Section: Community Medicine

Original Research Article

PREVALENCES OF CHRONIC KIDNEY DISEASE AND ITS RISK FACTORS IN RURAL CHENGALPATTU, TAMIL NADU

Omar Faizal[1], M.Sushma[2], Divya Arulprakasam[3], Nivetha Rajaraman[4], Keerthana Arunagirinadhan[5]

[1]*Assistant Professor, Department of Community Medicine, Neelima institute of Medical sciences, Hyderabad, Telangana, India.*
[2]*Associate Professor, Department of Community Medicine, St Peter's medical College, Hospital and research institute Hosur, Tamil Nadu, India*
[3]*Assistant Professor, Department of Community Medicine, St Peters Medical College Hospital and Research Institute, Hosur, Tamil Nadu, India*
[4]*Assistant Professor, PSP Medical College and hospital, Chennai, Tamil Nadu, India*
[5]*Assistant Professor, Govt Medical College, Tirunelveli, Tamil Nadu, India*

Received : *03/05/2025*
Received in revised form : *19/06/2025*
Accepted : *08/07/2025*

Corresponding Author:
Dr. Omar Faizal,
Assistant Professor, Department of Community Medicine, Neelima institute of Medical sciences, Hyderabad, Telangana, India.
Email: omarfaizal@outlook.com

DOI: 10.70034/ijmedph.2025.3.86

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 471-476

ABSTRACT

Background: The aim is to estimate the prevalence of chronic kidney disease (CKD) among adults residing in selected villages in Chengalpattu district, Tamil Nadu. To determine the association between socio-demographic characteristics (such as age, gender, education, occupation, marital status, and income) and the presence of CKD among the study participants.
Materials and Methods: This cross-sectional study was conducted in a rural field practice area from October 2021 to March 2022. Male and female residents of the selected hamlet who were at least 18 years old were included in the study. Participants were eligible for inclusion if they were available during the data collection period and provided written informed consent. A pretested semi-structured questionnaire was used to collect data.
Results: This study included 400 participants aged ≥ 18 years. The population under study had an average age of 47.8 ± 16.6 years. There were 263 (65.8%) female and 137 (34.2%) male participants. Compared with patients without CKD (45.4±16.3 years), those with CKD had a considerably higher mean age (60.8±11.9 years) (p<0.001). Compared to female patients (9.9%), male patients were more likely to receive a CKD diagnosis (27.0%) (p<0.001). There was a statistically significant relationship between CKD and lower educational attainment (P =0.02). The frequency of chronic kidney disease (CKD) was also found to be considerably greater among married patients, those with monthly incomes under ₹5,000, and those from unskilled occupational groups.
Conclusion: A significant association was found between CKD and several important factors. Targeting these risk factors will help reduce disease and death because many lifestyle factors are related to them. By raising awareness through IEC activities, CKD can be controlled, and its complications can be reduced.
Keywords: Lifestyle and behavioral factors, risk factors, non-communicable diseases, rural health, chronic kidney disease.

INTRODUCTION

Chronic kidney disease (CKD) has emerged as a formidable global public health challenge, affecting an estimated 700 million people worldwide, with the true burden likely exceeding 850 million when acute kidney injury (AKI) and kidney failure are included in the definition. This translates to a global prevalence of over 10%, a figure that is widely considered underestimated due to insufficient early detection and screening, particularly in low- and middle-income countries (LMICs). The global prevalence of CKD surged by 33% between 1990 and 2017, with the most significant increases observed outside high-income countries (HICs), notably in populous nations such as India and China, which together account for nearly one-third of all CKD cases globally.[1]

