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CKD Knowledge and Its Associated Factors Among Patients with Type 2 Diabetes Mellitus Attending Follow-up in a Penang Primary Health Clinic

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Abstract:

Objective: Information regarding the level of chronic kidney disease (CKD) knowledge and its associated factors among high-risk patients is crucial for the planning of CKD prevention strategies. This study aimed to determine the level of CKD knowledge and its associated factors among patients with a recent diagnosis of diabetes mellitus (DM) attending follow-ups at a primary healthcare clinic in Penang.

Material and Methods: This cross-sectional study involved the consecutive sampling of 100 recently diagnosed DM patients (within 5 years) attending diabetic follow-up at the Kepala Batas Health Clinic. The level of CKD knowledge was assessed using a self-administered validated questionnaire. Demographic characteristics were described using frequencies, percentages, means and standard deviations. Associated factors of CKD knowledge were determined using multiple logistic regression analysis. The level of statistical significance was set at p-value<0.05.

Results: As high as 81.0% of the participants scored less than four out of seven marks for CKD knowledge. The mean score was 2.61, while the median score was 3.0. Educational level was identified as the single determinant of CKD knowledge among the study participants.

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Conclusion: In this study, patients with a recent diagnosis of DM attending follow-up in primary healthcare showed a poor level of CKD knowledge. To ensure the success of the CKD prevention programme among high-risk groups, healthcare providers must provide relevant and effective education to all diabetic patients in the early phase after DM diagnosis; particularly among those with a lower education background.

Keywords: CKD, diabetes, kidney disease, knowledge

Introduction

Chronic kidney disease (CKD) is defined as an abnormality of kidney structure and function for three months or more, with implications for the health of the individuals. The diagnosis of CKD requires one of two criteria documented or inferred below for three months or more, i.e. GFR <60 ml/min/1.73 m^2, the presence of kidney damage biomarkers; including albuminuria ≥3.0 mg/mmol[1]. The damage to the kidney is progressive and usually irreversible, as the body's ability to maintain metabolic fluid and electrolyte balance is gradually impaired. Eventually, it will lead to end-stage renal failure (ESRF), necessitating renal replacement therapy, such as dialysis or renal transplant.

The prevalence of CKD is rising every year in many countries worldwide. It is estimated that about 10% or 843.6 million individuals are affected with CKD worldwide[2]. The rising prevalence has been attributed to the increasing prevalence of CKD risk factors, such as aging, obesity, hypertension and diabetes mellitus (DM) in the general population[3]. In Malaysia, the prevalence of CKD has increased from 9.05% in 2011 to 15.48% in 2018; with DM identified as the most significant contributing factor[4].

Based on the 2017 Global Burden of Disease (GBD) studies, CKD has emerged as the leading cause of worldwide mortality[5], making it a significant global public health problem. Cardiovascular disease (CVD) and end-stage renal failure (ESRF) were identified as the major causes that contribute directly to morbidity and mortality among CKD patients[3]. Apart from the detrimental health impact, CKD also gives rise to a significant economic loss to the country due to the high cost incurred in the management of the disease and its associated comorbidities as well as the reduced work productivity resulting from absenteeism and premature death among patients[6].

In view of the high prevalence and detrimental consequences of to humans, society, and the nation, CKD should be viewed as a significant public health concern that warrants comprehensive preventive strategies at all levels of care; primary, secondary, and tertiary levels. One of the most important preventive strategies is an effective screening programme that can facilitate the early detection of the disease. Identification of people at risk of CKD during earlier stages enables the initialisation of early treatment to prevent or delay adverse outcomes of CKD[7]. While many screening programmes have been implemented in health centres, little is known about the level of CKD knowledge and its associated factors, especially among high-risk individuals with DM and hypertension. In a local study conducted in the medical outpatient clinic of the Hospital Pakar Sultanah Fatimah, Johor, the knowledge of CKD among patients with DM and hypertension was lower as compared to those without the disease[8]. The success of CKD prevention requires a comprehensive educational programme that can deliver the necessary knowledge to enhance awareness and subsequently change people's attitudes and behaviour toward the disease. Therefore, adequate information on the level of CKD knowledge among diabetic patients and its associated factors is imperative to assist healthcare providers in preparing appropriate

and relevant educational content at any healthcare level. Effective education will shape the necessary awareness to increase the uptake of health screening, thus, facilitating early detection and eventually reducing the prevalence of ESRF. Hence, this study aimed to explore the knowledge of CKD and its associated factors among patients with a recent diagnosis of Type 2 DM attending follow-ups in a primary healthcare setting in Penang state.

