ORIGINAL ARTICLE

Psychometric Validation of a Malay-translated Questionnaire on Knowledge, Attitudes, and Practices of Chronic Kidney Disease Prevention Among Type 2 *Diabetes Mellitus* Patients

Anas Rosedi[1], Suhaily Mohd Hairon[1], Siti Suhaila Mohd Yusoff[2], Anees Abdul Hamid[3], Mohammad Fazrul Mohammad Basir[1], Dariah Mohd Yusoff[4]

[1] Department of Community Medicine, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.
[2] Department of Family Medicine, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.
[3] Primer Health Unit, Kelantan State Health Department, Aras 5, Wisma Persekutuan, Jalan Bayam, 15590 Kota Bharu, Kelantan, Malaysia.
[4] Faculty of Nursing and Allied Health Sciences, Open Universiti Malaysia, Kelantan Centre Point, Jalan SS 7/19, SS 7, 47301, Petaling Jaya, Selangor, Malaysia.

ABSTRACT

Introduction: The increasing worldwide incidence of Type 2 *Diabetes mellitus* (T2DM), especially in Malaysia's North-East Peninsular region, highlights the need to address related complications, notably chronic kidney disease (CKD). This study aims to validate the Malay-translated version of the Knowledge, Attitudes, and Practices (KAP) on CKD Questionnaire among T2DM patients in the specified region. **Materials and methods:** In this study, 260 Type 2 *Diabetes mellitus* (T2DM) patients from an outpatient clinic in a teaching hospital completed the self-administered Malay-translated KAP on CKD Questionnaire. A descriptive analysis was conducted to outline participants' demographic and clinical profiles. The questionnaire underwent content and face validation to ensure clarity and relevance. The Knowledge domain, consisting of 32 items, underwent 2-parameter Logistic Item Response Theory (2-PL IRT). Additionally, Confirmatory Factor Analysis (CFA) was employed to refine the structure of the 13-item Attitude and Practice domains. **Results:** The findings demonstrated the robust psychometric properties of the Knowledge domain, revealing unidimensionality and adequate discriminant indices. The Attitude and Practice domains underwent model refinement to achieve satisfactory fit indices. Composite reliability was employed for internal consistency, with Raykov Rho values indicating acceptable reliability. **Conclusion:** The validation of the Malay-translated KAP-CKD Questionnaire for T2DM patients in Malaysia offers a reliable and valid tool for assessing T2DM patients' KAP on CKD, benefiting researchers and healthcare professionals. This instrument significantly contributes to the field, fostering future research and improving understanding of CKD-related issues among T2DM patients.
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Corresponding Author:
Suhaily Mohd Hairon, DrPH
Email: suhailymh@usm.my
Tel : +609-7676640

INTRODUCTION

Diabetes mellitus Type 2 (T2DM) is a global public health challenge, with a rising prevalence that has significant implications for healthcare systems worldwide. In Malaysia, as in many other countries, the burden of T2DM is escalating, particularly in the North-East Peninsular region. NHMS 2019 reported a marked increase in the burden of T2DM patients, from 11.2% in 2011 to 18.3% in 2019 [1]. What is more concerning is the observed 120% surge in undiagnosed cases of diabetes during the same time frame, despite the standardized cut-off points for diagnosis of T2DM. This trend implied that an increasing number of individuals with diabetes may experience delayed diagnosis, resulting in diabetic complications already taken place before their condition was identified.

Among the myriad complications associated with T2DM, Chronic Kidney Disease (CKD) stands out as critical and frequently occurring worldwide. Chronic

kidney disease is defined as a condition where there are persistent elevation of urine albumin excretion (≥30 mg/g [≥3 mg/mmol]), persistent reduction of eGFR (<60ml/min per 1.73m2) or both which persist for 3 months or more [2]. A cross-sectional study in Malaysia report revealed a 70% increase in the prevalence of CKD, with a higher proportion of CKD patients demonstrating impaired estimated Glomerular Filtration Rate (eGFR) in comparison to 2011 [3, 4].

An essential component in addressing this challenge is a thorough understanding of the knowledge, attitudes, and practices (KAP) related to CKD among individuals with T2DM. Assessing these aspects can provide insights into the patient's awareness of CKD, their attitudes toward its prevention and management, and their practices in mitigating its risk. Several questionnaires were used in research to assess the KAP on CKD among patients in Malaysia; Unfortunately, most either had incomplete coverage of the KAP domain or lacked proper validation [5–7]. A well-validated questionnaire can accurately measure the latent variable that researchers aim to understand. This can aid in the formulation of effective educational interventions and healthcare strategies tailored to the specific needs of the population[8, 9].

