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Self-Care Activities among Diabetic Patients and Factors Affecting Glycaemic Control in Primary Health Care, Malaysia

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Abstract

Introduction: Self-care is a core component in diabetes control and reducing the risk of diabetic complications. Some factors may influence adherence to self-care activities among diabetic patients. Thus, this study aims to evaluate the pattern of diabetes self-care in Malaysian, factors influencing it and factors affecting glycaemic control.

Methodology: This is a cross sectional study conducted in a public health clinic (Klinik Kesihatan Seremban 2) from December 2014 until early March 2015. We assessed the patients by using the Validated Malay version of Summary of Diabetes Self-Care Activities (SDSCA) questionnaire.

Results: A total of 536 patients were involved in this study. Patients scored moderately in self-care activities with exercise and blood glucose testing were the lowest practice. There were several factors associated with the four domains measured in SDSCA. Gender (p=0.014) and current treatment (p=0.014) were the two significant factors associated with diet. While, exercise was related to educational level (p=0.031) and body mass index (p=0.007). Blood glucose testing showed significant relationship with duration of diabetes diagnose (p=0.002), attended diabetic course (p=0.039) and having heart disease (p=0.027). As for foot care, associated factors were gender (p=0.014) and ethnicity (p=0.040). More than half respondents (67.2%) have poor A1C reading. Blood glucose testing has weak correlation along with HbA1c (r=0.21, p<0.001). Among all the factors, only a few factor that show significance effect with HbA1c which are age (p=0.009), ethnicity (p=0.016), current treatment (p<0.001) and specialist reference (p=0.025).

Conclusion: Exercise and blood glucose testing need to be emphasized to improve glycaemic level. More strategies need to be explored to make sure patients adhere to self-care activities.

Keywords: Associated factors; Diabetes; Glycaemic control; SDSCA; Self-care

Introduction

Diabetes mellitus is a non-communicable disease of concern around the world affecting both developed and developing countries. In 2015, 415 million people worldwide suffered from diabetes and five million people died due to diabetes [1]. By 2040, it has been estimated that the number of people with diabetes will rise up to 642 million. In Malaysia, one in five adults aged 30 and older, or about 3.6 million Malaysians suffered from diabetes in 2014 [2]. Diabetes exerts a significant burden globally in forms of morbidity, mortality, decreased life expectancy, reduced quality of life, increased healthcare expenditure, reduced national productivity as well as loss of individual and national income. Other than that, increase blood glucose may inflict other complications in the heart, nerves, kidneys and eyes over time.

Patients carry out most of their activities by themselves and families. Thus, self-care in diabetic patients is important because diabetes is a self-managed disease that requires lifelong medical treatment and lifestyle adjustment [3]. A good diabetes self-care practices could control the level of diabetes and minimize the risk of acute and chronic diabetic complications [4,5]. These complications may affect the quality of life and may lead to death. Generally, good self-care practices in diabetes consist of eating balanced diet, performing physical activity, self-monitoring of blood glucose (SMBG) and foot care.

The Summary of Diabetes Self-Care Activities (SDSCA) questionnaire by Toobert et al. [3] is a widely used validated tool to evaluate self-care activities among diabetic patients. SDSCA consists of 10 items with four main domains, which are diet, exercise, blood glucose testing and foot care, as well as one domain regarding smoking. The SDSCA also includes 14 additional items which can be used to measure personal care such as the type of treatment used. In Malaysia, Jalaludin et al. translated and validated the SDSCA into Malay language for children and adolescent [6]. Mohammad Adam et al. did the version for adults [7].

Factors that may influence self-care adherence among diabetic patients are age, gender, ethnicity, marital status, level of education, income, social support, culture, health belief, self-efficacy, depression,

treatment and others [8-18]. There is evidence that good management of patients' self-care activities improves glycaemic control [19]. Therefore, the aim of our study was to evaluate the pattern of diabetes self-care among Malaysian, the factors influencing it and the factors affecting glycaemic control.

