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RESEARCH ARTICLE

Prevalence of Chronic Kidney Disease and Its Determinants in Rural Pondicherry, India-A Community Based Cross-Sectional Study

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Abstract:

Introduction:

The burden of CKD is on the rise globally and in India. There are scarce population based studies based in rural industrialized settings in India and elsewhere.

Objective:

To find out the prevalence and determinants of Chronic Kidney Disease (CKD) among adults in rural Pondicherry, India

Methods:

It was a community-based cross-sectional study in 13 villages of a Primary Health Centre in rural Pondicherry. A representative sample of 422 adults more than or equal to 50 years of both genders was selected by population proportional to size methods. All the participants were screened by SCORED questionnaire to get the potential cases of CKD. We did serum creatinine, urine examination, blood pressure and anthropometric measurement for the potential cases. CKD was diagnosed by estimation of glomerular filtration rate and presence of protienuria. The data was analyzed using Statistical Package for Social Science version 24. The study was approved by the Institutional Ethics Committee of SMCMCH, Pondicherry.

Results:

The prevalence of CKD was found to be 24.2% in the study sample of respondents 50 years or more. Most (73.5%) of the CKD cases were at stage 2, Stage 3a had 15% and stage 3b had 2% of the cases. The determinants of CKD were (60-69 years, PR: 2.36,CI:1.36-4.07), poor nutrition(underweight, overweight and obesity)poor nutritional status (underweight:PR: 2.26,CI:1.05-4.89), (overweight:PR: 2.19,CI:1.06-4.52), (obese:PR: 2.13 CI: 1.13-4.01) and presence of at least one chronic co-morbidity(PR:5.85,CI:1.38-24.78). Majority of the patients in the CKD group had minimal proteinuria 87.25%. And 42.15% of the CKD group had no diabetes mellitus or hypertension.

Conclusion and Recommendation:

Considering the higher prevalence of CKD in the study area, targeted screening of adult population should be undertaken as means of early detection, diagnosis, treatment and follow up of at-risk individuals to prevent further progression of CKD. Further research is required to look at the aetiology of CKD.

Keywords: Chronic kidney disease, Epidemiology, Rural, India, Hypertention, Diabetes mellitus.

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1. INTRODUCTION

According to K/DOQI clinical practice guidelines for Chronic Kidney Disease (CKD) evaluation, classification and stratification, the criteria for the definition of Chronic Kidney Disease is kidney damage for more than or equal to three months, as defined by structural or functional abnormalities of the kidney, with or without decreased Glomerular Filtration Rate (GFR), that can lead to decreased GFR, manifest by either pathologic abnormalities, or markers of kidney damage

including the abnormalities in the composition of blood or urine, or abnormalities in imaging tests.[1]OrGFR less than 60ml\min\1.73m2 for more than or equal to three months, with or without Kidney damage [1, 2].

The CKD, a silent killer has few symptoms and frequently goes unrecognized [3].

Though population based screening studies have been performed in developed countries, there are very few studies in developing world and especially in India where even though an attempt has been made to develop a national registry [4], one still does not know the true prevalence and incidence of CKD.

The burden of illness of CKD is high worldwide and outcomes and resources for care vary across countries irrespective of location. Hence earlier identification should improve outcome. The strategies to improve identification include increasing public awareness, professional education, changes in health care policy, delivery system, basic clinical and outcome research related to CKD [5].Many of the developing countries have no facility or programs to detect and evaluate CKD.Hence, it is of utmost urgency to start grass root programs to detect and educate the people and put in place both primary and secondary interventions of medical care. Early detection and education can help prevent the progression of kidney disease to kidney failure [6]. Late detection is the lost opportunity for making any life style changes and treating the aggravating factors [6].

