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Original Article

A study to assess the associated risk of developing cardiovascular diseases in chronic kidney disease

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ABSTRACT

Chronic kidney disease (CKD) is on the rise around the world and is strongly linked with the incidence of cardiovascular disease (CVD). This six-month observational study was conducted in the nephrology division of a 300-bed, multi-specialty tertiary care teaching hospital. A total of 90 prescriptions written for inpatients and outpatients in the nephrology ward are considered based on the inclusion criteria. Patient case sheets, patient questionnaires and interviews, biomedical and radiological reports, and the medication regimen chart are the primary means of data gathering. In this study, we identified the patient's age, hypertension, lipid abnormalities, male gender, cigarette smoking, and family history as traditional risk factors for both CVD and CKD. Nearly 40% of 90 individuals had a high risk of CVD, followed by 25 with intermediate risk, 19 with borderline risk, and 6 with low risk. We further conclude that successful CKD and CVD therapy requires good glycemic control, anti-hypertensive medicine, and hypolipidemic medication. Diabetes patients received SGLT-2 inhibitors, which improve CKD and CVD. The development of chronic kidney disease to stages 4 and 5 is slowed by anti-hypertensive medication, particularly with renin-angiotensin-aldosterone system inhibitors such as angiotensin-receptor blockers and angiotensin-converting enzyme (ACE) inhibitors. Patients with persistent hypertension, albuminuria, or heart failure with a poor ejection fraction benefit from treatment with aldosterone receptor antagonists. People with chronic kidney disease benefit from low-dose aspirin for secondary prevention of cardiovascular disease. Despite medication advancements, high blood pressure (BP) patients need a customised and evidence-based management plan to control BP, minimise CVD risk, and delay CKD progression. Early CKD treatment is essential for preventing the progression of both CKD and CVD.

1. Introduction

The term "chronic kidney disease" (CKD) describes a medical condition in which kidney function is reduced, leading to insufficient blood filtration. The term "chronic" describes the resulting renal impairment due to a medical disease that develops slowly over time[1, 2]. The damage described above may cause an increase in waste products already present in the human body. Several possible side effects might arise from having CKD. CKD also referred to as a chronic renal failure, chronic renal insufficiency, pre-dialysis, and pre-end-stage renal disease, is often

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categorised according to the underlying cause of the condition. As the condition progresses, individuals may experience the manifestation of oedema, characterised by localised swelling. Oedema occurs because of impaired renal excretion of excess fluid and sodium. Oedema may manifest in the lower extremities, namely the legs, feet, or ankles, and less often in the upper extremities, such as the hands or face [3, 4]..

The two approaches to diagnosing chronic kidney disease are a kidney biopsy or other indications of kidney damage for at least three months, with or without a decline in glomerular filtration rate (GFR), or a decline in GFR (60 mL/min per 1.73 m2) for at least three months, with or without evidence of kidney damage. The presence of albuminuria, haematuria, abnormal urine sediment, or a pathologic kidney biopsy are signs of an anatomical or structural problem, while a decline in GFR indicates a functional impairment in the kidneys. These symptoms must persist for a minimum of three months to establish the diagnosis of CKD [5].

The doctor should be able to identify the patient's stage of CKD after its diagnosis. Five main stages may be distinguished, with the severity of the sickness and degree of disease being strongly correlated with the pace of GFR decrease. The first two phases of kidney disease may exhibit either a normal GFR or a little decline; however, they often coincide with indicative indicators of renal impairment, typically an atypical urine albumin to creatinine level [3]. The illness is often underdiagnosed, primarily because of CKD exhibiting asymptomatic characteristics. It is typically not identified until it has progressed to advanced stages [6].

The CKD is strongly linked to cardiovascular illness [7-9]. Despite current treatment options, cardiovascular mortality rates are high in people with diabetes (type 2) and CKD [10]. Furthermore, the likelihood of experiencing failure of kidney and cardiovascular actions increases in correlation with the severity and CKD stage. In individuals requiring dialysis, cardiovascular disease (CVD) was found to be the primary reason for death [11-13]. Patients with relatively well-maintained estimated glomerular filtration rate (eGFR) were found to have a higher long-term risk of cardiovascular morbidity since those having kidney diseases in the advanced stage need dialysis [14-17].

Traditional risk factors for both CVD and CKD include age, high blood pressure, diabetes mellitus, dyslipidaemia, cigarette use, family history, and being a man. The aggressive modification of high blood pressure, diabetes, cholesterol levels, and cigarette usage is possible. Still, the presence of toxic metabolites from uraemia in people with chronic kidney disease, as well as problems with how chemical elements like calcium and phosphorus are broken down, contribute to the different effects of nitric oxide. These properties include significant vasodilation as well as antiplatelet, anti-adhesive, anti-proliferative, permeability-reducing, and anti-inflammatory effects [18]. These non-traditional risk factors are the reason for the augmented cardiovascular disease incidences in CKD patients [19].

