

ORIGINAL ARTICLE

Prevalence of Selected Cardiovascular Risk Factors among Patients with Chronic Kidney Disease Receiving Maintenance Hemodialysis at a Tertiary Care Hospital in Islamabad

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ABSTRACT

Objective: To determine the prevalence of selected traditional cardiovascular risk factors and CKD-related cardiovascular risk-associated abnormalities among patients with chronic kidney disease receiving maintenance hemodialysis.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: Department of Nephrology, Shifa International Hospital, Islamabad, from 15 September 2020 to 14 March 2021.

Materials and Methods: A total of 150 patients with CKD on maintenance hemodialysis, aged 18–70 years, were recruited using consecutive sampling. Patients with congenital or rheumatic heart disease, chronic liver disease or malignancy were excluded. Demographic and clinical data were collected, and laboratory investigations included complete blood count, serum calcium, phosphate, and HbA1C. Data were analyzed using SPSS version 22. Continuous variables were presented as mean $\pm$ standard deviation, and categorical variables as frequencies and percentages. Associations were assessed using chi-square tests, with $p \leq 0.05$ considered statistically significant.

Results: The mean age of participants was 51.2 ± 8.4 years; 103 (68.7%) were male and 47 (31.3%) female participants. Hypertension was present in 64.0% of patients, diabetes mellitus in 38.0%, hypocalcemia in 64.7%, hyperphosphatemia in 50.0%, and anemia in 72.0%. Anemia was slightly more prevalent in females (78.7%) than males (68.9%). Diabetes mellitus was significantly more common in males (44.7%) than females (23.4%) ($p=0.013$). Other risk factors did not show statistically significant sex or age differences.

Conclusion: Traditional cardiovascular risk factors and CKD-related abnormalities associated with cardiovascular risk were highly prevalent among patients receiving maintenance hemodialysis. Anemia was the most prevalent CKD-related cardiovascular risk-associated abnormality, followed by hypocalcemia, hypertension, hyperphosphatemia, and type 2 diabetes mellitus.

Key Words: Anemia, Cardiovascular Diseases, Chronic Kidney Disease, Hemodialysis, Hypertension.

Introduction

Chronic kidney disease (CKD) is a major global public health problem, with its prevalence and associated healthcare burden continuing to rise.¹ Available Pakistani studies have reported a substantial burden of CKD, with pooled or study-specific estimates varying according to the population and diagnostic criteria used. Diabetic nephropathy and

hypertension are among the leading causes of CKD in the Pakistani population.² These figures highlight CKD as a significant public health challenge in the country.

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality among patients with CKD, particularly those receiving maintenance hemodialysis (HD).³ The strong association between CKD and CVD is explained by shared traditional cardiovascular risk factors, including hypertension, diabetes mellitus, advanced age, and smoking, as well as CKD-specific factors such as uremic toxins, anemia, chronic inflammation, oxidative stress, and disturbances in calcium and phosphorus metabolism. Together, these factors contribute to structural and functional cardiac abnormalities and substantially increase cardiovascular risk among

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patients with end-stage renal disease (ESRD).⁴⁻⁷ Although several international studies have described the high burden of cardiovascular disease among patients undergoing hemodialysis, there is limited published evidence regarding the prevalence of cardiovascular disease risk factors among Pakistani patients with ESRD receiving maintenance hemodialysis. Given the high prevalence of CKD in Pakistan, the increasing burden of non-communicable diseases, and the resource constraints within the healthcare system, locally generated evidence is essential to guide risk stratification, preventive strategies, and clinical management.

Therefore, this study aimed to determine the prevalence of selected traditional cardiovascular risk factors and CKD-related cardiovascular risk-associated abnormalities among patients receiving maintenance hemodialysis.