The principal reported causes of CKD worldwide are diabetes mellitus, and hypertension associated with advancing age, obesity, and behavioral risk factors [7, 8]. CKD in Sub-Saharan African countries tend to affect adults with hypertension, diabetes mellitus, HIV, obesity, herbal medications, and chronic glomerulonephritis , all of them being the main contributing factor [9]. Recognized environmental risk factors for CKD include exposure to heavy metals (lead, cadmium, arsenic, mercury and uranium); agrochemicals; and nephrotoxic substances such as aristolochic acid, associated with Balkan endemic nephropathy, found in starfruit (*Averrhoacarambola L.*) and some Chinese herbal remedies [10]. Other CKD risk factors described are the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and the infectious diseases leptospirosis, hantavirus, leprosy and malaria (endemic in Central America). Other rare causes include heat stroke in mine workers and repeated episodes of rhabdomyolysis.

There have been reports of increasing presence of CKD in rural and coastal areas especially as reported in Srilanka and Andhra Pradesh in India [11].

This Study area chosen was in the middle of a highly industrialized rural setting in the Southeast coast of India. As there were reports of heavy concentration of heavy metals (especially cadmium- more than 130 times the toxic limit) [12] in water tested in adjoining coastal areas and the presence of large numbers of patients presenting with CKD and the pressing need for addition of more dialysis spots, all this gave us the impetus to conduct this community based rural survey in coastal Pondicherry, India.

There is also a paucity of studies in rural industrialized settings. Hence this attempt to study the prevalence of CKD in such a setting.

2. OBJECTIVES

To find out the prevalence and determinants of chronic kidney disease among adults in rural Pondicherry, India

3. MATERIALS AND METHODS

3.1. Study Setting

The present study was carried out in 13 villages of Primary Health Centre, Thirubhuvanai having a population of 32,265. The study site is located in the Union territory of Pondicherry. All these villages are located 26 kilometers from the seashore. The study was carried out between January 2016 and September 2017. Pondicherry(Puducherry), a Union Territory, is a former French colony on the southeast coast of India. It covers an area of 479 square kilometers. The climate varies from warm to humid to dry reaching 33-40 degrees centigrade in hot summer months. The economy of Pondicherry depends on tourism and industries of pesticides, caustic soda, petrochemicals, copper smelter, batteries, tyre retreading and fertilisers [13].

3.2. Study Design and Population:

This was a community-based cross sectional analytical study undertaken among adults more than or equal to 50 years of age of both gender. The best age range to define the target population had to be determined. So considering the age-dependent prevalence, it was likely that CKD screening would not be very efficient before the age of 50 years. The cut off in ages also reflects on the point of view of cost-effectiveness and the effective positive results procured [14 - 16]. Furthermore the SCORED criteria also starts assigning points from the cutoff age of 50 years [16].

3.3. Sample Size and Sampling

Since there were no previous estimates available, we did a pilot study on the sample of 100 (age $\geq$ 50 years) in a nearby similar geographical area. We found that 28% of them had chronic kidney disease. Thus, considering the prevalence of chronic kidney disease as 28%, 7% absolute precision, design effect of 2 and 5% alpha error, a sample of 317 was adequate. There were people who were reluctant to give blood samples as some of them felt they were asymptomatic and were hesitant to give the blood for estimation of serum creatinine. We decided to take 30% as non-responses based on pilot experiences. Considering the non-response rate of 30%, we increased the sample to 412 and finally, it was rounded off to the nearest highest figure of 420. Rounding off was suggested by the two senior epidemiologists, who are a part of our team. They felt rounding off was a conventional practice. It helps to collect equal number of subjects in each cluster. To begin with, 30 clusters were selected by using population proportional to size

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method. In each cluster, 14 house-hold were selected by a 'random walk' method. If the selected household had an individual ≥ 50 years, that person was invited to participate in the study. If there were more than one person ≥ 50 years, then the preference was given to the older one. In case, if the household had no individual ≥ 50 years or they refused to participate, the next consecutive household was selected until we achieved the sample of 14 participants per cluster.

