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SELF-MANAGEMENT KNOWLEDGE AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS IN HOSPITAL TAIPING, MALAYSIA

MAISARAH MOHAMAD FADZIL[1], MUHAMMAD HADIF SYAHMI MOHD AKMAL[1], YUET YEN WONG[1,3], CHIN FEN NEOH[2,3] AND QI YING LEAN[1,4*]

[1]Faculty of Pharmacy, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Bertam, Pulau Pinang, Malaysia
[2]Faculty of Pharmacy, Universiti Teknologi MARA, Cawangan Selangor, Kampus Puncak Alam, Selangor, Malaysia
[3]Collaborative Drug Discovery Research (CDDR) Group, Pharmaceutical and Life Sciences Community of Research, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia
[4]Vector-Borne Diseases Research Group (VERDI), Pharmaceutical and Life Sciences CoRe, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is characterised by hyperglycaemia resulting from insulin insufficiency, insulin resistance or both. Although different anti-diabetic agents are available to control blood glucose, patient self-management is essential for achieving good glycaemic control. Good knowledge of disease self-management is a pre-requisite to enable patients in making informed decisions in disease management. In this study, we aimed to determine the knowledge of self-management among patients with T2DM visiting outpatient pharmacy at Hospital Taiping. Adult patients with T2DM were invited to participate in a survey from December 2018 to February 2019. A pre-validated, self-administered questionnaire was used to capture patients' demographics, glucose level and diabetes self-management knowledge. A total of 148 patients responded to the survey. More than half of the patients (54.7%) in this study were found to have low knowledge scores (< 70%). The level of education ($p = 0.041$), occupation ($p = 0.024$) and the use of insulin ($p < 0.001$) were significantly associated with patients' level of self-management knowledge whereas no significant relationships were found between knowledge score across age, gender, ethnicity, living status, use of oral anti-diabetic agents, attending diabetes education before and the duration of diabetes. A low but significant negative correlation was found between the score of self-management knowledge and fasting blood glucose ($r = -0.264$, $p = 0.002$). Despite the fact that nearly half of the respondents had

*Corresponding author: leanqiying@yahoo.com

good knowledge scores, the knowledge gaps remain to be filled so that patients are empowered to practise self-management in managing their T2DM.

Keywords: Diabetes, Self-care, Self-management, Knowledge, Education

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease that can lead to increased mortality and morbidity. There are mainly two types of DM: (1) type 1 DM and (2) type 2 DM (T2DM). Type 1 DM or insulin-dependent DM commonly happens in early childhood due to insulin deficiency in the body whereas T2DM or insulin-resistance DM is resulted from either the body resists the use of insulin or does not produce sufficient insulin to maintain normal blood glucose level (American Diabetes Association 2021). T2DM accounts for 90% of DM cases worldwide (The International Diabetes Federation 2020). The number of adults living with DM is growing and will reach 463 million by the year 2045, globally. Notably, the prevalence of DM in Asia is growing rapidly with more than half of the world DM population are Asians (The International Diabetes Federation 2019). Currently, Malaysia has approximately 3.9 million or 1 in 5 of its population aged more than 18 years old and above had DM because of high affluence, lack of exercising and poor diet management (Institute of Public Health 2020).

Despite no cure to date, treatment modalities include pharmacological and non-pharmacological interventions that have been useful to control blood glucose level and mitigate DM-related complications in patients with T2DM (American Diabetes Association 2021). The non-pharmacological management of T2DM mainly through lifestyle modifications such as regular exercise, smoking cessation and most importantly diet control (Srinivasan and Davies 2019). Other diabetes self-management aspects include self-monitoring of blood sugar, medication taking, healthy coping, risk reduction and problem-solving are crucial in maintaining good glycaemic control (American Diabetes Association 2021; Srinivasan and Davies 2019). One of the biggest challenges in adapting to the needs of lifestyle changes is appropriate self-care action (Shrivastava, Shrivastava and Ramasamy 2013). Patients are the ones who involve and are responsible for daily diabetes care practices between their clinic visits to healthcare providers (Hessler *et al.* 2019). Therefore, patients' diabetes self-management knowledge is the cornerstone of the clinical management of T2DM to ensure patients' capability in living with well-controlled disease (Kugbey, Asante and Adulai 2017).