This research seeks to address this critical need by presenting the validation of the Malay-translated version of the KAP-CKD Questionnaire for T2DM patients. The validation of this tool within this specific population is essential, as it can help uncover an accurate and valid baseline KAP related to CKD, allowing formulation of targeted interventions and educational programs to facilitate early detection and reduce the burden of CKD, particularly among T2DM patients in Malaysia.

MATERIALS AND METHODS

Questionnaire of choice

This questionnaire was adapted from the CKD Screening Index developed by Khalil et al. and translated into Malay by Yusoff, Yusof, and Kueh [5, 10]. The questionnaire contained 58 items on the knowledge (32 items), attitude (13 items), and practice (13 items) domains. The knowledge domain consisted of 32 items, and each was answered either 'correct', 'wrong' or 'unsure'. The 13 items in the attitude domain used 5-point Likert from 'strongly disagree', 'disagree', 'unsure', 'agree' to 'strongly agree'. The 13 items in the practice domain were rated on a 4-point Likert scale from 'never', 'seldom', 'sometimes' and 'often'. The result of the exploratory factor analysis (EFA) was reported by Khalil et al. [10]. This questionnaire was chosen given the comprehensiveness that covered all KAP domains and it was widely used in research to determine the KAP on CKD [11, 16].

Content and Face Validation

Content validation was repeated in this study involving seven expert panels comprising two public health physicians, three family medicine specialists and two internal medicine specialists. The panels were required to rate the clarity and relevance of each item in the questionnaire. A content validity index (CVI) of less than 0.83 suggested that the item be removed from the questionnaire. The experts' feedback was incorporated into the questionnaire which led to an improved and refined version of the questionnaire compared to the pre-content validation version. Face validity was conducted to ensure that study participants could understand the items in the questionnaire. The post-content validation version was given to the 10 clinic patients to determine its clarity and comprehension. Special attention was given to item construction to avoid incomprehensibility. Validation study: 2-parameter logistic item response theory (2PL-IRT) and Confirmatory Factor Analysis (CFA).

This research employed a cross-sectional study design involving patients with type 2 *Diabetes mellitus* who attended outpatient clinics at a tertiary teaching hospital. Participants were Malaysian citizens aged between 18 and 80 years who had been under clinic follow-up for at least 1 year, and who could understand the Malay language. Those who were diagnosed with diabetes in pregnancy were excluded from this study. The sample size was determined based on the recommendations of Hair et al. and An & Sean, who consider a sample size of 260 to be fair and adequate for factor analysis [17-18]. The study participants were chosen through systematic random sampling where the 1st patients at the beginning of the clinic were selected by simple random sampling, and subsequently, every other patient was recruited after obtaining their consent. Each patient was given a patient information sheet that briefly explained the study and that their participation must be voluntary before they signed the consent form and answered the questionnaire. The questionnaires were given in an anonymous manner where the patient data would not be disclosed or distributed.

Descriptive analysis, 2PL-IRT and CFA were conducted using RStudio version 4.2.0 [19]. The descriptive analyses for the sociodemographic and clinical characteristics of the participants were done. Numerical data was described in mean (SD) or median (IQR) depending on its distribution. Categorical data was described in frequency and percentage (n (%)).

The knowledge domain outcome was put in the dichotomous form; hence, 2-PL IRT was employed using R package ltm, upon the items in its domain. Items with difficulty index beyond the range of -3 and +3 were sequentially removed. Then, items with low discriminant index (less than 0.34) were also removed sequentially. Each item's fitness was determined by a chi-square test using Monte Carlo simulation for more accuracy. Multiple parallel analysis was conducted to

determine the unidimensionality of the test. A p-value of more than 0.05 showed that unidimensionality was assumed.