The hallmark of chronic kidney disease (CKD) is the progressive loss of kidney function, which frequently goes unnoticed until it reaches an advanced stage, at which point symptoms start to show and consequences such as hyperkalemia, cardiovascular disease, and renal failure may arise.[2] The disease imposes a substantial economic and societal burden, especially in resource-limited settings, where access to kidney replacement therapies, such as dialysis and transplantation, is limited. In 2010, approximately 2.6 million people worldwide received kidney replacement therapy, a number projected to rise to 5.4 million by 2030 if the current trends persist. Alarmingly, millions more succumb to kidney failure without access to life-saving treatments, with the majority of premature deaths occurring in LMICs.[1]
Over the past ten years, the prevalence of CKD has significantly increased in India, making it a serious public health concern. According to national data, the prevalence of chronic kidney disease (CKD) among those aged 15 years and older increased from 11.2% between 2011 and 2017 to 16.38% between 2018 and 2023. The situation is particularly dire in rural areas, where the prevalence is 15.34%, significantly higher than the 10.65% observed in urban populations.[2]

Introduction: This discrepancy is caused by several factors, such as restricted access to medical care, a lack of understanding, and increased exposure to risk factors such as diabetes, high blood pressure, poor diet, and obesity. Notably, rural residents often present with CKD at more advanced stages, reflecting delayed diagnosis and intervention Research from India's rural areas highlights the rising prevalence of CKD and the risk factors that go along with it. A community-based study conducted near Shimoga, Karnataka, for example, revealed that the prevalence of chronic kidney disease (CKD) was 6.3% using the MDRD equation and 16.54% using the CG-BSA method. This study underscores the necessity of context-appropriate kidney function tests and heterogeneity in diagnostic criteria. CKD was found to be significantly predicted by increasing age, male sex, abdominal obesity, smoking, diabetes, and hypertension. These results are in line with more general epidemiological patterns that show that lifestyle-related illnesses, such as obesity and hypertension, are becoming more common in rural areas and frequently affect younger people.[3]

In comparison to their urban counterparts, rural participants typically have lower incomes, higher rates of tobacco use, higher occupational exposure to hazardous substances, and lower educational attainment, according to additional research from other rural settings, such as the Indian Chronic Kidney Disease (ICKD) study.[4] These socioeconomic and environmental factors further increase the risk of CKD in rural populations. Furthermore, the prevalence of kidney damage in rural communities can be as high as 17.2%, with proteinuria, a key marker of kidney dysfunction, present in 7.2% of individuals, primarily attributed to advanced age and hypertension.[5] International studies, such as those from rural China, corroborate these findings, reporting CKD prevalence rates of approximately 16.4% and identifying similar risk factors, including age, gender, obesity, diabetes, hypertension, and dyslipidaemia.[6]

The rising tide of CKD in rural areas is exacerbated by a dismally low level of awareness about the disease and its risk factors, underscoring the urgent need for targeted public health interventions. Early detection, regular surveillance, and preventive strategies are critical for curbing the growing morbidity and mortality associated with CKD, particularly in vulnerable rural populations, where the burden is most acute. Addressing the unique risk factor profile and socioeconomic challenges of rural communities is essential for developing effective and context-specific strategies for CKD management and prevention.[2,3]

Chronic kidney disease (CKD) is a major and growing global health concern that disproportionately affects rural communities in countries such as India. A thorough, multifaceted strategy for the identification, prevention, and management of CKD is required due to the interaction of demographic, lifestyle, and socioeconomic risk factors, especially in underserved rural areas where the burden of CKD is most severe.

MATERIALS AND METHODS

Study design and participants: This community-based, cross-sectional study was conducted in the rural field practice area of the Private Medical College Hospital, Chengalpattu district, Tamil Nadu, from October 2021 to March 2022. There are eight administrative blocks in the Chengalpattu district. The Maduranthakam block comprises 58 villages. The study included male and female members of the population aged 18 years or older and living within the chosen village. Participants who provided written informed consent and were available during data collection were eligible for inclusion. Individuals were excluded if they had any known acute illness at the time of the survey, were pregnant, undergoing dialysis, had previously been diagnosed with end-stage renal disease (ESRD), or were unwilling to participate.