Material and Methods

Subjects and sampling

This was a cross-sectional study conducted between November 2020 and October 2021. Patients attending diabetic follow-up in Klinik Kesihatan Kepala Batas (KKKB), Penang, Malaysia were recruited via consecutive sampling. The patients were approached during their blood-taking appointments to determine their eligibility for participation. Those who were recently diagnosed with type 2 DM (within the last five years) were included as the study subjects regardless of whether they were with or without hypertension. In contrast, those who were below the age of 21 years, illiterate, with pre-existing CKD or other kidney problems or on dialysis treatment were excluded. After obtaining informed consent, all subjects were given a validated self-administered questionnaire before proceeding to physical examination and blood taking for HbA1c. This study commenced after ethical clearance from Jawatankuasa Etika Penyelidikan Manusia (*JEPeM*) USM (JEPeM USM Code: USM/JEPeM/19040242) and the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (NMRR NO.: NMRR-18-3779-42152).

Questionnaire for assessment of CKD knowledge

The CKD knowledge questionnaire consisted of two sections. Section A and B captured sociodemographic characteristics and medical conditions of the subjects, while Section C consisted of questions to assess CKD knowledge in seven domains: anatomy, physiology, aetiology, presentation, progression, resources available and treatment of CKD as listed below. All the questions in section C were closed-ended multiple-choice questions, with a single response type.

Question no. 1: How many healthy kidney(s) does a normal person need? (Anatomy)

Question no. 2: What is the function of a kidney in the human body? (Physiology)

Question no. 3: What factor(s) can cause kidney disease? (Aetiology)

Question no. 4: What are the early symptoms of chronic kidney disease? (Presentation)

Question no. 5: Which of the following statements about kidney disease is correct? (Progression)

Question no. 6: Where dialysis treatment can be carried out? (Resources available)

Question no. 7: What is the best treatment option for End Stage Kidney Failure? (Treatment)

The questions in section C were adopted from a study conducted in Singapore that assessed the knowledge of CKD among primary care patients[9]. This study decided to adopt the questionnaire because this study's population is almost similar to the study population in Singapore. These were diabetic patients receiving treatment and follow-up in primary health care settings. In addition, the culture and ethnicity of this study population is also quite close to Singapore, justifying the adoption of the questionnaires.

For correct answers, a score of one was given, whilst wrong answers were scored as zero. The answer "I don't know" was considered as a lack of knowledge and was also given a score of zero. Therefore, the minimum score from Section C would be zero, whereas the maximum score would be 7.0. A score of ≤3.0 was considered as having poor knowledge, whilst a score of ≥4.0 was considered as having good knowledge.

The validity (content and face) and reliability (cronbach's alpha score) of the questionnaire were tested. For the assessment of content validity, a focus group

discussion was conducted with five experts in the field, including two family medicine specialists, one chemical pathologist, one nephrologist and one medical officer. The face validity was conducted with a group of five diabetic patients to detect any incorrect interpretations or ambiguity in the questions. Following that, the questionnaires were edited, revised, and finalised based on the input obtained during the content and face validity process. For the assessment of reliability, a pilot test was conducted. The questionnaire was administered to 35 diabetic patients from KKKB. The questionnaire's reliability was evaluated for all the domains using internal consistency (cronbach's alpha score). A cronbach's alpha score of 0.7 or higher is considered as a good internal consistency. For this study, the overall reliability of the section for CKD knowledge was 0.786, thus, indicating good internal consistency[10].