Items in the attitude and practice domains were analysed using CFA to confirm their factor loading and its relationship with their respective domain. 13 items in each domain were analysed separately. Rstudio software was used to employ this analysis and the packages used were *lavaan* (for CFA analysis), *semPlot* (for path diagram) and *readxl*. The Mardia test was conducted to determine if the data was normally distributed. This test was used to guide which estimator to be used when fitting the CFA model. Then, model fitness was determined using several fit indices which were divided into absolute fit indices (Chi-square goodness of fit test, Root Mean Square Error of approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR)) and incremental fit indices (Comparative fit index (CFI) and Tucker-Lewis fit index (TLI)). Cut-off points used to determine model fitness as recommended by Hair *et al* [17]: -

- Chi-square goodness-of-fit: p-values more than 0.05 but significant values can be expected.
- SRMR value:0.8 or less (with CFI above 0.92)
- RMSEA value: less than 0.7 (with CFI of 0.92 or higher)
- CFI value: above 0.92
- TLI value: above 0.92

Localization of misfit was done by inspecting the modification indices (MI). Items with high MI would have their errors correlated to constrain the model. Plot Diagrams were constructed for both the attitude and practice domains to present the factor loading for each item. Factor loadings were represented by numbers on the arrows. These numbers indicated the strength and direction of the relationship between the latent factor and the observed variable. Composite reliability was examined for the attitude and practice domain by calculating the Raykov Rho value. A value of more than 0.6 was deemed acceptable [20].

Ethical Clearance

This study obtained approval from the USM Human Research Committee (JePEM-USM) before initiating data collection (USM/JEPeM/KK/23010069).

RESULTS

Descriptive result

A total of 260 patients participated and completed the questionnaire in this study. The mean age of the participants was 63.3 ±9.1 years old. Most of them were Malay, 237 (91.2%) and were married, 223 (85.8%). Three-quarters of them earned RM 3030 or less. The mean duration of diabetes for the participants was 14.7 ±9.3 years. The demographic and clinical characteristics are summarised in Table I.

Table I: Demographic and Clinical Characteristics of The Participants

Demographic characteristic	n(%)
Age (years)	63.3(9.1) *
Duration of Diabetes (years)	14.7(9.3) *
BMI (kg/m²)	28.9(14.3) *
Sex	
Male	87(33.5)
Female	173(66.5)
Ethnicity	
Malay	237(91.2)
Non-malay	23(8.9)
Marital status	
Married	223(85.8)
Single	6(2.3)
Widowed	31(11.9)
Education status	
Up to primary school	32(12.3)
Secondary school	148(56.9)
Diploma	30 (11.5)
Degree	39(15.0)
Master's Degree or higher	11 (4.2)
Average income	
RM 3030 or lesser	179(68.8)
RM 3031 to RM 6619	55(21.2)
RM 6620 or higher	26 (10.0)

*Mean(SD)

Content and face validation

Several items (items K6, K9, K12 and K24) had CVI less than 0.83 hence they were removed from the questionnaire. This led to satisfactory results (CVI more than 0.83) for the item and overall questionnaire in terms of clarity, relevance and necessity.

The results of the face validation demonstrated satisfactory outcomes regarding the clarity and comprehension of items. The result showed that all the items left were clear and comprehensible with a face validity index (FVI) equal to 1.

2PL-IRT Result for the Knowledge Domain

The items in the knowledge domain were divided into 4 subfactors which were factor 1 (Renal function; Item K1 to K5, and K25), factor 2 (Risk factor of CKD; Item K7, K8, K10, K11, K13, K14, A15), factor 3 (Sign and symptom of CKD; Item K16 to K23, and K26) and factor 4 (Screening and management; Item K27 to K32). Item K25, K26 and K27 were removed as these items had difficulty and/or discrimination index value beyond the desired range leaving 25 items left in this domain. The test information curves for each subfactor indicated that 91.5% to 98.69% of the information in these subfactors was within the typical ability range of

-3 to +3. Modified parallel analyses for each subfactor showed non-significant results hence, unidimensionality was assumed. The final model for 2-PL IRT analysis is summarised in Table II.

Table II: Item Response Theory Analysis for Items in The Knowledge Domain (n = 260)

