ORIGINAL ARTICLE - PUBLIC HEALTH

A CROSS SECTIONAL STUDY ON CHRONIC KIDNEY DISEASE AMONG POPULATION OF 18 YEARS AND ABOVE IN ALAGAPURI MUKKULAM, VIRUDHUNAGAR

Goutham K [(1)], Selvameena [(1)] , Sudharshini S [(2)]

(1) - Directorate of Public Health & Preventive Medicine, Virudhunagar

(2) - Institute of Community Medicine, Madras Medical College

Abstract

BACKGROUND: There were increased numbers of Chronic Kidney Disease (CKD) patients identified in and around Alagapuri Mukkulam field area, Virudhunagar District, TamilNadu. This study is to identify the prevalence of CKD and CKDu (CKD of unknown etiology) and its association with different risk factors in this area.

OBJECTIVE : To estimate the prevalence of Chronic Kidney Disease (CKD) among population 18 years and above.
1. To estimate the prevalence of possible cases of CKDu (CKD of unknown etiology) among the study population.
2. To determine the factors associated with CKD among our study population

METHODS : Observational/cross sectional study. Using Cluster Random sampling 339 subjects (>18 years) were selected. History, Demographic, Anthropometric data, Urine blood/protein, Serum Creatinine, blood glucose were measured. eGFR was measured using CKD-EPI formula. Subjects with suspected CKD were reviewed after 3 months to confirm the diagnosis.

RESULTS : The mean eGFR in this study was 98.5 ml/min/1.73 m2. 18% (61) had decreased eGFR (<60 ml/min/1.73 m2) alone. The prevalence of subjects with decreased eGFR and urine proteinuria/hematuria was 20.3% (69) with mean eGFR of 40.1 ml/min/1.73 m2. Risk factors like hypertension and outdoor occupation (dehydration) only showed significant association. The CKDu prevalence was 10.9% (37) which was 53.7% of total CKD. These show there are other unknown risk factors yet to be identified.

CONCLUSIONS : The prevalence of CKD and CKDu in A.Mukkulam rural area is higher than other CKD prevalence studies. Thus there is a compelling need to create CKD database, to identify CKD 'hotspots' by active screening and do analytical/ experimental studies to identify unknown risk factors of CKD. This will pave way for devising strategies for its primordial and primary prevention.

KEYWORDS : chronic kidney disease, chronic kidney disease of unknown etiology, chronic kidney disease epidemiology collaboration equation 2021(CKD-EPI)

INTRODUCTION

Non communicable diseases (NCDs) are the most common causes of morbidity, premature death and have a major impact on our health-care costs, productivity, and growth. Cardiovascular disease, cancer, diabetes, and chronic respiratory diseases are the major four NCDS that has been prioritized in the Global NCD Action Plan endorsed by the World Health Assembly (2013). Chronic kidney disease (CKD) is a key determinant of the poor health outcomes of Major NCDs.[1]

In 2017 the global prevalence of CKD was 9.1% (697.5 million cases). The age-standardized global prevalence of CKD was higher in women and girls (9.5%) than in men and boys (7.3%). Nearly one-third of all cases of CKD were in China (132.3 million) and India (115.1 million).[2]

Unfortunately, In India there are inadequate longitudinal studies and data on CKD prevalence.[3] A recent study in rural Pondicherry showed the prevalence of CKD to be 28.5%.[4] Another study in Andhra Pradesh showed prevalence rate of 32.2%.[5]

In recent times chronic kidney disease of unknown etiology (CKDu) has been in rise and is more prevalent in rural pockets of developing countries. CKDu has been reported from Nicaragua, El Salvador, Costa Rica, Sri Lanka, India, Egypt, and Tunisia.[6] In the clinical context, a patient is labelled as CKDu after excluding all the known causes of CKD.[7-8] In India, CKDu was first reported from Uddanam region of Andhra Pradesh state in 2018.[9]

The main causes for CKD worldwide are diabetes mellitus, hypertension, obesity, advancing age and behavioural risk factors. Well recognized heavy metals which are risk factors for CKD are lead, mercury, arsenic, cadmium, uranium. Non steroidal anti-inflammatory drugs (NSAIDs) are also an important risk factor of CKD. Other rare causes include heat stroke in mine workers and repeated episodes of rhambomyolysis[4, 8] and heavy metal exposure by

Please Scan this QR Code to View this Article Online
Article ID: 2023:03:01:04
Corresponding Author : Goutham K
e-mail : drgoutham1993@gmail.com

consumption of ayurvedic medications.[10]