In 2020, according to the Global Burden of Disease report, CKD will account for one out of every seven fatalities worldwide. This is one of the largest increases among the primary causes of death [20], increasing by 20% since 2010. Globally, CKD affects about 850 million people, and it is projected to rise to fifth place among the leading causes of death by 2040. This epidemic of CKD has caused significant economic strain not only in developing nations but also in low- and middle-income nations. Economically developed nations provide all aspects of renal replacement therapy to their citizens, whereas countries with fewer resources struggle to engage patients with appropriate treatments [21]. The prevalence of CKD in adults with hypertension and diabetes was roughly double that of the general population [20].

In this study, we explored the interrelationships between the risk factors associated with CKD and CVD Additionally, we evaluated whether early intervention for CKD specifically intensive therapy as opposed to routine care, significantly impacts the progression of CKD and CVD.

2. Materials and Methods

2.1. Study sites, design, and period

This observational study was conducted for six months in the nephrology department of a 300-bed, multi-specialty tertiary care teaching hospital The survey included a total of 90 prescriptions written for inpatients and outpatients in the SVS nephrology ward.

2.2. Inclusion criteria

Patients who are 18 years of age or older. Individuals diagnosed with CKD who express their willingness to provide informed consent, as well as individuals who have coexisting conditions such as hypertension, diabetes, and/or dyslipidemias.

2.4. Exclusion criteria

Individuals who have been diagnosed with atherosclerotic disease, individuals who underwent major surgical procedures, individuals with immunodeficiency disorders such as HIV, and individuals with concurrent conditions such as tuberculosis.

2.6. Method of data collection

- ✓ Case Report Forms.
- ✓ Patient Questionnaire/Interview.
- ✓ Biomedical and radiological reports.
- ✓ Medication regimen chart.

2.7. Study procedure

In this prospective observational research, patients who meet the criteria are included after giving consent.

Patients' information is gathered using case report forms. The main components of this form include the patient's demographic data, current and historical medical histories, physical examination details, biomedical reports, and medication regimen.

This study took place at the SVS Medical College Hospital. All relevant information for the research has been obtained from the time of admission to the date of discharge, and the data has been assessed

2.8. The study's duration

A six-month timeframe was used to perform the study.

3. Results

3.1. The age of participants

According to the results, the number of people with chronic kidney disease is largest in the age group of 41–50 years, with 35 patients (38.8%). This is followed by the age group of 51–60 years, with 28 patients (31.1%), and the age group of over 80 years, with two patients (0.22%) (Table 1).

Table 1. The age of participants

Age	Total No of Patients	Percentage
30-40	7	7.78
41-50	35	38.89
51-60	28	31.11
61-70	12	13.33
71-80	6	6.67
>80	2	2.22

3.2. Distribution of Patients Based on Gender

Chronic kidney disease has been found in 55 males (61.2% of the total) and 35 females (38.8%) out of the 90 cases (Table 2). Figure 1 also shows how gender affects the number of people who have chronic kidney disease.

Table 2. Distribution of Patients Based on Gender

Gender	No. of patients	Percentage
Male	55	61.2
Female	35	38.8
Total	90	100

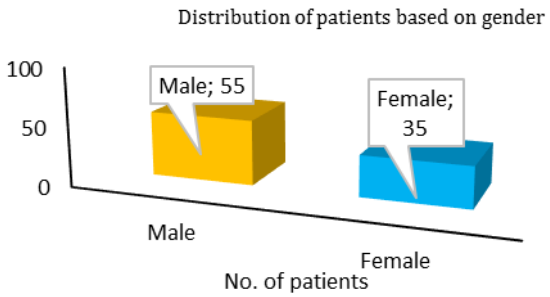

Fig. 1. Bar Diagram showing Gender-wise prevalence of chronic kidney failure

3.3. Distribution of patients based on stages of renal failure

CKD is characterised by kidney damage or by an eGFR less than 60 ml/min/1.73 m2 that has persisted for at least three months [22]. There are five stages of GFR:

GFR 90 mL/min/1.73 m2 is considered as G1, GFR 60-89 mL/min/1.73 m2 as G2, 45-59 mL/min/1.73 m2 as G3a, 30-44 mL/min/1.73 m2 as G3b, 15-29 mL/min/1.73 m2 as G4 and 15 mL/min/1.73 m2 as G5. The five stages of renal disease are categorised. The first stages of chronic kidney disease are phases 1–3. Stages 1 and 2 of CKD are distinguished by structural abnormalities, proteinuria, and high serum creatinine, while stage 3 of the disease is indicated by glomerular filtration rate (eGFR) estimation of 30 to 59 ml/min/1.73 m2 on at least two occasions, separated by at least three months. The earliest stage 3 infection detection may be by serum chemistry. Patients with severe CKD (CKD stages 4-5) are considerably more at risk when their GFR is less than 15 ml/min per 1.73 m2 or when they get dialysis treatment [20].

