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Research Article

Early Diagnosis for Chronic Kidney Disease and its Associated Risk Factors among Adults in a Rural Population of Delhi: A Cross-Sectional Study

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A B S T R A C T

Background: Chronic kidney disease (CKD) is emerging public health problem worldwide including India. It's diagnosis at 5th stage complicates treatment leading to end-stage renal disease (ESRD). The early interventions, life style modification and management may help to slow its progress.

Methods: A total of 859 participants were screened in OPD of Rural Health Training Center Najafgarh rural area of Delhi in 2018 after getting written informed consent from the participants. The data was recorded through a pre-structured questionnaire containing their personal and medical history. Blood sugar, urea, serum creatinine and serum albumin were examined. Other anthropometric parameters like blood pressure (BP) and height weight were also measured for the body mass index (BMI). Data was analyzed with the help of SPSS ver 16. CKD versus Non-CKD participants were compared for any significant difference and chi square test was.

Result: The mean age of participants was 39.72±SD 16.85 (range 18-90 years). More participants were males (61%), literate (81.8%) and unemployed (68.8%). 21.9%, 24.8% and 5.7% had previous history of BP, diabetes and any kidney problems. The overall prevalence of CKD was 8.7%; mean eGFR was 91.67 ± 24.20 in CKD versus 96.44±19.95 in non-CKD group. Prevalence of CKD stages 1, 2, 3a, 3b, 4 and 5 were 56%, 35%, 6.05%, 1.08%, 0.93% and 0.46% respectively. Hypertensive and diabetic were significantly associated with CKD.

Conclusion: The prevalence of CKD was 8.7% and 6.0% had stage 3a or worse. Diabetic and hypertensive patients should be screened for kidney diseases as early intervention may retard the progression of kidney disease.

Keywords: CKD, Early Diagnosis, Hypertension, Diabetes, Rural Population

Introduction

Chronic Kidney Disease (CKD) has been a global public health issue in the past decades and affects more than 10% population worldwide. People with diabetes and hypertension are exposed to 50% risk of developing CKD.[1] India is experiencing an alarming rise in the burden of non-communicable diseases however the data on the incidence of Chronic Kidney Disease (CKD) are sparse. Chronic Kidney Disease (CKD) is a progressive reduction in the renal functions of the body. In this condition the kidneys lose their normal functions, especially excretory and regulatory functions primarily due diabetes, hypertension, infections, autoimmune diseases and other toxic chemicals.[2] With chronic kidney disease, the kidneys do not usually fail all at once. Instead, disease often progresses slowly over a period of years. It is the final common pathway for many infections and noncommunicable diseases and is an independent risk factor for death from cardiovascular causes, leading to growing concern regarding increases in the estimated global prevalence, ranging from 8% to 16%.[3] It has been recently estimated that the age-adjusted incidence rate of ESRD in India to be 229 per million population (pmp)[4] and >100,000 new patients enter renal replacement programs annually in India.[5] On the other hand, because of scarce resources, only 10% of the Indian ESRD patients receive any renal replacement therapy (RRT).[6,7]

The burden of CKD is not only restricted to the requirement of renal replacement therapy for End-Stage Renal Disease (ESRD), but also its other serious outcomes, such as cardiovascular events and mortality, are strongly influenced by kidney involvement.[8,9] In 2010, the mortality caused by CKD almost doubled comparing with which in 1990 and it was ranked as the 18th risk factor in the mortality list.[10]

For patients who progress to end-stage renal disease, CKD is associated with enormous economic costs and early mortality.[11]

The major risk factors associated with CKD are Diabetes, Hypertension and obesity. It has been estimated that In India, diabetes and hypertension today account for 40-60% cases of CKD.[12] India has highest number of diabetics in the world having a prevalence of 3.8% in rural and 11.8% in urban adults which is associated with adverse outcomes in all stages of CKD. The prevalence of hypertension in India is reported to range between 20-40% in urban adults and 12-17% among rural adults.[13] With rising prevalence of these diseases in India, prevalence of CKD is expected to rise.

To address this problem there should be an early diagnosis community-based screening programs in which the patients being detected with CKD at an advanced stage. It is possible to reduce complications through earlier intervention.