CKD is associated with eight to ten fold increased cardiovascular mortality,[10, 11] in 35.8 million disability-adjusted life years (DALYs).[12] In 2017, CKD resulted in 1.2 million deaths and was the 12th leading cause of death worldwide.[12] The absence of kidney registries in most of the low- and middle-income countries had made it difficult to understand the true burden of CKD especially in our country. Community surveys showed that the number of people with end-stage kidney disease was only tip of the CKD iceberg.[11] Limited financial resources, lack of infrastructure and inadequate manpower are putting severe strain on existing health policies with respect to increasing burden of CKD.[13]

Considering cost of renal replacement and magnitude of the problem it appears that the best way forward for our country would be to adopt the strategy for prevention.[4] So, it is of utmost need to find the true prevalence of CKD and CKDu.

This study was done in Alagapuri Mukkulam Primary health centre (PHC) field area where the major occupation of the people was agriculture and strenuous manual labour. There were increased number of CKD patients identified in outpatient basis in A.Mukkulam PHC during routine screening for Non Communicable Diseases .Also there were increased number of CKD cases referred to nearby tertiary care centres .But there were no previous studies regarding CKD in this area. This gave us the need for this cross sectional study to identify its prevalence in this area.

OPERATIONAL DEFINITION OF CKD

According to recent guidelines of KDIGO, CKD is defined as abnormalities in kidney function and or structure, present for more than 3 months with implication on health, with[7] Duration more than 3 months: In order to differentiate CKD from AKI, which have different etiologies and require different interventions;[7] Decreased GFR: Threshold of GFR less than 60 ml/min/1.73 m2 (GFR categories G3a-G5) to indicate CKD.[7] Kidney damage: Structural /Functional kidney damage which can be identified by proteinuria, albuminuria, urine sediment abnormalities, imaging studies and renal biopsy.[7]

OPERATIONAL DEFINITION OF CKDu

The case definition for chronic kidney disease of uncertain etiology (CKDu) was published in Indian journal of nephrology in 2020.[9] Suspected case of CKDu was defined as eGFR less than 60 mL/min/1.73 m2 by CKD-EPI formula and/or positive urine protein/blood by dipstick excluding those with history of diabetes mellitus and /or self-reported history of renal disease of known etiology such as polycystic kidney disease, renal stones, history suggestive of chronic glomerulonephritis, and congenital kidney disease. Possible case was defined as those satisfying criteria for suspected cases with persistently low eGFR for more than 3 months. Definite cases was defined as those possible cases without blood pressure more than 140/90 mm of Hg in stage 1, 2 CKD and BP >160/100 mm of Hg in stage 3, 4, 5 CKD and/ or patient requiring two or more types of antihypertensive medications for BP control and/or CKD documented by ultrasound examination/tests to be suggestive of renal disease of known cause and/ or Kidney biopsy suggestive of chronic tubule-interstitial nephritis with absence of immune deposits.[9]

SUBJECTS AND METHODS

This was a Cross- sectional study. Cluster random sampling method was used. The study was done in A. Mukkulam PHC field area. It comprised of 42 villages. It is a part of rural Virudhunagar. Total population in this field area was 18,182, of which 18 plus population was 12,005. The villages were grouped into 5 Health Sub Centres. Each village represented a cluster. 12 clusters were randomly selected. From each cluster 30 samples were randomly selected from the Family health records maintained in the Health sub centers. Total sample size was 360.

A Five, 4-member teams were organized comprising of Male health care workers, Female health care workers and Lab technician. Patients with acute severe illness and psychiatric patients were excluded. Ethical clearance for conducting the study was obtained from Institutional Ethics Committee, Directorate of Public Health and Preventive Medicine, Chennai.

Informed consent was obtained for data collection and blood/urine samples collection. Interview questionnaire was used for data collection which consisted of patient's demographic details, medical information, family history, personal and behavioural history, and anthropometric measurements. This was prepared from the reference questioner used in Tamil Nadu CKD prevalence study of 2022. All members involved were trained of their roles before starting the data collection.

Blood samples were collected and transported to Tamil Nadu Public Health Laboratory through proper cold chain. Creatinine, eGFR was calculated using CKD-EPI Creatinine Equation 2021. This formula was recommended by The National Kidney Foundation (2021) to estimate GFR.[9, 14]

Urine and blood proteins were checked with dip stick. Those who had positive findings in urine dipstick with eGFR less than 65 ml/min/1.73 m2 were evaluated again after 3 months.