Nonetheless, poor understanding of DM has been shown to hinder proper self-management among patients, thus accelerating disease progression and risk of complications (Ang et al. 2018). Conversely, research has shown that the complications associated with DM can be reduced by improving the knowledge of self-management among patients with T2DM (Shrivastava, Shrivastava and Ramasamy 2013). Given poor glycaemic control remains prevalence among individuals with T2DM in Malaysia, the extent of diabetes self-management knowledge among patients with T2DM in Malaysia is urgently needed (Hussein *et al*. 2015). This is important before any interventions could be developed and implemented to improve patients' self-management knowledge, emphasis must be stressed on the areas where knowledge was found to be inadequate. Our study aimed to investigate the level of self-management knowledge and to identify the factors that influence the level of self-management knowledge among patients with T2DM.

METHODS

Study Design

A cross-sectional survey was conducted among patients with T2DM in Hospital Taiping, Perak in order to assess their diabetes-related self-management knowledge. The study was carried out from December 2018 to February 2019 at out-patient department of pharmacy. The study was approved by Medical Research Ethics Committee (MREC) with the approval number NMRR-18-3659-45196(IIR).

Study Subjects

The subjects of this study were patients who were diagnosed with T2DM, aged 18 years old and above, who could read and understand English or Malay languages. Patients who were diagnosed with type 1 DM, gestational DM, having cognitive impairment or mental problem, not able to read and understand English or Malay languages and unwilling to participate were excluded from this research.

Sample Size

The sample size was calculated by using an online sample size calculator (Raosoft®, http://www.raosoft.com/samplesize.html) with 95% confidence level and 5% margin of error. With a monthly population size of 240 patients with T2DM in Hospital Taiping, the minimum sample size of this research was 148 patients with T2DM. In anticipation of an incomplete response, the number of sample size was inflated by 10% to a total of 163 respondents. For the purpose of the study, patients who fulfilled the study inclusion criteria were conveniently approached until the minimum effective sample size was acquired.

Study Tool and Data Collection

A diabetes self-management knowledge questionnaire from a previous study (Jackson *et al*. 2014) was used in this study. The original English version of the diabetes self-management knowledge questionnaire was culturally adapted and translated to Malay language following established guidelines (Wild *et al*. 2005). Briefly, the instrument developer was contacted to ask for permission to use and translate the questionnaires. The English version was then translated by a language professional to a Malay version. An expert panel reviewed the translated version for conceptual and content equivalence. All comments from the review were submitted for correction and formation of the Malay version of questionnaire. The finalised Malay version was then back translated into English by another language professional for reconciliation to ensure equivalence to original texts. The questionnaire used in this study contains 14 items in part A: demographic characteristics of patients and 30 items in part B: diabetes self-management knowledge covering modifiable lifestyle factors, adherence to self-care practices and consequences of uncontrolled blood glucose level. Upon consent, the questionnaire was self-administered by participants and approximately 10–20 min was required for the participants to answer all the questions.

Data Analysis

All distributed questionnaires were evaluated for completeness before data key-in. Investigators then marked the right answers and calculated the total knowledge score as a percentage. The knowledge of self-management among patients was categorised into high or good (≥ 70%) and low or poor (< 70%). The data collected were then entered into IBM Statistical Package of the Social Science (SPSS) version 24 for further analysis. Descriptive statistics were used to describe the respondents' demographic characteristics and knowledge scores. Chi-square or Pearson's correlation tests were then used to determine the relationship between sociodemographic factors and diabetes self-management knowledge score. A prior probability of *p*-value, $p < 0.05$ was considered as statistically significant.

RESULTS

Sociodemographic Characteristics of the Respondents

A total of 148 participants completed the survey, their detailed demographic data are presented in Table 1. The majority of them were male (67.6%), with a mean age of 52 (SD 5.2) years old. In this study, most of the patients were aged between 51–60 years old (27.0%) and 41–50 years old (23.6%). Most of the patients were Malays (60.1%), followed by Indians (28.4%) and Chinese (11.5%).

