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Research Article

Cardiovascular Risk Factors and Its Presentation on Different Stages of Chronic Kidney Disease: Bangladesh Context

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Abstract:

Purpose:

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in patients with chronic kidney disease (CKD), with risk amplified by both traditional factors (hypertension, diabetes, dyslipidemia) and CKD-specific mechanisms such as inflammation, oxidative stress, anemia, and mineral bone disorders. Patients with chronic kidney disease (CKD) are associated with a significantly elevated cardiovascular risk.

Methods:

A hospital-based descriptive cross-sectional study was conducted and a total of 82 CKD patients were included in this study. SPSS version 25 used to analysis the data and Data analysis includes frequency distribution, cross-tabulation, co-relation and association, and statistically significant tests between variables (X2, p-value, and CI).

Results:

About 68.3% (n=56) patients were males and 31.7% (n=26) patients were females. About 80% (n=8) male and 20% (n=2) of the female patients were in the stage 3 followed by 66.7% (n=3), 33.3% (n-4) was stage 4 and 66.1% (n=39) and 33.9% (n=20) were stage 5 of the male and female patients respectively. The majority (41.5%) of the patients were 51-60 years age group and we found that around 34% of the young adults (31-50 years age group) also suffering from CKD. There was strong association of middle-aged people and suffering of CKD stages (x2 = 25.90, df = 9; Cramer's V = .39, OR: .68; 95% CI: .69-.91; p= .003). About 46.3% (n=38) patients had diabetes, 29.3% (n=24) had hypertension and 24.4% (n=20) of the glomerulonephritis of the CKD patients in our study. The average BMI was 25.05±4.18 kg/m2 in stages of 4 CKD and 24.00±3.52 kg/m2 in stage 5 CKD (p>.05). Around 50% (n=6) of the stage 4 CKD patients had BMI>25 kg/m2, 35.6% (n=21) had stage 5 CKD with almost same BMI. About 78% (n=46) of the patients had Micro-albuminuria with stage 5 CKD, 8.5% (n=5) had Non-Nephrotic range proteinuria with stage 5 CKD and 13.5% (n=8) of the patients had Nephrotic range proteinuria with stage 5 CKD (x2 = 35.70, df = 9; Cramer's V = .39, OR: .88; 95% CI: .85-1.950; p= .003). Cardiovascular risk factors at stage 5 were physical inactivity (67%), smoking (39%), hypertension (100%), diabetes (47%) and LVH (47%) very common. There was a strong association between above risk factors and stage 5 CKD of the patients (x2 = 25.60, df = 8; Cramer's V = .36, OR: .82; 95% CI: .78-1.440; p= .05).

Conclusion:

Understanding the complex disease mechanisms between CKD and elevated cardiovascular risk might contribute to optimizing individual patients' risk stratification and result in individualized diagnostic and treatment strategies via appropriate clinical biomarker application and individualized anti-inflammatory approaches. Early detection, individualized risk assessment, and the development of CKD-focused management strategies are essential to improve outcomes.

Key words: chronic kidney disease; cardiovascular risk; LVH; CMCH

Introduction:

Chronic Kidney Disease (CKD) is becoming a major public health issue in South Asian countries and CKD emerged as a global age standardized chronic disease that dramatically increased double between 2000 and 2025 [1]. Chronic Kidney Disease affects an estimated 674 million to over 850 million people globally [2]. The condition affects approximately 10%–13% of the world's population, making it a major, rising health crisis, with cases expected to rise due to diabetes, hypertension, and an aging population [3]. As of 2023, approximately 788 million people aged 20 years and older were estimated to have CKD, a significant rise from 378 million in 19904. The global age-standardized prevalence of CKD in adults is roughly 14.2%5. The prevalence of gender specific is approximately 10.4% in men and 11.8% in women. About 5.3 to 10.5 million people worldwide require dialysis or transplantation, yet many do not receive6. The key contributors of increasing number of CKD patients largely driven by increased prevalence of diabetes mellitus, hypertension, obesity, and an aging population7. There are region-specific risk factors that influence prevalence of CKD although the variation of mortality and morbidity related to age, sex, and socioeconomic status of the community [8].

Non-communicable diseases (NCDs) have emerged as the leading health crisis in Bangladesh, accounting for approximately 71% of all deaths in the country as of early 20269. The rapid epidemiological transition has shifted the burden from infectious diseases to chronic conditions, with NCDs now causing about 67% of estimated annual deaths, a significant portion of which are premature.

