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PREVALENCE OF CHRONIC KIDNEY DISEASE IN HYPERTENSIVE PATIENTS IN KASHMIR

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ABSTRACT
Aim: The kidneys regulate fluid balance, electrolytes, and waste elimination. Hypertension is a major risk factor for chronic kidney disease (CKD), damaging kidney function over time. This study aims to assess the prevalence of CKD in hypertensive patients and identify contributing factors. **Method**: A cross-sectional study was conducted at Government Medical College Baramulla, Jammu and Kashmir, India, with 100 hypertensive patients aged 45-65. Patients with a history of renal surgery or severe illness were excluded. Blood pressure was measured using a mercury sphygmomanometer, while serum creatinine and blood urea nitrogen (BUN) levels were analysed with an automated system. Urine tests, proteinuria assessments, and glomerular filtration rate (GFR) estimates (using the CKD-EPI equation) were performed. Data analysis was conducted using SPSS, with chi-square tests applied for categorical variables. Ethical approval and informed consent were secured. **Results**: Among the 100 patients, 53% were male and 47% female, with 63% from rural areas. CKD prevalence was higher in rural participants and increased with age. Significant associations with CKD included age (P=0.029), economic status (P=0.04), and body mass index (BMI) (P=0.01). Lifestyle factors such as smoking (P=0.001) and physical inactivity (P=0.006) were also influential. Clinically, the duration of hypertension (P=0.01) and diastolic blood pressure (P=0.002) were strongly correlated with CKD. **Conclusion**: CKD is common among hypertensive patients, especially those aged 60 and above. Key contributing factors include obesity, middle-class status, smoking, lack of exercise, prolonged hypertension, and elevated diastolic blood pressure, with beta blocker use also linked. Factors like gender, residence, education, occupation, family history, alcohol use, and comorbidities were not significant. Routine kidney function screening in hypertensive patients is essential for early detection and prevention.

KEYWORDS: Chronic kidney disease (CKD), Hypertension, Renal function tests, Glomerular filtration rate (GFR), Serum creatinine, Blood urea nitrogen (BUN).

INTRODUCTION

The kidneys play a vital role in maintaining water volume, electrolyte balance, and acid-base equilibrium in the body. They also serve the critical function of excreting metabolic waste and harmful substances. Renal function tests are essential for assessing the kidneys' functional capacity, including blood flow, glomerular filtration, and tubular function. These tests aim to detect renal impairment as early as possible and can be performed through blood and urine analysis.[1,2]

Hypertension, commonly known as high blood pressure, is a widespread medical condition contributing to kidney disease. The complex relationship between hypertension and kidney dysfunction highlights the need to understand their interaction for effective management and prevention.[3]

Hypertension places relentless strain on the kidneys' filtration units, known as nephrons. While the kidneys maintain a critical balance of fluids, electrolytes, and waste, consistently elevated blood pressure compromises the structural integrity of these nephrons. The increased pressure damages the small blood vessels and filters, reducing the kidneys' ability to function efficiently.[4,5]

One key link between hypertension and kidney disease is the glomerular filtration rate (GFR), which measures the kidneys' efficiency in filtering waste from the blood. Persistent high blood pressure can cause a gradual decline in GFR, signaling impaired kidney function.

Additionally, hypertensive nephropathy—a specific form of kidney damage caused by hypertension—leads to inflammation and scarring of renal tissue.[6]

This connection between hypertension and kidney disease is further aggravated by the renin-angiotensin-aldosterone system (RAAS), a hormonal system that regulates blood pressure and fluid balance. Chronic hypertension over activates the RAAS, accelerating kidney damage. This continuous activation increases sodium retention, which further raises blood pressure, creating a damaging cycle.[7]

Regular monitoring and effective management of blood pressure are essential to prevent or slow the progression of kidney complications related to hypertension.\

METHODOLOGY

Sample Size

A total of 100 hypertensive patients undergoing treatment were included in this study.

Inclusion and Exclusion Criteria

Patients of both genders, aged 45-65 years, were enrolled in the study. Exclusion criteria included those with a history of renal surgery, severe diseases, or polycystic kidney disorder.

Study Setting

The study was conducted at the Government Medical College, Baramulla, Jammu and Kashmir, India.

Data Collection

A convenient sampling technique was used in this prospective cross-sectional study. After informed consent, demographic data were collected through a questionnaire, and clinical data were gathered via blood and urine analyses.