Materials and Methods

This descriptive cross-sectional study was conducted from 15 September 2020 to 14 March 2021 at the Department of Nephrology, Shifa International Hospital, Islamabad. The sample size of 150 participants was calculated using the WHO sample size calculator, assuming a population proportion of 21 and a 91% confidence interval with a margin of error of 6.5%.² The population proportion used for the calculation was based on a previously reported prevalence of CKD in Pakistan. As this estimate was not specific to cardiovascular risk factors or CKD-related abnormalities among patients receiving maintenance hemodialysis, the sample-size calculation was not outcome-specific and is acknowledged as a limitation of the study. Participants fulfilling the inclusion criteria were recruited through consecutive sampling from both the Nephrology outpatient department and the hemodialysis unit of Shifa International Hospital, Islamabad.

Eligible participants included male and female patients aged 18–70 years with chronic kidney disease (CKD) receiving maintenance hemodialysis. Patients with congenital heart disease, rheumatic heart disease, chronic liver disease, or any malignancy were excluded from the study. In addition, the use of medications that influence mineral metabolism, such as phosphate binders,

calcium supplements, vitamin D analogues, and calcimimetics, was not specifically recorded or analysed. As these medications may affect serum calcium and phosphate concentrations, they could have influenced the observed prevalence of hypocalcemia and hyperphosphatemia.

Ethical approval was obtained from the Institutional Review Board/Ethics Committee of Shifa International Hospital, Islamabad (IRB No. 457-1277-2020; approval date: 20 June 2020). Eligible patients were enrolled after providing written informed consent.

A detailed clinical history was obtained, followed by a comprehensive physical examination. Blood pressure was measured before the hemodialysis session using an automated blood pressure monitor, with the patient seated and rested for 5 minutes. Two to three blood pressure readings were obtained, and the average of the readings was used for analysis. Five milliliters of venous blood were collected under aseptic conditions before the hemodialysis session for laboratory investigations. Laboratory investigations included complete blood count (CBC), serum calcium, serum phosphate, and glycated hemoglobin (HbA1c). Demographic, clinical, and laboratory data were recorded using a predesigned proforma.

Hypertension was defined as a previous physician diagnosis of hypertension, current use of antihypertensive medication, or a blood pressure $\geq 140/90$ mmHg. Type 2 diabetes mellitus (T2DM) was defined as a previous physician diagnosis of diabetes mellitus, current use of antidiabetic medication, or an HbA1c level $\geq 6.5\%$. Anemia was defined according to the World Health Organization criteria as a hemoglobin concentration of <13 g/dL in men and <12 g/dL in women. Hypocalcemia was defined as a serum calcium level of <8.4 mg/dL, while hyperphosphatemia was defined as a serum phosphate level of >4.5 mg/dL, based on the laboratory reference ranges used at Shifa International Hospital.

Data were analyzed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Cardiovascular risk factors were stratified according to age group (18–45

years and 46–70 years) and sex (male and female). Associations between categorical variables were assessed using the chi-square test. The assumptions for the chi-square test were verified before analysis. No confidence intervals were calculated. A p-value ≤ 0.05 was considered statistically significant.

Results

A total of 150 patients with chronic kidney disease (CKD) receiving maintenance hemodialysis were included in the study. The mean age was 51.2 ± 8.4 years. Most participants (111, 74.0%) were aged 46–70 years, while 39 (26.0%) were aged 18–45 years. There were 103 (68.7%) male and 47 (31.3%) female participants, giving a male-to-female ratio of 2.2:1.

Anemia was the most prevalent CKD-related cardiovascular risk-associated abnormality, affecting 108 (72.0%) patients, followed by hypocalcemia in 97 (64.7%), hypertension in 96 (64.0%), hyperphosphatemia in 75 (50.0%), and type 2 diabetes mellitus in 57 (38.0%) patients (Table I).

