RESEARCH ARTICLE

Epidemiology and risk factors of chronic kidney disease in rural areas (Badin) of Sindh, Pakistan

Shahnawaz Kareem[1], Asifa Jamali[2], Salam Ali[3], Muhammad Yousif Arbab[4], Beena Salman[5], Salman Imtiaz[6]

Abstract

Objective: To evaluate the epidemiology of chronic kidney disease in a rural setting.

Method: The retrospective study was conducted at Indus Hospital, Badin, Sindh, Pakistan, and comprised data of patients of either gender regardless of age who visited the nephrology clinic between July 2019 and July 2020. Data was retrieved from the institutional health management information system. Data was analysed using SPSS 21.

Results: Of the 348 patients, 184(52.9%) were males and 164(47.1%) were females. The overall mean age was 40.4±19 years. Obstructive nephropathy was the most frequent cause of chronic kidney disease 108(31%), followed by chronic kidney disease of unknown aetiology 79(22.7%). The most prevalent comorbid was hypertension in 106(30.5%) patients, while 56(16.1%) had Diabetes. Stone disease was found in 90(24.6%) patients. Age was strongly associated with chronic kidney disease (p<0.001). Among those with chronic kidney disease of unknown aetiology, 35(44.3%) patients were aged 31-50 years. The expected glomerular filtration rate in such patients was significantly associated with the cause of chronic kidney disease (p<0.001).

Conclusion: Unknown aetiology and kidney stones were the leading causes of chronic kidney disease among the rural population studied.

Keywords: Chronic kidney disease, Agricultural communities, Developing country, Kidney stone, Unknown aetiology.

(JPMA 73: 1399; 2023) **DOI: https://doi.org/10.47391/JPMA.6764**

Introduction

Chronic kidney disease (CKD) is a universal public health issue that has devastating effects on about 750 million people worldwide[1] with varying prevalence rates. Although the magnitude and impact of kidney disease are better defined in the Western world, emerging evidence suggests that the Eastern hemisphere has a similar or even greater kidney disease burden. The aetiology of end-stage renal disease (ESRD) is inconsistent in various parts of the world. Diabetes mellitus (DM) and hypertension (HTN) are known to cause the majority of the burden, but glomerular diseases and CKD of unknown aetiology (CKDu) remain important in low- and middle-income countries (LMICs).[2]

There is a wide gap in terms of the availability of various treatment modalities for the management of kidney diseases.[3] In developed countries, a significantly higher number of patients, including the elderly, receive renal replacement therapy (RRT) due to the provision of universal healthcare.[4] The lower numbers reported from LMICs is because patients are often not accepted in dialysis and transplant programmes. These differences in the demography and epidemiology are related to the transition of disease from infections to chronic lifestyle-related diseases, decreased birth rates, and increased life expectancy in developed countries.[5] In LMICs, infectious diseases continue to be prevalent due to inadequate sanitation, scarce supply of potable water, and accumulation of a high number of disease-spreading vectors.[6,7]

Pakistan, a developing country with nutritional deficiency and infectious diseases, also has the burden of diseases associated with the developed world, like DM, cardiovascular disease (CVD) and cancers.[8,9] Most of the studies conducted to evaluate the causes of kidney diseases in Pakistan are hospital-based, or a collection of the patient's data from outpatient clinics or dialysis facilities in urban areas of the country.[10,11] A few studies are community-based with small sample size and done in the larger cities of the country.[12-14] There is a need to study the dynamics and characteristics of the CKD population in rural areas which is the larger population segment in Pakistan, as indicated by data of the Pakistan Bureau of Statistics (PBS).[15]

The current study was planned to evaluate the characteristics of the population and causes of CKD in a rural setting.

[1,2,4]Department of Medicine, The Indus Hospital Health Network, Civil Hospital, Badin, Pakistan; [3]Department of Hemodialysis, The Indus Hospital Health Network, Civil Hospital, Badin, Pakistan; [5,6]Department of Nephrology, The Indus Hospital and Health Network, Karachi, Pakistan.

