ORIGINAL ARTICLE

PREVALENCE OF CHRONIC KIDNEY DISEASE AMONG COMMUNITY REMOTE AREAS IN SABAH: POPULATION-BASED STUDY

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ABSTRACT

In this population-based study, we determined the prevalence of chronic kidney disease (CKD) of community in remote areas of Ranau, Sabah to have accurate information for health-care planning. It also investigated the association of risk factors with the prevalence of CKD. A sample of 270 individuals, compared to the study of the National Health and Morbidity Survey 2011, of the adult population (over 18 years old) undertaken in West Malaysia. We measured the estimated glomerular filtration rate (eGFR) using this CKD-EPI equation. The total prevalence of CKD in this group was 53%. An estimated 3.3% had stage 1 CKD (eGFR >90 ml/min per 1.73m^2), 32.6% had stage 2 (eGFR 60–89 ml/min per 1.73m^2), 4.1% had stage 3 (eGFR 30–59 ml/min per 1.73m^2), 7% had stage 4 (eGFR 15–29 ml/min per 1.73m^2), and 6% had stage 5 CKD (eGFR <15 ml/min per 1.73m^2). Only 4% of respondents with CKD were aware of their diagnosis. The significant risk factors included family history of kidney disease, alcohol consumption, smoking status, hypertension, diabetes mellitus, and dyslipidemia. Thus, CKD in East Malaysia are common and warrants early detection, and treatment to potentially improve outcomes can be implemented.

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INTRODUCTION

Chronic Kidney Disease (CKD) is a significant public health issue[1]. It is a worldwide burden attracting major attention due to its rapidly progressing numbers.[2,3] Recent global CKD prevalence is estimated to be between 10 – 15%.[4] A previous study reported 9.1% of West Malaysians to have CKD.[5]

CKD can develop gradually, taking months to years, frequently leading to permanent loss of kidney function over time. Harmful effects of CKD are the accumulation of water, waste, and toxic substances in the body that are excreted by the kidneys. The loss of kidney function is known to cause anemia, high blood pressure, bone diseases, and acidosis disorders (excessive acidity of body fluids) associated with cholesterol and fatty acids. As CKD continues to progress, the glomerular filtration rate decrease and remaining nephrons are unable to effectively eliminate metabolic wastes and environmental toxicants from the body. This inability may escalate the mortality and/or morbidity of an individual[1].

As the renal replacement therapy (RRT) in Sabah has been increased up to 2,047 patients and RRT places a large burden on the health-care budget[15]. Therefore, it is important to obtain accurate local data on CKD to facilitate health care planning, especially in remote areas. The objective of this population-based study was to determine the prevalence of CKD among community aged over 18 years in remote areas of Ranau, Sabah. We also studied the association of risk factors with the prevalence of CKD.

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MATERIALS AND METHODOLOGY

2.1 Study Area

The study was conducted in the district of Ranau, Sabah, North Borneo of Malaysia which comprises a total population of 94,029. More than 85% of the population comprises of the Dusun tribe.[16]

2.2 Patient background

This study was carried out at the Nephrology Health Care Clinic in Ranau Hospital. Most of the patients aged 18 to 65 years, who gave their consent, were diagnosed as CKD and referred to be assessed by physicians. Simple random sampling was used. Pediatric patients, pregnant women, infections disease patients such as those suffering from HIV, and Hepatitis were excluded.

2.3 Sampling method

All respondents were randomly interviewed by trained data collectors using a standard validated questionnaire with fully written consent. This was a cross-sectional study where we evaluated 270 respondents. The questionnaires included demographic characteristics, socioeconomic and health status. Physical examination and blood tests were performed.

Blood pressure (BP) was measured by Omron Japan Model HEM-907 (Tokyo, Japan),[19] which has been validated and calibrated. BP was measured with the respondent at rest in a sitting position, with the BP set and appropriate-sized cuff at chest level. Two readings were taken 15 min apart, and the average measurement was used for analysis.

2.3.1 Blood Sampling Method

Written consent was obtained from the respondents for blood sampling and it was done to determine the serum creatinine (SCr), in which 5ml of blood samples were taken by using a disposable syringe from the vein and collected in a capped plastic sterile tube. The procedures were carried out aseptically and precautions taken during the use of a tourniquet to prevent blood contamination as per protocols. The blood samples were transported by using a cool box and the temperature was maintained at 4ºC and sent immediately to the laboratory within 24 hours.