Clinical Parameters

- **Blood Sample**: 2.5 ml of blood was drawn using a simple venipuncture technique, and a urine sample was collected in a 50 ml container for protein and creatinine analysis.
- **Blood Pressure**: Blood pressure was recorded after a 5-minute rest using a mercury sphygmomanometer with a standard or large cuff. Hypertension was defined as a blood pressure reading ≥140/90 mmHg.
- **Serum Creatinine**: Measured using an automated analyser with the Jaffe reaction, and reported in mg/dL. Elevated levels indicate impaired kidney function.
- **Blood Urea Nitrogen (BUN)**: This test was performed on all patients to measure the amount of nitrogen in the blood derived from urea. Elevated BUN levels suggest kidney dysfunction, measured using an automated biochemical analyser.
- **Proteinuria**: A 24-hour urine collection was performed to assess protein levels. Persistent proteinuria is a marker of kidney damage.
- **Glomerular Filtration Rate (GFR)**: GFR was calculated using the CKD-EPI equation, factoring in serum creatinine, age, sex, and race. Results were expressed in mL/min/1.73 m².
- **Imaging Studies**: These were performed to visualize the kidneys and identify any structural abnormalities.

CKD Classification

The classification of CKD was based on the National Kidney Foundation guidelines

- Stage 1: GFR ≥ 90 mL/min/1.73 m² (Kidney damage with normal or increased GFR)
- Stage 2: GFR 60-89 mL/min/1.73 m² (Kidney damage with mild GFR reduction)
- Stage 3: GFR 30-59 mL/min/1.73 m² (Moderate GFR reduction)
- Stage 4: GFR 15-29 mL/min/1.73 m² (Severe GFR reduction)
- Stage 5: GFR < 15 mL/min/1.73 m² (Kidney failure).

For multivariate analysis, a GFR < 60 mL/min/1.73 m² was considered indicative of CKD.

Statistical Analysis

Collected data were entered into a data entry form and analyzed using Microsoft Excel and SPSS version 22. Frequencies and percentages were used to describe the data. Associations between categorical variables and CKD were analyzed using chi-square tests. A p-value ≤ 0.05 was considered statistically significant.

Ethical Considerations

This study was approved by the Ethics Committee, and informed consent was obtained from all participants before the commencement of the study.

RESULTS

Table 1: Frequency distribution of individuals according to socio-demographic data.

Variables		Frequency
Area of residence	Urban	37
	Rural	63
Gender	Male	53
	Female	47
Age	45-50	22
	50-55	29

	55-60	23
	60 or above	26
profession	Employee	12
	Farmer	15
	Marchant	15
	House wife	30
	Others	28
Economics (Income per month)	Upper class	21
	Middle class	58
	Lower class	21
Education	illiterate	16
	primary	26
	matriculation	27
	higher	31
Marital status	married	72
	Divorced/widowed	13
	single	15
BMI. Category	Normal Weight	53
	Under weight	12
	Over Weight	26
	Obese	9

Table 1. presents a comprehensive demographic and socioeconomic profile of a group of 100 patients. Of these, 53% were male, and 47% were female. A significant portion, 63%, lived in rural areas, while 37% were from urban areas. In terms of age distribution, 22% were between 45-50 years old, 29% were aged 50-55, 23% were between 55-60, and 26% were aged 60-65. Educationally, 16% were illiterate, 26% had primary education, 27% had completed matriculation, and 31% had attained higher education. Economically, 21% were from the upper class, 58% from the middle class, and 21% from the lower class. Regarding occupations, 12% were government employees, 14% were farmers, 15% were merchants, 30% were housewives, 28% belonged to the 'others' category, and 1% had an unclassified occupation. In terms of physical activity, 54% did not engage in regular walking, while 46% did. Marital status showed that 15% were single, 72% were married, and 13% were either widowed or divorced. Finally, BMI-wise, 12% were underweight, 53% had a normal weight, 26% were overweight, and 9% were classified as obese.

Table 2: Table shows the percentage and frequency distribution of other life style variables.

Variables	**Frequency**	
	output	**Yes**
Smoking	No	11
	yes	89
Drink alcohol	No	16
	Yes	84
Exercise	No	54
	Yes	46

Table 2. offers a thorough overview of the patients' lifestyle habits. Concerning physical activity, 54% of the patients did not engage in regular walking, while 46% did. Regarding smoking habits, 11% of the patients were smokers, while 89% did not smoke. Alcohol consumption was also assessed, showing that 16% of the patients consumed alcohol, whereas 84% did not.

Table 3: Table shows the percentage and frequency distribution of clinical data.

variables		**Frequency**
Family history of CKD	yes	17
	no	83
Other Co morbidities	No	59
	Yes	41
Duration of Hypertension	0-5 years	43
	6-10 years	37
	Above 10 years	20

DBP	<_90	72
	>90	38
SBP	<140	64
	>140	36

Table 4. provides a detailed analysis of various clinical parameters in the patient cohort. Systolic blood pressure (SBP) data showed that 64% of the patients had an SBP below 140 mmHg, while 36% had an SBP exceeding 140 mmHg. Comorbid diseases were present in 41% of the patients, with the remaining 59% having no comorbid conditions. The duration of hypertension varied, with 43% of patients having had the condition for 0-5 years, 37% for 6-10 years, and 20% for more than 10 years. A family history of kidney disease was reported by 17% of the patients, while 83% had no such history. Additionally, proteinuria was observed in 61% of the patients, while 39% did not show signs of proteinuria.