Table I: Frequency of Selected Traditional Cardiovascular Risk Factors and CKD-Related Cardiovascular Risk-Associated Abnormalities Among Patients Receiving Maintenance Hemodialysis (N = 150)

Selected Cardiovascular Risk Factors and CKD-Related Abnormalities	Frequency (%)	
	Yes	No
Hypertension	96 (64.0%)	54 (36.0%)
Type 2 Diabetes Mellitus	57 (38.0%)	93 (62.0%)
Hypocalcemia	97 (64.7%)	53 (35.3%)
Hyperphosphatemia	75 (50.0%)	75 (50.0%)
Anemia	108 (72.0%)	42 (28.0%)

Among patients aged 18–45 years, hypertension was present in 21 (53.8%) patients compared with 75 (67.6%) patients aged 46–70 years; however, the difference was not statistically significant ($p=0.125$). Similarly, type 2 diabetes mellitus was observed in 10 (25.6%) younger patients and 47 (42.3%) older patients, with no statistically significant difference ($p=0.065$). Hypocalcemia was present in 23 (59.0%) younger patients and 74 (66.7%) older patients ($p=0.387$), while hyperphosphatemia was identified in 22 (56.4%) and 53 (47.7%) patients, respectively ($p=0.352$). Anemia was observed in 30 (76.9%) patients aged 18–45 years and 78 (70.3%) patients

aged 46–70 years ($p=0.426$). None of the cardiovascular risk factors showed a statistically significant association with age (Table II).

Table II: Association of Selected Cardiovascular Risk Factors and CKD-Related Abnormalities with Age Groups (N = 150)

		18-45 years (n=39)	46-70 years (n=111)	p-value
Hypertension	Yes	21	75	0.125
	No	18	36	
Diabetes Mellitus type 2	Yes	10	47	0.065
	No	29	64	
Hypocalcemia	Yes	23	74	0.387
	No	16	37	
Hyperphosphatemia	Yes	22	53	0.352
	No	17	58	
Anemia	Yes	30	78	0.426
	No	9	33	

Among male participants, hypertension was present in 67 (65.0%) patients compared with 29 (61.7%) female patients ($p=0.692$). Type 2 diabetes mellitus was significantly more common among males than females (46 [44.7%] vs. 11 [23.4%]; $p=0.013$). Hypocalcemia was present in 65 (63.1%) male and 32 (68.1%) female patients ($p=0.554$), whereas hyperphosphatemia was observed in 50 (48.5%) males and 25 (53.2%) females ($p=0.597$). Anemia was present in 71 (68.9%) male and 37 (78.7%) female patients; however, this difference was not statistically significant ($p=0.215$). No significant sex-based differences were observed for hypertension, hypocalcemia, hyperphosphatemia, or anemia (Table III).

Table III: Association of Selected Cardiovascular Risk Factors and CKD-Related Abnormalities with Sex (N = 150)

		Male (n=103)	Female (n=47)	p-value
Hypertension	Yes	67	29	0.692
	No	36	18	
Type 2 Diabetes Mellitus	Yes	46	11	0.013
	No	57	36	
Hypocalcemia	Yes	65	32	0.554
	No	38	15	
Hyperphosphatemia	Yes	50	25	0.597
	No	53	22	
Anemia	Yes	71	37	0.215
	No	32	10	

Discussion

This study evaluated the prevalence of traditional cardiovascular risk factors (hypertension and type 2 diabetes mellitus) and CKD-related cardiovascular risk-associated abnormalities (anemia, hypocalcemia, and hyperphosphatemia) among patients with chronic kidney disease (CKD) receiving maintenance hemodialysis at a tertiary care hospital in Pakistan. The principal findings were that anemia was the most prevalent CKD-related cardiovascular risk-associated abnormality in our study (72.0%), followed by hypocalcemia (64.7%), hypertension (64.0%), hyperphosphatemia (50.0%), and type 2 diabetes mellitus (38.0%). With the exception of diabetes mellitus, which was significantly more common among male patients, no significant differences in cardiovascular risk factors were observed across age or sex groups.

The mean age of the study population was 51.2 ± 8.4 years, and most participants were between 46 and 70 years of age. A male predominance was observed, with a male-to-female ratio of 2.2:1, which is consistent with previous studies reporting a higher proportion of men among patients receiving maintenance hemodialysis.^{14,15} This pattern may reflect differences in disease prevalence, healthcare access, and health-seeking behavior.