The majority of patients had received at least secondary school education (71.6%). Among the patients, up to 35.8% worked in the private sector and their monthly salaries were between RM1,001 to RM1,500 (30.4%). Most lived with family (85.8%) with nearly half of the respondents (43.2%) had been diagnosed with T2DM for 5 years and below. It was also noted, more than half of the respondents with T2DM (60.8%) were taking insulin and most of them (96.0%) were treated with oral antidiabetic agents. In addition, the fasting blood glucose level of patients was mostly (75%) more than 7.0 mmol/L.

Table 1: Sociodemographic characteristics of the respondents (*n* = 148).

Sociodemographic characteristics	*n* (%)
Age (years old)	
21–30	21 (14.2)
31–40	23 (15.5)
41–50	35 (23.6)
51–60	40 (27.0)
61–70	26 (17.6)
> 70	3 (2.0)
Gender	
Male	100 (67.6)
Female	48 (32.4)

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Table 1: (*continued*)

Sociodemographic characteristics	*n* (%)
Ethnic	
Malay	89 (60.1)
Chinese	17 (11.5)
Indian	42 (28.4)
Education level	
No formal education	8 (5.4)
Primary school	34 (23.0)
Secondary school	81 (54.7)
University/College	25 (16.9)
Occupation	
Government	32 (21.6)
Private	53 (35.8)
Self-employment	21 (14.2)
Retired	9 (6.1)
Unemployed	33 (22.3)
Living status	
Alone	15 (10.1)
With family	127 (85.8)
With non-family members	6 (4.1)
Household monthly income (RM)	
≤ 500	19 (12.8)
501–1,000	27 (18.2)
1,001–1500	45 (30.4)
1,501–2,000	18 (12.1)
2,001–2,500	13 (8.8)
2,501–3,000	8 (5.4)
3,001–3,500	7 (4.7)
3,501–4,000	2 (1.4)
4,001–4,500	2 (1.4)
4,501–5,000	1 (0.7)
> 5,000	6 (4.1)
Duration of diabetes (years)	
1–5	64 (43.2)
6–10	42 (28.4)
11–15	24 (16.2)
16–20	9 (6.1)
> 20	9 (6.1)

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Table 1: (*continued*)

Sociodemographic characteristics	*n* (%)
Fasting blood glucose (mmol/L)	
≤ 7	37 (25.0)
7.1–7.5	47 (31.8)
7.6–8.0	37 (25.0)
8.1–8.5	7 (4.7)
8.6–9.0	6 (4.1)
9.1–9.5	3 (2.0)
9.6–10	11 (7.4)
> 10	0 (0)
Use of insulin	
Yes	90 (60.8)
No	58 (39.2)
Use of oral anti-diabetic agents	
Yes	142 (96.0)
No	6 (4.0)
Attended diabetes education class	
Yes	125 (84.5)
No	23 (15.5)

Respondents' Diabetes Self-Management Knowledge

Table 2 summarises the respondents' diabetes self-management knowledge scores. Nearly half of the patients (45.3%) recorded a good knowledge score (≥ 70%) whereas the bare majority (54.7%) had a low level (< 70%) of self-management knowledge in the management of T2DM.

Table 2: Diabetes self-management knowledge of patients.

Knowledge score	No. of questions answered correctly	*n* (%)	*n* (%)
Poor score < 70%	6–10	3 (2)	81 (54.7)
	11–15	26 (17.6)	
	16–20	52 (35.1)	
Good score ≥ 70%	21–25	55 (37.2)	67 (45.3)
	26–30	12 (8.1)	

Further item analysis of the diabetes self-management knowledge revealed that from the 30 questions, most patients (72.3%–98.6%) generally performed better in familiar knowledge items (16 items) but not in new unfamiliar items (14 items), in which only 17.6%–67.6% of them answered correctly (Table 3). Almost all of the patients (*n* = 146; 98.6%) could answer question 25 correctly. The majority of them (98.6%) acknowledged that the glucose readings from self-monitoring of blood glucose at home

help doctors to plan for their treatment. Nonetheless, only 26 (17.6%) respondents could provide a correct answer to question 3 (Table 3). Most of the patients (82.4%) perceived that only doctors should make plans for patients to achieve treatment goals.