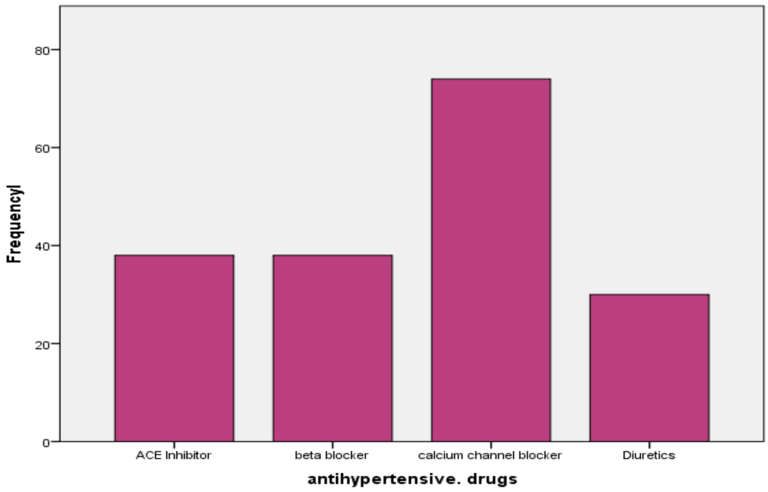

Figure 1: Figure represents the frequency distribution of utilization antihypertensive drugs.

This graph (Shown in fig.1) represents the antihypertensive medicines used by patients. Majority of 74 patients used calcium channel blocker; beta blocker and ACE inhibitor were used by 38 patients. and diuretics were used by 30 patients.

Table 4: Table shows the Descriptive Data of DBP and SBP.

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Diastolic blood pressure	100	60.00	110.00	85.2700	10.51200
Systolic blood pressure	100	100.00	170.00	138.8000	12.72872

Table 4. offers a statistical summary of blood pressure measurements in the patient group. Diastolic blood pressure ranged from a minimum of 60.00 mmHg to a maximum of 110.00 mmHg, with a mean of 85.27 mmHg and a standard deviation of 10.51 mmHg. Systolic blood pressure values ranged from a minimum of 100.00 mmHg to a maximum of 170.00 mmHg, with a mean of 138.80 mmHg and a standard deviation of 12.73 mmHg.

Table 5: Table shows the Descriptive Data of urea, creatinine, GFR.

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Urea	100	4.00	182.00	52.0202	39.22488
Serum creatinine	100	.34	6.60	1.1401	1.14741
GFR	100	9.00	144.00	90.4500	34.00071

Table 6. presented a statistical analysis of renal function indicators among the patient group. For urea levels, based on 99 patients, the values ranged from a minimum of 4.00 mg/dL to a maximum of 182.00 mg/dL, with a mean of 52.02 mg/dL and a standard deviation of 39.22 mg/dL. Serum creatinine measurements, based on 100 patients, ranged from a minimum of 0.34 mg/dL to a maximum of 6.60 mg/dL, with a mean of 1.14 mg/dL

and a standard deviation of 1.15 mg/dL. The glomerular filtration rate (GFR) values ranged from 9.00 to 144.00, with a mean of 90.45 and a standard deviation of 34.00.

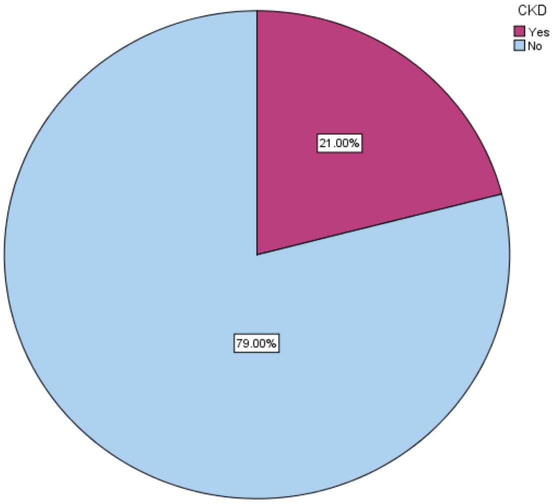

Figure 2: Figure represents the prevalence of CKD.

The above graph (shown in fig. 2) Represents the Frequency distribution of hypertensive patients who had CKD. Among the 100 patients 21 had the CKD and 79 do not had CKD.