Sample Size and Sampling Method: The required sample size was calculated from the Screening and Early Evaluation of Kidney Disease (SEEK) study [4] by Singh AK et al., who found a 17.5% prevalence of CKD in India, with 5% absolute precision and design effect,1.5. Overall, approximately 400 participants were selected using multistage cluster sampling techniques, with a 20% non-response rate.

In the first stage, one block was selected from eight blocks in the Chengalpattu district. Second, among the 58 villages from the selected block, nine villages were randomly chosen from the field practice area. Households were then selected from each village using systematic sampling. One eligible adult from each household was recruited using the Kish grid method to avoid selection bias in the study.

Data Collection of the Study Sample: Once the selection procedure was completed, the purpose of the study was explained, and written informed consent was obtained from all participants. Data were collected using a pretested semi-structured questionnaire that included items on sociodemographic characteristics, medical history, and lifestyle behaviors (e.g., smoking, alcohol intake, salt-restricted diet, and exercise). Anthropometric measurements of height, weight, and body mass index (BMI) were recorded. Blood pressure was measured using a mercury sphygmomanometer following the WHO guidelines. For urine analysis, spot urine samples were screened using dipsticks for proteinuria and glucosuria. Random blood glucose and serum creatinine levels were determined using standard laboratory methods.

The estimated Glomerular Filtration Rate (eGFR) was calculated according to the MDRD equation: $eGFR=175\times(Scr)-1.154\times(Age)-0.203\times$ (0.742 if female). CKD was diagnosed according to the KDIGO 2012 guidelines: participants with eGFR <60 mL/min/1.73 m² or persistent proteinuria (≥1+ on dipstick) were classified as having CKD.

RESULTS

In total, 400 adults aged ≥ 18 years were included in the study. The mean age of the study population was 47.8 ± 16.6 years. There were 137 (34.2 %) males and 263 (65.8 %) females among the participants. In terms education, most of the participants (52 %) were educated up to Class XII, followed by 36.5% illiterates, while only 11.5% received higher education. In terms of occupation, homemakers accounted for the highest number (37.5%), followed by farmers (30.0 %). Most subjects (75.7%) earned a monthly income of ₹5000 or more, and a high percentage (83.2%) were married.

Regarding lifestyle characteristics, 17.5% had a smoking history, whereas 19.75% consumed alcohol. Regarding dietary restrictions, 127 participants (31.75%) had salt restriction, but only 18 (4.5%) exercised regularly. Diabetes mellitus and hypertension were present in 22.2% and 19.2% of participants, respectively. According to BMI, 48.7% had normal weight, and 45.5% were overweight or obese. Urine analysis using dipstick tests revealed albuminuria (≥1+) in 4.25% of participants. Chronic Kidney Disease was found in 15.8% (n = 63) of participants.

Table 1: Baseline Characteristics of the Study Population (N = 400)

Variable	Category / Mean ± SD	n (%)
Age (years)	47.8 ± 16.6	—
Gender Male		137 (34.2%)
	Female	263 (65.8%)
Education Illiterate		146 (36.5%)
	Up to Class XII	208 (52.0%)
High degree		46(11.5)
Occupation	Homemakers	150 (37.5%)
Farmers		120 (30.0%)
Income	≥ 5000	303 (75.7%)
Marital status Married		333(83.2%)
Smoking History	Current/Past	70(17.5%)
Alcohol Use Current/Past		79(19.75%)
Salt-Restricted Diet	Current/Past	127(31.75%)
Exercise Yes		18 (4.5%)
Diabetes Mellitus	Present	89 (22.2%)
Hypertension Diagnosed		81 (19.2%)
BMI	Normal (18.5–24.9 kg/m²)	195 (48.7%)
	Overweight / Obese	182 (45.5%)
Albuminuria (Dipstick)	Positive (≥1+)	17 (4.25%)
CKD Prevalence Any Stage (1–4)		63 (15.8%)

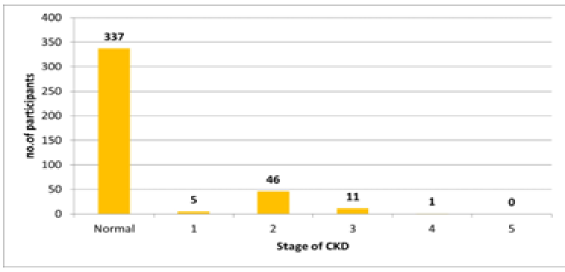

Figure 1: Distribution of stages of Chronic Kidney Disease (CKD) distribution among the study participants.