3.4. Data Collection Procedure

The data was collected by the team of trained faculty in Community Medicine, who were trained in palliative care, a nurse, and medical interns. The data was collected during evening and morning hours, when most of the people were available in their houses. After obtaining informed consent, the trained doctor administered the screening tool – Screening for Occult Renal Disease ("SCORED" [15, 16], sensitivity-92% and specificity 68%) to screen the selected participant. Assuming that those having a"SCORED"score of four or more had a chance of having CKD, they were selected for further clinical examination and laboratory investigation [15]. The permission to use this tool for the purpose of the present research was obtained. In addition to screening for renal disease, information on other variables such as socio-demographic details such as age, gender, marital status, educational status, diet, physical activity, current medical problem, and family history of chronic kidney disease was obtained by using a pre-designed and pre-tested questionnaire. Modified Dr B. G. Prasad's scale for the year 2016 was used to measure the Socio-Economic Status (SES) and the marital status was recorded as married, never married, widowed and separated. International Physical Activity Questionnaire was used to collect information on physical activity as low, moderate and heavy based on total metabolic equivalents (MET)-minutes/ week score [17]. We also collected information on ever and current use (use in the past 30 days) of tobacco products and alcohol use with its age of onset and duration of consumption. Anthropometric measurements like height, waist circumference and weight were measured following WHO-STEPS standards of anthropometric measurement [18]. Blood Pressure was measured seated, by using Aneroid Sphygmomanometer (duly calibrated) with an average of 3 readings using the JNC-8 Criteria [19].

The investigators collected 5 ml of a random urine sample for sugar, protein>1+ [5], and haematuria estimation, visually read by using dipstick method (Urostix-Siemens). A non-fasting, 5 ml of venous blood sample was obtained by using aseptic precautions for estimation of serum creatininebyJaffe's method using Roche Cobras Mira Plus auto analyzer. The blood samples were collected in glass test tubes and urine samples were collected in plastic containers. The collected samples of blood and urine were labeled and transported with quality control for temperature set at 4-9 degree Celsius [20] to the accredited laboratory of Biochemistry Department of SMVMCH for laboratory investigations.

The respondents whose urine samples were found positive for at least protein, blood or pus and if they had a history of hypertension, diabetes or family history of any kidney diseases and elevated serum creatinine, were examined by the senior Nephrologists at SMVMCH who has been working in the study area for last more than six years. Glomerular Filtration Rate (GFR) is the optimal way to measure renal function and also is the best overall index of kidney function. To estimate the GFR, the Nephrologist used the MDRD study equation which required age, sex, and race and creatinine values. This formula gives unbiased estimates of Glomerular Filtration Rate in the general population [21].

3.5. Ethical Issues

The present study was cleared by the Research Committee of SMVMCH and the Institutional Ethics Committee (IEC) of SMVMCH, Pondicherry. All those cases who were found to have CKD were offered free of cost consultation and treatment at SMVMCH.

3.6. Data Entry and Analysis

Data was entered in EpiData Manager Software (version 4.2,EpiData Association, Odense, Denmark). SPSS statistical package version 24 (SPSS Inc, Chicago, IL) was used for data analysis. Descriptive statistics were calculated for all the variables. The questionnaires were traced and the information was re-checked and re-entered. Initially, the frequency tables were obtained for discrete variables such as socio demographic characteristics, life style variables such as diet, physical activity, smoking and other forms of tobacco use, alcohol intake were measured. Bivariate analysis was done to calculate unadjusted Prevalence Ratio (PR) to establish the strength of association between Chronic Kidney Disease with various risk factors. 95% Confidence Interval (CI) were constructed around the PR values. Since the overall prevalence of among respondents was higher than 20%, we carried out multivariate analysis using negative binomial regression to get the adjusted PR and to select the variables that best predict the risk of development of CKD among the study sample. The dependent variable was patients who had CKD and the independent variables were age, gender, socio-economic status, education, religion, marital status, tobacco and alcohol consumption, physical activity, obesity, dietary practices, taking pain killer and the presence of presence of at least one of the self-reported comorbidities(hypertension-also checked, diabetes mellitus, cardio-vascular diseases-heart failure, myocardial infarction, hypercholesterolemia, peripheral vascular diseases, cerebro-vascular diseases-stroke and anemia. The level of significance was set at 5 percent.