SAMPLE CALCULATION

The overall pooled prevalence of Chronic Kidney Disease among Indian adult is 10.2 %.[15] The prevalence value p will be 10.2 % for calculation of sample size.

$$n = \frac{z^2 p(1-p)}{d^2} \times \text{deff}$$

Z = 1.96 (statistical significant constant for 95% CI);
p =10.2 %; d = 5% absolute precision;
Confidence level – 95%; Design effect – 2
Sample size is calculated to be 279
Adding 20% non-response rate
n = 335 (minimum sample size)
Accordingly, sample size was 360.

Analysis done using SPSS version 16. All Continuous variables expressed as Mean and Standard Deviation; Categorical variables expressed as Percentages and Proportions. Chi square test with Yates correction and Fisher's exact test was used to find association between two qualitative variables. The test considered Significant if P<0.05, at 95% Confidence Interval.

RESULTS

1. DEMOGRAPHIC CHARACTERISTICS

Data was collected from 339 patients. Population distribution among different age groups and gender are given in Table 1. Majority were married; farmers/labourers (62.2%) by occupation; Hindus by religion. Most of them belonged to Upper lower socioeconomic class [16] with education upto primary school. 84.4% (287) were using Panchayat/bore water for drinking purposes. 36(10.6%) were tobacco users and 64 (18.8%) had history of alcohol consumption.

2. CHARACTERISTICS OF CO MORBIDITIES / MEDICAL INFORMATION

Table 2 shows prevalence of Diabetes and Hypertension among different age groups and gender. Prevalence of Diabetes was 15.3% (52) and that of Hypertension was 33.6% (114). 21.2% (72) had high normal Blood Pressure, 15.6 % (53) stage I hypertension and 5.3% (18) had stage II hypertension according to recent guidelines of hypertension classification.[17]

History suggestive of prior kidney involvement like hematuria/proteinuria, edema/ facial puffiness, UTI, and renal stones were found in 75 (22.1%) patients. The prevalence of obesity / overweight in our study was 21.8% similar to latest ICMR-India B3 report of Tamilnadu.[18]

Table 1: Demographic Characteristics (N=339)

Variable	Category	Participants (n=339)	Percentage (%)
Age	18 – 29	75	22.1
	30 – 44	94	27.7
	45 – 59	78	23
	>60(n=91)	92	27.2
Gender	Male	157	46.3
	Female	182	53.7
Marital status	Unmarried	52	15.3
	Married	284	83.8
	Widow/widower	3	0.9
Outdoor occupation	Yes	106	31.3
	no	233	68.7
Religion	Hindus	338	99.7
	Muslim	1	0.3
Source of drinking water	Bore well	10	2.9
	Municipal /Panchayat water	287	84.7
	Can water	42	12.4
Socioeconomic status	Upper middle	14	4.1
	Middle	68	20.1
	Upper lower	244	72
	Lower	13	3.8

Table 2: Diabetes and Hypertension among Agegroup and Gender (N=339)

	Diabetes		Hypertension	
	Present (n=52; 15.3%%)	Absent(n=287)	Present (n=114; 33.6%)	Absent(n=225)
Males(n=157)	25(15.9%)	132(84.1%)	58(36.9%)	99(63.1%)
Females(n=182)	27(14.8%)	155(85.2%)	56(30.8%)	126(69.2%)
Age group(years)				
18-29(N=75)	2(2.7%)	73(97.3%)	13(17.3%)	62(82.7%)
30-44(N=87)	12(12.8%)	82(87.2%)	23(24.5%)	71(75.5%)
45-59(N=78)	16(20.5%)	62(79.5%)	31(39.7%)	47(60.3%)
>60(N=91)	22(23.9%)	70(76.1%)	47(51.1%)	45(48.9%)

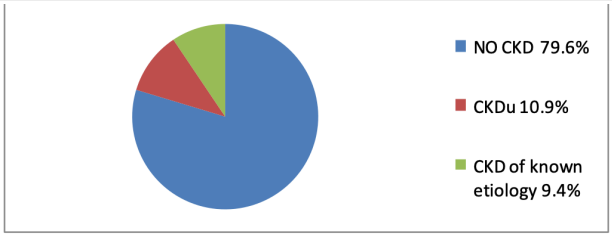

Figure 1: CKD Prevalence

The mean eGFR in my study was 98.5 ml/min/1.73 m2. Figure 1 depicts the prevalence of CKD which was 20.3% (69) with mean eGFR of 40.1 ml/min/1.73 m2. CKD patients with