Factor	Items	Difficulty (b)	Discrimination (a)	χ^2 (df= 8)	*p*-value	Amount of information for ability within -3 to +3
I know that: :-						
Factor 1 Kidney function	The kidneys function					
	K1 – To regulate the water content in my body.	-0.56	2.33	73.10	<0.001	98.69%
	K2 – To regulate the content of electrolytes such as sodium, potassium, phosphorus, and calcium in my body.	0.24	2.02	38.58	<0.001	
	K3 – To eliminate toxins that enter my body.	-0.77	1.50	45.76	<0.001	
	K4 – To produce hormones to generate red blood cells.	0.46	1.88	25.48	0.001	
	K5 – To produce hormones to generate red blood cells.	1.03	2.08	85.34	<0.001	
Factor 2 Risk factors for CKD	The following risk factors will increase the risk of chronic kidney disease:-					
	K7 – Hypertension	-1.32	0.94	16.78	0.032	94.86%
	K8 – Diabetes Mellitus	-1.78	3.61	8.21	0.413	
	K10 – Smoking	0.10	1.26	27.09	0.001	
	K11 – Excessive body weight	-0.67	1.45	36.61	<0.001	
	K13 – Recurrent kidney stones	-0.19	2.46	33.70	<0.001	
	K14 – Recurrent urinary tract infection	-0.52	2.09	27.46	0.006	
	K15 – Having a family member with chronic kidney disease.	0.61	0.82	24.43	0.002	
Factor 3 Sign and Symptom for CKD	Signs and symptoms of chronic kidney disease are:-					
	K16 – Fatigue	-0.88	2.56	28.71	<0.001	98.64%
	K17 – Concentration problems	0.32	1.38	33.24	<0.001	
	K18 – Loss of appetite	-0.25	2.69	13.37	0.099	
	K19 – Difficulty sleeping	-0.26	2.31	6.26	0.618	
	K20 – Muscle cramps	0.02	1.58	14.20	0.077	
	K21 – Leg swelling	-1.56	1.87	22.06	0.005	
	K22 – Dry skin	-0.46	2.25	15.54	0.049	
	K23 – Itchy skin.	-0.41	2.24	15.08	0.058	
Factor 4 Screening and Management of CKD	K28 – Regular urine protein testing allows early detection of chronic kidney disease.	-1.32	1.76	62.63	<0.001	91.5%
	K29 - Chronic kidney disease is a curable disease.	1.28	0.54	69.56	<0.001	
	K30 - All stages of kidney disease have the same management plan.	0.73	1.00	93.63	<0.001	
	K31 - There are five stages of chronic kidney disease.	-0.11	0.99	89.07	<0.001	
	K32 - Stage 5 chronic kidney disease patients require lifelong dialysis treatment.	-1.40	2.25	42.09	<0.001	

CFA Result for the Attitude Domain

For the attitude domain, 13 items were divided into two factors as reported in the exploratory factor analysis (EFA) by Khalil et al. Factor 1 was named as 'seeking help/assistance' (Items A1-A4) and Factor 2 was named as 'action and applications' (Items A5-A13). Item A5 was modified to be more specific for T2DM patients. Item A6 was modified to be a reverse statement. Item A9, A11, A12 and A13 were reported to have low FL by Khalil et al., but they had good scores in I-CVI in terms of clarity and relevance during content validation. These items were also revised to avoid double-barrelled questions and to be more suitable for T2DM patients.

The Mardia test was significant hence multivariate normality was not met. Other robust estimators were used in the CFA for the attitude domain and MLR were the estimator of choice. Model 1 was assessed, and fit indices were generated. Item A6 and A11 were removed due to having low factor loading (FL < 0.3), Model 2 was

established, and fit indices were reassessed. Given all fit indices being met, localization of misfit was not done. Raykov Rho was calculated for Model 2. Based on the low Raykov Rho value for Factor 1 (0.422), item A4 was transferred to Factor 2, resulting in the establishment of Model 3 which is the final model for the attitude domain. The model fit indices, as shown in Table V, remained satisfactory. The summary of CFA analysis and the composite reliability for the attitude domain are summarized in Table III. The composite reliability value for model 3 had improved for both Factor 1 (0.645) and Factor 2 (0.908) which satisfied the criteria proposed by Bagozzi and Yi [20]. The factor loadings were above the acceptable limit (FL ≥ 0.3) which confirmed the convergent validity. Table V shows the discriminant validity through correlation analysis. The plot diagram for the final model (Model 3) in the attitude domain is reported in Figure 1.