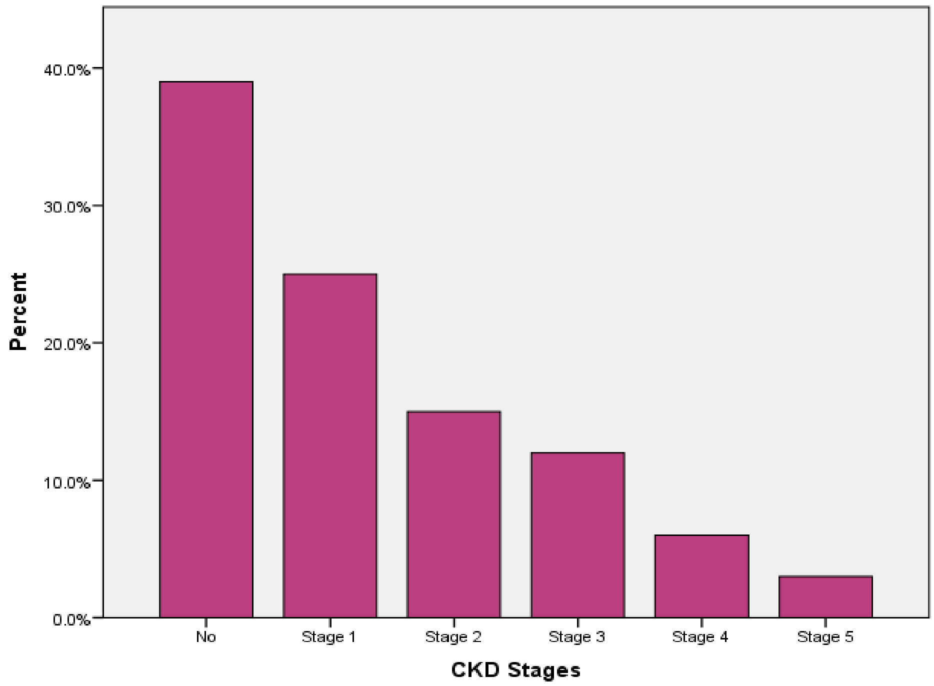

Figure 3: Figure represents the prevalence of different stages of CKD.

This graph (shown in fig. 3) represents the different stages of CKD according to calculated GFR rates. out of 100 patients 39 had no impairment of kidney functions had normal urea and GFR range.25 patients had stage 1 of CKD,15 had stage 2, stage 3 was present in 12 patient, stage 4^{th} in 6 patients and 5^{th} stage which is also called end stage renal failure was present in 3 patients.

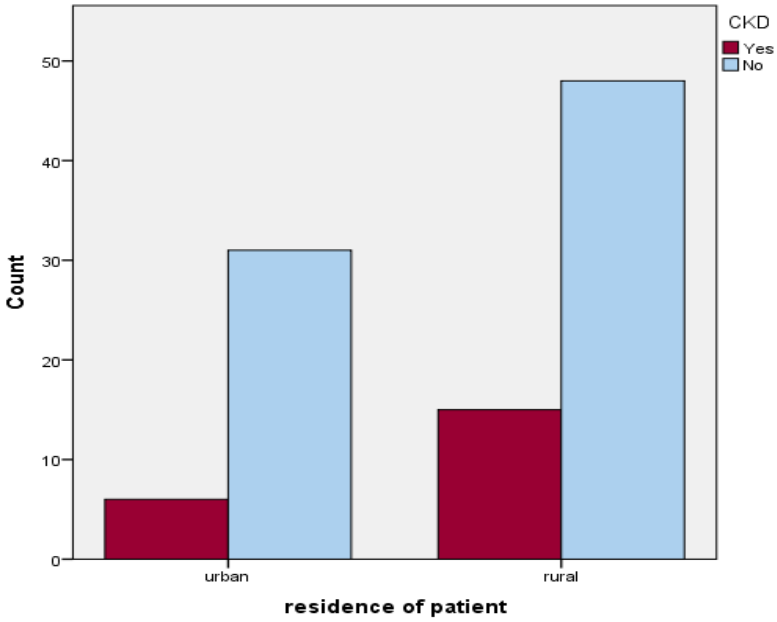

Figure 4: Frequency distribution of CKD. Among individuals according to area of residence.

This graph (shown in fig. 4) categorizes the data based on the area of residence, dividing participants into urban and rural dwellers. Among urban residents, 6 individuals were diagnosed with CKD (Chronic Kidney Disease), whereas 31 were not, totalling 37 participants from urban areas. In contrast, rural areas had a higher number of CKD cases, with 15 individuals diagnosed and 48 not diagnosed, making up a total of 63 participants. This distribution suggests a higher prevalence of CKD in rural areas compared to urban settings.