[Figure 1] shows the prevalence of CKD stages, with a representation of the affected participants' stages. Most participants (84.2%) had normal kidney function, while 15.8% were distributed across CKD stages 1-4.Stage 2

CKD (11.5%) was the most common among those affected, followed by stage 3 (2.75%)

According to [Table 2], there was a significant relationship between CKD and different sociodemographic factors. The mean age of the participants with CKD was significantly greater (60.8±11.9 years) than that of those without CKD (45.4±16.3 years) (p<0.001). Male participants had a higher likelihood of being diagnosed with CKD (27.0%) than female participants (9.9%) (p<0.001). A statistically significant correlation was observed between lower educational level and CKD (P =0.02). The same was found for the increased prevalence of CKD, which was significantly higher among people from unskilled occupational groups, those with a monthly income of less than ₹5,000, and married patients.

Table 2: Association Between Demographic Profile and Presence of Chronic Kidney Disease (CKD) Among Study Participants (N = 400)

Variable	Category	CKD Present n (%)	CKD Absent n (%)	Chi-square value	p-value
Age (years)	Mean ± SD	60.8 ± 11.9	45.4 ± 16.3	-	0.001***
Gender	Male	37 (27.0%)	100 (73.0%)		0.001***
	Female	26 (9.9%)	237 (90.1%)		
Education	Low (Illiterate, I–V)	41	153	8.231	0.02*
	Medium (VI–XII)	17	143		
	High (Diploma, Degree, PG)	5	41		
Occupation Category	Unskilled (Farmer, Labourer)	32	109	8.1497	0.02*
	Skilled (Salaried, Self-employed)	12	77		
	Others (Homemaker, Student, Retired, Others)	19	151		
Income/Month (₹)	< 5000	26 (26.8%)	71 (73.2%)	11.792	0.01**
Marital Status	Married	59 (17.7%)	274 (82.3%)	5.801	0.02*
	Unmarried/Other	4 (6.8%)	63 (93.2%)		

Significant *p-value<0.05, **p-value<0.01, ***p-value<0.001

Lifestyle- and behavior-related factors, as showed in Table-3 seem significant correlated with CKD. CKD was highly prevalent among current or former smokers compared to non-smokers (34.7% versus 11.5%, p<0.001). Similarly, alcohol consumption was associated with an increased prevalence of CKD (41.8% versus 9.6%, p<0.001). In addition, those on salt-restricted dietary patterns had a higher prevalence (27.6%) than those not on such a diet (10.3%) (p<0.001), which can be presumed to represent physician-recommended dietary restriction following a diagnosis. There was no significant association between regular physical exercise and CKD (p=0.580). Diabetes mellitus and hypertension were significantly associated with CKD (p<0.001 and p=0.033, respectively).

Table 3: Association Between Lifestyle and Behavioural Risk Factors, Comorbid Illness and Presence of Chronic Kidney Disease (CKD) Among Study Participants (N = 400)

Variable	Category	CKD Present n (%)	CKD Absent n (%)	Test value	p-value
Smoking History	Current/Past	25 (34.7%)	45 (65.3%)	27.749	0.001***
	Never	38 (11.5%)	292 (88.5%)		
Alcohol Use	Current/Past	33 (41.8%)	46 (58.2%)	50.347	0.001***
	Never	30 (9.6%)	283 (90.4%)		
Salt-Restricted Diet	Yes	35 (27.6%)	92 (72.4%)	19.556	0.001***
	No	28 (10.3%)	245 (89.7%)		
Exercise	Yes	2 (11.1%)	16 (88.9%)	0.306	0.580
	No	61 (16.0%)	321 (84.0%)		
Diabetes Mellitus	Yes	34 (38.2%)	55 (61.8%)		0.001***
	No	29 (9.3%)	282 (90.7%)		
Hypertension	Yes	19 (23.5%)	62 (76.5%)	16.720	0.033*
	No	44 (13.8%)	275 (86.2%)		