Materials and Methods

It was a cross-sectional study conducted in 2018 at Rural Health Training Center (RHTC), Najafgarh, New Delhi, a field practice area of the Department of Community Medicine, Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi. Study population was constituted of all patients above 18 years of age attending the OPD of RHTC. Pregnant ladies were excluded from the sample.

The sample size was calculated on the basis of a previous study which recorded prevalence of CKD in rural population as 17.2%.[14] Taking 95% confidence interval, the required sample size was 251. Taking 5% absolute error and morbidity prevalence 10%. However, a total of 859 subjects were included in the study.

Study Instruments and Data Collection

A predesigned, pretested, semi-structured questionnaire containing socio-demographic profile like age, sex, education, income etc. was used to obtain the data. Apart from this, patient disease history like BP, Hypertension, Kidney problems were also recorded. The questionnaire used was bilingual including local terms (Hindi). It was field tested on 50 subjects before the study. Before starting the interview, the written informed consent was also obtained by the participants. To study the kidney disease profile in the study population three steps were included in the study.

Step 1: The information on socio-demographic variables like age, gender, marital status. Income etc was collected using a questionnaire. **Step 2:** Anthropometric measurements such as height & weight and blood pressure were measured using standardized protocols and instruments. **Step 3:** Random blood samples (5 ml) were collected from the participants for the estimation of biochemical parameters like Glucose, Urea, creatinine and albumin. Blood samples were tested onsite through the semi-automated analyser of the mobile lab procured from the Accuster Technologies Pvt. Ltd., Gurugram. The mobile lab was already pretested and validated form the ICMR and used for the early diagnosis.[5]

Blood Collection

Under aseptic condition 5 ml of the patient's intravenous blood was obtained and centrifuged at 4000 rpm for 8-10 minutes. Blood samples were collected for testing different blood parameters related to the kidney diseases and its associated factors. Urea and creatinine are the good indicators of a normal functioning of kidney whereas, Glomerular Filtration Rate (GFR) is also used as the best test to determine the stages of kidney disease. Urea level was measured by calorimetric method,[16] Serum creatinine level was measured by Jaffe Colorimetric method,[17] whereas glucose by the glucose oxidase peroxidase method[18] and albumin level by Albumin BCG method respectively.[19] A modified modification of diet in Renal Disease (MDRD-3) equation was used to calculate GFR values. GFR (mL/min/1.73 m^2) = 175 × (Scr)- 1.54 × (Age) - 0.203 × (0.742 if female) × (1.212 if African American.[20]

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Anthropometric Measurements

BMI Measurement

Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared using the formula "weight (Kg)/ height (m^2)". Overweight and obesity were defined as BMI ≥23–24.9 kg/m^2 and BMI ≥25 kg/m^2, respectively.[21]

Blood Pressure Measurement

Blood pressure was recorded three times in sitting position, in the right arm, using a standard android dial BP apparatus (mercury type of BP apparatus is phased out from health care setting). The standard protocol was followed and the average of the last two readings was used in the analyses.[22]

eGFR (Estimated Glomerular Filtration Rate)

A blood test called eGFR (estimated Glomerular Filtration Rate) indicates roughly how well the kidneys are working to filter out waste from your blood. eGFR is reported in millilitres per minute and a normal eGFR is greater than 90 mL/min. CKD stages were defined using NKF-KDOQI guidelines (eGFR < 60 ml/min/1.73 m^2).[20]

The five stages of CKD and GFR for each stage is defined as below:

- Stage 1 with normal or high GFR (GFR > 90 mL/min with other signs of kidney damage like structural, radiological, urinary abnormalities)
- 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)

Note: In Stages 1 and 2, there are often few symptoms. If at this stage CKD is caught early, medications and lifestyle changes can slow down its progress and even stop or reverse CKD depending on its cause.

Ethical Issues

Each selected participant was given explanation about the procedure and objectives of the study. Written informed consent was obtained and referral services were provided if required at the rural health training centre. The prior ethical clearance for the study was obtained from the VMMC &SJH Institutional Ethics Committee (IEC).