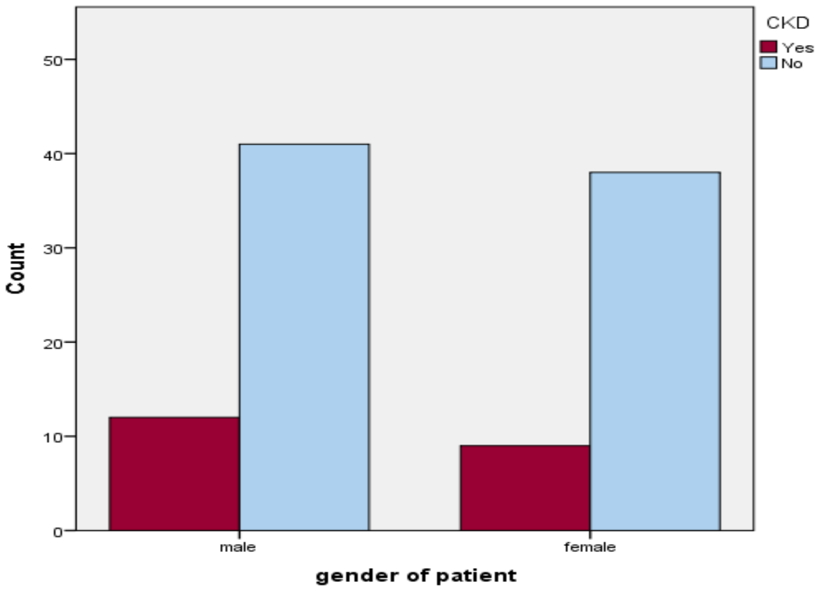

Figure 5: Frequency distribution of CKD among individuals according to Gender.

This graph (shown in fig. 5) shows that out of the total 100 participants, males constitute 53, with 12 diagnosed with CKD and 41 not diagnosed. Females make up the remaining 47 participants, with 9 diagnosed with CKD and 38 without the disease. This indicates that a slightly higher number of males than females were diagnosed with CKD, reflecting potential gender differences in CKD prevalence.

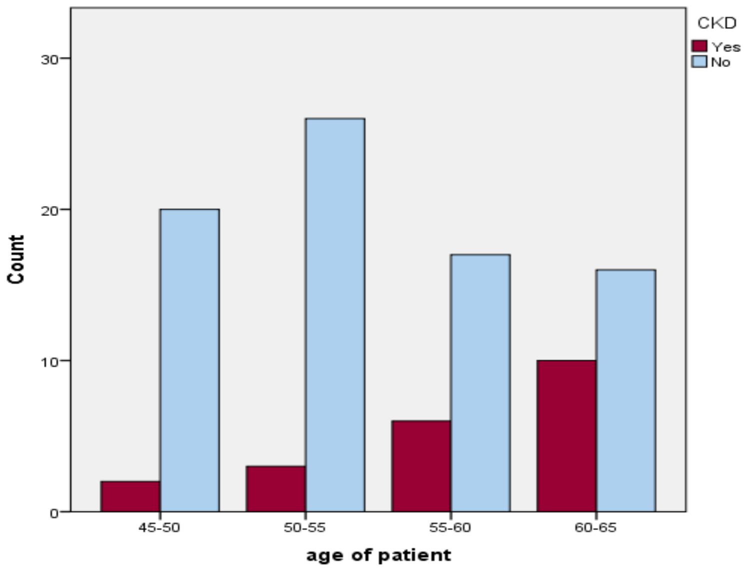

Figure 6: Frequency distribution of CKD. among individuals according to age of patients.

This graph (shown in fig.6) shows age parameter is divided into four categories: 45-50, 50-55, 55-60, and 60 or above. The 45-50 age group had 22 participants, with 2 diagnosed with CKD. The 50-55 age group included 29 participants, with 3 diagnosed cases. In the 55-60 age group, out of 23 participants, 6 were diagnosed with CKD. The oldest age group, 60 or above, had the highest number of CKD cases, with 10 out of 26 participants diagnosed. This indicates an increasing trend of CKD prevalence with advancing age.