Table 3: Proteinuria /Hematuria and CKD stage wise Prevalence of CKD of known Etilogy And CKDu (N=69)

CKD STAGE	eGFR (ml/min)	CKDu (N=37)N, %	CKD of known etiology (N=32) N, %	Total CKD(N=69) N, %
1	>90 (N=7)	3(8.1%)	4(12.5%)	7(10.1%)
2	60 – 89 (N=2)	0	2(6.2%)	2(2.9%)
3A	45 – 59 (N=20)	16(43.2%)	4(12.5%)	20(29%)
3B	30 – 44 (N=14)	8(21.6%)	6(18.8%)	14(20%)
4	15 – 29 (N=18)	8(21.6%)	10(31.2%)	18(26%)
5	<15 (N=8)	2(5.5%)	6(18.8%)	8(12%)
Proteinuria/Hematuria		8(21.6%)	13(40.6%)	21(30.4%)

CKD – Chronic Kidney Disease

Table 4: Association of CKD with Socio-Demogrraphic details (Ses) N=339

Age (years)	CKD (n=69) n (%)	Non CKD (n=270) n (%)	P and chi square value
18 – 44 (n=169)	6(3.5%)	163(96.5%)	68.882 P = .000*
45 – 59 (n=78)	21(27%)	57(73%)	
>60 (n=92)	42(45.7%)	50(54.3%)	
Gender			
Male (n=157)	35(22.2%)	122(77.8%)	.678 P=.410
Females (n= 182)	34(18.7%)	148(81.3%)	
SEC			
Upper middle (n=14)	0	14(100%)	FET- 6.803 P=0.066
Middle (n=68)	10(14.8%)	58(85.2%)	
Upper lower (n=244)	55(22.6%)	189(77.4%)	
Lower (n=13)	4(30.7%)	9 (69.3%)	
Marital status (married n=284)	64(22.5%)	220(7.5%)	11.626 *p=.003
Outdoor occupation (n=233)	56(24%)	177(76%)	6.226 *P=.013

*- significant p value; CKD – chronic kidney disease; SEC- Socio economic class; FET - Fisher's exact test.

proteinuria/ hematuria was 30.4% (21) among whom 11.5% (8) had preserved eGFR (>60 ml/min/1.73 m2). Table 3 shows CKD of known etiology and CKDu stage wise frequency with majority in stage 3A. It also shows proteinuria/hematuria prevalence among them. Table 4 describes the association between CKD and Socio demographic characteristics of my study population. In our study there were nil CKD among age groups of 18 to 30 years and CKD prevalence increased as age increased and CKD was common in farmers/labourers (79.7%).

Table 5: Association between CKD with Co Morbities and history suggestive of Prior Renal Damage N=339

Co morbidities	CKD(n=69)n,%	Non CKD (n=270)n, %	Chi square and p value
Hypertension (n=114)	34(29.8%)	80(70.2%)	9.503 *p= .002
Diabetes (n=52)	13(25%)	39(75%)	.818 P=.366
History suggestive of renal injury			
Proteinuria(n=18)	9(50%)	9(50%)	10.306 *p=.001
Edema(n= 4)	2(50%)	2(50%)	2.194 P=.139
Renal stones(n=16)	2(12.5%)	14(87.5%)	.639 P=.424
Facial puffiness(n=3)	2(66.7%)	1(33.3%)	4.005 *p=.045
Hematuria(n=8)	2(25%)	6(75%)	.109 P=.741
Urinary tract infection (n=26)	6(23.1%)	20(76.9%)	.129 P=.720

*- significant p value; CKD– chronic kidney disease.

Table 6: Association of CKD with risk factors (N=339)

Other factors	CKD (n=69)n, %	Non CKD (n=270)n, %	Chi square and p value
Smoking (n=36)	9(25%)	27(75%)	1.307 P=.520
Alcohol (n=64)	13(20.3%)	51(79.7%)	.394 P=.821
Snake bite (n=7)	4(57.1%)	3(42.9%)	5.967 *p=.015
BMI (overweight n= 48)	9(18.8%)	39(81.2%)	.675 P=.879
BMI (obesity n=26)	4(15.4%)	22(84.6%)	.675 P=.879

*- significant p value; CKD – chronic kidney disease.; BMI- body mass index

Table 5 represents association between CKD and Co morbidities. 29.8% of CKD had hypertension. Hypertension, history of proteinuria, facial puffiness showed significant association. Table 6 shows association of CKD with other etiological factors among which snake bite (4 of 7 had CKD); outdoor occupation (dehydration) showed significant association as 56 patients diagnosed as CKD had outdoor

occupation.