Statistical Analysis

The Entire data obtained from the study was entered in excel sheet and tabulated. Frequency, percentage, means, Standard Deviation (SD), median, minimum and maximum values of variables was calculated. IBM SPSS Statistics for Windows, version 16 was used for the data analysis. The results were explained in simple proportions. Difference between groups was assessed using chi square test for their statistical significance. P-value less than 0.05 was considered statistically significant.

Result

A total of 890 subjects were screened for the study. We excluded 31 subjects who were either less than 18 years of age (n=12), with history of dialysis (n=13) and with history of kidney transplantation (n=3) (Figure 1). We further excluded subjects for which certain variables results were not recorded (n=3). These variables included gender, age, history of dialysis or kidney transplantation, serum creatinine. The total subjects included in this analysis are 859. The mean ± SD age of all participants was 39.72±16.85 years (range 18-90 years) and 61% of them were males and 39% were females. Out of the total participants 21.9%, 24.8% and 5.7% had previous history of Blood pressure, diabetes and kidney problems. In the clinical investigations, hypertension was observed in 14.9% of the study population while 14.2% of them were diabetic. Abnormal serum creatinine, urea level and albumin were 1.9%, 76 % and 16.4% respectively. The mean ± SD of BMI was 23.49±6.41 kg/m^2. Defining overweight and obesity as BMI between 25–30 and >30 kg/m^2 respectively. The prevalence of overweight and obesity in our sample was 44.1% and 44.2%, respectively. The remaining baseline demographics, clinical and laboratory data were summarized in Table 1 and 2.

Table 1.Socio-demographic factors and CKD status of the participants

Variables	Total no. of participants n=859 (%)	CKD Status (using MDRD)		Chi square	P-value
		Non-CKD n=784 (%)	CKD n=75 (%)		
BMI (kg/m^2)					
Male	524 (61.0)	473 (60.3)	51 (68.0)	1.38	0.21
Female	335 (39.0)	311 (39.7)	24 (32.0)		
Age					
18-25 years	246 (28.6)	242 (30.9)	4 (5.3)	134.8	0.001
26-35 years	145 (16.9)	144 (18.4)	1 (1.3)		
36-45 years	176 (20.5)	169 (21.6)	7 (9.3)		
46-55 years	120 (14.0)	102 913.0)	18 (24.0)		

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56-65 years	107 (12.5)	89 (11.4)	18 (24.0)		
66 & above	65 (7.6)	38 (4.8)	27 (36.0)		
Education					
Illiterate	156 (18.2)	135 (17.2)	21 (28.0)	4.62	0.02
Literate	703 (81.8)	649 (82.8)	54 (72.0)		
Occupation					
Prof.	18 (2.1)	16 (2.0)	2 (2.7)	6.14	0.40
Semi-prof.	20 (2.3)	20 (2.6)	0		
Clerk/ shop owner/ farm owner	36 (4.2)	34 (4.3)	2 (2.7)		
Skilled	47 (5.5)	43 (5.5)	4 (5.3)		
Semi-skilled	67 (7.8)	65 (8.3)	2 (2.7)		
Unskilled	80 (9.3)	73 (9.3)	7 (9.3)		
Unemployed	591 (68.8)	533 (68.0)	58 (77.3)		
Income					
Rs.0-5000	103 (12.0)	92 (11.7)	11 (14.7)	6.78	0.07
Rs.5001-10,000	293 (34.1)	259 (33.0)	34 (45.3)		
Rs.10001-50000	435 (50.6)	406 (51.8)	29 (38.7)		
Rs.50001 & above	28 (3.3)	27 (3.4)	1 (1.3)		
BP History					
Yes	188 (21.9)	158 (20.2)	30 (40.0)	14.6	0.001
No	671 (78.1)	626 (79.8)	45 (60.0)		
Diabetes history					
Yes	213 (24.8)	178 (22.7)	35 (46.7)	19.8	0.001
No	646 (75.2)	606 (77.3)	40 (53.3)		
Kidney problem history					
Yes	49 (5.7)	42 (5.4)	7 (9.3)	1.34	0.18
No	810 (94.6)	742 (94.6)	68 (90.7)		