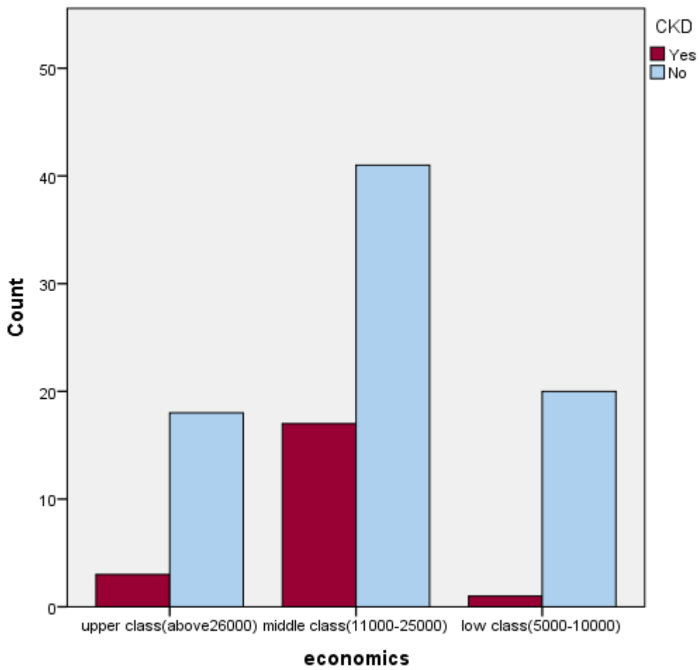

Figure 7: Frequency distribution of CKD Among individuals according to Economics status of patient.

This graph (shown in fig.7) shows economic status, based on monthly income, was classified into Upper Class, Middle Class, and Lower Class. The Upper Class had 21 participants, with 3 diagnosed with CKD. The Middle Class included the highest number of participants (58), with 17 CKD cases. The Lower Class had 21 participants, with only 1 diagnosed case. This suggests that CKD prevalence is higher in the Middle Class compared to Upper and Lower Classes.

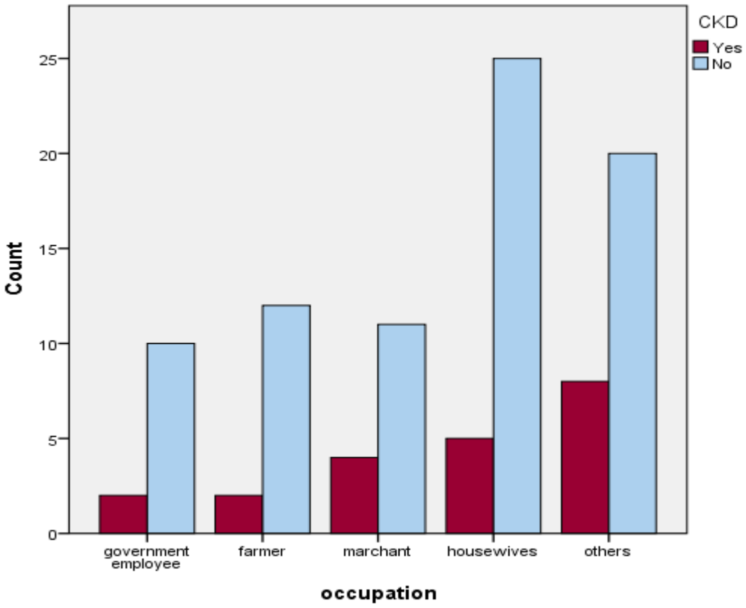

Figure 8: Frequency distribution of CKD among individuals according to occupation status of patient.

This graph (shown in fig.8) shows participants' professions were considered, with five categories: Employee, Farmer, Merchant, Housewife, and Others. Employees had 12 participants, with 2 diagnosed with CKD. Farmers included 15 participants, with 2 cases of CKD. Merchants had 4 CKD cases out of 15 participants. Housewives showed 5 CKD cases among 29 participants, while the 'Others' category had 8 diagnosed cases out of 28 participants. This distribution suggests varying CKD prevalence across different professions, with the 'Others' category having the highest number of cases.