In the study that was conducted, it was seen that the majority of individuals were classified as stage 2, with a total of 35 patients. This was followed by stage 3, which consisted of 27 patients; stage 4 with 15 patients; stage 5 with 9 patients; and the least prevalent stage, stage 1, with just 4 patients (Table 3).

Table 3. Distribution of patients based on stages of renal failure

Stage of CKD	No. of patients	Percentage
Stage 1	4	4.44
Stage 2	35	38.89
Stage 3	27	30.0
Stage 4	15	16.67
Stage 5	9	10.0

3.4 Risk of Cardiovascular Disease According to ASCVD Risk Estimator Plus

The Atherosclerotic Cardiovascular Disease (ASCVD) risk calculator was developed by the American College of Cardiology (ACC). The tool is sometimes referred to as the ASCVD Risk Estimator Plus. This tool evaluates the probability of an individual acquiring cardiovascular disease within a decade. The assessment considers various patient risk factors, including age, gender, ethnicity, blood pressure, utilization of antihypertensive medications, cholesterol levels, usage of statins, diabetes status, family medical history, prior aspirin therapy for mitigating cardiovascular risks, and smoking habits (past or present).

In the present investigation, the ASCVD risk calculator was used to evaluate the risk of heart disease in individuals with chronic renal disease. In this investigation, it was observed that almost 40 patients exhibited a high risk of developing CVD, followed by 25 patients with an intermediate risk, 19 patients with a borderline risk, and 6 patients who were classified as having a low risk, as shown in Table 4.

Table 4. Risk of Cardiovascular Disease According to ASCVD Risk Estimator Plus

RISK of CVD	No. of patients
Low-risk (<5%)	06
Borderline risk (5% to 7.4%)	19
Intermediate risk (7.5% to 19.9%)	25
High risk (≥20%)	40

3.5. Treatment approaches used to minimise the risk of cardiovascular disease.

Also, Hypertension, diabetes, and dyslipidemia are among the concurrent disorders that the majority of CKD patients have. Treatment is based on the stage of the illness and the findings of the biochemistry. Dietary change has a substantial impact on CKD. In contrast to regular protein intake, a low-protein diet led to a slower decline in GFR, which slowed the progression of the disease. It may also help to avoid kidney damage by consuming less acid in the diet (for example, eating a greater number of vegetables and fruits as well as fewer meat, poultry, eggs, and cheese). In our research, the results of altering the typical risk factors, such as quitting smoking, consuming less alcohol, exercising regularly, and losing weight for both renal and cardiovascular disease, have shown excellent advantages.

Drug dosages may be changed in people with CKD by measuring the GFR and medication clearance by the kidneys. Adequate glycemic management, in addition to anti-hypertensive and hypolipidemic medications, is essential for the successful treatment of CKD and CVD. Patients with diabetes are given sodium-glucose co-transporter inhibitors-2 (SGLT-2 inhibitors) which have been found to improve CKD and CVD. Aside from lowering blood pressure, anti-hypertensive therapy, particularly when combined with inhibitors of the renin-angiotensin-aldosterone system (RAAS) like ACE (angiotensin-converting enzyme) inhibitors and angiotensin-receptor blockers, also reduces proteinuria, delays the progression of advanced chronic kidney disease (stages 4 or 5), and slows the loss of estimated glomerular filtration rate (eGFR). Aldosterone receptor antagonists may also be taken into consideration for individuals with albuminuria, hypertension that is resistant to therapy, or heart failure with a low ejection fraction. Statin and ezetimibe-based hypolipidemic treatment have shown positive effects on both CKD and CVD. Some patients with CKD get low-dose medications like aspirin, platelet inhibitors, and thrombolytics as secondary CVD prophylaxis. The majority of people with CKD may benefit from diuretics when they are managed. They decrease the amount of extracellular fluid, blood pressure, and the risk of CVD in CKD. The treatment of CKD typically involves the use of diuretics like furosemide and torsemide. The greatest results were seen in several other patients' cases after starting dialysis. Furthermore, we advised the patient to stop taking NSAIDs, proton pump inhibitors, and other herbal treatments until a doctor advised them to do so since they may result in nephrotoxicity.

Patients with CKD are more vulnerable to the side effects of medications, hence those with questionable therapeutic value should be avoided if possible. Information has to be given to the patients regarding options of treatment and be encouraged to take part in the process of making decisions. Information about the potential consequences of CKD should be included in early education along with various kidney replacement therapy methods. Transplantation from a living donor, preferably before or shortly after the initiation of haemodialysis, is the gold standard for treating end-stage renal disease (ESRD).