Methodology

Data collection

This was a cross sectional study that took place in Klinik Kesihatan Seremban 2, Negeri Sembilan. Data was collected during patients' routine clinic appointments for 3 months, starting from December 2014 until early March 2015. All eligible patients who agreed to participate were recruited into the study. The inclusion criteria were Malaysian diabetic patients aged 18 and above, able to read and write in Malay and diagnosed as diabetic patients. Consented patients were given the questionnaire to complete either by themselves or with aid. Patients who were unable to read and write in Malay language were excluded from the study. This study received ethical approval from Medical Research and Ethics Committee(MREC), Ministry of Health Malaysia with ID: NMRR-14-523-19349 and Research Ethics Committee, Universiti Kebangsaan Malaysia with ID: FF-2016-085.

Sample size

This study aims to determine the associated factors toward diabetes self-care practices among T2DM patients in Malaysia using an Analysis of Covariance (ANCOVA). The factors under consideration in this study including age, gender, ethnicity, marital status, education level, household income, duration of diabetes diagnosis, patients' body mass index (BMI), current treatment, specialist referral, attended diabetic course, the present of hypertension, dyslipidemia and diabetes complications. Sample size is estimated based on rule of thumb for ANCOVA [20]. To be able to achieve statistics that are representing the parameters in the targeted population, a minimum sample size of 300 is required to answer the objective of study based on observational study.

Questionnaire

The validated Malay version of SDSCA questionnaire was used [7]. The SDSCA scores the patients for a range of activities according to the number of days in a week each activity was performed. In addition to the SDSCA, the questionnaire included sociodemographic data (age, gender, ethnicity, marital status, educational level and household income) and other disease-related information such as current treatment regime, specialist referral, attended diabetes course, the presence of hypertension and dyslipidaemia, and complications. Then, the patients' height, weight and glycated hemoglobin (HbA1c) were obtained from their medical records.

Statistical analyses

Descriptive statistics was used to assess the characteristics of the study population and the patterns of diabetes self-care activities among respondents. SDSCA score was calculated by mean number of days for the questions under each domain. The score was categorized into good (mean ≥ 5.25), moderate (mean=3.50-5.25) and poor (mean<3.50).

Then, multifactorial Analysis of Variance (ANOVA) was conducted to identify the factors associated with diabetes self-care activities. The factors under consideration in this study were age, gender, ethnicity, marital status, education level, household income, duration of diabetes diagnosis, patients' body mass index (BMI), current treatment regime, specialist referral, attended diabetic course, the presence of hypertension, dyslipidemia and complications.

Since the data showed heteroscedasticity, Spearmen's Rank-Order Correlation was applied to determine correlation between SDSCA and glycaemic control. Lastly, Analysis of Covariance (ANCOVA) was used to identify factors that contributed to poor glycaemic control. All analysis was performed by using IBM SPSS statistics version 20(IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

Result

A total of 536 eligible patients participated in the study (Table 1). The mean age was 56.55 (± 10.83) years. There were 53.7% female, 55.8% Malay, and 84.3% married. Most of them were obese with BMI ≥ 27.5 kg/m^2 and on oral anti-diabetic agent. Other than that, majority of patients had hypertension and poor HbA1c reading.

Profile	Mean (SD)	N (%)		Profile	Mean (SD)	N (%)
Age (in year)				Current treatment		
				None (Diet and exercise)	-	14 (2.6)
<30 years	56.55 (± 10.83)	5 (0.9)		Tablet (Oral anti-diabetic agent)	-	341 (64.3)
30-60 years		342 (63.8)		Tablet and insulin	-	145 (27.3)
>60 years		189 (35.3)		Insulin only	-	31 (5.8)
Gender				Specialist reference		
Male	-	248 (46.3)		Yes	-	232 (43.9)
Female	-	288 (53.7)		No	-	271 (51.2)
Ethnicity				Unsure	-	26 (4.9)