In the present study, hypertension was observed in 64.0% of patients receiving maintenance hemodialysis, while type 2 diabetes mellitus was present in 38.0%. These findings are broadly comparable with data from Pakistan, although some variation exists between study populations. A recent study among hemodialysis patients in Lahore reported hypertension in 58% and diabetes mellitus in 56% of participants, compared with 64.0% and 38.0%, respectively, in our cohort.¹⁴ The higher prevalence of hypertension in our study may reflect differences in patient characteristics, referral patterns, dialysis-related factors, and diagnostic criteria, whereas the lower prevalence of diabetes may be related to differences in the underlying causes of CKD and demographic characteristics. In our study, diabetes mellitus was significantly more common among male patients than female participants (44.7% vs. 23.4%; $p=0.013$). However, the cross-sectional design of the study does not allow causal inferences regarding this association.

The observed sex difference may reflect differences in underlying diabetes prevalence, lifestyle factors, healthcare utilization, or other unmeasured characteristics of the study population. Further multicenter studies with larger sample sizes are needed to determine whether this association is consistent across patients receiving maintenance hemodialysis.

Disorders of mineral metabolism were highly prevalent in this cohort. Hypocalcemia was observed in 64.7% of patients, while hyperphosphatemia affected 50.0%. These findings are consistent with the well-recognized disturbances in calcium-phosphate homeostasis that occur in advanced CKD due to impaired phosphate excretion, reduced vitamin D activation, and secondary hyperparathyroidism.¹⁷ Although these abnormalities were slightly more frequent among female patients, the differences were not statistically significant.

Anemia was the most prevalent CKD-related cardiovascular risk-associated abnormality affecting nearly three-quarters of the study population. Reduced erythropoietin production, iron deficiency, chronic inflammation, and shortened red blood cell survival contribute to the high prevalence of anemia in patients with advanced CKD.¹⁹ Although anemia was more common among female participants, the difference did not reach statistical significance. Early identification and appropriate management of anemia are important components of comprehensive care for patients receiving maintenance hemodialysis.¹⁹

The findings of this study have important clinical implications for the management of patients undergoing maintenance hemodialysis in Pakistan. Regular assessment of blood pressure, glycemic status, hemoglobin, and mineral metabolism should form an integral part of routine nephrology care to facilitate early identification and management of cardiovascular risk factors.

This study has several limitations. As a single-center, cross-sectional study, the findings may not be generalizable to the wider CKD population and causal relationships cannot be established. The relatively small sample size may have limited statistical power to detect significant subgroup differences. In addition, the sample size was calculated using the best available national CKD

prevalence estimate during protocol development rather than an outcome-specific prevalence for cardiovascular risk factors in patients receiving maintenance hemodialysis, which should be considered when interpreting the findings. Laboratory parameters were measured at a single time point without longitudinal follow-up. In addition, dialysis adequacy, duration and frequency of hemodialysis, underlying causes of CKD, cardiovascular imaging findings, cardiac biomarkers, nutritional status, medication adherence, and socioeconomic factors were not evaluated. Future multicenter prospective studies incorporating these variables are warranted to provide a more comprehensive assessment of cardiovascular risk in patients with CKD receiving maintenance hemodialysis.

Conclusion

Traditional cardiovascular risk factors and CKD-related abnormalities associated with cardiovascular risk were common among patients receiving maintenance hemodialysis. Anemia was the most prevalent abnormality, followed by hypocalcemia, hypertension, hyperphosphatemia, and type 2 diabetes mellitus. Type 2 diabetes mellitus was more prevalent among male participants, whereas the remaining variables were not significantly associated with age or sex. Routine assessment and appropriate management of these abnormalities should be incorporated into the care of patients receiving maintenance hemodialysis to reduce cardiovascular risk.

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CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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