L, Wang F, Wang L, Wang W, Liu B, Liu J, et al. Prevalence of chronic kidney disease in China: a cross-sectional survey. *Lancet*. 2012;379(9818):815-822.
8. Anand S, Khanam MA, Saquib J, Saquib N, Ahmed T, Alam DS, et al. High prevalence of chronic kidney disease in a community survey of urban Bangladeshis: a cross-sectional study. *Global Health*. 2014;10(1):1.
9. Jessani S, Bux R, Jafar TH. Prevalence, determinants, and management of chronic kidney disease in Karachi, Pakistan: a community-based cross-sectional study. *BMC Nephrol*. 2014;15(1):1.
10. Singh AK, Farag YM, Mittal BV, Subramanian KK, Reddy SRK, Acharya VN, et al. Epidemiology and risk factors of chronic kidney disease in India: results from the SEEK (Screening and Early Evaluation of Kidney Disease) study. *BMC Nephrol*. 2013;14(1):1.
11. Stanifer JW, Muir A, Jafar TH, Patel UD. Chronic kidney disease in low- and middle-income countries. *Nephrol Dial Transplant*. 2016;31(6):868-874.
12. Dhanorkar M, Prasad N, Kushwaha R, Behera M, Bhaduarua D, Yaccha M, et al. Impact of early versus late referral to nephrologists on outcomes of chronic kidney disease patients in Northern India. *Int J Nephrol*. 2022;2022:4768540.
13. Chu CD, Lamprea-Montealegre JA, Estrella MM. Too many for too few: finding appropriate nephrology referrals for patients with CKD that optimize outcomes. *Am J Kidney Dis*. 2022;79(3):330-332.
14. Kinchen KS, Sadler J, Fink N, Brookmeyer R, Klag MJ, Levey AS, et al. The timing of specialist evaluation in chronic kidney disease and mortality. *Ann Intern Med*. 2002;137(6):479-486.
15. Smart NA, Titus TT. Outcomes of early versus late nephrology referral in chronic kidney disease: a systematic review. *Am J Med*. 2011;124(11):1073-1080.e2.
16. Carney EF. The impact of chronic kidney disease on global health. *Nat Rev Nephrol*. 2020;16(5):251-252.
17. Parameswaran S, Geda SB, Rath M, Kohli HS, Gupta KL, Sakhuja V, et al. Referral pattern of patients with end-stage renal disease at a public sector hospital and its impact on outcome. *Natl Med J India*. 2011;24(4):208-213.
18. Daniel WW. *Biostatistics: A Foundation for Analysis in the Health Sciences*. New York: Wiley; 1978.

19. Lee J, Lee JP, An JN, Kim SG, Kim YL, Yang CW, et al. Factors affecting the referral time to nephrologists in patients with chronic kidney disease: a prospective cohort study in Korea. *Medicine (Baltimore)*. 2016;95(19).
20. Nakamura S, Nakata H, Yoshihara F, Kamide K, Horio T, Nakahama H, et al. Effect of early nephrology referral on the initiation of hemodialysis and survival in patients with chronic kidney disease and cardiovascular diseases. *Circ J*. 2007;71(4):511-516.
21. Wauters JP, Bosson JL, Forneris G, Turc-Baron C, Golshayan D, Paternoster G, et al. Patient referral is influenced by dialysis centre structure in the Diamant Alpin Dialysis cohort study. *Nephrol Dial Transplant*. 2004;19(9):2341-2346.
22. Kessler M, Frimat L, Panescu V, Briançon S. Impact of nephrology referral on early and midterm outcomes in ESRD: EPidemiologie de l'Insuffisance REnale chronique terminale en Lorraine (EPIREL): results of a 2-year, prospective, community-based study. *Am J Kidney Dis*. 2003;42(3):474-485.
23. Tseng CL, Kern EF, Miller DR, Tiwari A, Maney M, Rajan M, et al. Survival benefit of nephrologic care in patients with diabetes mellitus and chronic kidney disease. *Arch Intern Med*. 2008;168(1):55-62.
24. Smart NA, Dieberg G, Ladhani M, Titus T. Early referral to specialist nephrology services for preventing the progression to end-stage kidney disease. *Cochrane Database Syst Rev*. 2014;(6).
25. Yun D, Bae S, Park S, Kim YC, Kim DK, Oh KH, et al. Referral to nephrologists is associated with the slow progression of kidney dysfunction in patients with type 2 diabetes mellitus. *Kidney Res Clin Pract*. 2025.
26. Navaneethan SD, Nigwekar S, Sengodan M, Anand E, Kadam S, Jeevanantham V, et al. Referral to nephrologists for chronic kidney disease care: is non-diabetic kidney disease ignored? *Nephron Clin Pract*. 2007;106(3).
27. Kazmi WH, Obrador GT, Khan SS, Pereira BJ, Kausz AT. Late nephrology referral and mortality among patients with end-stage renal disease: a propensity score analysis. *Nephrol Dial Transplant*. 2004;19(7):1808-1814.
28. Stack AG. Impact of timing of nephrology referral and pre-ESRD care on mortality risk among new ESRD patients in the United States. *Am J Kidney Dis*. 2003;41(2):310-318.
29. Agrawal V, Ghosh AK, Barnes MA, McCullough PA. Perception of indications for nephrology referral among internal medicine residents: a national online survey. *Clin J Am Soc Nephrol*. 2009;4(2):323-328.
30. Nandita SK, Jagadeesha M, Sanjeev VN, Pramod Kumar M. Understanding factors affecting referral of chronic kidney disease patients: perception of specialist, general physicians and patients. *Int J Health Sci*. 2022;6(S1):8283-8297.
31. Cheng L, Hu N, Song D, Liu L, Chen Y. Early versus late nephrology referral and patient outcomes in chronic kidney disease: an updated systematic review and meta-analysis. *BMC Nephrol*. 2025;26(1):25.
32. Spencer D. Health care costs associated with unrecognized progression to late-stage kidney disease. *Am J Manag Care*. 2023.