Blood sampling

Approximately 3 ml of venous blood was drawn from each subject for the measurement of HbA1c. The blood was analysed using an HbA1c analyser (Alere Afinion AS100) to determine the diabetic status of the subjects. An HbA1c value of ≤7.5% was considered good diabetic control, whilst a value of >7.5% was considered poor diabetic control.

Statistical analysis

The data were analysed using Statistical Package for Social Sciences (IBM SPSS Statistic for Windows, version 26.0. Armork NY: IBM Corp). The demographic characteristics were described using frequencies, percentages, means and standard deviations. Differences between mean scores of categorical variables were performed using chi-square and one-way ANOVA test. Multiple logistic regression analysis was performed to determine the associated factors of CKD knowledge. The level of statistical significance was set at a p-value<0.05.

Results

Demographic characteristics

A total of 100 subjects completed the questionnaire. The majority of the subjects were aged 21–60 years, with an equal number of males and females. Most of the subjects were Malays (82.0%). In terms of religion, 83.0% of the subjects were Muslims, whilst 9.0% and 8.0% were Hindus and Buddhists respectively. More than half (63.0%) of them completed a secondary level education, while 23.0% and 16.0% had tertiary and primary level education respectively. Only 19.0% of subjects were professionals/executives, whilst the rest were non-professionals (42.0%), unemployed (34.0%), and retirees (5.0%). Most of the subjects (69.0%) earned less than RM 2,000 per month. Approximately 60.0% had poor diabetic control. Furthermore, more than half of the subjects (67.0%) had heard about CKD before, with most of them receiving their information from the subjects' family and friends that have CKD (Table 1).

CKD knowledge

In terms of CKD knowledge level, the mean score was 2.61 and the median score was 3.0 (Figure 1). As high as 81.0% of them scored less than four out of the total seven marks. Among the subjects, 66.0% were aware that the kidney's function is to filter blood waste products. About half (55.0%) of them knew that DM and hypertension can cause kidney disease. A similar percentage of subjects (55.0%) knew that the best treatment for ESRF is a renal transplant. However, less than half of them (42.0%) knew that dialysis treatment could be conducted at home or a dialysis centre. Only 19.0% of subjects knew that kidney disease could be prevented and 16.0% knew that kidney disease could present without any symptoms. A very small portion (9.0%) of the subjects knew that one kidney is sufficient to live a normal life (Figure 2).

Factors associated with CKD knowledge

Study subjects who have heard about CKD showed a significantly higher CKD knowledge score (p-value=0.011) than those who have never heard about the disease. In addition, Malay (p-value=0.024), tertiary education (p-value=0.001), and higher monthly income (p-value=0.009) were associated with a higher CKD knowledge score (Table 1).

After categorising the subjects into having poor (≤3.0 scores) or good (≥4.0 scores) CKD knowledge, the simple logistic regression analysis showed that race, marital status, education level, occupation, and monthly income, were important factors associated with CKD knowledge (Table 2), therefore, these were included in the multivariate logistic regression analysis. However, after adjusting for the confounding factors, the analysis showed that only education level was a significant independent predictor of CKD knowledge. A subject with secondary education had 4.690 times the odds (95% CI: 1.383 to 15.907, p-value 0.013), while a subject with primary education had 39.753 times the odds (95% CI: 3.784 to 417.620, p-value 0.002) to have poor CKD knowledge as compared to subjects with tertiary education when adjusted for race (Table 3).

Discussion

Worldwide, published literature has revealed a high prevalence of poor CKD knowledge among the general public[8]. Nevertheless, previous studies in Hong Kong and Australia reported that CKD knowledge was higher among CKD high-risk individuals compared to their counterparts[11,12]. A previous study conducted among outpatients in a state hospital in Malaysia reported a contradicted finding whereby, DM or hypertension patients were not significantly associated with a better knowledge level of CKD[8]. This study determined the CKD knowledge among subjects with a history of recent DM diagnosis within five years in a primary healthcare centre. It was observed that most of the subjects had poor knowledge of CKD. The finding shows that CKD knowledge is poor among diabetic patients in Malaysia, regardless of the extent of their comorbidities and the level of healthcare facilities that they visit.