Chronic kidney disease (CKD) poses a severe, rapidly rising, and largely under-diagnosed burden in Bangladesh, with prevalence estimated around 22.48% exceeding both South Asian and global averages10. Driven primarily by uncontrolled hypertension and diabetes, this NCD burden is worsened by high out-of-pocket costs (66% of health spending) and limited primary care screening, often leading to late-stage diagnosis11. Studies indicate that roughly one in four people in Bangladesh may be suffering from some form of kidney disease, with prevalence sometimes higher in urban areas (~26%). Hypertension (20%–24% prevalence) and type 2 diabetes (7.2%–7.4% prevalence) are the primary, increasing drivers behind the CKD epidemic. Rural populations are heavily affected, with studies finding that 1 in 3 people with high blood pressure in rural areas have a high risk of developing CKD11. Studies show that CKD cases can be skewed towards males, with one study indicating 54.76% of patients were male, though both genders face significant risks12. Climate change-driven increases in water salinity in coastal regions are strongly linked to rising hypertension and subsequent kidney issues. The high cost of treatment and lack of widespread subsidized care make CKD a major cause of financial catastrophe for families, contributing to the broader 61% disease burden caused by NCDs in the country. Chronic Kidney Disease (CKD) patients face high cardiovascular (CV) risk from both traditional factors (hypertension, diabetes, smoking, dyslipidemia) and CKD-specific issues like inflammation, anemia, oxidative stress, vascular calcification, and abnormal calcium-phosphate metabolism, leading to higher rates of heart attack, stroke, and sudden death, requiring a multidisciplinary approach and specific therapies like SGLT2 inhibitors for management.

This study is conducted to evaluate cardiovascular risk factors in CKD patients that may be useful to understand the nature of risk factors and study findings may materials to reduce the rate of CKD progression and development of CVD in Bangladesh context.

Methods:

Design of the Study:

We collected our quantitative data following the cross-sectional study design. A structured questionnaire was used to collect data from the patients who attended a tertiary hospital and medical college. A total of 82 patients were included during the study period following the approved study protocol. A purposive sampling method we followed to recruit the patients. The study duration was six months. We included all patients of CKD admitted in CMCH Medicine and nephrology department.

Study Location:

The study was conducted at Medicine and nephrology department of Chittagong medical college and Hospital, Bangladesh.

Inclusion Criteria:

- Patients with CKD
- All ages patients
- Patients willing to participate in the study

Exclusion Criteria:

- Patients on renal replacement therapy (Transplantation or dialysis)
- Patients not willing to participate in the study
- Seriously ill patients, bedridden patients

Sampling of the Respondents:

CKD Patients were selected purposively and data were recorded in the pre-design questionnaire. Fisher, et al., 1991 was followed to determine the sample size of the study. The respondents aged 30 years and above were included in this study. The proportional representation according to the inclusion of the age groups were confirmed.

Data collection tool development:

An interview format was developed and used to collect clinical data, including structured and open-ended questions. The interview schedule was pretested, the results of which were analyzed to determine reliability. A nephrologist determined the validity of the questions.

Study procedure:

The researcher had a data quality control mechanism following the submitted study protocol. According to the inclusion and exclusion criteria, clinical examination and information related to patients and CKD relevant and its risk factors was recorded. 10 cc venous blood was collected following the Jaffe, God-pep, Chod-pep and TGO-pep methods. Glomerular filtration rate was calculated by modification of diet in Renal disease (MDRD) formula. LVH was evaluated by echocardiogram (LVH defined as when LV diameter >13mm). Every day collected data is checked and edited if required. Necessary data clearance and consistency were checked and SPSS data was rechecked accordingly.

Consent and Ethical Consideration:

Ethical clearance for the study has been obtained from Chittagong Medical College and Hospital. Written and verbal consent was obtained from each participant after explaining the purpose and nature of the research. Participation in the study was voluntary and participants were informed of their right to quit/refuse their participation at any stage of the study if they do not want to participate. Confidentiality of the information was assured by using an anonymous consent form.

Data analysis plan:

Collected data was edited and coded and then entered into the computer for analysis. The data was analyzed using the Statistical Package for Social Science (SPSS) version [26]. A univariate logistic regression with adherence as the dependent variable was used to determine variables that are independently associated with adherence. Secondly, variables with significant univariate associations ($p<0.05$) were entered into a multivariate logistic regression model using backward elimination to identify variables that are significant predictors of adherence to corneal ulcer screening. Potential predictors of adherence (such as age, gender,

eGFR, stage of CKD) were considered. Data analysis includes frequency distribution, cross-tabulation, co-relation and association, and statistically significant tests between variables (X2, p-value, and CI).