Table 3: Item analysis of diabetes self-management knowledge.

No. of item	Question	Yes *n* (%)	No *n* (%)	Not sure *n* (%)
Item 1	Fasting blood glucose (FBG) test can be used to monitor blood sugar control of 2–3 months	119 (80.4)	29 (19.6)	0
Item 2	Dietary instructions should be written out, even if the person with diabetes is illiterate: someone at home should be available to interpret it for him/her	125 (84.5)	23 (15.5)	0
Item 3	**Only the doctors should make plans on how a person with diabetes can achieve his/her health target goals**	**122 (82.4)**	**26 (17.6)**	**0**
Item 4	Blood glucose level should be measured before and after every physical activity	106 (71.6)	41 (27.7)	1 (0.7)
Item 5	Having physical activity for 20–30 min per session at least 3 days per week is essential (Example of physical activities: brisk walking, house activities, climbing staircase)	143 (96.6)	5 (3.4)	0
Item 6	Regular exercise does not reduce the need for insulin or other diabetic drugs	46 (31.1)	100 (67.6)	2 (1.3)
Item 7	Maintaining a healthy weight is not important in management of diabetes	64 (43.2)	84 (56.8)	0
Item 8	A person with diabetes should only ask for help when he/she feels sick from his/her healthcare team	116 (78.4)	32 (21.6)	0
Item 9	Cigarette smoking can worsen diabetes	97 (65.5)	49 (33.1)	2 (1.4)
Item 10	A person with diabetes taking medicines when he/she feels good is waste of money	33 (22.3)	115 (77.7)	0
Item 11	Being drunk while on diabetic medicines is not a serious problem	61 (41.2)	85 (57.4)	2 (1.4)
Item 12	Diet and exercise are not as important as medication in the control of diabetes	69 (46.6)	79 (53.4)	0
Item 13	Instructions about medicines and other self-care practices should not be strictly followed	31 (20.9)	117 (79.1)	0
Item 14	Regular medical check-ups are not essential when a person with diabetes is feeling well	65 (43.9)	83 (56.1)	0
Item 15	Taking low dose Aspirin tablet every day decreases risk of having heart attack and stroke	118 (79.7)	26 (17.6)	4 (2.7)

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Table 3: (*continued*)

No. of item	Question	Yes *n* (%)	No *n* (%)	Not sure *n* (%)
Item 16	Diabetes medicines are not taken throughout the life time of a person with diabetes	42 (28.4)	106 (71.6)	0
Item 17	At the initiation of insulin therapy for a person with diabetes who may require it, appropriate advice on self-monitoring blood glucose and diets should be given to the person	122 (82.4)	22 (14.9)	4 (2.7)
Item 18	There should be mutual agreement between a person with diabetes and the doctor if he/she cannot change a particular lifestyle	107 (72.3)	40 (27.0)	1 (0.7)
Item 19	A person with diabetes should take extra care of his/her feet especially when cutting his/her toenails	142 (95.9)	6 (4.1)	0
Item 20	Tight elastic hose or socks are not bad for a person with diabetes	83 (56.1)	64 (43.2)	1 (0.7)
Item 21	A person with diabetes should take care of his/her teeth and brush and floss his/her teeth every day	100 (67.6)	48 (32.4)	0
Item 22	If blood sugar is close to normal, a person with diabetes is likely to have more energy, feel less thirsty and urinate less often	124 83.8)	24 (16.2)	0
Item 23	No person should check blood glucose and blood pressure of a diabetic patient except qualified medical doctor and other health personnel in the hospital	98 (66.2)	50 (33.8)	0
Item 24	A person with diabetes should report any change in his/her eyesight to his/her doctor	128 (86.5)	20 (13.5)	0
Item 25	**Self-monitoring blood glucose allows doctor and other healthcare team to gather data for treatment planning**	**146 (98.6)**	**1 (0.7)**	**1 (0.7)**
Item 26	Self-monitoring blood glucose enables a person with diabetes to monitor and react to changes in his/her blood glucose levels	145 (98)	3 (2)	0
Item 27	Shaking, confusion, behavioural changes and sweating are signs of high blood glucose	90 (60.8)	58 (39.2)	0
Item 28	Prolonged high blood glucose level can cause eye problem or even blindness	143 (96.6)	4 (27.7)	1 (0.7)
Item 29	Monitoring blood pressure is not as important as monitoring blood glucose in a person with diabetes	79 (53.4)	69 (46.6)	0
Item 30	Prolonged uncontrolled blood glucose level can cause heart attack, stroke and kidney problems	142 (95.9)	6 (4.1)	0