4. RESULTS

Table **1** gives the background details of the study sample. The mean duration of residing in current living place was 43.29 years (±20.18 SD).

Out of 422 respondents 102 (24.2%; 95% CI- 20.2 - 28.5%) respondents had Chronic Kidney Disease (CKD) (Table **2**). Among 102 CKD patients 9 (8.8%) had Stage 1 CKD, 75 (73.5%) had stage 2 CKD, 15 (14.7%) had stage 3a CKD, two (2.0%) had stage 3b CKD and one had stage 5 CKD. There were no significant sex differentials in occurrence and stages of CKD (Table **3**).

Table 1. Background characteristics of the respondents.

Characteristics	Total N=422
Age	
50 to 59 years	194 (46.0)
60 to 69 years	138 (32.7)
70 to 79 years	68 (16.1)
> 80 years	22 (5.2)
Gender	
Male	187 (44.3)
Female	235 (55.7)
Socio Economic Status (in Rupees)	
Class I (6323 and above)	30 (7.1)
Class II (3161 – 6322)	62 (14.7)
Class III (1897 – 3160)	87 (20.6)
Class IV (948 – 1896)	124 (29.4)
Class V (< 948)	119 (28.2)
Pension Scheme	
Yes	231 (54.7)
Health Insurance	
Yes	53 (12.6)
Education	
Illiterate	191 (45.3)
Primary	88 (20.9)
Middle	61 (14.5)
High School	60 (14.2)
Higher Secondary School	15 (3.6)
Under- graduation	6 (1.3)
Post- graduation	1 (0.2)
Marital Status	
Married	320 (75.9)
Never Married	4 (0.9)
Widowed	93 (22.1)
Divorced	1 (0.2)
Separated	4 (0.9)
Religion	
Hindu	400 (94.8)
Muslim	19 (4.5)
Christian	3 (0.7)
Membership in Self-Help Groups	
Yes	29 (6.9)
No	393 (93.1)
Type of Family	
Joint family	139 (32.9)
Nuclear family	280 (66.4)
Three generation family	3 (0.7)

Figures in parenthesis are percentages

In multivariate analysis three variables (age, nutritional status and chronic morbidities) emerged as significant predictors for the risk of developing CKD. There were rise in age, (60-69 years, PR: 2.36, CI: 1.36-4.07), (70-79 years, PR:2.83,CI: 1.53 – 5.25) and (≥ 80 years, PR: 4.17,CI: 1.76-9.88), poor nutritional status (underweight,PR: 2.26, CI: 1.05-4.89), (overweight, PR: 2.19, CI: 1.06-4.52), (obese,PR: 2.13 CI: 1.13-4.01) and at least one chronic morbidity (PR: 5.85, CI:1.38-24.78) were found to be independently associated with CKD (Table **4**).

Table 2. Prevalence of CKD among the study sample.

Presence of CKD	Men (n=187)	Women (n=235)	Total (N=422)
Yes	44 (23.5)	58 (24.6)	102 (24.2)
No	143 (76.5)	177 (75.3)	320 (75.8)

Figures in parenthesis are percentages

Table 3. Stages of CKD among those who had the condition.

Presence of CKD	Men (n=44)	Women (n=58)	Total (N=102)
Stage I	4 (9.1)	5 (8.6)	9 (8.8)
Stage 2	30 (68.2)	45 (77.6)	75 (73.5)
Stage 3a	8 (18.2)	7 (12.1)	15 (14.7)
Stage 3b	1 (2.3)	1 (1.7)	2 (2.0)
Stage 5	1 (2.3)	0	1 (1.0)

Figures in parenthesis are percentages

The number of respondents who tested positive for proteinuria was 119 out of the 422 people(28.19%).In the CKD group of 102 patients 89 respondents(with CKD) had only (minimal) +1 proteinuria(87.25%) as compared to 10 people out of 102 who had ++2 proteinuria and only 3 people had +++3 proteinuria. Respondents who had Diabetes mellitus were 122 out of 422 respondents (28.67%) and 131 out of 422(31.04%) respondents had hypertension. The people in the CKD group(102 patients) with diabetes mellitus were 31(30.39%) and those with hypertension in the CKD group(102 patients) were 24(23.52%).

