ORIGINAL ARTICLE

Diabetic Knowledge of T2DM Patients in Hospital Pakar Sultanah Fatimah, Muar, Johor, Malaysia

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ABSTRACT

Introduction: Diabetic knowledge is one of the limiting factors in optimizing treatment for diabetic patients. Despite educational programs carried out by healthcare practitioners, most diabetic patients are not managing their diabetes well. Thus, this study aimed to determine the level of patients' diabetic knowledge in Hospital Pakar Sultanah Fatimah and factors affecting it. **Methods:** A cross-sectional study was conducted among Type 2 Diabetic Mellitus (T2DM) patients in Hospital Pakar Sultanah Fatimah using the 14-item Michigan Diabetes Knowledge Test (MDKT) validated questionnaire. The questionnaires were self-administered by patients during their scheduled appointments at outpatient pharmacy and Medical Outpatient Clinic (MOPC). Descriptive statistics were used to summarize patients' demographics, socioeconomic status and knowledge scores; while non-parametric tests were used to analyze the relationship between diabetic knowledge with patient demography and socioeconomic status. **Results:** There were a total of 262 respondents with median (IQR) age of 59(13.5) years. Majority of the patients were Malay, retiree/unemployed and have household income less than RM3000. 66.4% of patients scored ≥7 points in MDKT-14. Race, household income and educational levels were significantly associated with knowledge scores ($p=0.003$, $p=0.027$ and $p<0.001$ respectively). A multivariate analysis was conducted and found that race and education level were significantly predictive of knowledge score with adjusted $R^2=0.28$. **Conclusion:** The respondents' diabetic knowledge was moderate. By identifying the income, race and educational level as the contributing factors of patient's poor diabetic knowledge score, we may target these areas to improve patients' medication adherence and hence treatment outcome.

Keywords: Type 2 Diabetes Mellitus (T2DM), Diabetic Knowledge, MDKT-14

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INTRODUCTION

Diabetes mellitus (DM) is classified by the World Health Organization (WHO) as one of the four important non-communicable diseases (NCDs) that needs to be addressed by world leaders where it was reported to cause 1.6 million deaths globally. The global disease burden for DM was reported to increase dramatically over the past few decades with the global prevalence almost doubling from 4.7% in 1980 to 8.5% in 2014 (1). A projection of current prevalence showed that between 2010 and 2030, developing countries are likely to see a 69% increase in number of adults with diabetes (2). The Malaysian National Health and Morbidity Survey conducted in 2015 showed a 15% increase in number of patients living with diabetes compared to the same survey that was conducted in 2010 (3). Thus, it is important to address the underlying issues that affect the glycaemic control in diabetic patients.

Long-standing hyperglycaemia in diabetic patients often leads to long-term complications, hence it may increase the cost burden of diabetic treatment (4,5). International Diabetes Federal (IDF) Diabetes Atlas 9th edition 2019 reported that 760 billion USD was spent on diabetes alone. This amounts to 10% of the global health expenditure (5). A similar study done in Malaysia found that the total cost for diabetes per year in 2011 was approximately RM2.04 billion, where RM1.40 billion was incurred by the government (5,6). Although studies have proven that having higher level of diabetic knowledge can improve glycaemic control and reduce complications, there are insufficient targeted strategies to enhance patients' diabetic knowledge (6).

Consequently, it is important to understand the extent of disease-related knowledge in diabetic patients to improve their glycaemic control. Therefore, this study was carried out to evaluate diabetic knowledge among Type 2 Diabetic Mellitus (T2DM) patients in Hospital Pakar Sultanah Fatimah (HPSF) and the factors affecting

their level of diabetic knowledge.

MATERIALS AND METHODS

Study and Sample Design

A cross-sectional study was conducted among patients with T2DM in HPSF. Data collection was conducted at outpatient pharmacy and Medical Outpatient Clinic (MOPC) from 1st February to 1st April 2018 using convenience sampling technique. Patients were recruited after agreeing to participate in the study and filling the informed consent form. The purpose of the study and study procedure were explained to the patients before the questionnaires were administered. The questionnaires were self-administered by the participants and patients were required to answer them within 15 minutes. Sample size was calculated by using an automated software program named Epi Info 7 sample size calculator. The response distribution was set at 22.6% which is the prevalence of T2DM adult patients according to epidemiology research on prevalence of diabetes in Malaysia that was conducted in 2013 and the calculated target sample size was 190 patients (7). The confidence limit was set at 5%, level of significance (α) at 0.05 and the desired power of the study (1-β) at 90%. In our study a total of 262 participants were recruited within the data collection time frame. The inclusion criteria of the respondents were patients diagnosed with T2DM for at least 1 year, T2DM patients on pharmacological therapy, and patients aged 18 years or older. The exclusion criteria were patients who are not able to self-administer the questionnaire, patients who have physical or mental impairment that affect their ability to answer the questionnaire and incomplete questionnaires with missing data. Ethical approval for this study was obtained from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (KKM NIHSEC/P17-2044(6).