Note: = True answer

The Relationship of Sociodemographic Factors with Diabetes Self-Management Knowledge Score

We then analysed the relationship of sociodemographic factors and diabetes self-management knowledge score (Table 4). Patients' education level (p = 0.041) and occupation (p = 0.024) were significantly associated with their level of self-management knowledge. Besides, a significant difference (p < 0.001) of knowledge scores was observed for the use of insulin but not in those who received oral anti-diabetic agents (p = 0.549).

In this study, our results showed that previous exposure to diabetes educational class (p = 0.469) and the duration of diabetes (p = 0.068) did not affect patients' self-management knowledge. Our findings also showed that age (p = 0.275), gender (p = 0.542) and ethnicity (p = 0.179) were not related to the level of diabetes self-management knowledge.

Table 4: The relationship of patients' sociodemographic factors with diabetes self-management knowledge.

Sociodemographic factors	Diabetes self-management knowledge		*p*-value*
	Poor score < 70% *n* (%)	Good score ≥ 70% *n* (%)	
Gender			
Male	53 (35.8)	47 (31.8)	0.542
Female	28 (18.9)	20 (13.5)	
Age			
21–30	9 (6.1)	12 (8.1)	0.275
31–40	15 (10.1)	8 (5.4)	
41–50	16 (10.8)	19 (12.8)	
51–60	22 (14.9)	18 (12.2)	
61–70	16 (10.8)	10 (6.8)	
> 70	3 (2.0)	0 (0)	
Ethnic			
Malay	44 (29.7)	45 (30.4)	0.179
Chinese	9 (6.1)	8 (5.4)	
Indian	28 (18.9)	14 (9.5)	
Education level			
No formal education	8 (5.4)	0 (0)	**0.041**
Primary school	20 (13.5)	14 (9.5)	
Secondary school	39 (26.4)	42 (28.4)	
College/University	14 (9.5)	11 (7.4)	

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Table 4: (*continued*)

Sociodemographic factors	Diabetes self-management knowledge		*p*-value*
	Poor score < 70% *n* (%)	Good score ≥ 70% *n* (%)	
Occupation			
Government	12 (8.1)	20 (13.5)	
Private	30 (20.3)	23 (15.5)	
Self-employment	9 (6.1)	12 (8.1)	**0.024**
Retired	8 (5.4)	1 (0.7)	
Unemployed	22 (14.9)	11 (7.4)	
Living status			
Alone	9 (6.1)	6 (4.1)	
With family	70 (47.3)	57 (38.5)	0.526
With non-family members	2 (1.4)	4 (2.7)	
Duration of diabetes			
1–5	34 (23.0)	30 (20.3)	
6–10	18 (12.2)	24 (16.2)	
11–15	18 (12.2)	6 (4.1)	0.068
16–20	4 (2.7)	5 (3.4)	
> 20	7 (4.7)	2 (1.4)	
Use of insulin			
Yes	61 (41.2)	29 (19.6)	**< 0.001**
No	20 (13.5)	38 (25.7)	
Use of oral anti-diabetic agents			
Yes	77 (52.0)	65 (43.9)	0.549
No	4 (2.7)	2 (1.4)	
Attended diabetes education class			
Yes	70 (47.3)	55 (37.2)	0.469
No	11 (7.4)	12 (8.1)	

Note: *Pearson's Chi-squared test

The Relationship of Self-Management Knowledge with Fasting Blood Glucose (FBG) Level

Table 5 shows the number of patients who had a poor and good self-management knowledge with regards to their controlled (FBG ≤ 7 mmol/L) and uncontrolled (FBG > 7 mmol/L) FBG level. In this study, there was a significant negative correlation (r = −0.264, p = 0.002) between level of self-management knowledge and FBG level. Relatively, there were more respondents (n = 25, 16.9%) with good self-management knowledge who attained controlled FBG while a smaller number of respondents (n = 12; 8.1%) from poor self-management knowledge group had controlled FBG level.