43 people in the CKD group(42.15%) had no diabetes mellitus or hypertension but had (minimal)+1 proteinuria.

5. DISCUSSION

In the present study, we found that24.2% of the study sample had Chronic Kidney Disease (CKD) among 50 years and above in rural Pondicherry. Most of the CKD cases (73.5%) were at stage 2. In the present study, we found a higher prevalence of CKD especially in stage 3 CKD (17%).

The Nephrologist made a final diagnosis of CKD with GFR estimation and presence of proteinuria using K/DOQI Updated clinical guidelines - Stage 1 with normal or high GFR (GFR > 90 ml/min), Stage 2 mild CKD (GFR = 60-89 ml/min), Stage 3A moderate CKD (GFR = 45-59 ml/min), Stage 3B moderate CKD (GFR = 30-44 ml/min), Stage 4 Severe CKD (GFR = 15-29 ml/min), Stage 5 End stage CKD (GFR < 15 ml/min) [2].

The determinants for CKD were in advancing age with poor nutrition (underweight, overweight and obesity) and the presence of at least one chronic morbidity.

There have been only a few rural surveys for screening of CKD in Indian scenario. A large community-based screening in a geographical region closer to Chennai found a prevalence of 0.7% CKD [22] Another study in rural Karnataka, found the prevalence of CKD as 6.3% by GFR estimation using MDRD equation [23]. An PAN Indian Urban study by Singh *et al*. (SEEK Study) showed a prevalence of CKD as 17.2 percent

[20]. Another Semi-Urban Indian study showed a prevalence of CKD in stage 3 to be 4.2percent [24, 25]. Yet another study by Agarwal *et al*. in Urban setting in Delhi, India found the prevalence of 0.79% for stage 3 and above CKD with a serum creatinine cut-off 1.8mg/dl (a very high cut-off value). However, they did not consider proteinuria and GFR in calculation [25, 26]. Studies from China [3], KEEP Study-USA [27], Singapore [28], Norway [29], Australia [30], Benin Togo-WestAfrica [31], KEOP study in USA [32],SHARE screening in HongKong [33], Japan [34] show a prevalence of CKD ranging between 4-15% of the adult Population and widely varying screening methods. Prevalence in North Central Province, Uva and North Western Provinces in the agricultural communities in Sri Lanka showed a CKD prevalence rate of 5-16.9% with more severe disease in the females [35].