Table III: Result for Confirmatory Factor Analysis for Attitude and Practise Domain

Domain	Item		Factor Loading	Raykov' Rho
Attitude	**I believe that**			
	Factor 1a	A1 - I would be surprised if I was diagnosed with chronic kidney disease.	0.376	0.645
	(Seeking Help/ Assistance)	A2 - I will discuss with my friends about chronic kidney disease.	0.730	
		A3 - I will discuss with my family about chronic kidney disease	0.817	
	Factor 2a	A4 - I will see a doctor if I experience signs and symptoms of chronic kidney disease.	0.785	0.908
	(Action and Applications)	A5 - I believe maintaining good blood sugar levels is very important to prevent chronic kidney disease.	0.763	
		A7 - Doing physical activities that can improve my health is important.	0.696	
		A8 - I want to detect my health problems at an early stage.	0.856	
		A9 - I will get kidney disease in the future if my diabetes is not controlled.	0.790	
		A10 - Doctors and nurses should give me more information about chronic kidney disease.	0.712	
		A12 - Diabetic patients can prevent chronic kidney disease.	0.506	
		A13 - Prevention of kidney disease requires commitment from diabetic patients.	0.800	
Practise	**To prevent chronic kidney disease, I believe that I need to :**			
	Factor 1p (Lifestyle)	P1 - Eating a balanced diet.	0.490	0.644
		P2 - Doing moderate-intensity exercises such as walking and jogging.	0.624	
		P3 - Maintaining normal body weight.	0.706	
		P6 - Limiting salt intake in my diet.	0.390	
		P7 - Limiting sugar intake in my diet.	0.342	
	Factor 2p (Compliance)	P11 - Recognizing signs of chronic kidney disease.	0.422	0.606
		P12 - Seeking medical treatment if I experience signs of chronic kidney disease.	0.831	
		P13 - Seeking family support if I get chronic kidney disease.	0.463	

Table IV: Fit Indices for The Attitude and Practise Model

Domain	Model	No of Items	χ^2 (df)	*p*-value	SRMR	RMSEA	CFI	TLI
Attitude	**Model 1**	13	127.96(64)	<0.001	0.061	0.074	0.93	0.92
	Model 2	11	83.21(43)	<0.001	0.054	0.075	0.95	0.94
	Model 3	11	50.61(43)	0.198	0.036	0.032	0.99	0.99
Practise	**Model 1**	13	No fit indices were generated					
	Model 2	13	365.14(64)	<0.001	0.117	0.154	0.407	0.277
	Model 3	8	94.74	<0.001	0.09	0.124	0.771	0.663
	Model 4	8	23.90(18)	0.158	0.054	0.038	0.98	0.97

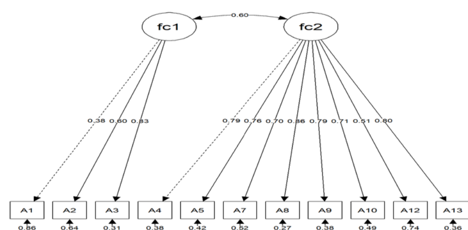

Figure 1: Plot Diagram for the Attitude Domain.

CFA Result for the Practice Domain.

There were also 13 items in the practice domain (P1-P13). Similar to the attitude domain, Model 1 was constructed as reported in the Exploratory Factor Analysis (EFA) by Khalil et al. Factor 1 within the practice domain was named 'lifestyle' (Items P1-P7 and P11). Factor 2 within the practice domain was named 'compliance' (Items P9, P10, P12, and P13). Item P4, P5 and P13 were reported to have low factor loading but its content validation result was shown to have good clarity and relevance (I-CVI for both is 1). P6 and P7 were reported as one item in the EFA analysis, but in this study, it was separated to avoid being a double-barrelled question. P8 was a new item added and it was agreed by our expert during content validation. P8 was put under Factor 1 of the practice domain in view that it is not a standard treatment for T2DM to be complied with. Item P9 was revised from compliance to medication to compliance to follow-up, as we assumed item P10 already covered compliance to medication.

Like the attitude domain, the multivariate normality was not assumed, and alternative robust estimators (MLR) were used for the practice domain. Initially, no fit indices were generated because The R output reported that Model 1 did not converge in the analysis. Revisions were made in Model 2 where P11 was transferred to Factor 2. Model 2 fit indices were generated however they are not satisfactory. Items with low factor loading (FL < 0.3) were identified which were P4, P5, P8, P9 and P10 and Model 3 was generated. Then, modification indices were generated where items P6 and P7 were noted to have high MI values hence both item's errors were correlated. The final model (Model 4) then fulfilled the fit indices as shown in Table IV. The Raykov Rho calculated for Factor 1 was 0.644 and Factor 2 was 0.606. No further model constraining was done because further constraining would result in a more complicated model and a lesser CR value. The summary of the CFA and composite reliability for the practice domain are presented in Table III. The composite reliability for the practice domain also met the criteria proposed by Bagozzi and Yi, and the factor loadings were above the acceptable limit (FL ≥ 0.3), confirming convergent validity. Additionally, Table V displays the discriminant validity through correlation analysis for the practice domain. Furthermore, a plot diagram illustrating the final model in the practice domain is depicted in Figure 2.