Table 2.Clinical variables related to the CKD Status of the participants

Variables	Total no. of participants n=859 (%)	CKD Status (using MDRD)		Chi square	P-value
		Non-CKD	CKD		
BMI (kg/m²)					
Normal	100 (11.6)	94 (12.0)	6 (8.0)	1.19	0.54
Overweight	379 (44.1)	346 (44.1)	33 (44.0)		
Obese	380 (44.2)	344 (43.9)	36 (48.0)		
Hypertension (HTN)*					
Hypertensive	128 (14.9)	103 (13.1)	25 (33.3)	20.4	0.001
Non-Hypertensive	731 (85.1)	681 (86.9)	50 (66.7)		
Diabetes**					
Yes	122 (14.2)	103 (13.1)	19 (25.3)	7.38	0.005
No	737 (85.8)	681 (86.9)	56 (74.7)		

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Serum creatinine level					
Normal	843 (98.1)	784 (100.0)	59 (78.7)	158.9	0.001
Abnormal	16 (1.9)	0	16 (21.3)		
Blood urea level					
Normal	206 (24.0)	198 (25.3)	8 (10.7)	7.21	0.004
Abnormal	653 (76.0)	586 (74.7)	67 (89.3)		
Blood albumin level					
Normal	718 (83.6)	665 (84.8)	53 (70.7)	8.99	0.002
Abnormal	141 (16.4)	119 (15.2)	22 (29.3)		

*Systolic blood pressure (SBP) equal to or more than 140 mmHg and/or Diastolic Blood Pressure (DBP) equal to or more than 90 mmHg or those being treated for hypertension.[23]

**Diabetes was defined as random blood sugar >= 200 or on any medications for diabetes mellitus (ADA definition).[24]

Prevalence of CKD

Using MDRD equation the overall prevalence of CKD was 8.7% with a mean eGFR of 91.67±24.20. in CKD versus 96.44 ±19.95 in non-CKD group, while 14.9%, 14.2% were found hypertensive and diabetic respectively. Abnormal serum creatinine, urea level and albumin were 1.9%, 76 % and 16.4% respectively. Prevalence of CKD stages (GFR <60 ml/min/1.73 m^2) 1, 2, 3a, 3b, 4 and 5 were 56%, 35%, 6.05%, 1.08%, 0.93% and 0.46% respectively. CKD was higher in males (68%) followed by females (32%) across all stages of CKD. Approximately 6% of the study samples had CKD stage 3 or worse. Out of the total CKD population 0.46% have shown kidney damage (eGFR <15 ml/min/1.73 m^2) i.e. End Stage Renal Disease (ESRD).

Discussion

In the present study, we found that CKD as broadly defined is evident in 8.7% of the adult population. The same prevalence of CKD is also reported by Anand S et al.[25] In the study approximately 6% of the study samples had CKD stage 3 or worse which is also been reported by other authors.[14,26] Generally, increased age, gender, history of diabetes, BP and kidney problem, hypertension, diabetes and abnormal level of creatinine, albumin and urea level were significantly associated with higher risk of CKD. These findings were also similar to results of previous studies. Older age was reported to be independently associated with increased risk of reduced renal function, further supported by our present study.[27,28] Agrawal SK et al.[29] performed a community-based study to determine the prevalence of CKD in the South Zones of Delhi. They used the multi-stage cluster sampling method in recruiting their subjects. They defined "renal failure" as a serum creatinine >1.8 mg/dL and reported a prevalence of CKD of 0.79%. The investigators noted that their study has a limitation in that urinary protein was not measured and persons with albuminuria or microalbuminuria were not included in the estimated prevalence of CKD. Therefore, their findings underestimate the prevalence of CKD in the study population. However, ours may have slight overestimated since participants were those who were morbid.

Hypertension and diabetes are also major risk factors of CKD.[30-32] Increased prevalence of CKD could be partly explained by the high prevalence of risk factors like diabetes and hypertension in the screened population (14.9% and 14.2%, respectively). The prevalence of diabetes and hypertension in India varied widely in many studies and ranged from 6-20% and 13-58%, respectively.[33-35] Among the CKD group, 33.3% had hypertension and 25.3% had diabetes mellitus. Despite the high prevalence that we reported in our study, subjects in our cohort had a low awareness of CKD. Self-reported kidney problem was observed in 5.7%.