Table 5: The relationship of diabetes self-management knowledge with FBG level.

Knowledge score	FBG (mmol/L)		Total	r^2, *p*-value*
	Controlled (FBG ≤ 7)	Uncontrolled (FBG > 7)		
Poor	12 (8.1%)	69 (46.6%)	81 (54.7%)	
Good	25 (16.9%)	42 (28.4%)	67 (45.3%)	−0.264, 0.002
Total	37 (25.0%)	111 (75.0%)	148 (100.0%)	

Note: *Pearson correlation coefficient.

DISCUSSION

This study assessed the level of self-management knowledge and its contributing factors among patients with T2DM. The current findings revealed that a bare majority of diabetic patients with T2DM who had follow-up at the hospital had a low level of self-management knowledge in T2DM although the rest recorded a good knowledge score. Our results were different from other studies (Jackson *et al*. 2014; Lee *et al*. 2020; Tan and Magarey 2008). Jackson et al (2014) conducted a similar study in Nigeria found most of their patients (79.5%) had scored a high level of knowledge, only 20.5% showed a low level of knowledge (Jackson *et al*. 2014). In contrast, a survey conducted among a smaller number (*n* = 126) of adult patients with T2DM from in- and out-patient departments of an urban general hospital, a district hospital and two rural health care centres in Malaysia using a 75-item questionnaire were found to have poor self-management knowledge, 53% of the respondents scored below 50% in their diabetes-related knowledge (Tan and Magarey 2008). The possible reasons for the variations were the use of a different set of questions which covered different aspects of knowledge, the different ways of DM management by the community in different hospital settings, ethics and cultures. Another recent study using The Literacy Assessment for Diabetes and Diabetes Knowledge Test for assessing diabetes-specific literacy and knowledge among 196 patients attending a primary care clinic at Seremban reported that only 3.6% of participants had a good diabetes-related knowledge (Lee *et al*. 2019), further alarming concern about the knowledge insufficiency among patients.

Interestingly, in this study, most patients were found to know that doctor and healthcare professional can make a treatment planning from their self-monitoring of blood glucose data. The readings from self-monitoring of blood glucose provide a better picture for doctors and other healthcare teams in managing patients' condition, especially in optimising the safety and efficacy of complex insulin regimens (Czupryniak *et al*. 2014). Nonetheless, most of them perceived that solely the doctors should decide on how patients with DM can accomplish their health goals. This suggests that it is uncommonly known by patients that they could work collaboratively with doctors in making plans to achieve their health targets.

The current findings recorded that the majority of the patients were aged between 41 and 60 years old, which is in line with the report of International Diabetes Federation, stating the highest number of people with DM was between 40 and 59 years old in 2019 (The International Diabetes Federation 2019). Besides, in this study, most of the patients were Malays (60.1%), followed by Indians (28.4%) and Chinese (11.5%). The population segregation in Malaysia, lifestyle and dietary habits for each ethnic could

be the reasons for this. On the other hand, patients' level of self-management knowledge was significantly associated with their education level and occupation. This corroborates with previous findings (Jackson *et al*. 2014; Qamar *et al*. 2017; Tan and Magarey 2008; Lee *et al*. 2019) that the knowledge score of patients was shown to be significantly related to the level of education and occupation. Those patients with a higher academic level thus their occupation probably have higher exposure and understanding of the knowledge from the books, social media or the Internet. In addition, they might also have fewer communication barriers with healthcare providers during their usual medical follow-up. In our study, patients with no formal education had the lowest knowledge score if compared to patients with higher education levels.