Table 7: Association between CKD And Family history of Comorbidities (N=339)

Family history of	CKD(n=69)n,%	Non CKD(n=270)n,%	Chi square and p value
Hypertension (n=59)	12(20.3%)	47(79.7%)	.000 P=.997
Diabetes(n=43)	8(18.6%)	35(81.4%)	.093 P=.760
Kidney disease(n=17)	3(17.6%)	14(82.4%)	.081 P=.776
Kidney disease requiring dialysis(n=1)	1(100%)	0	3.925 *p=.048
Heart disease(n=1)	1(100%)	0	3.925 *p=.048

Table 8: Association of CKDu with Gender, Age, Socioeconomic Status (Ses) N=69

Age (years)	CKDu (n=37) N %	CKD of known etiology (n=32) N %	P and chi square value
18 – 44 (n=6)	3(50%)	3(50%)	FET- 0.268 P = .933
45 – 59 (n=21)	12(57.1%)	9(42.9%)	
>60 (n=42)	22(52.4%)	20(47.6%)	
Gender			
Male (n=35)	18(51.4%)	17(48.6%)	.091 P=.763
Females (n= 34)	19(55.9%)	15(44.1%)	
SEC			
Middle (n=10)	6(60%)	4(40%)	FET – 1.022 P=.730
Upper lower (n=55)	28(51%)	27(49%)	
Lower (n=4)	3(75%)	1(25%)	
Marital status (married n=64)	34(53.1%)	30(46.9%)	2.233 P=.327
Outdoor occupation (n=56)	30(53.6%)	26(46.4%)	.000 P=.986

CKD – Chronic Kidney Disease; BMI- Body mass index; CKDu- CKD of unknown etiology; SEC- Socio economic vclass; FET - Fisher's exact test.

No significant association was seen with Diabetes, smoking, alcohol, obesity, stroke, heart disease, traditional/ pain medications or diet. Table 7 shows association between CKD and family history of co morbidities where family history of Kidney disease requiring dialysis and heart disease showed significant association.

Multiple logistic regression analysis of the study population for CKD showed no significance for risk factors such as age, hypertension, outdoor occupation, snake bite, history of proteinuria/edema, and family history of dialysis/ heart disease.

Table 9: Association of CKDu with risk factors (N=69)

Other factors	CKDu (n=37)n,%	CKD of known etiology(n=32)n,%	Chi square and p value
Smoking (n=9)	4(44.4%)	5(55.6%)	3.054 P=.217
Alcohol (n=13)	8(61.5%)	5(38.5%)	1.919 P=.383
Snake bite (n=4)	1(25%)	3(75%)	1.399 P=.237
Urinary tract infection (n=6)	1(16.7%)	5(83.3%)	3.609 P=.057
BMI (overweight N=9)	5(55.6%)	4(44.4%)	1.088 P=.780
BMI (obesity N=4)	2(50%)	2(50%)	1.088 P=.780

CKD – Chronic Kidney Disease; BMI- Body mass index

4. CHARACTERISTICS OF CKDU AND ITS ASSOCIATION

CHRONIC KIDNEY DISEASE OF UNKNOWN ETIOLOGY (CKDu)

Prevalence of Possible cases of CKDu was 13.9% (47) in our study with no CKDu cases between 18 and 30 years shown in Table 8. Since CKD itself causes mild hypertension, as per operational definition we excluded patients with blood pressure of more than 140/90 mm of Hg in patients with stage I & II CKD and blood pressure more than 160/100 mm of Hg in stage III, IV & V CKD or patients who are on two or more types of antihypertensives. This showed CKDu prevalence of 10.9% (37). Table 8 shows association between CKDu, CKD of known etiology and Socio demographic factors. This showed no significant association. Table 9 shows association between CKDu, CKD of known etiology and other risk factors. This also showed no significant association. Out of 37 CKDu patients 21.6% had proteinuria/hematuria, among which 0.8% had preserved eGFR (> 60 ml/min/1.73 m2). This signifies that proteinuria/hematuria is significantly low in CKDu population in our study.

DISCUSSION

Over the past few years, the number of CKD patients referred to higher centre was increasing in Mukkulam region. CKD was also a main health concern among this rural population.