Study Instrument

The Michigan Diabetes Knowledge Test (MDKT) was developed by the Michigan Diabetes Research and Training Center (MDRTC) to assess the general diabetic knowledge among diabetic study subjects (8). For better understanding among Malaysian study subjects, the MDKT-Malaysian version was translated and validated by Al-Qazaz HK et al. (2010) titled, "The 14 item Michigan Diabetes Knowledge Test: Translation and validation study of the Malaysian version" (9). The MDKT-Malaysian version was used in this study after gaining copyright permission via email from corresponding author (9). The MDKT-Malaysian version consists of 14 items in the form of multiple choices questions with one correct answer. The knowledge score was evaluated by giving one point for each correct answer and zero for each wrong answer or no response. The total knowledge scores therefore were in the range of 0 to 14, where higher scores indicate higher level of diabetic knowledge. Patients who scored less than 7 points were considered to have poor diabetic knowledge while those who scored 7 points or more were considered to have acceptable diabetic knowledge (9).

Statistical Analysis

All the data were pooled and analysed using IBM SPSS Statistics Version 17. Descriptive statistics were used to summarize patient's demographic, socioeconomic and clinical characteristics. These variables were expressed in terms of percentages while patient's age and knowledge scores were expressed as median and interquartile range (IQR). Parametric assumption was not met in our study, thus non-parametric tests namely Mann Whitney Test and Spearman's correlation were used. Normality testing was done using Histogram method and Shapiro-Wilk test. In addition, the significant differences between categorical independent variables on knowledge score were analysed using Kruskal-Wallis test and Mann Whitney U test. Chi-square test was used to investigate the relationship between categorical data and the level of diabetic knowledge among respondents, while multiple linear regression was used to further analyse the statistically significant variables with diabetic knowledge score. In this study, p-value less than 0.05 was considered to be statistically significant.

RESULTS

Demographic and Socioeconomic status

A total of 262 respondents who met the study inclusion criteria participated in this study. 59.2% of the respondents were male while 40.8% were female. The median age of the respondents was 59 years old with majority of the respondents being elderly patients aged 60 years and above. On top of that, majority of the respondents were Malay patients (70.6%), followed by Chinese patients (24.0%), and Indian patients (5.3%). Besides that, approximately half of the respondents were unemployed or retiree (53.4%), while only 5.7% of the patients were working in healthcare related sectors. Moreover, 86.6% of respondents have income below RM3001. Apart from that, majority of the respondents only received either primary or secondary school level of education (86.2%). The demographic and socioeconomic data of the respondents are summarized in Table I.

Clinical Characteristic and Glucometer

Nearly half (49.2%) of the respondents in this study were diagnosed with T2DM within the past 5 years, while another 50.8% have been diagnosed with T2DM for more than 5 years. Besides that, the numbers of respondents who were taking either oral antidiabetic medication solely or insulin solely were 53.8% and 26.7% respectively. Among respondents in this study, only 39.7% of the respondents claimed to have

Table I: Distribution of respondents according to their demographic, socioeconomic status and clinical characteristics

Variables	Value
Age (Median ± IQR)	59 ± (13.5)
Gender	
Male	155(59.2%)
Female	107(40.8%)
Race	
Malay	185(70.6%)
Chinese	63(24.0%)
India	14(5.3%)
Occupational Status	
Healthcare profession	15(5.7%)
Non-healthcare profession	107(40.8%)
Unemployed/retiree	140(53.4%)
Income (Rm)	
Below 2000	158(60.3%)
2000-3000	69(26.3%)
3001-5000	28(10.7%)
5001-8000	5(1.9%)
>8000	2(0.8%)
Education	
No formal education	14(5.3%)
Primary level	107(40.8%)
Secondary level	119(45.4%)
College/University	19(7.3%)
Others	3(1.1%)
Knowledge Score (Median ± IQR)	8 ± (5)
≥ 7 points	174(66.4%)
< 7points	88(33.6%)
Duration Diagnosed T2Dm	
1-5 years	129(49.2%)
6-10 years	68(26.0%)
>10 years	65(24.8%)
Type Of Antidiabetic Taken	
Insulin	70(26.7%)
Oral antidiabetic medication	141(53.8%)
Insulin and oral antidiabetic medication	51(19.5%)
Glucometer	
Yes	104(39.7%)
No	158(60.3%)

glucometer at home (Table I).