The poor knowledge among diabetic patients reflects a possible gap in patient-provider communication. The patients might not be receiving adequate education from the healthcare providers about their disease and its potential complications, or it also can be the failure of the patients themselves to understand the information delivered by healthcare providers. Indeed, a lack of CKD knowledge is not only a common problem among diabetic patients, but it is also a major issue among those with established CKD diagnosis[13]. Therefore, more aggressive actions are needed to address this problem. To begin with, an appropriate and effective educational programme must be designed to enable early detection of CKD at all healthcare facilities, especially among high-risk individuals.

Overall, the level of CKD knowledge was poor among the study population. Nevertheless, a few items in the questionnaire were answered correctly by most of the subjects. In particular, the subjects knew about the main function of the kidney. They were also aware that DM and hypertension are the common causes of CKD. These findings showed that diabetic patients have a good basic understanding of CKD. Nonetheless, their knowledge regarding the aetiology, presentation, progression, and treatment of CKD was poor. This was probably related to low health literacy among the patients. In general, health literacy is defined as the ability of a person to access, understand, evaluate as well as use the health information obtained to make sound judgment and decisions about their health[14]. Low health literacy is a significant issue in the healthcare system, as it is associated with a poor understanding of a disease's condition and management among patients with chronic diseases[13]. Based on a study conducted in Malaysia, most diabetic patients showed a low level of health literacy[15]. This explains why our subjects had poor overall CKD knowledge despite of having a basic understanding of the disease.

Table 1 Demographic characteristics and comparison of mean knowledge score of CKD

Variables	No (%)	CKD knowledge score, Mean (S.D.)	F statistic	p-value
Age (years)				
21–40	12 (12.0)	2.75 (1.055)	0.430	0.67
41–60	88 (88.0)	2.59 (1.218)		
Race				
Malay	82 (82.0)	2.74 (1.194)	2.574	0.02*
Chinese	9 (9.0)	2.13 (0.991)		
Indian	9 (9.0)	2.00 (1.118)		
Gender				
Male	50 (50.0)	2.48 (1.111)	1.087	0.28
Female	50 (50.0)	2.74 (1.275)		
Marital status				
Single	7 (7.0)	1.86 (1.069)	0.720	0.64
Married	80 (80.0)	2.76 (1.204)		
Divorced/Separated	13 (13.0)	2.08 (0.954)		
Religion				
Islam	83 (83.0)	2.72 (1.203)	1.538	0.17
Buddha	8 (8.0)	2.13 (0.991)		
Hindu	9 (9.0)	2.00 (1.118)		
Education level				
Primary school	14 (14.0)	1.64 (1.151)	4.524	0.001*
Secondary school	63 (63.0)	2.54 (1.119)		
Tertiary education	23 (23.0)	3.39 (0.941)		
Occupation				
Professional	19 (19.0)	3.16 (0.958)	1.550	0.17
Non- professional	42 (42.0)	2.26 (1.170)		
Unemployed	34 (34.0)	2.64 (1.228)		
Retired	5 (5.0)	3.20 (1.303)		
Income				
Less than RM2000	69 (69.0)	2.45 (1.207)	3.062	0.009*
RM2000–RM4999	22 (22.0)	2.77 (1.110)		
Above RM5000	9 (9.0)	3.44 (1.014)		
Hypertension				
No	44 (44.0)	2.61 (1.061)	0.027	0.98
Yes	56 (56.0)	2.61 (1.303)		
Diabetes control				
Good control (≤7.5)	40 (40.0)	2.45 (1.061)	1.093	0.28
Poor control (>7.5)	60 (60.0)	2.72 (1.277)		
Ever heard about CKD				
No	33 (33.0)	2.18 (1.236)	2.582	0.01*
Yes	67 (67.0)	2.82 (1.127)		

*p-value<0.05, considered significant
S.D.=standard deviation, CKD=chronic kidney disease

Table 2 Univariable logistic regression analysis for factors associated with poor CKD knowledge