Table V: Square root of AVE and inter-factor correlation as evidence of discriminant validity for Attitude and Practise Domain

	Domain	Attitude		Practise	
Domain	Factor	Factor 1a	Factor 2a	Factor 1p	Factor 2p
Attitude	Factor 1a	0.645*	0.691		
	Factor 2a	0.691	0.747*		
Practise	Factor 1p			0.528*	0.329
	Factor 2p			0.329	0.600*

*The square root of AVE

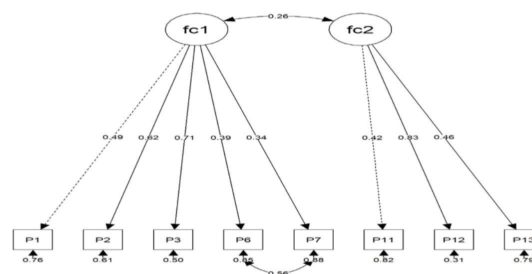

Figure 2: Plot Diagram for the Practice Domain.

DISCUSSION

The primary aim of this study was to validate the questionnaire of KAP on CKD which was developed by Khalil et al. in Malaysia. Notably, there was an absence of research confirming the construct validity of this questionnaire before this study, despite its application in multiple studies to assess KAP regarding CKD [5, 12–16]. Consequently, this study's findings in psychometric properties are pioneering and currently could not be directly compared with other studies. Furthermore, there are several items in this questionnaire especially in the attitude and practise domain that can be emulated to assess the prevention of other microvascular and macrovascular complications of T2DM.

The IRT analysis employed in this study revealed good psychometric properties in the knowledge domain. All items that remained in each subfactor of the knowledge domain had difficulty and discriminatory indices within the desired range despite some of them showing a significant chi-square goodness-of-fit test. Items with difficulty indices and discriminatory indices within the desired range, allowed research to ensure that items are appropriately challenging when being used in different populations and effectively discriminate between individuals with varying levels of the trait [21]. The

significant result could be due to the chi-square test being sensitive to large sample sizes which resulted in small differences between the observed and expected values [22]. Furthermore, the non-significance result of the unidimensionality test means that each item in the same subfactor measures the same construct hence justifying the retainment of the items [23].

MLR (Maximum Likelihood Robust) estimator chi-square statistic was equivalent to the Yuan-Bentler test statistic, and it can provide robust parameter estimate and standard error despite violations of multivariate normality as evidenced in the significant Mardia test in this study [24]. Several items such as Items A6, A11, P4, P5, P8, P9 and P10 were removed due to having low factor loading. The cut-off point for factor loading used in this study was 0.3 because it is the minimum value agreed upon to justify the inclusion of an item into the model [25]. Removal of items with low factor loading led to the formation of a better model evidenced by improved model fitness indices in this study.

Furthermore, the inclusion of items with factor loading within 0.3 to 0.4 (Items A1, P6 and P7) was pivotal in fulfilling the model fitness indices. Numerous studies have shown that items with factor loading within 0.3 to 0.4 were sufficient especially when the fit indices were met [26–28]. Item P6 and P7 were found to have high MI as they originated from one item which appeared to be double-barrelled. Double-barrelled items can introduce ambiguity that may affect the validity of the questionnaire [29]. Hence, it was justified to divide the item into two single unambiguous items as done in this study. P8 was put under Factor 1 of the Practice domain in view that it is not a standard treatment for T2DM to be complied with. Item P9 was revised from compliance to medication to compliance to follow-up, as we assumed item P10 already covered compliance to medication. P11 was transferred to factor 2 because the items appear to be an important part of compliance with prevention and early recognition of CKD

Composite reliability was used in this study compared to Cronbach Alpha as it may provide a more accurate and comprehensive understanding of the internal consistency of the scale. Although Cronbach's alpha was a common estimator for the reliability of tests and scales, it was grounded on the 'tau-equivalent model' which assumes that each item, on a similar scale would measure the same latent trait [30]. This assumption was not met in CFA where the latent trait was further divided into subfactors, in this case, there are two subfactors for each latent trait attitude and practice. The advantage of composite reliability was it remained unbiased when used in congeneric items, making it a better measure of internal consistency in this questionnaire [31]. However, The lower Raykov Rho value for attitude and practice in this study compared to the Cronbach Alpha reported by Khalil et al. can be explained by the fact that Raykov Rho considers the correlated error covariances in the calculation of reliability.