Diabetic Knowledge Test

The median (IQR) diabetic knowledge score of the respondents was 8(5). Majority of the respondents in this study, which were 66.4% scored ≥7 points, while 33.6% of respondents have poor diabetic knowledge, <7 points (Table I). Among all 14 questions that were answered by the respondents, more than 70% of the respondents answered four questions wrongly. These were questions related to hypoglycemia management, understanding about "free food", A1c measurement, and the effect of infection towards blood glucose levels (Table II).

Factors Affecting the Level of Diabetic Knowledge

The results of this study shows that race, income status and educational level were significantly associated with the diabetic knowledge score whereby X^2 (2)=11.75, p=0.003, X^2 (4)=10.99, p=0.027 and X^2 (4)=77.61, p<0.001 respectively as shown in table III. On the other hand, factors that were not significantly associated with diabetic knowledge score were occupation, duration that patient was diagnosed with T2DM, type of antidiabetic medication taken, gender, and availability

Table II: Frequency Distribution of Patients' Response on Diabetic Knowledge Test Questions (N=262)

Questions	Answered Correctly N (%)
Q1: The diabetes diet is	107 (40.8)
Q2: Which of the following is highest in carbohydrate?[β]	164 (62.6)
Q3:Which of the following is highest in fat?	148 (56.5)
Q4:Which of the following is a "free food"?	68 (26)
Q5:A1C is a measure of your average blood glucose level for the past	76 (29)
Q6:Which is the best method for home glucose testing?	177 (67.6)
Q7:What effect does unsweetened fruit juice have on blood glucose?	128 (48.9)
Q8:Which should not be used to treat a low blood glucose?	77 (29.4)
Q9: For a person in good control, what effect does exercise have on blood glucose?	169 (64.5)
Q10:What effect will an infection most likely have on blood glucose?	72 (27.5)
Q11:The best way to take care of your feet is to	184 (70.2)
Q12:Eating foods lower in fat decreases your risk for	179 (68.3)
Q13:Numbness and tingling may be symptoms of	199 (76)
Q14:Which of the following is usually not associated with diabetes	167 (63.7)

β = answers given for this question have been adjusted according to Malaysia food culture

Table III: Association between Demographic, Socioeconomic, and Clinical Characteristic with Total Knowledge Score

Variables	N	Mean rank	Median (IQR)	P-value
Race			1(1-2)	0.003*
Malay	185	141.71		
Chinese	63	108.75		
Indian	14	98.93		
Occupation			3(2-3)	0.051
Healthcare Profession	15	162.47		
Non-Healthcare Profession	107	119.69		
Unemployment/Retiree	140	137.21		
Income			1(1-2)	0.027*
<2000	158	122.37		
2000-3000	69	134.07		
3001-5000	28	165.27		
5001-8000	5	188.50		
>8000	2	149.00		
Education			3(2-3)	<0.001*
No formal education	14	63.00		
Primary level	107	93.03		
Secondary level	119	160.81		
College/university	19	203.37		
Others	3	205.50		
Duration T2Dm			2(1-2.25)	0.180
1-5 year	129	139.71		
6-10 year	68	119.45		
>10 year	65	127.82		
Type Of Antidiabetic			2(1-2)	0.139
Insulin	70	126.59		
Oral antidiabetic medication	141	139.44		
Insulin and oral antidiabetic medication	51	116.28		
Gender			1(1-2)	0.436
Male	155	134.52		
Female	107	127.13		
Glucometer			2(1-2)	0.075
Yes	104	141.72		
No	158	124.77		

* significant at p<0.05

of glucometer (Table III).

It was noted that although factors such as gender and whether or not patient own a glucometer were not significantly association with diabetic knowledge score, U=7825, p=0.436 and U=7153, p=0.075 respectively, it was noted that the respondents that own a glucometer have higher diabetic knowledge score as the mean rank was higher, 141.72 (Table III).

Besides that, this study also found that, non-Malays were 2.6 times more likely than Malays to have low level of diabetic knowledge score (OR 2.6, 95% CI 1.5-4.5, p<0.001). On top of that, respondents with income less than RM3001 have 3.4 times to lower diabetic knowledge scores compared to respondents with higher salary. Apart from that, our study have also shown that respondents who had only primary-education or lower were 7 times more likely to obtain lower diabetic knowledge scores as compared to respondents with higher educational level (OR 7.0, 95% CI 3.9-12.7, p<0.001) (Table IV).