The serum creatinine level was measured by the enzymatic laboratory method of Sabah Gribbles Laboratory, Malaysia. The estimated GFR (measured in millimeters per minute per 1.73m^2) was calculated using the CKD-EPI creatinine formula[20], where e-GFR= 141 x min (Scr / k, 1) ^{a} x max (SCr / k, 1) $^{-1,209}$ x 0.993^{age} x 1.018 (if female) SCr is serum creatinine (mg / dL), k = 0.7 (female) and 0.9 (male), a = - 0.248 (female) and -0.207 (male), min is the minimum of SCr /k or l and max is the maximum of SCr/k or l.

Fasting blood sugar and total cholesterol were estimated by dry method (CardioChek PA, Gribbles Sabah, MY), which has been validated.[18]

2.4 Definitions

CKD stages 1 and 2 was defined as eGFR > 90 ml/min per 1.73m^2 and 60–89 ml/min per 1.73m^2, respectively. Stages 3, 4, and 5 were defined as eGFR 30–59, 15–29, and <15 ml/min per 1.73m^2, respectively, regardless of kidney damage.

Diabetes mellitus was defined as a fasting capillary blood glucose level > 6.1 mmol/l on CardioChek, or self-reported diabetes diagnosed by medical personnel, or random capillary blood glucose >11.1 mmol/l.

Hypercholesterolemia was defined as random or fasting blood cholesterol > 5.2 mmol/l or self-reported hypercholesterolemia diagnosed by medical personnel.

Hypertension was defined as the average of two BP readings with systolic BP >140 and/or diastolic BP > 90mmHg20 and/or self-reported hypertension previously diagnosed by medical personnel.

2.5 Statistical analysis

Statistical analyses of data were performed by using SPSS version 26 to identify whether there was any significant prevalence of CKD among the respondents. Data were presented as mean and median for continuous variables and proportion for categorical variables. Prevalence estimates of all outcomes were performed. Factors associated with CKD were assessed using logistic regression. Unadjusted odds ratio between exposure variables and indicators of CKD was determined. Adjusted odds ratios and 95% confidence intervals were estimated. The P-value of <0.05 is considered significant.

2.6 Ethical approval and consent

Approval and ethical clearance were given by the National Medical Research Register (NMRR) (Ethics Approval Number: NMRR-18-2615-44151) and the UMS Research committee. The approval also was obtained from the Director of the State Health Department for blood sampling which was conducted by the staff of the health department. All respondents were required to sign a written informed consent form before enrolment.

RESULT AND FINDINGS

There were 270 respondents consented to participate out of initially 400 targeted, giving a response rate of 68%. Table 1 compares the overall National Health and Morbidity Survey (NHMS) 2011 cohort in West Malaysia aged > 18 years (N=15,147) with the CKD study (N=270). There was no difference observed in the profile of both studies.

Table 1 Comparison between National Health and Morbidity Survey (NHMS) cohort samples and CKD samples

Socio-demographic Characteristics	NHMS cohort (>18 years), N=15,147			CKD Study, N=270			
	Number	Mean	Median	Number	Mean	Median	IQR
Age (years)	15,147	42.2	41.0	270	45.1	46.0	20
Systolic blood Pressure(mmHg)	14,631	129.5	127.0	270	134.7	134.0	20
Diastolic blood pressure (mmHg)	14,630	80.2	80.0	270	84.1	84.0	12
Glucose level (mmol/l)	13,436	6.1	5.4	270	5.3	5.0	1.3
Cholesterol level (mmol/l)	13,742	4.9	4.8	270	5.4	5.1	1.3

Abbreviations: CKD, chronic kidney disease; IQR, interquartile range.

Table 2. Prevalence of CKD stages (N=270)

CKD Stage	Number of respondents	Prevalence of CKD (%)
Normal	127	0.0
Stage 1	9	3.3
Stage 2	88	32.6
Stage 3	11	4.1
Stage 4	19	7.0
Stage 5	16	6.0
Total	270	53%

Abbreviations: CKD, chronic kidney disease

Out of 270 respondents, 143 (53%) were diagnosed with CKD based on eGFR measurements (Table 2). Overall, 47% of the respondents had eGFR >90 ml/min per 1.73m^2 which was normal, 3.3% had 4.1% stage 1 CKD, 32.6% had stage 2 CKD, 4.1% had stage 3 CKD, 7.0% had stage 4 CKD and 6.0% had stage 5 CKD (eGFR < 15 ml/min per 1.73m^2). Using univariate analysis, the factors associated with significantly increased prevalence of CKD were smoker, alcohol drinker, diabetes, hypertension, dyslipidemia, and family history of kidney disease (Table 3). All the factors associated with CKD was significant (p<0.05).