In this study, the prevalence of CKD was 20.3 % and CKD with low eGFR (<60 ml/min/1.73 m2) was 17.9% which was very high compared to other CKD prevalence studies done in other regions. This was higher than Uddanam prevalence study done in the year 2018 which, like Mukkulam, is a rural area with predominant population being farmers.[19]

Likewise the prevalence of CKDu was 10.9% (53.6% of CKD population) which was also very high compared to other studies.

The CKD prevalence is rising in developing countries and there are only few prevalence studies. The CKD prevalence in Indian population was 10.2% (2018) [15] using MDRD formula for eGFR calculation. In another study in Northern Peru, the prevalence was only 1.7%.[20]

In Srilanka, where CKDu was first reported (also in Central America) the prevalence of CKDu was 15.1 – 22.9% in some districts.[21-22]

In another study of CKDu in South India (Tondaimandalam Nephropathy) 51.7% of the CKD patients were identified as CKDu which has striking resemblance to our study where 53.6 % of CKD were CKDu.[23] In yet another study, the prevalence of eGFR < 60 ml/min/1.73 m2 was between 1.6% and 4.8%, highest in rural south India.[24]

The wide range of CKD prevalence indicates that there are 'CKD hotspots' where CKD prevalence is high in some areas and there is a need to identify these hotspots to compare etio-pathological patterns in different hotspots.

CKDu is distinct by its clinicopathologic characteristics and has multifactorial etiology like toxins, dehydration, water contamination and heavy metals.[9] Heat/dehydration, inflammation, male sex and pesticides are the main hypotheses proposed for Central America, whereas in South Asia the emphasis has been on the possible roles of water contamination/metals and/or pesticides.[25] In this study males are predominantly affected and are more common in 4th decade of life and older. There was a mild difference from CKDu in Sri Lanka where females were predominantly affected and proteinuria was more common. There was also a difference from CKDu from Central America where young adults 20 – 40 years where affected. The clinical presentation of CKDu in this study was similar to that of CKDu of Uddanam area, Narasinghapur block in Odisha, Akola district in Maharashtra, Canacona district in Goa.[9] This tendency shows there might be different and multiple etiologies causing rising trend of CKDu in India.

Proteinuria/hematuria in CKD of known etiology was 40.6% in this study, whereas in CKDu it was only 21.6% (Table 3). This difference in proteinuria may be due to the difference in pathology of CKD and CKDu where CKDu is a tubulointerstitial disease which has low proteinuria and that of CKD of known etiology has significant proteinuria due to glomerular pathology.

The prevalence of Diabetes was 15.3% in this study (Table 2). A systematic review (1992-2018) prevalence of Diabetes in India showed a wide range from 1.9 – 25.2% with its highest in South India.[26] Another article showed that there was huge rise in diabetes in rural population from 8% in 2011 to 13.5% in 2020(TREND project).[27] Diabetics with proteinuria were seen in 16 patients in this study (30.7%) and were similar to a study where the prevalence was 15- 40% (2005).[28]

Diabetes is a proven etiology for CKD. In a study done on 2012, the prevalence of diabetic nephropathy was 31%.[29] Surprisingly total CKD and diabetes showed no significance in this study as only 13 (18.8%) diabetics had CKD. But, CKD of known etiology showed significant association with diabetes. This may be due to the rising trend of CKDu in this population. This clearly shows there are other factors for CKD in this population.

The prevalence of hypertension in this study was 33.6% (Table 2). The prevalence was high compared to the recent article (2018) in rural adults of TN, Kanchipuram district which was 26.2 %.[30] This high prevalence could be attributed to the high prevalence of CKD, as CKD itself caused mild hypertension.[9] This can be substantiated with the fact that stage 2 Hypertension was seen only in 5.3% of total population and stage 1 was seen in 15.6%. But the hypertension prevalence was not similarly high in other CKD hotspots like Uddanam CKD, where it was only 16.7 %.

In this study, the outdoor work history showed significant association. This shows that dehydration as hypothesized in other studies may be one of the factors associated with the development of CKDu and awareness about importance of adequate hydration may be a simple but effective step in reducing kidney injury. Out of 7 Snake bite history 4 had CKD with significant association showing snake bite as risk factor for CKD. Family history of chronic kidney disease and heart disease also showed significant association to CKD.