Table 4. Bivariate analysis and multivariate analysis

Risk Factors	Total N = 422	With CKD n = 102	Unadjusted PR (95% CI)	Adjusted PR[#]
Age				
50-59	194 (46.0)	23 (11.9)	1	1
60-69*	138 (32.7)	38 (27.5)	2.32 (1.45 – 3.71)	2.36 (1.36 – 4.07)
70-79*	68 (16.1)	27 (39.7)	3.35 (2.07 – 5.43)	2.83 (1.53 – 5.25)
≥80*	22 (5.2)	14 (63.6)	5.37 (3.27 – 8.82)	4.17 (1.76 – 9.88)
Gender				
Male	187 (44.3)	44 (23.5)	1	1
Female	235 (55.7)	58 (24.7)	1.05 (0.74 – 1.48)	1.01 (0.59 – 1.75)
Socio Economic Status				
Class I (6323 &above)	30 (7.1)	6 (20.0)	1	1
Class II(3161 – 6322)	62 (14.7)	18 (29.0)	1.45 (0.64 – 3.28)	2.22 (0.86 – 5.72)
Class III(1897 – 3160)	87 (20.6)	24 (27.6)	1.38 (0.62 – 3.05)	1.72 (0.66 – 4.44)
Class IV(948 – 1896)	124 (29.4)	28 (22.6)	1.13 (0.51 – 2.48)	1.52 (0.60 – 3.83)
Class V(< 948)	119 (28.2)	26 (21.8)	1.09 (0.49 – 2.41)	1.29 (0.49 – 3.39)
Education				
Illiterate	191 (45.3)	52 (27.2)	1.26 (0.89 – 1.76)	1.12 (0.69 – 1.82)
Literate	231 (54.7)	50 (21.6)	1	1
Religion				
Hindu	400 (94.8)	97 (24.2)	1.07 (0.48 – 2.35)	1.06 (0.36 – 3.09)
Muslim and Christian	22 (5.2)	5 (22.7)	1	1
Tobacco Usage				
Non-Tobacco usage	267 (63.3)	68 (25.5)	1	1
Less than 5 year	9 (2.1)	3 (33.3)	1.31 (0.51 - 3.37)	0.70 (0.16 – 2.99)
More than 5 years	146 (34.6)	31 (21.2)	0.83 (0.57 - 1.21)	0.81 (0.50 – 1.31)
Alcohol Consumption				
Non-alcoholic	347 (82.2)	85 (24.5)	1	1.01 (0.99 – 1.04)[@]
Less than 5 year	15 (3.6)	2 (13.3)	0.54 (0.15 - 2.00)	
More than 5 years	60 (14.2)	15 (25.0)	1.02 (0.63 - 1.64)	
Physical Activity				
Low	194 (46)	61 (31.4)	2.18 (1.29 – 3.69)	1.61 (0.86 - 3.02)
Moderate	131 (31)	27 (20.6)	1.43 (0.79 – 2.57)	1.21 (0.62 - 2.38)
High	97 (23)	14 (14.4)	1	1
Nutritional Status				
Normal	109 (25.8)	15 (13.8)	1	1
Underweight*	54 (12.8)	16 (29.6)	2.15 (1.15 – 4.02)	2.26 (1.05 - 4.89)
Overweight*	80 (19.0)	21(26.2)	1.90 (1.05 – 3.46)	2.19 (1.06 – 4.52)
Obese*	179 (42.4)	50 (27.9)	2.03 (1.2 – 3.43)	2.13 (1.13 – 4.01)
Dietary Habit				
Vegetarian	60 (14.2)	23 (38.3)	1.76 (1.21 – 2.56)	1.19 (0.68 - 2.09)
Mixed diet	362 (85.8)	79 (21.8)	1	1
Fruit Consumption per Week				
Never consumed	93 (22.1)	23 (24.7)	1.03 (0.68 – 1.54)	0.89 (0.51 - 1.51)
At least one day	329 (77.9)	79 (24.0)	1	1

(Table 4) contd.....

Risk Factors	Total N = 422	With CKD n = 102	Unadjusted PR (95% CI)	Adjusted PR[#]
Vegetable Consumption per Week				
Never consumed	43 (10.2)	17 (39.5)	1.76 (1.16 - 2.67)	1.24 (0.67 - 2.28)
At least one day	379 (89.8)	85 (22.4)	1	1
Pain Killer				
Not taking	359 (85.1)	86 (24.0)	1	1
Taking pain killer <5 year	41 (9.7)	7 (17.1)	0.71 (0.35 - 1.43)	0.78 (0.38 - 1.62)
Taking pain killer >5 year	22 (5.2)	9 (40.9)	1.71 (1.0 - 2.92)	0.56 (0.20 - 1.57)
Chronic Co-morbidity				
No Chronic Co-morbidity	56 (13.3)	5 (8.9)	1	1
At least one chronic Co-morbidity*	366 (86.7)	97 (26.5)	2.97 (1.26 - 6.97)	5.85 (1.38 - 24.78)