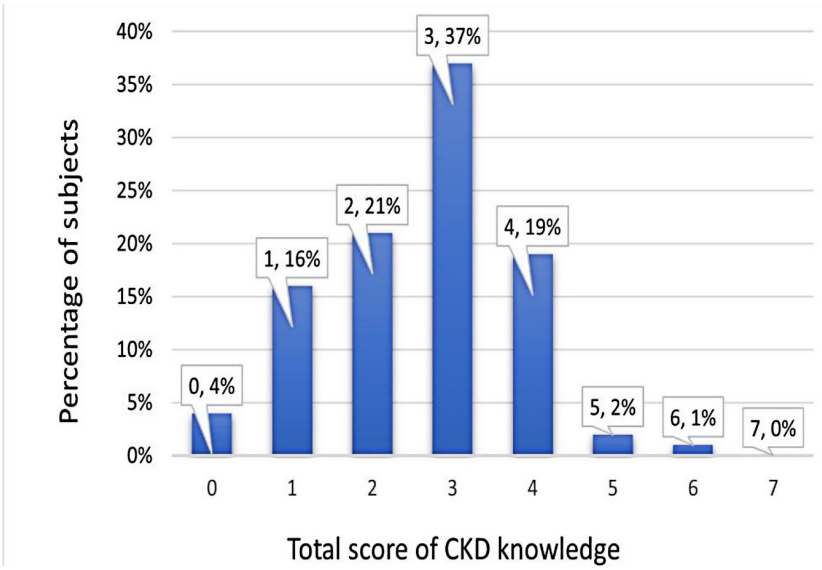
Variable	Crude OR (95% CI)	p-value
Age (years)		
21–40	1	
41–60	0.64 (0.194, 2.110)	0.46
Gender		
Female	1	
Male	1.38 (0.628, 3.029)	0.42
Race		
Malay	1	
Non-Malay	0.45 (0.052, 3.882)	0.003
Marital status		
Single	1	
Married	0.30 (0.054, 1.616)	0.16
Divorced	0.90 (0.120, 6.777)	0.92
Education level		
Tertiary	1	
Secondary	4.60 (1.406, 15.065)	0.01
Primary	61.75 (6.178, 617.179)	<0.001
Occupation		
Professional	1	
Non-professional	6.09 (1.717, 21.626)	0.005
Unemployed	3.75 (1.031, 13.646)	0.05
Retired	0.94 (0.081, 10.899)	0.96
Monthly income		
Above RM5000	1	
RM2000 – RM4999	2.00 (0.332, 12.046)	0.45
Less than RM2000	4.29 (0.831, 22.151)	0.08
Co-existing Hypertension		
No	1	
Yes	0.98 (0.445, 2.162)	0.96
Diabetic status		
Good control (HbA1c ≤7 mmol/l)	1	
Poor control (HbA1c >7 mmol/l)	1.48 (0.641, 3.420)	0.36
Ever heard about CKD		
No	1	
Yes	3.154 (1.315, 7.564)	0.01

p-value<0.05 considered as significant.
OR=odds ratio, CI=confidence interval, CKD=chronic kidney disease

Table 3 Multiple logistic regression between educational status and CKD knowledge

Variables	B	Adjusted OR (95% CI)	p-value
Education levels			
Tertiary level		1	0.004
Secondary level	1.670	4.690 (1.383, 15.907)	0.013
Primary level	4.009	39.753 (3.784, 417.620)	0.002

Constant =–1.753, OR=odds ratio, CI=confidence interval, CKD=chronic kidney disease