Correspondence: Salman Imtiaz. e-mail: salman.imtiaz@tih.org.pk

Materials and Methods

The retrospective study was conducted at Indus Hospital, Badin, Sindh, Pakistan, and comprised data of patients of either gender regardless of age who visited the nephrology clinic between July 2019 and July 2020. The hospital is one of the largest secondary care facilities in Badin district of in Sindh province. The district is an agricultural area with a total area of 6,726 sqkm.[16]

After approval from the institutional ethics review board, data was retrieved from the institutional health management information system (HMIS) using a structured proforma. Data of patients with incomplete information was excluded.

Data was analysed using SPSS 21. Mean±standard deviation were computed for normally distributed continuous variables, while, for skewed data, median with interquartile range (IQR) were also used. Data normality was checked using Shapiro-Wilk's test. Frequencies with percentages were calculated for categorical variables. Association of variables, like gender, age, and estimated glomerular filtration rate (eGFR) with a provisional diagnosis of CKD was assessed using chi-square or Fisher exact test, as appropriate. P≤0.05 was considered statistically significant.

Results

Of the 348 patients, 184(52.9%) were males and 164(47.1%) were females. The overall mean age was 40.4±19 years (range: 2-100 years). Obstructive nephropathy (ONP) was the most frequent cause of CKD 108(31%), followed by CKDu 79(22.7%) (Figure).

The most prevalent comorbid was HTN in 106(30.5%) patients, while 56(16.1%) had DM. The stone disease was found in 90(24.6%) patients. The most common presenting complaint was proteinuria 147(42.2%), followed by haematuria 91(26.1%) (Table 1).

The mean creatinine level on the first visit was 2.6±2.8 mg/dL while the mean maximum creatinine level was 3.1±3.4 mg/dL (Table 2). Gender was not associated with CKD (p>0.05) while age was strongly associated (p<0.001). Among those with CKDu, 35(44.3%) patients were aged 31-50 years. The eGFR in such patients was significantly associated with the cause of CKD (p<0.001) (Table 3).

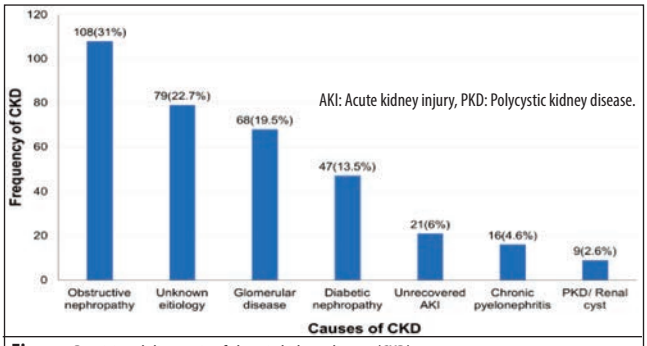

Figure: Provisional diagnosis of chronic kidney disease(CKD).

Table-1: Demographic and clinical variables of the CKD patients.

	n (%)
Gender	
Male	184(52.9)
Female	164(47.1)
Age (years)	
Mean of age	257(73.9)
Marital status	
Married	91(26.1)
Single	56(16.1)
Comorbid	
Diabetes Mellitus	106(30.3)
Hypertension	90(25.8)
Stone disease	11(3.2)
Ischemic heart disease	100(28.7)
Congestive heart Failure	1(0.3)
Sign and symptoms	
Cerebrovascular accident	91(26.1)
Haematuria	147(42.2)
Proteinuria	42(12.1)
Pedal oedema	19(5.5)
Periorbital swelling	66(19)
Use of Medications	
Anti HTN medication	13(3.7)
ACE inhibitor/ARB	117(33.6)
eGFR ranges	
≥ 90	55(15.8)
60 – 89	64(18.4)
30 – 59	43(12.4)
15 – 29	69(19.8)

CKD: Chronic kidney disease, HTN: Hypertension, eGFR: Estimated glomerular filtration rate, ACE: Angiotensin-converting enzyme, ARB: Angiotensin receptor blockers.

Table-2: Laboratory parameters.