Table 3. Factors associated with CKD Prevalence by Univariate Analysis (N=143)

Variable	n (%)	Adjusted OR (95% CI)	P-value
Smoking status		2.72 (0.48-3.32)	0.041
Smoker	89 (62.2)		
Alcohol consumption		3. 28 (2.13- 13.89)	0.005
Drinker	92 (64.3)		
Diabetes	51 (35.7)	2.89 (1.83-4.06)	0.005
Hypertension	114 (79.7)	3.01 (1.37-8.93)	0.001
Dyslipidemia	69 (48.3)	2.01 (1.12- 1.05)	0.047
Family history of kidney disease	109 (76.2)	5.12 (2.75-9.60)	0.000

OR= odds ratio, CI= confidence interval; P<0.05 with chi-square test

DISCUSSIONS

CKD is defined by using the Modification of Diet in Renal Disease (MDRD) equation together with CKD-EPI.[6] In South Korea, Taiwan, and Thailand. CKD was defined by using the MDRD equation with eGFR< 60 ml/min per 1.73m^2. In Beijing, eGFR was measured using calibrated serum creatinine while the Japanese used eGFR and dipstick to define CKD.

The demographic characteristic of the CKD study was similar to that of the overall NHMS 2011 cohort (Table 1). There was no difference in the profile of both cohorts except for certain respondents in the CKD sample. This suggests that the CKD study was conducted on a valid representative sample for the population of the remote area i.e. Ranau, Sabah. There was a good response rate of 68%.

This study assessed the prevalence of CKD among respondents living in Ranau, Sabah using the GFR. The overall prevalence of CKD in the study was 53%. The prevalence of CKD by stages 1,2,3,4, and 5 were 3.3%, 32.6%, 4.1%, 7.0% and 6.0% respectively. In a previous population-based study reported that the prevalence of CKD stage 5 in Malaysia was 0.36% in people above 18 years of age[5]. Our estimated prevalence of stage 5 CKD was higher than in other studies. This difference in CKD prevalence might be due to the difference in case studies and variables.

The prevalence of CKD in West Malaysia of 9.07% is similar to their rate in the region. The prevalence of CKD in Asia varies within South Asia: 10.2% in India, 17.3% in Bangladesh, 16.9% in Pakistan, and 10.6% in Nepal[6, 7]. While, in other Asian regions it was: 17.5% in Thailand, 13% in Japan, 6.8% South Korea, 12% in Taiwan, and 13% in Beijing. The prevalence depends on methodology, CKD definition, and study design incorporated[5].

In this study, a significant association between family history and CKD has been found[8]. Previous studies use lower eGFR and albuminuria to define CKD[9]. The result obtained was positive correlation even after adjusting for age, sex, race, diabetes, hypertension, and socioeconomic background.

This study found a significant correlation between smoking and CKD. Tobacco in cigarettes heavily increases the risk for a wide range of chronic conditions including cancer, cardiovascular disease, and respiratory disease. A study found CKD and its relationship with smoking[13]. The study found that smoking increases the risk for both atherosclerotic and non-atherosclerotic vascular disease, hence, directly increasing the vascular and nonvascular morbidity and mortality in patients with CKD.

This study also found a significant correlation between alcohol consumption and CKD. Excessive alcohol consumption generally leads to liver damage but few studies have also found that ethanol can cause kidney damage[10]. Along with an unhealthy diet and lifestyle, heavy alcohol consumption can greatly contribute to CKD. However, few studies show that there is no obvious correlation between alcohol and CKD due to confounding factors such as smoking, drug

abuse, used of NSAIDS, high fat diet, and coffee that may interfere in study.[17]

Diabetes is associated with hypertension was closely associated with the development of CKD.[11] This is due to an increase in deterioration in glomerular filtration in renal damage caused by diabetes together with hypertension amplifying vascular damage which later leads to renal insufficiency. Elevation of blood pressure both caused by and resulting in increased progression of kidney disease leads to an intermingled cause and effect relationship between hypertension and CKD.