In short, this study showed that CKD and CKDu are high in Mukkulam area and there is a dire need to identify the causes for CKDu. There is a compelling need to identify CKD hotspots and carry out cohort/case control studies to

plan the next step. We could open a CKD database in all hospitals (from primary to tertiary level), actively identify and monitor CKD cases. This will help in identifying CKD hotspots. Further, follow up of the patients, performing renal biopsy; Ultrasonography may help in identifying the etiology. By surveillance and management of CKD we could improve the quality of life and decrease the burden of this disease.

STRENGTHS AND LIMITATIONS

In this study CKD and CKDu was identified by following the latest guidelines. Random cluster sampling was adopted and door to door survey was done. Questionnaire used was with reference to standard questionnaire used in TN CKD prevalence study 2022. Serum creatinine was done in TN Public Health Laboratory.

There are certain limitations in this study. To assess the function of kidney, urine dipstick test was used whose role in identification of microalbiminuria is limited. Urine PCR could have been a better modality but could not be done due to less feasibility. Renal biopsy, USG KUB could not be done due to non availability of resources.

Other factors hypothesized on etiology of CKDu like agrochemicals, heavy metals from ground waters were not analyzed.

ACKNOWLEDGEMENT

I sincerely extend my thanks to The Director of Public Health and Preventive Medicine, Dr. T. S. Selvavinayagam, MD, DPH, DNB, Joint Director, Government of Tamil Nadu for his concern and support in conducting this study. I also thank Additional director, Directorate of Public Health, Dr.A.Somasundharam MBBS,DPH,MD,MAE for his timely guidance and support throughout the course of this study. Also I heartily thank Dr. Sudharshini MD community medicine, Madras medical college for her guidance and support.

I'm extremely grateful for Dr. A.Palanichamy MBBS,DPH Principle of Health and Family Welfare Training Centre, Madurai, Dr.V.Yashodhamani MBBS DPH Deputy Director of Health, Virudhunagar, Dr. M. Mohammed Nizar MBBS, Block Medical Officer, Narikudi for permitting and supporting me in conducting this study in an efficient manner.

I'm immensely thankful to my Guide, Assistant Professor of community medicine, Virudhunagar medical college, Dr.M.Selva meena , M.D. Community Medicine for her motivation, valuable suggestion, guidance and expert advice without whom this study would not have achieved its final shape.

I'm forever indebted to my Mukkulam primary centre health team comprising of Staff nurses, Lab technicians, Village health Nurses, Midlevel health providers, Health inspectors, Women Health Volunteers and Multipurpose health workers, without whom the idea for this study would not have become a reality.

This acknowledgement would be incomplete if I don't thank all the subjects who gave their consent and cooperation for this study.

REFERENCES

1. William G.Couser1 Giuseppe Remuzzi 2ShanthiMendis3 MarcelloTonelli2;The contribution of chronic kidney disease to the global burden of major non communicable diseases. 2011 International Society of Nephrology

2. Ellen F. Carney ,The impact of chronic kidney disease on global healthNature Reviews Nephrology volume 16, page251 (2020)

3. P. Varma1 Prevalence of chronic kidney disease in India - Where are we heading? Indian J Nephrology. 2015 May-Jun.

4. Ravi Kumar P1 ,Amol Dongre2 , R. Muruganandham3 , Pradeep Deshmukh4 and D. Rajagovindan5 ; Prevalence of Chronic Kidney Disease and Its Determinants in Rural Pondicherry, India-A Community Based Cross-Sectional Study; The Open Urology & Nephrology Journal, 2019, Volume 12.

5. YoussefMKFarag1,Kuyilan KaraiSubramanian2,VikrumA. Singh3,RaviRajuTatapudi4Ajay K. Singh5 ; Occupational risk factors for chronic kidney disease in Andhra Pradesh: 'Uddanam Nephropathy' Published online: 12 Oct 2020.

6. Gifford FJ1 Gifford RM2 Eddleston M3 Dhaun N4 ; Endemic nephropathy around the world. Kidney Int Rep. 2017; 2:282–92.

7. Definition and classification of CKD Kidney International Supplements (2013) 3, 19–62; doi:10.1038/kisup.2012.64 & 2013 KDIGO.

8. Emily C. Moody,1 Steven G. Coca,2 and Alison P. Sanders3 ; Toxic metals and chronic kidney disease: A systematic review of recent literature PMC 2019 Dec 1.

9. Y. J. Anupama 1, Suresh Sankarasubbaiyan2 Gangadhar Taduri3 ; Chronic Kidney Disease of Unknown Etiology: Case Definition for India – A Perspective; Indian J Nephrology. 2020 Jul-Aug.