CONCLUSION

The adapted Malay-translated questionnaire was specifically designed and validated among Type 2 *Diabetes mellitus* (T2DM) patients, focusing on KAP on CKD. The questionnaire comprised 44 items across three domains (25 items for knowledge, 11 for attitude, and 8 for practice). Through rigorous psychometric evaluation using Item Response Theory (IRT) and factor analysis, the validity and reliability of the KAP domains were established. This instrument stands as a robust tool for use in future research endeavours involving adult T2DM patients in Malaysia, providing a means to explore and assess their KAP concerning CKD.

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REFERENCES

1. National Institutes of Health. National Health and Morbidity Survey (NHMS) 2019: NCDs - Non-Communicable Diseases: Risk Factors and other Health Problems. Shah Alam: National Institutes of Health; 2019 [cited 2024 July 9]. Available from: http://www.iku.gov.my/nhms-2019.
2. Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group. KDIGO 2022 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. Kidney Int. 2022;102(S31). doi: 10.1016/j.kint.2022.06.008.
3. Hooi LS, Ong LM, Ahmad G, Bavanandan S, Ahmad NA, Naidu BM, et al. A population-based study measuring the prevalence of chronic kidney disease among adults in West Malaysia. Kidney Int. 2013;84(5):1034-1040. doi: 10.1038/KI.2013.220.
4. Saminathan TA, Hooi LS, Mohd Yusoff MF, Ong LM, Bavanandan S, Rodzlan Hasani WS, et al. Prevalence of chronic kidney disease and its associated factors in Malaysia; Findings from a nationwide population-based cross-sectional study. BMC Nephrol. 2020;21(1):1-11. doi: 10.1186/s12882-020-01966-8.
5. Yusoff DM, Yusof J, Kueh YC. Knowledge, Attitude and Practices of the Risk for Chronic Kidney Disease Among Patients in a Tertiary Teaching Hospital. Malaysian J Nurs. 2016;8(1):3-11.