CKD was independently associated with type 2 DM and longer duration of DM. This corresponds with the finding of several studies that reported that the likelihood of developing CKD was greater among patients with a longer duration of diabetes. CKD is estimated to affect 50% of patients with type 2 DM. Improvement in cardiovascular survival in a patient with type 2 DM has contributed to patients surviving longer, allowing sufficient time to develop renal disease[14].

The study also found a significant association between CKD and dyslipidemia. Dyslipidemia is a common complication associated with the decline in GFR. Patients with CKD usually have dyslipidemia or more specifically hypertriglyceridemia due to increased concentration of lipoprotein that is rich with triglyceride. Hypertriglyceridemia occurs because of two reasons; delayed catabolism and the increase in hepatic production of triglyceride-rich lipoproteins. Delayed catabolism is mainly responsible for increasing the concentration of triglyceride-rich lipoprotein in CKD patients[12].

In this study, the following limitations should be considered. First, we were not able to take the underlying risk factors into accounts such as ethnicity, geographical, nationality, and type of herbal medication used. Second, the cross-sectional design of the study makes it impossible to infer the causal relationship between indicators of CKD and associated factors. Third, as Ranau is just one of the districts in the state of Sabah, the prevalence of CKD reported could not be generalized to the whole Sabah population. Fourth, people who were aware that they had CKD were more likely to agree to participate in the study which may lead to overestimation in the prevalence of CKD. Fifth, there is also a possibility of overestimation of CKD due to potential selection bias from missing data. Lastly, the study subjects were recruited from a single hospital which may limit the generalizations of the findings of this study. Therefore, these findings cannot represent symptoms of CKD of the whole population.

Thus, the prevalence of CKD is higher than what is reported in other studies on kidney disease (probably due to sample sizes and different geographical areas). It is also dependent upon smoking, alcohol consumption, hypertension, diabetes mellitus, dyslipidemia, and family history. These factors should be considered 'high risk' in Malaysia, and early detection of CKD in these groups should be implemented.

CONCLUSION

Prevalence of CKD among community remote areas Sabah was 53%. The significant risk factors associated with CKD in this study were family history of kidney disease, alcohol consumption, smoking status, hypertension, dyslipidemia, and diabetes mellitus. Thus, CKD in East Malaysia is common, early detection and treatment among these communities to potentially improve outcomes can be implemented. Further research should look into the impact of other variables such as type of occupation, and source of water intake as these are potential risk factors for impairment of renal function.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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ABBREVIATION AND SYMBOLS

CKD = Chronic Kidney Disease
DM= Diabetes Mellitus
e-GFR= Estimated Glomerular Filtration
ESRD= End-Stage Renal Disease
NKF= National Kidney Foundation
NSAID= Non-steroid Anti-Inflammatory Drugs
SCr = Serum Creatinine