Significant *p-value<0.05, **p-value<0.01, ***p-value<0.001

[Table 4] summarizes the clinical and laboratory parameters. Although BMI was not significantly related to CKD (p=0.289) or waist-hip ratio (p=0.361), both biochemical markers were strongly associated. The mean serum creatinine level was higher in CKD patients (0.96 ± 0.28 mg/dL) than in non-CKD patients (0.59 ± 0.12 mg/dL) (p<0.001). Mean plasma glucose concentration was significantly higher in CKD patients those without CKD than in (176.2 ± 93.6 mg/dL vs. 127.8 ± 61.9 mg/dL, p < 0.001). The mean eGFR in CKD participants was significantly lower (78.8 ± 22.5 mL/min/1.73 m²) than that of participants without CKD (151.8 ± 43.3 mL/min/1.73 m²) (p<0.001).

Table 4: Association Between clinical examination and lab investigation and presence of chronic kidney disease (CKD) among study participants (N = 400)

Variable	Category	CKD Present n (%)	CKD Absent n (%)	Test value	p-value
BMI kgm2	Mean ± SD	24.34±4.62	25.01±4.57	0.66762	0.289
Waist-Hip Ratio	Mean ± SD	1.01±0.07	1.06±0.49	0.05621	0.361
Mean SBP	Mean ± SD	135.37± 12.62	126.61±14.28	-8.75084	0.001***
Mean DBP	Mean ± SD	80.63± 6.29	78.21± 7.32	-2.42918	0.01**
Serum Creatinine (mg/dL)	Mean ± SD	0.96 ± 0.28	0.59 ± 0.12	-.3714	0.001***
Plasma Glucose (mg/dL)	Mean ± SD	176.2 ± 93.6	127.8 ± 61.9	-48.3577	0.001***
GFR (mL/min/1.73 m²)	Mean ± SD	78.8 ± 22.5	151.8 ± 43.3	73.01724	0.001***

Significant *p-value<0.05, **p-value<0.01, ***p-value<0.001.

[Figure 2] represents the study's findings on urine albumin levels among participants, establishing early renal changes. Urinary albumin was negative in 11.5% of participants, with 3+ levels seen in 0.5% of participants.

A significant association was found between albuminuria and CKD ($p < 0.001$).

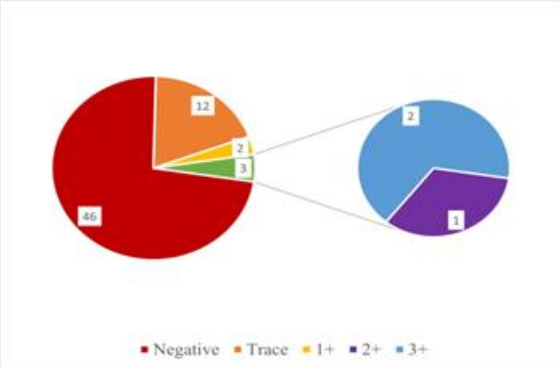

Figure 2: Distribution of chronic urine albumin levels among the study participants.

DISCUSSION

In the study population, the proportion of Stage I was proportionately less than the expected levels between the normal and stage II. This is because Stage I disease has a normal or high GFR, and abnormal urine results, structural abnormalities, or gene traits indicate kidney disease. However, we could only assess urine albumin using dipstick tests. These dipstick tests are less sensitive to very low levels of protein leakage from the kidneys. Kodgirwar PS et al, also reported the Non albuminuric CKD which was a leading appearance in non-communicable disease rural people of central India.[5]

The majority of the study participants (263 [65.8 %]) were women. Majority 333(83.2%) of the study participants were married. Maximum number 160(40%) had completed VI-XII class education. The maximum number of subjects was 150 (37.5 %), and 114(28.5%) of the subjects had a family size of four. Of the 400 subjects, 48.7% (195 subjects) belonged to the normal BMI category. The average age of the study population was 47.98 years, and 43(10.8%) of the 400 subjects had been diagnosed with hypertension among the study population. The majority (383 [95.8 %]) had negative urine albumin.17 (4.25%) of the study subjects had the presence of albumin in urine.