3.6. Evaluation and management of CKD-related problems

The occurrence of electrolyte imbalances, changes in mineral and bone metabolism, and anaemia were detected in a subgroup of people with moderate to severe CKD. The frequency of measuring laboratory abnormalities such as a comprehensive blood picture, albumin, basic metabolism panel, phosphate, lipid panel, thyroid hormone, parathyroid hormone, and 25-hydroxyvitamin D is determined by the stage of CKD. In certain cases, erythropoietin-stimulating medications may be used to treat anaemia. For the treatment of mineral and bone diseases, doctors often prescribe calcium acetate and vitamin D3 supplements. Treatment for hyperkalemia often includes consuming less salt and potassium. Supplemental bicarbonate is often used to treat metabolic acidosis.

4. Discussion

In our research, we observed that people between the ages of 41 and 50 are more likely to have CKD, which is similar to a study done in 2021 by Oommen John, who discovered that the median population age was 44 and that CKD risk increased with age [23]. Furthermore, we discovered that men experience CKD at a higher rate than females, which contrasts with previous research [24] that observed females experience CKD at a higher rate than males.

Therefore, several studies observed outcomes of lowering the frequent risk factors for both cardiovascular and renal disease by using both traditional and intensive care treatments. The majority of people with CKD benefit from therapy with diuretics. They reduce the amount of extracellular fluid, lower blood pressure, and reduce CVD risk in CKD. Hypolipidemic therapy, anti-hypertensive drugs and good glycemic control form the basis of effective treatment for both CKD and CVD. Since medications have been shown to have positive effects on both CKD and CVD, it is important to highlight the use of SGLT-2 inhibitors) in diabetic patients [25, 26].

Additionally, RAAS inhibitor-based anti-hypertensive medication and statin-based hypolipidemic therapy had positive effects on both CKD and CVD [27]. Aspirin, platelet inhibitors, and thrombolytics are more likely to be administered to patients with preserved GFR than to those with reduced GFR. Perhaps more significant was the finding that in the same investigations, patients with decreased GFR who underwent the procedures benefited in a manner comparable to that of patients with intact GFR [28, 29].

5. Recommendations and limitations

However, more research is required to assess the correlation between CKD and CVD, as well as to establish CKD as an analogous risk factor for cardiovascular events. Moreover, it is essential to do additional research in order to explore novel interventions for the early prevention of adverse cardiovascular outcomes. Therefore, the implementation of strategies to manage emerging risk factors in the initial phases of CKD has the potential to mitigate the advancement of both renal dysfunction and the occurrence of cardiovascular events, which are now the primary global cause of mortality.

6. Conclusion

Conventional and shared risk factors for CVD and CKD include age, hypertension, diabetes mellitus, dyslipidemia, and cigarette use, a family history of CVD or CKD, and being male. Medical professionals have an important role in reducing the worldwide burden of CKD through early detection, appropriate staging, and prompt referral. Comprehensive treatment of hypertension, diabetes, excessive cholesterol, and tobacco use is feasible.

Non-traditional risk factors, such as toxic metabolites from uraemia in people with CKD and disruptions in the metabolism of chemical components like phosphorus and calcium, contribute to the increased incidence of CVD in CKD patients. Many methods that lower cardiovascular risk are included in the best treatment for CKD. Treatment of albuminuria and delivery of renin-aldosterone antagonist inhibitors are examples of these methods. It is also important to avoid possible nephrotoxic chemicals and adjust the dosage of medications.

Patients with CKD need constant monitoring to identify and treat complications such as hyperkalemia, metabolic acidosis, anaemia, and others. CKD is a serious condition that has far-reaching effects; thus, significant efforts are needed to develop and implement effective preventative and therapeutic strategies to reduce the prevalence of CKD and slow its progression.

Abbreviations

ACC: American college of cardiology
ACE: Angiotensin-converting enzyme
ASCVD: Atherosclerotic cardiovascular disease
CKD: Chronic kidney disease
CVD: Cardiovascular disease
eGFR: Estimated glomerular filtration rate.
ESKD: End-stage kidney disease
GFR: Glomerular filtration rate
HIV: Human immunodeficiency virus
MI: Myocardial infraction
SGLT-2: Sodium glucose cotransport 2

Conflict of Interests

All authors declare no conflict of interest.

Ethics approval and consent to participate

No human or animals were used in the present research.

Consent for publications

All authors read and approved the final manuscript for publication.

Informed Consent

The authors declare not used any patients in this research.

Availability of data and material

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

Authors' contributions

All authors had equal role in study design, work, statistical analysis and manuscript writing.

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