Table IV: Association between race, educational level and income with the level of respondents' diabetic knowledge

Independent variables	<7points (n=88)	≥ 7 points (n=174)	OR (95%CI)	Chi-square	p-value
Race					
Non-Malay	38(14.5%)	39(14.9%)			
Malay	50(19.1%)	135(51.5%)	2.6 (1.5-4.5)	12.1	P<0.001*
Income					
≤3000	83(31.7%)	144(55%)			
>3000	5(1.9%)	30(11.5%)	3.4(1.2-9.2)	6.7	P=0.009*
Educational level					
<secondary	67(25.6%)	54(20.6%)			
≥secondary	21(8%)	120(45.8%)	7.0(3.9-12.7)	47.8	P<0.001*

* significant at p<0.05

Multivariate Analysis on the Factors affecting Knowledge score

As shown in table V, the combination of the significant factors namely race, income status and educational level had significantly predicted a 28% variance in knowledge scores, F(3,258)=35.11, p<0.001. However, the income was not a significant predicting factor for diabetic knowledge score with p=0.836. A simple linear regression equation relating the factors to diabetic knowledge score was shown as follows, Y= 3.52 + 0.04 (Income) + 1.91 (Education) - 0.69 (Race) (Table V).

Table V: Simultaneous Multiple Linear Regression Analysis Summary for Income, Education and Race Predicting Total Knowledge Score

Variable	B	SEB	β
Income	0.04	0.20	0.012
Education	1.91	0.22	0.492*
Race	-0.69	0.27	-0.137**
Constant	3.52	0.72	

* significant at p<0.05; ** significant at p<0.001; Adjusted R^2 =0.28
B=unstandardized beta coefficient, SEB=standard error of unstandardized beta coefficient, β =standardised beta coefficient

DISCUSSION

In this study, our T2DM patients had moderate level of knowledge with median (IQR) diabetic knowledge score of 8(5). This finding were nearly the same with a study conducted at Penang General Hospital in Malaysia by Al-Qazaz et al. (2011) and another study conducted in Palestine by Sweileh et al. (2014) whereby respondents obtained a median (IQR) diabetic knowledge score of 7(5) and 8(3) respectively (10,11). In view of diabetic knowledge is an important component for diabetic patient to manage their diabetes well, more aggressive intervention is needed towards diabetic patients with low diabetic knowledge. On the other hand, Al-Aboudi et al. (2016) had reported a median diabetic knowledge score of 9 in their observational study done in Saudi Arabia, which was higher than our finding in this study (12). However, difference in knowledge score reported by Al-Aboudi et al. (2016) can be explained by the observation that the study had smaller study populations and their demographic settings were different from our study.

Although diabetic educational programmes were continuously carried out since the commencement of the Diabetes Medication Therapy Adherence Clinic in 2009 and Diabetes Resource Centre in 2014, the diabetic knowledge scores of patients in HPSF still remained moderate, it was similar to the study finding reported by Al-Qazaz et al. (2012). The mean (SD) score of 14-item MDKT was 7.88 (3.01) in their study and it was used as a comparison because it carried out in a government hospital setting. (13). Therefore, current educational programme might not able to overcome the issue of patient not managing their diabetes well. Thus, it is important to tailor the educational programmes that are carried out in hospitals towards targeting the individual factors that impact diabetic knowledge such as race, household income and educational level of diabetic patients. In addition, awareness on the importance of lifestyle modifications such as exercise, weight reduction and diet alongside pharmacological therapies should be instilled in patients to promote healthier living and better adherence. With the improved lifestyle choices and medication adherence, patients will be able to reduce long term complications and hence reduce treatment costs.

Furthermore, this study showed that patients in HPSF had poor understanding about "free food" and the management of hypoglycaemia. These finding were consistent with the study conducted by Al-Qazaz et al. (2012) whereby less than 30% of respondents in that study answered those questions correctly (13). Besides, Zainuddin et al. (2017) also agreed that there was insufficient understanding in general diabetic knowledge relating to diet and hypoglycaemia management among patients (14). Therefore, more emphasis should be placed on helping all diabetic patients understand about

diabetic diet instead of only those who are referred to dietician for dietary counselling. This is because medical nutrition therapy is vital in the management of diabetes for all diabetic patient.