Besides, in usual clinical practice, it is common for patients who were started on insulin therapy to be taught on how to self-inject and monitor their blood glucose levels (American Diabetes Association 2021). These contents are not usually extended to subjects who are only on oral treatment. Education sessions may improve patients' diabetes-related knowledge, yet it alone could not have explained a better knowledge level as patients may not understand and follow the instruction due to the complexity of insulin regimen and blood glucose self-monitoring. This was postulated in our findings, in which a higher percentage of subjects on insulin treatment scored relatively poorer compared to non-insulin users. Likewise, those who had attended a diabetes education class might not have full comprehension and the ability to assimilate the knowledge into daily diabetes self-management, which was well reflected in this study, previous exposure to diabetes education class did not affect patients' self-management knowledge.

Our findings also showed that age, gender and ethnicity were not related to the level of self-management knowledge. These were different from previous studies in which presented that age, gender and ethics were associated with self-management knowledge level (Chinnappan *et al*. 2017; Jackson *et al*. 2014). A likely explanation of these discrepancies is that the compositions of study subjects in term of their age, sex and races differed in each study. Similarly, the duration of the illness also did not affect the patients' knowledge. This is in agreement with previous findings from a local study (Azimah *et al*. 2010). However, others reported that the knowledge of self-management among patients was related to the duration of diabetes (Jackson *et al*. 2014). Those with shorter disease duration also reported being more likely to have inadequate self-management behaviours (Ang *et al*. 2018). A longer duration of DM may potentially increase patients' diabetes self-management knowledge due to the experience gained from living with the disease. Having said that, patients with a shorter duration of DM may also gain knowledge from various rich resources due to wide and instant accessibility to the Internet and social media.

Studies have shown that a higher level of self-management in patients with T2DM could improve glycaemic control (Modarresi *et al*. 2020; Tan *et al*. 2011). Clinical data have shown that more patients with controlled FBG to achieve haemoglobin (HbA_{1c}) level of less than 7% (Tayek *et al*. 2018). Likewise, in the current finding, the level of self-management knowledge was inversely proportional to the FBG level. The sub-optimal glycaemic control group of patients tended to have inadequate knowledge about diabetes whereas more respondents with good self-management knowledge attained controlled FBG. This suggests that a better-informed patient will have more advantage in empowerment and disease control (Trivedi *et al*. 2017). In contrast, poor knowledge may lead to poor glycaemic control and therefore the likelihood of disease progression and its complications. It has been reported that poor glycaemic control was associated with microvascular complications such as retinopathy and albuminuria (Samuelsson *et al*. 2021). Some patients with a good level of self-management

knowledge, however, have poor glycaemic control, as reported by others (Azimah *et al*. 2010). This speculates that the control of glycaemic level in patients might be affected by other factors such as patient's belief, use of alternative medicines and their level of medication adherence. Moreover, a previous systematic review also reported that those with barriers to healthcare access such as participants without transportations tend to receive less patient education and a longer distance between patient's homes to health facilities was correlated to poor glycaemic control (Horigan *et al*. 2017).

There are some limitations in this study. The survey was done for 3 months only and within the period of time, the patients were recruited using convenient sampling from an outpatient pharmacy. There was also a possibility of recall bias due to the nature of survey. The questionnaire was available only in English and Malay which excluded respondents who use other vernacular languages. The study subjects were limited to only one hospital setting, the findings of the study could not be generalised to other individuals with T2DM in Malaysia at large. Besides, due to the missing data of glycated HbA_{1c} in this study, the analysis could only be performed on FBG level though HbA_{1c} is a better parameter reflecting how well-controlled patients' blood sugar over a period of 3 months. Future study should take into consideration the use of HbA_{1c} in the data analysis. Nevertheless, the findings of this study highlighted that there is inadequate self-management knowledge among patients with T2DM which needs attention and intervention by healthcare providers.

CONCLUSION

Although nearly half of the patients with T2DM had good self-management knowledge yet there were a few knowledge gaps identified among patients from this study. Their education level affected the level of self-management knowledge which also shown to influence their fasting blood glucose, reflecting their glycaemic control. Structured innovative approaches to diabetes self-management education are needed to improve patient's self-management knowledge especially in areas where the patients are found lacking. This empowers them to participate in active disease self-management in order to attain and maintain glycaemic control in the long-term, thus preventing diabetes complications.

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