REFERENCES

1. Sarah E. Orr and Christy C. Bridges, Chronic Kidney Disease and Exposure to Nephrotoxic Metals, International Journal Molecular Sciences, 2017.
2. Hewa M. S. Wasana, Dharshani Aluthpatabendi, W. M. T. D. Kularatne, Pushpa Wijekoon, Rohan Weerasooriya, Jayasundera Bandara, Drinking water quality and chronic kidney disease of unknown etiology (CKDu): synergic effects of fluoride. cadmium and hardness of water, Environ Geochem Health (2015). DOI 10.1007/s10653-015-9699-7.
3. Ramya Hettiarachchi and Chrishantha Abeysena, Association of Poor Social Support and Financial Insecurity with Psychological Distress of Chronic Kidney Disease Patients Attending the National Nephrology Unit in Sri Lanka, Hindawi International Scottish Intercollegiate. Diagnosis and management of chronic kidney disease. A national clinical guideline. Scottish Intercollegiate Guidelines Network. 2018: 3-6.
4. Hill NR, Fatoba ST, Oke JL, et al. Global prevalence of chronic kidney disease a systematic review and meta-analysis. PLoS One 11: e0158765, 2016.
5. L.S. Hooi, L.M. Ong, G. Ahmad, et al. A population-based study measuring the prevalence of chronic kidney disease among adults in West Malaysia. Kidney Int, 84 (5) (2013), pp. 1034-1040.
6. Mehedi Hasan, Ipsita Sutradhar, Rajat Das Gupta, and Malabiker Sarker. Prevalence of chronic kidney disease in South Asia: a systematic review. BMC Nephrology. (2018),19:291 DOI: https://doi.org/10.1186/s12882-018-1072-5.
7. Liang Feng, Hithanadura Asita de Silva, Imtiaz Jehan, Aliya Naheed, Anuradhani Kasturiratne, Gulshan Himani, Mohammad Abul Hasnat and Tazeen H. Jafar. Regional variation in chronic kidney disease and associated factors in hypertensive individuals in rural South Asia: findings from the control of blood pressure and risk attenuation—Bangladesh, Pakistan, and Sri Lanka. Nephrol Dial Transplant (2019), 34: 1723–1730 DOI: 10.1093/ndt/gfy184.
8. Paul E. Drawz, John R. Sedor, Thomas H. Hostetter, Family History and Kidney Disease. Am J Kidney Dis. 2012;59(1):9-10 DOI:10.1053/j.ajkd.2011.11.012
9. McClellan WM, Warnock DG, Judd S, et al. Association of family history of ESRD, prevalent albuminuria, and reduced GFR with incident ESRD. Am J Kidney Dis. 2012;59(1):25-31.
10. Zhenliang Fan, Jie Yun, Shanshan Yu, Qiaorui Yang, Liqun Song. Alcohol Consumption Can be a "Double-Edged Sword" for Chronic Kidney Disease Patients. Med Sci Monit, 2019; 25: 7059-7072. DOI: 10.12659/MSM.916121
11. Yook Chin Chia and Siew Mooi Ching. Hypertension and the development of New-onset chronic kidney disease over 10 years period: a retrospective cohort study in a primary care setting in Malaysia. BMC Nephrology 2012, 13:173. Retrieved June 5, 2020, from

http://www.biomedcentral.com/1471-2369/13/173.

12. Ivana Mikolasevic, Marta Žutelija, Vojko Mavrinac, Lidija Orlic. Dyslipidemia in patients with chronic kidney disease: etiology and management. International Journal of Nephrology and Renovascular Disease 2017:10 35–45.
13. Natalie Staplin, Richard Haynes, William G. Herrington, Christina Reith, Alan Cass, Bengt Fellstrom, Lixin Jiang, Bertram L. Kasiske, Vera Krane, Adeera Levin, Robert Walker, Christoph Wanner, David C. Wheeler, Martin J. Landray, Colin Baigent, and Jonathan Emberson. Smoking and Adverse Outcomes in Patients With CKD: The Study of Heart and Renal Protection (SHARP). Am J Kidney Dis. 2016. Retrieved June 22, 2020, from DOI: http://dx.doi.org/10.1053/j.ajkd.2016.02.052.
14. Shewaneh Damtie, Belete Biadgo, Habtamu Wondifraw Baynes, Sintayehu, Ambachew, Tadele Melak, Daniel Asmelash, Molla Abebe. Chronic Kidney Disease and Associated Risk Factors Assessment among Diabetes Mellitus Patients at A Tertiary Hospital, Northwest Ethiopia. Ethiop J Sci.2018;28(6):691. Retrieved July 2, 2020, from DOI: http://dx.doi.org/10.4314/ejhs.v28i6.3.
15. 24th Report of the Malaysia Dialysis and Transplant Registry 2016.
16. Pejabat Kesihatan Ranau, Sabah Statistics Population. 2011.
17. Dunkler D, Kohl M, Heinze G et al: Modifiable lifestyle and social factors affect chronic kidney disease in high-risk individuals with type 2 diabetes mellitus. Kidney Int, 2015; 87(4): 784–91
18. Noor Ani A, Ummi Nadiah Y, Noor Azah D et al. Sensitivity and specificitof CardioCheks PA in detecting individuals with abnormal cholesterol and glucose level. Int J Biomed 2012; 2: 132–135.
19. Gurpreet K, Tee GH, Karuthan C. Evaluation of the accuracy of the Omron HEM-907 blood pressure device. Med J Malaysia 2008; 63:239–243.
20. Levey A, Stevens L, Schmid C et al. for the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI). A new equation to estimate glomerular filtration rate. Ann Intern Med 2009; 150: 604–612.