	Mean±SD	Median, IQR	Minimum	Maximum
Creatinine on the first visit (mg/dl)	2.6±2.8	1.3, 2.2	0.34	17.3
Maximum creatinine (mg/dl)	3.1±3.4	1.6, 3	0.45	17.5
Latest creatinine (mg/dl)	2.5±2.7	1.3, 2.2	0.34	17.3
Urea (mg/dl)	64.6±67.1	32.5, 68.4	5	310.1
Haemoglobin (Gm/dl)	11±2.6	10.9, 3.5	4	17.5
Total leucocyte count (/µl)	9139.6±3653	8300, 3843	782	29000
Platelet (/µl)	301643.1±127323.1	279000, 114750	17100	950000
Albumin (mg/dl)	3.7±0.7	3.8, 0.53	1.1	5.1
Sodium (mmol/L)	139.4±5	140, 7	111	162
Potassium (mmol/L)	4.4±0.9	4.5, 1.2	2.6	8
Chloride (mmol/L)	108.1±5.7	108, 6	80	126
Bicarb (mmol/L)	20.3±4	21, 5	8	31
Calcium (mg/dl)	8.6±0.95	8.6, 1.4	6	11.2
Phosphorus (mg/dl)	4.6±1.6	4, 1.6	1.38	17.3
Expected Glomerular filtration rate	64.2±45.5	58.9, 81.6	3.2	184.9

SD: Standard deviation, IQR: Interquartile range.

Table-3: Association of gender, age and eGFR with a provisional diagnosis of CKD.

Parameters	Unrecovered from AKI	CKDu	ONP	DNP	GNP	Ch, Pyelo	PKD/ Renal cyst	*p*-value
Gender								
Male	10(47.6)	46(58.2)	57(52.8)	30(63.8)	34(50)	5(31.3)	2(22.2)	0.124
Female	11(52.4)	33(41.8)	51(47.2)	17(36.2)	34(50)	11(68.8)	7(77.8)	
Age (years)								
< 15	0	4(5.1)	9(8.3)	0	13(19.1)	1(6.3)	0	<0.001
15 - 30	11(52.4)	15(19)	32(29.6)	4(8.5)	27(39.7)	3(18.8)	1(11.1)	
31 - 50	5(23.8)	35(44.3)	36(33.3)	12(25.5)	18(26.5)	9(56.3)	5(55.6)	
51 - 65	4(19)	13(16.5)	19(17.6)	22(46.8)	6(8.8)	1(6.3)	2(22.2)	
> 65	1(4.8)	12(15.2)	12(11.1)	9(19.1)	4(5.9)	2(12.5)	1(11.1)	
eGFR ranges (ml/min)								
≥ 90	3(14.3)	5(6.3)	61(56.5)	7(14.9)	33(48.5)	6(37.5)	2(22.2)	<0.001
60 - 89	5(23.8)	7(8.9)	22(20.4)	3(6.4)	8(11.8)	4(25)	6(66.7)	
30 - 59	5(23.8)	12(15.2)	16(14.8)	17(36.2)	10(14.7)	3(18.8)	1(11.1)	
15 - 29	4(19)	19(24.1)	4(3.7)	9(19.1)	4(5.9)	3(18.8)	0	
< 15	4(19)	36(45.6)	5(4.6)	11(23.4)	13919.1)	0	0	

eGFR: Estimated glomerular filtration rate, CKD: Chronic kidney disease, CKDu: Chronic kidney disease of unknown aetiology, ONP: Obstructive nephropathy, DNP: Diabetic nephropathy, GNP: Glomerular nephropathy, Ch. Pyelo: Chronic pyelonephritis.

Discussion

To the best of our knowledge, the current study is the first to present data of CKD patients living in a rural area of Pakistan where the majority of the residents work in agricultural fields. The study found kidney stone disease and CKDu to be the most prevalent cause of renal failure, which is somewhat similar to the studies done almost three decades ago.[17,18] However, recent urban data has reported different results,[10,18,19] suggesting that chronic glomerulonephritis, diabetic nephropathy (DNP) were the major causes of ESRD ahead of CKDu and kidney stone. DM has emerged as the leading cause of CKD in recent times which might be explained by the rapid urbanisation in the last few decades in Pakistan.