Available from: https://api.semanticscholar.org/CorpusID:207837450.
6. Yann Ng C, Shiun Lee Z, Seong Goh K. Cross-sectional study on knowledge of chronic kidney disease among medical outpatient clinic patients. Med J Malaysia. 2016;71(3):99-104. Available from: https://e-mjm.org/2016/v71n3/chronic-kidney-disease.pdf.
7. Isa S, Norliana JA, Ismaliza I, Yusof A, Hami R. CKD Knowledge and Its Associated Factors Among Patients with Type 2 *Diabetes mellitus* Attending Follow-up in a Penang Primary Health Clinic. J Health Sci Med Res. 2023;42(2). doi: 10.31584/jhsmr.2023981.
8. Yusoff MSB, Arifin WN, Hadie SNH. ABC of questionnaire development and validation for survey research. Educ Med J. 2021;13(1):97-108. doi: 10.21315/EIMJ2021.13.1.10.
9. Dowrick AS, Wootten AC, Murphy DG, Costello AJ. We used a validated questionnaire: What does this mean and is it an accurate statement in urologic research? Urology. 2015;85(6):1304-1311. doi: 10.1016/j.urology.2015.01.046.
10. Khalil AA, Al-Modallal HM, Abdalrahim MS, Arabiat DH, Abed MA, Zeilani RS. Development and psychometric evaluation of the Chronic Kidney Disease Screening Index. Ren Fail. 2014;36(8):1200-1207. doi: 10.3109/0886022X.2014.928969.
11. Tegegne B, Demeke T, Amme S, Edmealem A, Ademe S. Knowledge towards Prevention and Early Detection of Chronic Kidney Disease and Associated Factors among Hypertensive Patients at a Chronic Illness Clinic of Jimma Town Public Hospitals. Biomed Res Int. 2020:2020:1-8. doi: 10.1155/2020/5969326.
12. Alvis Zibran M, Mohammadnezhad M, Page R, Khan S. Knowledge, Attitude and Practice of Type 2 Diabetic Patients with Chronic Kidney Disease: A literature review. ARC J Public Health Community Med. 2018;3(2):19-27. doi: 10.20431/2456-0596.0302004.
13. Sahu G, Kumar S, Acharya S, Talwar D, Annadatha A, Patel M, et al. The Act of Prevention: Knowledge, Attitudes, and Perception Among Caretakers of Kidney Disease Patients in Rural Wardha District of Central India. Cureus. 2022;14(3):e23058. doi: 10.7759/cureus.23058.
14. Asmelash D, Chane E, Desalegn G, Assefa S, Lake Aynalem G, Fasil A. Knowledge and Practices towards Prevention and Early Detection of Chronic Kidney Disease and Associated Factors among Hypertensive Patients in Gondar Town, North West Ethiopia. Int J Hypertens. 2020;2020:1-8. doi: 10.1155/2020/2860143.
15. Sa'adeh HH, Darwazeh RN, Khalil AA, Zyoud SH. Knowledge, attitudes and practices of hypertensive patients towards prevention and early detection of chronic kidney disease: a cross sectional study from Palestine. Clin Hypertens. 2018;24(1):1-13. doi: 10.1186/S40885-018-0091-7.
16. Alghamdi A, Alaryni A, AlMatham K, Hakami O, Qutob R, Bukhari A, et al. Knowledge, Attitudes, and Practices of High-Risk Patients towards Prevention and Early Detection of Chronic Kidney Disease (CKD) in Saudi Arabia. Int J Environ Res Public Health. 2023;20(1):871. doi: 10.3390/ijerph20010871.
17. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate Data Analysis. 7th ed. New Jersey, USA: Pearson Education, Inc; 2010.
18. Gie Young A, Pearce S (2013) A Beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis. Tutor Quant Methods Psychol 9:79–94. doi: 10.20982/tqmp.09.2.p079
19. R Core Team. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2024. Available from: https://www.R-project.org/.
20. Bagozzi RP, Yi Y. On the evaluation of structural equation models. J Acad Mark Sci. 1988;16(1):74-94. doi: 10.1007/BF02723327.
21. Fatima S, Ahmed ST, Kazi SH, Iftikhar A. The Relationship of Difficulty and Discrimination Indices with Physiology Teaching and Learning. Pakistan J Med Dent. 2021;10(2):109-113. doi: 10.36283/pjmd10-2/019.
22. Kyriazos TA. Applied Psychometrics: Sample Size and Sample Power Considerations in Factor Analysis (EFA, CFA) and SEM in General. Psychology. 2018;9(8):2207-2230. doi: 10.4236/psych.2018.98126.
23. Ziegler M, Hagemann D. Testing the unidimensionality of items: Pitfalls and loopholes. Eur J Psychol Assess. 2015;31(4):231-237. doi: 10.1027/1015-5759/a000309.
24. Li CH. Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. Behav Res Methods. 2016;48(3):936-949. doi: 10.3758/s13428-015-0619-7.
25. Tavakol M, Wetzel A. Factor Analysis: a means for theory and instrument development in support of construct validity. Int J Med Educ. 2020;11:245-247. doi: 10.5116/ijme.5f96.0f4a.
26. Zahiruddin WM, Arifin WN, Mohd-Nazri S, Surianti S, Zawaha I, Bakar RA, et al. Development and validation of a new knowledge, attitude, belief and practice questionnaire on leptospirosis in Malaysia. BMC Public Health. 2018;18(1):1-12. doi: 10.1186/s12889-018-5234-y.
27. Goni MD, Naing NN, Hasan H, Wan-Arfah N, Deris ZZ, Arifin WN, et al. A confirmatory factor analysis of the knowledge, attitude and practice questionnaire towards prevention of respiratory tract infections during Hajj and Umrah. BMC Public Health. 2020;20:1-8. doi: 10.1186/s12889-020-09756-5.
28. Aziz AA, Nordin NIF, Noor NM, Bachok N, Isa SNI.

Psychometric properties of the 'Skala Kepuasan Interaksi Perubatan-11' to measure patient satisfaction with physician-patient interaction in Malaysia. Fam Pract. 2014;31(2):236-244. doi: 10.1093/fampra/cmt062.

29. Menold N. Double Barreled Questions: An Analysis of the Similarity of Elements and Effects on Measurement Quality. J Off Stat. 2020;36(4):855-886. doi: 10.2478/jos-2020-0041.

30. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011;2:53-55. doi: 10.5116/ijme.4dfb.8dfd.

31. Padilla MA, Divers J. A Comparison of Composite Reliability Estimators: Coefficient Omega Confidence Intervals in the Current Literature. Educ Psychol Meas. 2016;76(3):436-453. doi: 10.1177/0013164415593776.