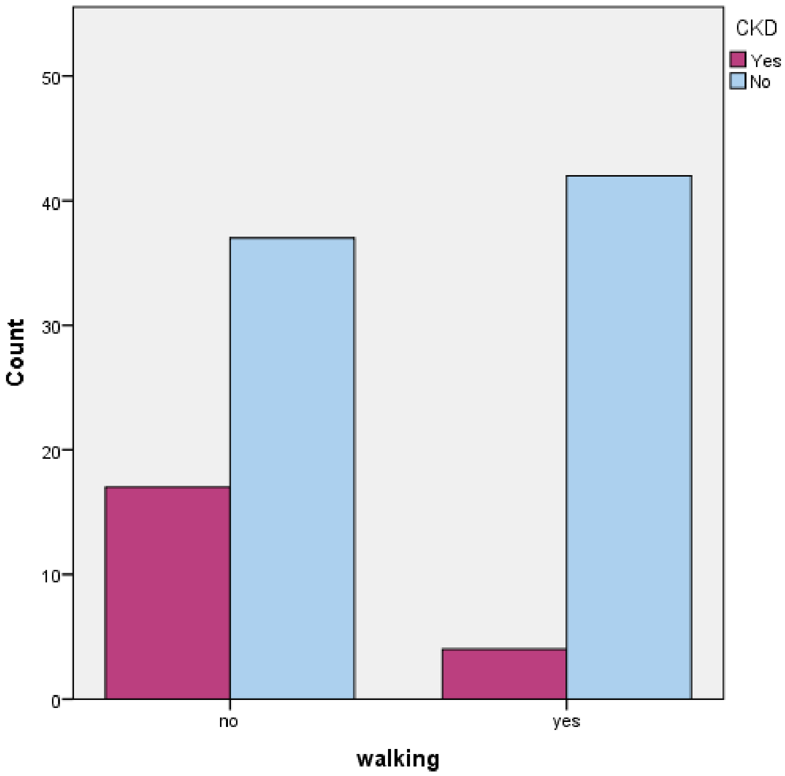

Figure 8: Frequency distribution of CKD among individuals according to exercise or walking in daily life style.

This graph (shown in fig. 8) shows total 46 patients walk/ exercise daily from which only 4 had CKD. 53 patients did not walk daily and among them 21 patients had CKD. Those who exercise daily had less prevalence of CKD.

Table 6: Represents the Association between CKD and sociodemographic factors.

variables		CKD1		Association			
		yes	No	Chi test	df	P value	significance
Area of residence	Urban	6	31	0.810	1	0.26	Not significant
	Rural	15	48				
Gender	Male	12	41	0.183	1	0.8	Not significant
	Female	9	38				
Age	45-50	2	20	9.03	3	0.029	Significant
	50-55	3	26				
	55-60	6	17				
	60 or above	10	16				
profession	Employee	2	10	2.3	5	0.7	Not significant
	farmer	2	13				
	Marchant	4	11				
	House wife	5	25				
	others	8	20				
Economics (Income per month)	Upper class	3	18	6.23	2	0.04	Significant
	Middle class	17	41				
	Lower class	1	20				
Education	illiterate	3	13	6.72	3	0.08	Not significant
	primary	8	18				
	matriculation	8	19				
	higher	2	29				
Marital status	married	15	57	0.42	2	0.9	Not significant
	Divorced/widowed	3	10				
	single	3	12				
BMI. Category	Normal Weight	8	45	9.9	3	0.01	Significant
	Under weight	0	12				
	Over Weight	10	16				
	Obese	3	6				

The table 6. analyses the association between various demographic and socio-economic factors and the presence of chronic kidney disease (CKD1) using Chi-square tests. Significant associations with CKD1 are found in age (P = 0.029), economic status (P = 0.04), and BMI category (P = 0.01), indicating that these factors significantly influence the prevalence of CKD. Conversely, area of residence, gender, profession, education, and marital status show no significant associations with CKD, with P-values greater than 0.05, suggesting these variables do not significantly affect CKD.

Table 7: Represents the Association between CKD and lifestyle factors.

Variables		CKD		Association			
	output	Yes	No	Chi test	df	P value	significance
Smoking	No	14	75	13. 5	1	0.001	Significant
	yes	7	4				
Drink alcohol	No	20	64	2.4	1	0.11	Not significant
	Yes	1	15				
Exercise	Yes	4	42	7. 7	1	0.006	Significant
	No	17	37				

The table 7. examines the association between smoking, alcohol consumption, and exercise with the presence of chronic kidney disease (CKD) using Chi-square tests. A significant association is found with smoking (P = 0.001), indicating smokers are more likely to have CKD. Exercise also shows a significant association (P = 0.006), suggesting a lower prevalence of CKD among those who exercise. However, alcohol consumption does not have a significant association with CKD (P = 0.11), implying that drinking alcohol is not significantly related to the prevalence of CKD in this study.

Table 8. Represents the Association between CKD and Clinical factors.

variables		CKD		Association			
		yes	No	Chi test	df	P value	Significance
Family history of CKD	yes	6	11	2.5	1	0.1	Not significant
	no	15	68				
Other Co morbidities	No	11	30	1.42	1	0.3	Not significant
	Yes	10	49				
Duration of Hypertension	0-5 years	7	36	8. 72	2	0.01	Significant
	6-10 years	5	32				
	Above 10 years	9	11				
DBP	<_90	9	63	11. 1	1	0.002	Significant
	>90	12	16				
SBP	<140	12	52	0.54	1	0.4	Not Significant
	>140	9	27				
Drugs taken	Beta blocker	13	25	9.3	3	0.002	Significant
	Calcium Channel blocker.	18	56				
	ACE Inhibitor	5	22				
	diuretics	12	18				

The table 8. investigates the relationship between chronic kidney disease (CKD) and various health-related variables using Chi-square tests. Significant associations with CKD are observed for the duration of hypertension (P = 0.01), diastolic blood pressure (DBP) (P = 0.002), and the type of drugs taken (P = 0.002), indicating that longer hypertension duration, higher DBP, and certain medications are significantly related to CKD prevalence. Conversely, family history of CKD (P = 0.1), other comorbidities (P = 0.3), and systolic blood pressure (SBP) (P = 0.4) do not show significant associations, suggesting these factors are not significantly associated with CKD in this study.