This might reflect the lack of healthcare resources available to the population. Our study had several potential limitations. We used convenience study design rather than a cluster randomization design and/or household survey. However, our sampling strategy may not be ideal for evaluation of true prevalence. Another limitation was the single measurement of serum creatinine and albumin. The other limitation is that we used the MDRD equation using the race factor for compatible for Americans. However, there are concerns of the application of the definition and staging system for current eGFR estimating equations to the Indian population. Different diet and muscle mass in the Indian as compared to the North American populations may lead to both differences in the normal level for kidney function in the population as well as the relationship between creatinine and GFR as reflected in the estimating equations; where these equations have been predominantly developed and validated.

Conclusion

The study found that the prevalence of diabetes, hypertension and CKD in rural area is high. Possibly with shifting population the difference between urban and rural areas is getting blurred. Undoubtedly, we need more data

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and study to validate these findings. An urgent need to develop specific strategies aiming to reduce the burden of CKD is required.

Conflicts of Interest: None

References

1. Eckardt KU, Coresh J, Devuyst O, Johnson RJ, Köttgen A, Levey AS et al. Evolving importance of kidney disease: from subspecialty to global health burden. *Lancet* 2013; 382(9887): 158-169. [PubMed].
2. Venktapathy R, Govindarajan V, Oza N, Parameswaran S, Dhanasekaran BP, Prashad KV et al. Salivary creatinine estimation as an alternative to serum creatinine in chronic kidney disease patients. *IJN* 2014; Article ID 742724, 6.
3. Abdulla HI, Al-Kotany MY, Mahdi KA. Assessment of oral manifestations of patients with renal failure undergoing hemodialysis by serum and salivary biomarkers. *MDJ* 2012; 9(1): 118-129.
4. Modi GK, Jha V. The incidence of end-stage renal disease in India: a population-based study. *Kidney Int* 2006; 70(12): 2131-2133.
5. Kher V. End-stage renal disease in developing countries. *Kidney Int* 2002; 62(1): 350-362.
6. Jha V. End-stage renal care in developing countries: the India experience. *Ren Fail* 2004; 26(3): 201-208.
7. Sakhuja V, Sud K. End-stage renal disease in India and Pakistan: burden of disease and management issues. *Kidney Int Suppl* 2003; 83(83): S115-8.
8. Bello AK, Nwankwo E, El Nahas AM. Prevention of chronic kidney disease: a global challenge. *Kidney International* 2005; S11-17.
9. Nugent R A, Fathima SF, Feigl AB, Chyung D. The burden of chronic kidney disease on developing nations: a 21st century challenge in global health. Nephron. *Clinical Practice* 2011; 118: c269-77.
10. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012; 380(9859): 2095-2128.
11. USRDS. Atlas of end-stage renal disease Bethesda: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. 2013. Cited in January 7 2013.
12. Rajapurkar MM, John GT, Kirpalani AL, Abraham G, Agarwal SK, Almeida AF et al. What do we know about chronic kidney disease in India: First report of the Indian CKD registry? *BMC Nephrol* 2012; 13: 10.
13. Narula AS. Chronic kidney disease. The looming threat. *MJAFI* 2008; 64(1): 2, 3.
14. Singh AK, Farag Youssef MK, Rajapurkar Mohan M. Epidemiology and risk factors of chronic kidney disease in India - results from the SEEK (Screening and Early Evaluation of Kidney Disease) study. *BMC Nephrology* 2013; 14: 114.
15. Kishore J, Mondal AK, Chandra L et al. Validation of Mobile lab "Field and laboratory-based validation of mobile lab (Suitcase & Labike model) against gold standard methods". Advance Research Publications, Ghaziabad. 2018.
16. Hao-Hua D, Guo-Lin H, Feng-Lin L, Liu AL, Xia XH, Chen W. Colorimetric detection of urea, urease, and urease inhibitor based on the peroxidase-like activity of gold nanoparticles. *Analytica Chimica Acta* 2016; 915: 74-80.
17. Jaffe M. Uber den niederschlag, welchenpikrinsaure in normalenhrnerzeugt und ubere ineneue reaction des kreatinins. *Z Physiol Chem* 1886; 10: 391-400.
18. Trinder P. Determination of blood glucose using an oxidase-peroxidase system with a non-carcinogenic chromogen. *J Clin Pathol* 1969; 22(2): 158-161.
19. Young DS. Effects of drugs on clinical laboratory tests for albumin. 4th ed. AACC Press, Washington, DC. 1995, 3-22.
20. Levey AS, Coresh J, Greene T, Marsh J, Stevens LA, Kusek JW et al. Expressing the modification of diet in renal disease study equation for estimating glomerular filtration rate with standardized serum creatinine values. *Clin Chem* 2007; 53(4): 766-772.
21. Misra A, Vikram NK, Gupta R, Pandey RM, Wasir JS, Gupta VP. Waist circumference cut off points and action levels for Asian Indians for identification of abdominal obesity. *International Journal of Obesity* 2006; 30(1): 106-111.
22. Mancia G, Sega R, Bravi C, Vito GD, Valagussa F, Cesana G et al. Ambulatory blood pressure normality: results from the PAMELA study. *J Hypertens* 1995; 13: 1377-1390.
23. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. *JAMA* 2003; 289(19): 2560–72.
24. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus: Report of the expert committee on the diagnosis and classification of diabetes mellitus. *Diabetes Care* 2003; 26(Suppl 1): S5-20.
25. Vassalotti JA, Stevens LA, Levey AS. Testing for chronic kidney disease: a position statement from the national kidney foundation. *Am J Kidney Dis* 2007; 50(2): 169-180.
26. Anand S, Shivashankar R, Ali MK, Kondal D, Binukumar B, Montez-Rath ME et al. Prevalence of chronic kidney disease in two major Indian cities and projections for associated cardiovascular disease. *Kidney Int* 2015; 88(1): 178-185.