10. Sujiv Akkilagunta, 1 K. C. Premarajan, 2 Sreejith Parameswaran, 3 and Sitanshu Sekhar Kar4 ; Association of non-allopathic drugs and dietary factors with chronic kidney disease: A matched case–control study in South India J Family Med Prim Care. 2018 Nov-Dec; 7(6): 1346–1352.

11. OlugbengaE1.AyodeleC2 Olutayo3 Alebiosu4 ; Burden of Chronic Kidney Disease: An International Perspective; https://doi.org/10.1053/j.ackd.2010.02.001.

12. Gifford FJ1 Gifford RM2 Eddleston M3 Dhaun N4 ; Endemic nephropathy around the world. Kidney Int Rep. 2017;2:282–92.

13. M. Rajapurkar 1 M. Dabhi2 ; Burden of disease – prevalence and incidence of renal disease in India Clinical Nephrology, Vol. 74 – Suppl. 1/2010 (S9-S12).

14. https://www.kidney.org/professionals/kdoqi/gfr

15. Mehedi Hasan1, Ipsita Sutradhar2, Rajat Das Gupta3, Malabika Sarker4 ; Prevalence of chronic kidney disease in South Asia: a systematic review : Hasan et al. BMC Nephrology (2018)

16.https://ihatepsm.com/blog/modified-kuppuswamy-scale9

17. Dwaipayan Sarathi Chakraborty, a ,Sandeep Lahiry, b and Shouvik Choudhury c Hypertension Clinical Practice Guidelines (ISH, 2020): What Is New? 2021 Aug 2. doi: 10.1159/000518812

18. Rajendra Pradeepa et al ; Prevalence of generalized & abdominal obesity in urban & rural India- the ICMR - INDIAB Study (Phase-I) [ICMR - INDIAB-3] The ICMR-INDIAB Collaborative Study Group .Indian J Med Res. 2015 Aug; 142(2): 139–150.doi: 10.4103/0971-5916.164234

19. RaviRajuTatapudi1 et al ; High Prevalence of CKD of Unknown Etiology in Uddanam, India 16 October 2018.

20. Andrea Ruiz-Alejos et al ; CKD and CKDu in northern Peru: a cross-sectional analysis under the DEGREE protocol BMC Nephrology. 2021; 22: 37.Published online 2021 Jan 21. doi: 10.1186/s12882-021-02239-8

21. Rajapakse S1 Shivanthan MC2 Selvarajah M3 ; Chronic kidney disease of unknown etiology in Sri Lanka. Int J Occup Environ Health. 2016;22:259–64.

22. Correa-Rotter R1 Wesseling C2 Johnson RJ3 ; CKD of unknown origin in Central America: The case for a Mesoamerican nephropathy. Am J Kidney Dis. 2014;63:506–20.

23. SreejithParameswaran1 et al ; A Newly Recognized Endemic Region of CKD of Undetermined Etiology (CKDu) in South India—"Tondaimandalam Nephropathy" Kidney International Reports November 2020

24. Cristina O Callaghan., et al ; .Prevalence of and risk factors for chronic kidney disease of unknown aetiology in India: secondary data analysis of three population-based cross-sectional studies 2019.BMJ Journal.

25. Let's take the heat out of the CKDu debate: more evidence is needed Neil Pearce and Ben Caplin Published in final edited form as: Occup Environ Med. 2019 June ; 76(6): 357–359. doi:10.1136/oemed-2018-105427

26. SachinAtre 1 SonaDeshmukh2 ManjushaKulkarni3 ; Prevalence of type 2 diabetes mellitus (T2DM) in India: A systematic review (1994–2018)Author links open overlay panel Volume 14, Issue 5, September–October 2020, Pages 897-906

27. https://sites.dundee.ac.uk/inspired-nihr/wp-content/uploads/sites/113/2020/04/Press-release-25.2.2020.pdf

28. Jorge L. Gross, MD et al ; Diabetic Nephropathy: Diagnosis, Prevention, and Treatment.

29. Mohan M Rajapurkar et al ; What do we know about chronic kidney disease in India: first report of the Indian CKD registry.

30. T. K. Raja1 1, T. Muthukumar2 , Anisha Mohan P3 A cross sectional study on prevalence of hypertension and its associated risk factors among rural adults in Kanchipuram district, Tamil Nadu International Journal of Community Medicine and Public Health Raja TK et al. Int J Community Med Public Health. 2018 Jan;5(1):249-253.