In several recent studies, investigators strongly believe that educational level have a direct influence on patient's diabetic knowledge scores as reported by Zainuddin et al. (2017) ($p<0.01$) and Mandpe et al. (2014) ($p<0.001$) in their study (14,15). This finding was proven in our study where the educational level of respondent was significantly associated with their level of diabetic knowledge, ($p<0.001$). Thus, same approach of standard diabetic counselling might not be effective toward diabetic patients with different educational background. Therefore, the patients with lower educational level should be the targeted candidates for special diabetic educational programs such as Diabetes Mellitus Special Clinic and extra attention or patience should be given to this group of patients to make them understand the context of diabetic management. Nonetheless, a study conducted by Nazir et al. (2016) showed that education level was not significantly associated with diabetic knowledge with $p=0.321$ (16). However, the study done by Nazir et al. (2016) had respondents who were earning higher income and had higher educational level than the respondents in this study, so it is not representative of our study population.

In addition, this study found that the patient's monthly income was one of the factors that significantly affect diabetic knowledge of patients. It appeared that patients with lower income had lower diabetic knowledge scores as compared to those with higher income. A study done by Niguse et al. (2019) had found that middle income patients were twice as likely to have higher level of diabetic selfcare knowledge score compared to the patients that earn a lower income (17). This was as similar as reported by Al-Qazaz et al. (2012), the household income status was significantly associated with the patients' diabetic knowledge (13). Managing diabetes is costly and require long term commitment, including the cost of medical supplies and diabetic formula milk. Diabetic patients with lower household income and lack of diabetic knowledge without financial assistance or alternatives may have burden in managing their diabetes. Income inequality within the population is a pertaining issue experienced by developing countries like Malaysia (18). Therefore, more targeted measures to narrow the gap by helping the patients in the lower income group may benefit the economic growth as well as reduce diabetic prevalence in the future (18).

Similarly, ethnic disparity within the population also affects patients' diabetic knowledge scores. It was proven in our study that, non-malay respondents were more likely to have lower diabetic knowledge score compared to malay respondents. These was probably due to the vast differences in culture and language among various ethnic groups in a country leading to different levels of understanding of their illnesses (19). In the United Kingdom, the prevalence of T2DM were higher among minority South Asian groups and these groups of patients had poorer diabetic knowledge and self-care management when compared to the white majority in the country (19). The finding was alike with a study done by Baradaran et al. (2006) at Glasgow, Scotland. (20) Currently, there were limited studies that investigate the relationship between ethnicity and diabetes knowledge scores, but Al-Qazaz et al. (2012) had reported differently from our study which showed that ethnicity was not significantly associated with diabetic knowledge (13). However, Baradaran et al. (2006) in their study found that conducting culturally competent educational sessions can significantly improve the minority group diabetic knowledge by 12.5% with $p=0.04$ from the baseline knowledge score (20). Thus, extra care should be given to the minority group with language barrier or cultural differences to improve their understanding about the disease. Therefore, one of the ways in order to improve the diabetic knowledge in these minority patients include conducting diabetic educational programmes in multiple languages and using multilingual visual aids to reinforce the important points.

Lastly, the possession of a glucometer was also one of the factors that may affect patients' diabetic knowledge scores. A glucometer is an important self-monitoring tool for diabetic patients as they can gauge how well their disease control is with the current medications and whether or not they need modification in their treatment regimen. However, in our study, the usage of glucometer was less than 40%. The low percentage of respondents that own a glucometer was consistent with the study done by Al-Qazaz et al. (2012) (13). Failing to own a glucometer was believed to be the factor that led to the patients having lower diabetic knowledge scores, which was proven by Zowgar et al. (2018) where possession of glucometer was significantly associated with diabetic knowledge score, $p=0.002$ (21). Correspondingly, the affordability of having a glucometer and the lack of awareness on the importance of having a glucometer impedes patients from owning their own glucometer (22). Our data were consistent with the previous studies whereby respondents with their own glucometer had higher diabetic knowledge scores, although no statistically significant association was found. Most of the patients come from low or middle-income families. Thus, supportive measure such as subsidizing or renting out glucometers should be carried out to improve the affordability of diabetic patients for self-management.

CONCLUSION

In conclusion, the respondents' diabetic knowledge was moderate in Hospital Pakar Sultanah Fatimah, Muar. By identifying the household income, race and educational

level as the contributing factors of patients' poor diabetic knowledge score, we may target these. Although the interventions and educational programmes conducted nowadays were evolving, but they were lacking in areas of specification and individualization. Those programmes seldom take into consideration the different of culture, language, financial ability and educational status of diabetic patients. Thus, individualized patient education programme by including the risk factor contributing to poor diabetic knowledge and focussed on goal setting for each patient should be conducted in the future. Moreover, health educators should include patients when setting goals in optimization of each patient's diabetes management.

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