Results:

About 68.3% (n=56) patients were males and 31.7% (n=26) patients were females. The male and female ration was 2.1. In our study around 80% (n=8) male and 20% (n=2) of the female patients were in the stage 3 followed by 66.7% (n=3), 33.3% (n-4) was stage 4 and 66.1% (n=39) and 33.9% (n=20) were stage 5 of the male and female patients respectively. The majority (41.5%) of the patients were 51-60 years age group and we found that around 34% of the young adults (31-50 years age group) also suffering from CKD. There was strong association of middle-aged people and suffering of CKDstages (x2 = 25.90, df = 9; Cramer's V = .39, OR: .68; 95% CI: .69-.91; p= .003)

	Stages of CKD						
Age categories	Stage 2	Stage 3	Stage 4	Stage 5	Total	95% CI	Significance of the test
>30 years	-	-	8.3% (n=1)	13.6% (n=8)	11% (n=9)	.710-.952	$\chi 2$ =22.50, DF= 7, P =.07
31-40 years	100% (n=1)	20% (n=2)	-	15.3% (n=9)	14.6% (n=12)	.680-.925	$\chi 2$ =28.60, DF= 9, P =.003
41-50 years	-	20% (n=2)	16.7% (n=2)	20.2% (n=12)	19.5% (n=16)	.680-.955	$\chi 2$ =26.60, DF= 9, P =.002
51-60 years	-	40% (n=4)	58.4% (n=7)	39% (n=23)	41.5% (n=34)	.675-.950	$\chi 2$ =26.60, DF= 9, P =.001
61-70 years	-	10% (n=1)	8.3% (n=1)	8.5% (n=5)	8.5% (n=7)	.680-.955	$\chi 2$ =26.60, DF= 9, P =.003
<70 years	-	10% (n=1)	8.3% (n=1)	3.4% (n=2)	4.9% (n=2)	.669-.950	$\chi 2$ =32.60, DF= 10, P=.04

Table 1: CKD stages of the patients by age

About 46.3% (n=38) patients had diabetes, 29.3% (n=24) had hypertension and 24.4% (n=20) of the glomerulonephritis of the CKD patients in our study. The average BMI was 25.05±4.18 kg/m2 in stages of 4 CKD and 24.00±3.52 kg/m2 in stage 5 CKD (p>.05). Around 50% (n=6) of the stage 4 CKD patients had BMI>25 kg/m2, 35.6% (n=21) had stage 5 CKD with almost same BMI. We did not find any association of stages of CKD and BMI of the CKD patients (x2 = 12.70, df = 5; Cramer's V = .29, OR: .48; 95% CI: .45-2.91; p= .056).

	Stages of CKD						
Age categories	Stage 2	Stage 3	Stage 4	Stage 5	Total	95% CI	Significance of the test
Micro-albuminuria	-	80% (n=8)	91.7% (n=11)	78% (n=46)	79.2% (n=65)	1.110-2.950	$\chi 2$ =29.50, DF= 12, P =.03
Non-Nephrotic range proteinuria	100% (n=1)	20% (n=2)	-	8.5% (n=5)	9.8% (n=8)	1.120-2.850	$\chi 2$ =25.70, DF= 8, P =.002
Nephrotic range proteinuria	-	20% (n=2)	8.3% (n=1)	13.5% (n=8)	11% (n=9)	1.130-2.760	$\chi 2$ =28.50, DF= 9, P =.004

Table 2: CKD stages by types of proteinuria

Our distribution of types of proteinuria and stages of CKD showed that 78% (n=46) of the patients had Micro-albuminuria with stage 5 CKD, 8.5% (n=5) had Non-Nephrotic range proteinuria with stage 5 CKD and 13.5% (n=8) of the patients had Nephrotic range proteinuria with stage 5 CKD (table 2). We found strong association between type of proteinuria and patients stages of CKD (x2 = 35.70, df = 9; Cramer's V = .39, OR: .88; 95% CI: .85-1.950; p= .003).

Cardiovascular risk factors at stage 5 were physical inactivity (67%), smoking (39%), hypertension (100%), diabetes (47%) and LVH (47%) very common. There was a strong association between above risk factors and stage 5 CKD of the patients (x2 = 25.60, df = 8; Cramer's V = .36, OR: .82; 95% CI: .78-1.440; p= .05).