CKD=chronic kidney disease

Figure 1 Distribution of marks on knowledge of CKD amongst the subjects

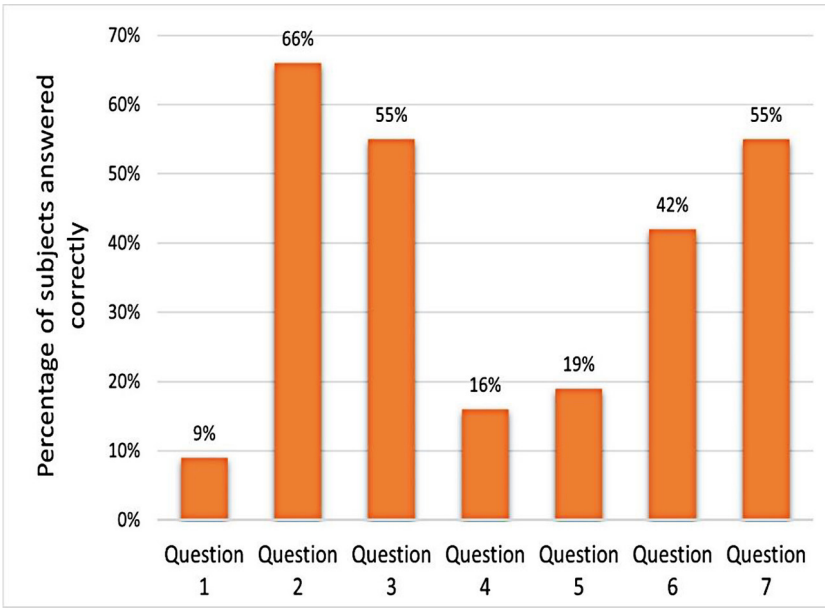


Figure 2 Percentage of subjects that answered chronic kidney disease knowledge questions correctly

In this study, multiple regression showed that education level was the only significant predictor of CKD knowledge. Diabetic patients with tertiary-level education were more likely to record a good level of CKD knowledge than those with only a secondary or primary level of education. This finding is aligned with a study conducted in Jordan whereby, education level was identified as the key determinant of CKD knowledge among patients with hypertension and DM[16]. Similar findings were also reported in studies conducted among the general population in India and Tanzania[17,18]. Education plays an important role in health, as it is the basis of a patient's health literacy. Individuals with a higher education level often display better critical thinking skills and health-seeking behaviours; both of which facilitate them to obtain more information regarding health and disease[14]. Thus, higher health literacy among individuals with higher education levels is commonly linked to better CKD knowledge as compared to individuals with lower education levels.

On the other hand, studies conducted in Bangladesh and India revealed that apart from education, other factors such as gender, occupation, and monthly income also played a significant role in the CKD knowledge level among type 2 DM patients[19,20]. The disparity in their findings, as compared to this study, could be attributed to the differences in the demographic and socioeconomic characteristics of the study participants as well as the questionnaire used for the assessment of CKD knowledge.

In this current study, the validated questionnaire that was used for the assessment of subjects' knowledge of CKD covers the anatomy, physiology, aetiology, presentation, progression, resources available and treatment of CKD. There have been several studies that have also adopted the same questionnaire to measure CKD knowledge, however, these studies involved different groups of subjects. For example, a local study conducted in Johor measured CKD knowledge among medical outpatient clinics. That study found that the subjects had poor CKD knowledge especially in those from low socioeconomic groups[8]. Other studies, using the same questionnaires, were conducted among local university students in Selangor and Pahang. Based on those studies, CKD knowledge was poor among university students, especially undergraduates. Post-graduate students, on the other hand, showed better knowledge[21,22]. This study's findings are in agreement with those studies that reported subjects with higher education had higher CKD knowledge than those with lower education. Apart from knowledge, the latter study also assessed the awareness domain using the same questionnaire. Two questions were considered related to CKD awareness, i.e. "Have you ever heard about CKD" and "Where did you get the information about chronic kidney disease from?". Based on these questions, the study concluded that university students, especially post-graduates and those with medical backgrounds, have a high awareness of CKD.

Assessment of awareness is important, as it is considered the basis of the Knowledge-Attitude-Practice (KAP) model. One of the questionnaires for the assessment of CKD awareness has been developed and was validated in China in 2014. The questionnaire covers 4 components, i.e., awareness about the disease, CKD-related diet and exercise, laboratory examination results and medical resources. There were 18 closed-ended questions, with a five-point Likert scale ("know nothing about it", "know a bit", "know basically", "know most of it" and "know clearly"). The respondents were required to choose the most suitable answer for each of the questions[23]. With good validity, stability, and consistency, the questionnaire was considered a reliable tool for the assessment of CKD awareness among CKD patients. Nevertheless, the utility of such a questionnaire is still restricted in our population, due to a lack of a validation study. It is hoped that a proper validation study of assessment tools for CKD awareness could be conducted for patients with high CKD risk in our

population, thus enabling more accurate and proper KAP CKD assessment.