Note: Figures in this parenthesis are percentage, * indicate p value <0.05 in multivariate analysis,
PR = Prevalence ratio, [#] Six outlier case were removed in multivariate analysis, [@]taken as continuous variable for analysis.
The independent variables studied and adjusted for were age, gender, socio-economic status, education, religion, marital status, tobacco and alcohol consumption, physical activity, obesity, dietary practices, taking pain killer and chronic morbidities

Only three factors emerged as the predictors of CKD, which were advancing age, poor nutritional status and the presence of at least a chronic co-morbidity. Though advancing age and co-morbidities like hypertension and diabetes mellitus are well-known risk factors in causation and progression of CKD, the altered nutritional status (malnutrition and overweight /obesity) was a notable finding in this study. In the study from rural Karnataka the prevalence of diabetes was quite lower at 3.82% and the prevalence of hypertension was 33.57% [23]. Whereas other studies from rural India give similar prevalence of diabetes at 24% and that of hypertension at 32% [36].Yet another rural study from Pondicherry gives similar prevalence of Hypertension as 24% [37]. Gender, abdominal obesity, smoking, and co-morbities, were found to be significant factors in the rural study from Karnataka, India [23]. Obesity is known to cause a hemodynamic burden on kidneys that causes glomerular injury, elevated blood pressure and causes proteinuria [38]. Hence weight reduction in the early phase of life has to be advocated strongly to curb this epidemic. A high BMI is one of the strongest risk factors for new onset CKD [39]. Only a few studies have provided insights as to when malnutrition occurs during the course of kidney disease, similarly, whether early to moderate CKD is associated with some abnormalities in nutritional status or body composition is ill defined [40]. Malnutrition and inflammation complex (MICS) starts developing relatively early in the course of CKD and shows gradual worsening until ESRD is reached with mechanisms related to low GFR including decreased clearance of pro-inflammatory cytokines, volume overload, oxidative stress, carbonyl stress and decreased anti-oxidant levels [41].

CKD stage 3 and 5 are associated with a spontaneous reduction of the mean protein intake from1.0gm/kg bodyweight/day to about 0.5gm/kgm body weight per day accompanied by a reduction in energy intake [42 - 44]. There are little data on the prevalence of PEM in predialysis CKD stages, But a change in body composition including a reduction in body cell mass has been recently reported [45]. The prevalence of Protein Energy Wasting (PEW) progressively increases during the evolution of CKD. It is reported that 40% of the patients present with symptoms of PEW at the entrance in dialysis [46, 47]. There is strong evidence for a relationship which exists between malnutrition, inflammation and atherosclerosis [46 - 50].

The co-morbidities prevalent in CKD are also associated with inflammation and PEM. Also, acidosis may contribute to protein catabolism and reduction in lean body mass. But the fact is the causes and consequences of the PEM in CKD are not well understood [51].

A similar “rural clusters study” done recently in adults above 40 years (mean age 58years) in rural Bangaldesh, Pakistan and Sri Lanka have also reported older age, presence of diabetes mellitus and elevated blood pressure as factors independently with higher odds of CKD.Surprisingly the overall prevalence of CKD reported there was 38.1% with a high incidence in Sri Lanka (58.3%) [52]. Yet another recent prospective cohort study in adults between 40 and 75 years from Iran shows that older age, larger body mass, hypertension and diabetes mellitus are all associated with CKD.They also had a similar prevalence of 23.7% with CKD 3a and 3b prevalence of 20% and 3.3% respectively [53].

Hence, the traditional risk factors for CKD including older age, hypertension, and diabetes were all confirmed in our study.

The fact that majority of the CKD patients with proteinuria (87.25%) had only minimal proteinuria(trace to+1 proteinuria) and the fact that 42.15% of the respondents had no diabetes mellitus or hypertension but had trace to +1 proteinuria seems to point towards some other aetiology, other than conventional etiological factors like diabetes mellitus or hypertension. It is also known that CKDu(CKD of unknown aetiology often presents with only mild to moderate proteinuria [11, 35].