Renal stone disease is not commonly identified as the primary cause of ESRD, but recent population-based studies tend to agree, like a French study that found that 40% of stone formers who developed ESRD had a solitary functioning kidney before developing ESRD.[20] A study in North America[21] evaluated the cause of solitary functioning kidney among 115 stone formers and found that the leading three causes of loss of function in one kidney were staghorn calculi or high stone burden, infection and ureteral obstruction, while surgery was responsible for kidney loss in only 8% subjects.

There is a significant increase in the incidence of stone disease globally in both genders due to various reasons, like changing diet patterns, obesity and global warming.[22] Southeastern areas of Pakistan are recognized as 'stone belts' due to the hot climate, and, therefore, the incidence of stone disease is high in the area. These areas are mostly agricultural and away from large cities where tertiary care centres dealing with stone removal are mostly located. People suffer profound damage to the kidney parenchyma before reaching these distant hospitals.[23]

Further, CKDu is also recognised as a leading cause of CKD in Badin district, referred to as Badin nephropathy.[24] Recently, agricultural communities, like El Salvador in Central America (Mesoamerican nephropathy), Sri Lanka (Sri Lankan nephropathy), and Uddanam in central India (Uddanam nephropathy), have been identified to be vulnerable to CKD. Reasons cited include heat and dehydration, pesticides (glyphosate, paraquat, etc.), heavy metals in drinking water (arsenic, cadmium), and infections (malaria, dengue, and leptospirosis), but none are exclusively identified as the primary cause of the disease.[25] The prolonged asymptomatic phase of the disease highlights the need for early screening facilities in vulnerable populations, like farmers and field workers.

Acute kidney injury (AKI) is also common in such a community due to infections like malaria, dengue, diarrhoea, and acute pyelonephritis. There were 6% of patients in the current study who had AKI due to snakebite, after which they had partial recovery and developed CKD. Snakebite is highly prevalent in farming communities, and those who face a delay in the administration of relevant emergency assistance develop AKI.[26]

The current study has limitations of small sample size and retrospective hospital-based data.

Despite the limitations, the study showed a completely different aetiology of CKD in rural areas, which comprises 70% of the country's population. Both the leading CKD causes identified are preventable and deserve a prospective population-based study to identify the true incidence and underlying aetiology. With respect to CKDu,

there is a dire need to screen the vulnerable population in the initial stages of the disease, including renal biopsy and urine evaluation for exposure to toxins. Similarly, for kidney stone disease, there is a need to know the dietary pattern, water contaminations, and urine biochemistry to understand the types of stones in this population to plan a preventive strategy.