Of the 400 participants, 127(31.8%) followed a salt-restricted diet. Among the 400 participants, 330 (82.5%) had never smoked. Among the participants, only 18(4.5%) had the habit of exercising. The majority of the subjects (313 [78.2 %]) had no history of alcohol consumption. Among the 400 subjects, 337(84.2%) were normal, 46(11.5%) had stage 2 CKD, 11(2.8%) had stage 3 CKD, 5 (1.2%) had stage 1 CKD, and 1(0.2%) had stage 4. A total of 63 (15.75) patients had a history of CKD.

Y. J. Anupama et al, studied the occurrence of CKD amongst adults in a rural area in Shimoga district of Karnataka State in South India from the kidney disease screening (KIDS) project. They revealed that the occurrence of CKD was 16.54% using the CG-BSA method. There was no statistically worthy association of CKD with gender, increased age, abdominal obesity, occurrence of smoking, or presence of DM and hypertension.[6]

As CKD was present in only 63 subjects, further inferential statistics were performed between the presence and absence of CKD among the study population. i.e., individual grades were not considered for the inferential statistics. Significant relations were established between CKD and urine albumin, hypertension, alcohol usage, history of smoking, swollen eyelids, pedal oedema, salt-restricted diet, high BP, and diagnosed DM. Significant associations between CKD and menstrual history, occupation, income, marital status, and gender were also found.

Screening for CKD is recommended to be cost-effective in patients with DM and hypertension. CKD screening may be cost-effective in inhabitants with advanced frequencies of CKD, fast rates of development, and extra helpful drug treatment. Various other studies also support the cost-effectiveness of the scores and tools used in the early diagnosis of CKD among general population.[7] The mainstream of nephrology and its services is focused on costly private sector hospitals. Financial issues limit the accessibility of kidney replacement therapy to large sections of the population. Haemodialysis and peritoneal dialysis are similarly costly.[8]

India has exclusive circumstances and contests that affect the prompt diagnosis and management of CKD. Facilities and expertise available in different parts of the country are unevenly dispersed. The prevention and prompt detection of CKD require the participation of physicians at all levels. The largest patients with CKD can be managed by their primary physicians with judicious nephrology appointments. The Indian Society of Nephrology segments should upsurge capability and lead to consistency of delivered care. Wanted creativities, such as governmental establishment of inexpensive and easily reachable RRT (where available), extreme decrease in profitable transplantation, and increasing reduced donor transplants, are refining care of patients with ESKD.[9]

CONCLUSION

Among 400 patients, 337 (84.2%) had normal kidney function, while 63 (15.8%) had CKD, with 5 (1.2%) in stage 1, 46 (11.5%) in stage 2, 11 (2.8%) in stage 3, and 1 (0.2%) in stage 4. Urine albumin, hypertension, alcohol consumption, smoking history, salt restriction, and documented diabetes were all found to have significant associations with chronic kidney disease (CKD). Significant associations were also found between CKD status and sociodemographic factors such as gender, marital status, income, and occupation.

Age, serum creatinine, plasma glucose, and mean GFR were all statistically significantly higher in CKD patients. Since CKD is closely linked to diabetes and hypertension, managing these illnesses is essential for both avoiding CKD and lessening the burden of cardiovascular diseases. Morbidity and mortality can be further reduced by addressing modifiable lifestyle risk factors such as obesity, alcohol use, and smoking. To avoid CKD and associated consequences, it is crucial to increase public awareness through focused IEC (Information, Education, and Communication) initiatives.

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