Studies on KAP associated with CKD have accumulated in recent years. A KAP survey using questionnaires measures not only CKD knowledge, but also attitudes and practices towards the disease. Knowledge refers to a person's understanding regarding CKD, whilst attitude refers to beliefs, behaviours or tendencies towards CKD; whereas practice refers to actions a person takes in response to stimuli, based on his or her understanding and tendency toward CKD[24]. KAP questionnaires for CKD have been developed and used in many studies across populations and cohorts. For example, a study in Tanzania has been conducted to validate a KAP questionnaire for CKD among their general population[18]. The questionnaire consists of 25 closed-ended questions, of which ten questions with a four-point categorical response scale ('Yes', 'No', 'Do not know', and 'Unsure') were used to assess subjects' knowledge of the aetiology, symptoms, diagnosis, prevention and treatment of CKD. Another eight and seven questions were used to assess the attitude and practice of the subjects toward CKD, respectively. Compared to their questionnaire, this study's questionnaire in the knowledge domain consisted of only 7 questions that require a single best-option response. In addition, none of this study's questions were designed to assess knowledge of CKD prevention. In terms of the scoring system, a score of 1 for a correct answer, while a zero score was given for both "do not know" and incorrect answer. Similarly in their study, a score of 1 was given for the correct answer, whereas a score of zero was given for incorrect, "do not know" and "unsure" answers. Despite differences in the subject groups and questionnaire, this study's findings were in alignment with their study that reported low CKD knowledge.

A more recent KAP questionnaire for CKD was developed in 2019. This questionnaire was validated and has been used among patients with diabetes and CKD in Fiji. Out of 40 questions, 15 were categorized into the knowledge domain that covers aetiology, physiology, symptoms, diagnosis, prevention, and CKD delaying and worsening factors. Each of the questions was provided with a 3-response option: "Yes", "No" and "Do not Know"[25]. Based on their questionnaire survey, they found that CKD knowledge was high in their population, which is opposite to our findings. These contradictory findings could be due to the difference in the study subjects as well as the questionnaire scoring system. In this study, the subjects were diabetic patients without CKD. Whilst in their study, the subjects were those with diabetes and CKD that might have been exposed to information regarding CKD during consultation and counselling by the treating team. In terms of scoring, they gave 2 marks for each correct answer, 1 mark for "I do not know" and a zero mark for an incorrect answer. For this study, it was believed that the subjects who answered as "do not know" or "unsure," should be considered as having a lack of knowledge, therefore, they should be given a zero score. The use of a validated KAP questionnaire with an appropriate and standardized scoring system is crucial to ensure the outcomes are comparable between studies, and most importantly that it can serve the intended purpose.

The findings of this study should be interpreted in light of certain limitations. Firstly, the findings of the study cannot be generalised to the entire diabetic population in Malaysia, as this study involved only patients from a single primary healthcare centre in KKKB; wherein, the majority of them were Malays. Secondly, the sample size of this study was small, hence, certain small differences between groups might not have been detected. Thirdly, the self-administered questionnaire could give rise to incorrect responses, due to misinterpretation, subsequently affecting their knowledge score.

Conclusion

In conclusion, recently diagnosed diabetic patients attending follow-ups in primary healthcare showed a poor level of CKD knowledge. To ensure the success of any CKD prevention programme among high-risk individuals, it is crucial for healthcare providers to provide adequate and effective education to all diabetic patients at the early phase following diagnosis; particularly to those with a low education background. The delivery of well-designed and customised health education at primary and secondary healthcare levels, based on a properly validated and constructed questionnaire survey will help to improve patients' health literacy, subsequently enhancing their participation in self-management interventions for CKD prevention.

Conflict of interest

There are no potential conflicts of interest to declare.

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