Conclusion

CKDu and kidney stones were found to be the leading causes of CKD in the rural population studied. CKDu, obstructive nephropathy and diabetic nephropathy were more common in males compared to females, while CKD due to unrecovered AKI, chronic pyelonephritis, and polycystic kidney disease/renal cyst were more prevalent in females than males.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. GBD 2015 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016; 388:1603-58. doi: 10.1016/S0140-6736(16)31460-X.
2. 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:e0158765. doi: 10.1371/journal.pone.0158765.
3. Ayodele OE, Alebiosu CO. Burden of chronic kidney disease: an international perspective. Adv Chronic Kidney Dis. 2010; 17: 215-24. doi: 10.1053/j.ackd.2010.02.001.
4. Jha V. Current status of chronic kidney disease care in southeast Asia. Semin Nephrol. 2009; 29: 487–96. doi: 10.1016/j.semnephrol.2009.06.005.
5. Engelgau MM, El-Saharty S, Kudesia P, Rajan V, Rosenhouse S, Okamoto K. Regional aging, and disease burden. Capitalizing on the demographic transition: tackling noncommunicable diseases in South Asia. Washington, DC: World Bank, pp-2011.
6. Ayodele OE, Alebiosu CO. Burden of chronic kidney disease: an international perspective. Adv Chronic Kidney Dis. 2010; 17:215-24. doi: 10.1053/j.ackd.2010.02.001.
7. Rajapurkar MM, John GT, Kirpalani AL, Abraham G, Agarwal SK, Almeida AF, et al. What do we know about chronic kidney disease in India: first report of the Indian CKD registry? BMC Nephrol. 2012; 13:10. doi: 10.1186/1471-2369-13-10.
8. 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; 379:815–22.
9. Pappas G, Akhtar T, Gergen PJ, Hadden WC, Khan AQ. Health status of the Pakistani population: A health profile and comparison with the United States. Am J Public Health. 2001; 91:93-8. doi: 10.2105/ajph.91.1.93
10. Salman B, Imtiaz S, Qureshi R, Dhrolia MF, Ahmad A. The Causes of Chronic Kidney Disease in Adults in a Developing Country. [Online] [Cited 2017 February 24]. Available from: URL: https://www.scitechnol.com/peer-review/the-causes-of-chronic-kidney-disease-in-adults-in-a-developing-country-rZUx.php?article_id=6044
11. Rizvi S A, Manzoor K. Causes of Chronic Renal Failure in Pakistan: A Single Large Center Experience. Saudi J Kidney Dis Transpl. 2002; 13:376-9.
12. Alam A, Amanullah F, Baig-Ansari N, Lotia-Farrukh I, Khan FS. Prevalence and risk factors of kidney disease in urban Karachi: baseline findings from a community cohort study. BMC Res Notes. 2014; 7:179. doi: 10.1186/1756-0500-7-179.
13. 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; 15:90. doi: 10.1186/1471-2369-15-90.
14. Imtiaz S, Salman B, Qureshi R, Drohlia MF, Ahmad A. A review of the epidemiology of chronic kidney disease in Pakistan: A global and regional perspective. Saudi J Kidney Dis Transpl. 2018; 29:1441-51. doi: 10.4103/1319-2442.248307.
15. Area, population, density, and urban/rural proportion. [Online] [Cited 2022 January 01]. Available from: URL: https://www.pbs.gov.pk/content/area-population-density-and-urban-rural-proportion.
16. Pakistan Bureau of Statistics. District at a glance Badin. [Online] [Cited 2022 February 20]. Available from: URL: www.pbs.gov.pk>content>district-glancebadin.
17. Kumar H, Alam F, Naqvi SAJ. Experience of hemodialysis at the kidney center. J Pak Med Assoc 1992; 42:234-6.
18. Rizvi SA, Naqvi SA. Renal replacement therapy in Pakistan. Saudi J Kidney Dis Transplant. 1996; 7:404-8.
19. Ullah K, Butt G, Masroor I, Kanwal K, Kifayat F. Epidemiology of chronic kidney disease in a Pakistani population. Saudi J Kidney Dis Transpl. 2015; 26:1307-10. doi: 10.4103/1319-2442.168694.
20. Jungers P, Joly D, Barbey F, Choukroun G, Daudon M. ESRD caused by nephrolithiasis: Prevalence, mechanisms, and prevention. Am J Kidney Dis. 2004; 44: 799-805.
21. Worcester E, Parks JH, Josephson MA, Thisted RA, Coe FL. Causes and consequences of kidney loss in patients with nephrolithiasis. Kidney Int 64: 2204-13. doi: 10.1046/j.1523-1755.2003.00317.x.
22. Romero V, Akpinar H, Assimos DG. Kidney stones: a global picture of prevalence, incidence, and associated risk factors. Rev Urol. 2010; 12:2-3: e86-e96.
23. Imtiaz S, Alam A. Strategies for preventing end-stage kidney disease: The impact of kidney stone disease on chronic kidney disease in Pakistan. J Pak Med Assoc 2021; 71:2244-6. DOI: 10.47391/JPMA.01-114.
24. Imtiaz S, Alam A. Status of chronic kidney disease of unknown aetiology in Pakistan. J Pak Med Assoc.2021; 71:336-7. doi: 10.47391/JPMA.113.
25. Johnson RJ, Wesseling C, Newman LS. Chronic Kidney Disease of Unknown Cause in Agricultural Communities. N Engl J Med. 2019: 380; 1843-52. doi: 10.1056/NEJMra1813869.
26. Jamali A, Yousif M, Kareem S, Ali S, Salman B, Imtiaz S. Epidemiology and complications of snakebite in a rural area of Badin and Thar Sind, Pakistan. J Pak Med Assoc. 2022:11. DOI:10.47391/JPMA.4547.