Discussion:

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in Chronic Kidney Disease (CKD) patients, with risk accelerating as kidney function declines. CKD is an independent risk factor for cardiovascular events, often termed cardiorenal syndrome. Key drivers include traditional risk factors (hypertension, diabetes, dyslipidemia) and CKD-specific factors (inflammation, anemia, mineral metabolism disorders).

Our discussion section highlights the risk factors of cardiovascular disease (CVD) with chronic kidney disease (CKD).

The evidence consistently demonstrates that CKD is not merely a comorbidity but an independent and potent risk factor for CVD, with both traditional (hypertension, diabetes, dyslipidemia, smoking) and CKD-specific (chronic inflammation, anemia, oxidative stress, mineral and bone disorders, fluid overload) contributors accelerating cardiovascular pathology. Literature showed that the risk of cardiovascular events and mortality increases progressively as renal function declines, with even early-stage CKD conferring a risk that surpasses that of reaching end-stage kidney disease (ESKD)[12]. This risk is further amplified in advanced CKD and dialysis-dependent populations, where cardiovascular complications account for up to half of all deaths.

In our study majority of the patients were males and males also larger number in the stage 5 of CKD. Cardiovascular disease (CVD) is the leading cause of death in chronic kidney disease (CKD), affecting 50% of patients with advanced (Stage 4-5) CKD. Risk factors include traditional elements (hypertension, diabetes, smoking) and unique CKD-related factors (anemia, uremia, mineral metabolism disorders) that accelerate atherosclerosis, heart failure, and vascular calcification[13].

Our data revealed that majority (41.5%) of the patients were 51-60 years age group and we found that around 34% of the young adults (31-50 years age group) also suffering from CKD. This finding associated with age of middle people and co-morbidity of suffering of CKD stages.

Diabetes mellitus (DM) and Chronic Kidney Disease (CKD) are two of the strongest, often co-existing risk factors for cardiovascular disease (CVD), creating an additive or multiplicative risk for heart attacks, stroke, and heart failure. Approximately 30-40% of people with diabetes develop diabetic kidney disease (CKD), leading to high rates of premature death[15]. About 46.3% (n=38) patients had diabetes, 29.3% (n=24) had hypertension and 24.4% (n=20) of the glomerulonephritis of the CKD patients in our study.

The average BMI was 25.05±4.18 kg/m2 in stages of 4 CKD and 24.00±3.52 kg/m2 in stage 5 CKD (p>.05). Around 50% (n=6) of the stage 4 CKD patients had BMI>25 kg/m2, 35.6% (n=21) had stage 5 CKD with almost same BMI. High BMI 25 kg/m is a major risk factor for cardiovascular disease (CVD), including hypertension, diabetes, and abnormal cholesterol, typically increasing with weight. Maintaining a healthy BMI significantly reduces these risks, while obesity leads to higher morbidity and earlier onset of CVD.

About 78% (n=46) of the patients had Micro-albuminuria with stage 5 CKD, 8.5% (n=5) had Non-Nephrotic range proteinuria with stage 5 CKD and 13.5% (n=8) of the patients had Nephrotic range proteinuria with stage 5 CKD.

Cardiovascular risk factors at stage 5 were physical inactivity (67%), smoking (39%), hypertension (100%), diabetes (47%) and LVH (47%) very common. There was a strong association between above risk factors and stage 5 CKD of the patients. Microalbuminuria (MAU) is a key marker of early-stage chronic kidney disease (CKD) and a strong, independent predictor of cardiovascular (CV) mortality and morbidity. It represents systemic endothelial damage and vascular leakage, directly linking kidney disease with severe cardiovascular risks such as heart failure, stroke, and left ventricular hypertrophy

Physical inactivity is a major, independent modifiable risk factor for cardiovascular disease (CVD), ranking alongside smoking, high blood pressure, and high cholesterol in mortality impact. Sedentary behavior contributes directly to obesity, hypertension, diabetes, and systemic inflammation, with inactive individuals facing 30–50% higher risk of developing high blood pressure.

Conclusion:

Understanding the complex disease mechanisms between CKD and elevated cardiovascular risk might contribute to optimizing individual patients' risk stratification and result in individualized diagnostic and treatment strategies via appropriate clinical biomarker application and individualized anti-inflammatory approaches. Early detection, individualized risk assessment, and the development of CKD-focused management strategies are essential to improve outcomes.

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Author contributions:

All authors together conceived and developed the study under the lead of the first author. The 1st author developed the study concept note and questionnaire. All authors attended the synthesis of the data into SPSS for analysis and writing the draft version. All authors developed the first draft and the entire team discussed the results and contributed to the final manuscript and approved the final draft of the manuscript.

Conflict of Interest:

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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