ISSN: 2349-7181
DOI: https://doi.org/10.24321/2349.7181.201921

27. Varma PP. Prevalence of chronic kidney disease in India - Where are we heading? *Indian J Nephrol* 2015; 25(3): 133-135.
28. Shan Y, Zhang Q, Liu Z, Hu X, Liu D. Prevalence and risk factors associated with chronic kidney disease in adults over 40 years: a population study from Central China. *Nephrology (Carlton, Vic.)* 2010; 15: 354-361.
29. Chen W. Liu Q, Wang H, et al. Prevalence and risk factors of chronic kidney disease: a population study in the Tibetan population. *Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association - European Renal Association* 2011; 26: 1592-1599.
30. Agarwal SK, Dash SC, Irshad M, Raju S, Singh R, Pandey RM. Prevalence of chronic renal failure in adults in Delhi, India. *Nephrol Dial Transplant* 2005; 20(8): 1638-1642.
31. Chen J. Epidemiology of hypertension and chronic kidney disease in China. *Current Opinion in Nephrology and Hypertension* 2010; 19: 278-282.
32. Qin X, Wang Y, Li Y, Xie D, Tang G, Wang B et al. Risk factors for renal function decline in adults with normal kidney function: a 7-year cohort study. Journal of Epidemiology and Community Health 2015; 69: 782-788.
33. Levey AS, Bilous R, Shlipak MG. CKD and diabetes: what can we learn from their similarities and differences? *American Journal of Kidney Diseases: The Official Journal of the National Kidney Foundation* 2016; 67: 360-363.
34. Prasad DS, Kabir Z, Dash AK, Das BC. Prevalence and risk factors for diabetes and impaired glucose tolerance in Asian Indians: a community survey from urban Eastern India. *Diabetes Metab Syndr* 2012; 6(2): 96-101.
35. Devi P, Rao M, Sigamani A, Faruqui A, Jose M, Gupta R et al. Prevalence, risk factors and awareness of hypertension in India: a systematic review. *J Hum Hypertens* 2013; 27(5): 281-287.

ISSN: 2349-7181
DOI: https://doi.org/10.24321/2349.7181.201921