The findings of the present study are based on a representative sample from a rural setting of Pondicherry. Hence, the findings of the present study based on a sample can be generalized to the population in Pondicherry. We used the standard definition for the diagnosis of CKD by estimation of GFR by MDRD equation for each individual and patients with proteinuria were included as evidence of kidney damage. The analysis is robust and the confounders were adjusted to determine the factors responsible for the CKD. However, the limitations of the present study should be kept in mind. It is

hard to make cause and effect relationship using the cross-sectional data as there is no information on temporality of events. Another limitation in this study was that a spot urine testing was done only once. Finally, the unavailability of isotope dilution mass spectrophotometry (IDMS) [12] negates a national uniform method to estimate serum creatinine in an Indian setting. Also, the repeated estimations of serum creatinine and proteinuria would have increased the Precision. Yet another limitation was that the occupational exposure of the respondents was not collected.

6. RAPPORT BUILDING (PATIENT AND PUBLIC INVOLVEMENT)

The public was involved in the initial discussions regarding the feasibility of this study, its importance and its implications for the lay public and patients in the future as such. Permission from the village elders, head men and their advisors was sought for initially.The questionnaire was shown to them and their opinion sought on the various headings in it. We also requested their help for the information dissemination, as we plan to screen in the next phase of the study, for looking in detail at the aetiology of CKD in this area.

CONCLUSION

Considering the higher prevalence of CKD in the study area, targeted screening of adult population should be undertaken as means of early detection, diagnosis, treatment and follow-up of at risk individuals to prevent further progression of CKD. A similar approach has been reported as medical outreach services to underserved populations in rural areas [54 - 56]. Another major implication is that if we would be to able to detect CKD earlier, in stage 2 and 3, a drastic lifestyle change may help in the prevention and progression of CKD. Acquiring evidence that current interventions to reduce CKD risk in the obese are efficacious and deployable, is an urgent priority to set goals and means for risk modification [57]. As CKD is also a major risk factor for cardiovascular morbidity and mortality, early detection of CKD is of paramount importance. Considering the possible role of environmental agents in industrialized communities, further investigation is required to confirm the link between the potential environmental pollutants with CKD [12, 58].

ARTICLE SUMMARY

Strengths and limitations of this study

• As this was an exclusive rural based survey in an industrialized setting showing a higher prevalence of CKD, it is more representative of the population at large as a major part of the population resides here in the villages unlike an urban or a mixed group. Similar rural studies are rarely done / reported.

• The diagnosis of chronic kidney disease was based on a standardized estimation of the Glomerular filtration rate by the MDRD study equation and by the presence of proteinuria as a sign of kidney damage.

• The analysis is robust and the confounders were adjusted to determine the factors responsible for CKD.

• Estimation of serum creatinine and urine for proteinuria was checked only once. The repeated estimations of serum creatinine and proteinuria would have increased the precision of the study.

• Finally, the unavailability of isotope dilution mass spectrophotometry (IDMS)as a uniform method to estimate serum creatinine in an Indian setting is a limitation in the study.

CONTRIBUTORSHIP STATEMENT

RKP was responsible for the development of the concept, design, drafting the manuscript, collecting data, interpretation of data and revision of the manuscript. AD was responsible for contributing to the design, analysis of data, interpretation of data, helping in drafting and revising the manuscript. RM was responsible for helping in collecting the data, development of the manuscript and reviewing the data. PD involved in the planning of the study, analysis, reviewing the statistical data and revision of the manuscript. DR was involved in the reviewing of the data, reviewing of the laboratory reports, revision of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for the study that are the basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

STANDARD FOR REPORTING

STROBE guidelines and methodology were followed.

AVAILABILITY OF DATA AND MATERIAL

All available data can be obtained by contacting the corresponding author. All of the individual participant data collected during the trial is available, after de-identification, beginning 3 months and ending 5 years following article publication.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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