CONCLUSION

This study aimed to determine the prevalence and associated factors of chronic kidney disease (CKD) in hypertensive patients, analysing data from 100 individuals.

The prevalence of CKD in hypertensive patients was 21%, as indicated by a calculated glomerular filtration rate (GFR) below 60 ml/min/m². Breaking this down further, the prevalence by CKD stages was as follows: stage 1 at 25%, stage 2 at 15%, stage 3 at 12%, stage 4 at 6%, and stage 5 at 3%. These findings are consistent with a study conducted by Hill et al. (2016), which reported a significant connection between hypertension and CKD, with prevalence rates ranging from 20% to 25% across various groups. Additionally, a study by Bahrey et al. reported a prevalence of 22% in Ethiopia. Conversely, Krittayaphong et al. found a higher prevalence rate of 36%. The variations in results can be attributed to differences in populations, environmental factors, and samples.[8,9,10]

Our study indicates that CKD prevalence is not significantly associated with a specific gender, as approximately the same prevalence was observed in both males and females. This finding aligns with the results of Bahrey et al. (2019), while Weldegiorgis et al. reported a higher prevalence in men. The extent of these differences may vary based on population and study design.[9,19] Moreover, the prevalence was found to be similar in both urban and rural areas, likely due to comparable lifestyles.

Age was identified as a significant factor influencing CKD prevalence in hypertensive patients, with individuals aged 60 or older exhibiting a higher prevalence rate. Similar findings were reported by Kazancioglu (2013) and Bahrey et al. The deterioration of kidney function in older age, combined with a lack of regular check-ups, contributes to the increased prevalence of CKD.[9,14]

Economic status also showed a significant association with CKD prevalence, particularly within the middle-class population. The sample size of the lower economic class was too small for conclusive analysis; however, a strong association was noted among the middle class. This may be attributed to limited access to regular medical check-ups. This observation is supported by Vart et al. (2015).[11]

Education, however, was not significantly associated with CKD prevalence. This finding is consistent with studies by Choi et al. (2024) and Kampmann et al. (2023), suggesting that education alone, without considering other socioeconomic factors, does not directly impact CKD prevalence. While education plays a crucial role in determining health literacy and behavior, the relationship between education and CKD risk appears to be influenced by various other factors.[12,13]

Our study found a significant association between body mass index (BMI) and CKD. This is corroborated by a meta-analysis conducted by Wang et al. (2016), which reported that overweight and obese individuals have a higher risk of developing CKD compared to those with normal weight.[15]

Additionally, the prevalence of CKD was lower among individuals who exercised regularly. This finding is supported by studies from Robinson-Cohen et al. (2014) and Seidu et al. (2023), which indicate that exercise or physical activity helps reduce blood pressure, obesity, and hyperlipidaemia—all risk factors for CKD. Furthermore, regular physical activity may lead to a reduction in adipocytokines, which can adversely affect renal endothelium and slow the atherosclerotic process.[17,18]

In contrast, our study found no significant association between alcohol consumption and CKD prevalence among hypertensive patients. Other studies suggest that alcohol consumption is linked to higher CKD prevalence. The variation in our findings may stem from the low alcohol consumption rates in the studied area, with only a small number of patients reporting alcohol use.

The significant association between smoking and CKD in our study aligns with findings from Hallan and Orth (2011), who reported that smoking is a modifiable risk factor for CKD progression due to its negative effects on renal hemodynamic and increased oxidative stress.[16,19]

Moreover, our study indicated that patients with a history of hypertension lasting 10 years or more exhibited a higher prevalence of CKD. Similar findings were reported by Whelton et al. (2018), as chronic hypertension gradually damages renal vasculature.[20]

Both diastolic blood pressure (DBP) and systolic blood pressure (SBP) contribute to CKD development; however, our study found that high diastolic blood pressure (above 90 mmHg) is more significantly associated with CKD. This finding is corroborated by Hiroyuki et al. (2024) and may be attributed to its effects on the microvascular system, suggesting the need for further research to understand the importance of maintaining and continuously monitoring DBP to prevent CKD.[21]

Lastly, a family history of kidney disease was not significantly associated with CKD prevalence, a finding supported by Kebede et al. (2022).[22]

Interestingly, our study revealed that the prevalence of CKD was higher among patients taking beta-blockers for hypertension. While some researchers argue that beta-blockers are beneficial in the early stages of CKD to prevent mortality, others suggest that nonselective beta-blockers may lead to adverse effects. Therefore, careful and selective use of beta-blockers should be implemented based on the patient's condition.[23,24]

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