Malay	-	299 (55.8)		Attended diabetic course		
Chinese	-	62 (11.6)		Yes	-	201 (37.8)
Indian	-	168 (31.3)		No	-	310 (58.4)
Others	-	7 (1.3)		Unsure	-	20 (3.8)
Marital status				Clinical		
Married	-	440 (84.2)		Hypertension	-	
Single	-	17 (3.3)		No	-	171 (31.9)
Divorce	-	17 (3.3)		Yes	-	365 (68.1)
Widow	-	48 (9.2)		Dyslipidemia		
Education level				No	-	291 (54.3)
None	-	29 (5.5)		Yes	-	245 (45.7)
Primary school	-	74 (14.1)		HbA1c		
Secondary school/Certificate	-	285 (54.3)		Good (HbA1c<7% [53 mmol/mol])	7.70 (± 2.40)*	168 (32.8)
Diploma/Bachelor degree	-	119 (22.7)		Poor (HbA1c ≥7% [53 mmol/mol])		344 (67.2)
Master/PhD	-	18 (3.4)		Complications		
				Retinopathy		
Household income				Yes	-	28 (5.2)
Less than RM 1000	-	150 (30.2)		No	-	508 (94.8)
RM 1001-RM 2000	-	126 (25.4)		Nephropathy		
RM 2001-RM 3000	-	79 (15.9)		Yes	-	18 (3.4)
RM 3001-RM 5000	-	90 (18.2)		No	-	518 (96.6)
More than RM 5001	-	51 (10.3)		Neuropathy		
BMI				Yes	-	6 (1.1)
				No	-	530 (98.9)
Underweight (<18.5 kg/m^2)	28.58 (± 5.42)	5 (1.0)		Heart disease		
Normal (18.5-22.9 kg/m^2)		57 (11.3)		Yes	-	25 (4.7)
Overweight (23.0-27.4 kg/m^2)		161 (31.9)		No		511 (95.3)
Obese (≥ 27.5 kg/m^2)		281 (55.8)		*Median (IQR)		

Table 1: Characteristics of study population.

Domain	Question	Number of Item	Mean (SD)
Overall	1-11a	10	3.82 (± 1.18)
Diet	1,2,3,5a	4	4.43 (± 1.74)
Exercise	05-Jun	2	2.87 (± 1.94)
Blood sugar testing	07-Aug	2	1.78 (± 2.07)
Foot care	9a-11a	2	5.56 (± 1.94)

Table 2: The patterns of diabetic self-care activities.

Table 2 shows the participants' score for diabetic self-care activities. The four domains in self-care activities are diet, exercise, blood sugar testing and foot care. The score for each domain is the number of days the patients' practiced the self-care activities within a week. The score for an activity ranges from 0-7, reflecting the number of days the activity was performed. Higher score means more compliance towards the activities. The mean overall score of self-care activities among respondents was 3.82 (± 1.18) days with diet and foot care having the highest with mean score of 4.43 (± 1.74) days and 5.56 (± 1.94) days accordingly.

Table 3 shows factors that were associated with the four domains measured in SDSCA. Women (p=0.014) and patients on insulin only (p=0.014) had significantly higher score in the diet domain compared to other groups.

On the other hand, education level (p=0.031) and BMI (p=0.007) showed significant association with the exercise domain. A higher the level of education was correlated with having less exercise. Patients with primary level of education exercised the most while those with postgraduate education exercised the least. However, it is possible due to small sample size of postgraduate education. As for BMI, normal and overweight group exercised more than obese group.

Variable	Diet		Exercise		Blood glucose testing		Foot care	
	Marginal means (95% CI)	p value*	Marginal means (95% CI)	p value*	Marginal means (95% CI)	p value*	Marginal means (95% CI)	p value*
Profile Age (in year)								
<30 years	4.33 (2.15, 6.51)	0.746	3.33 (0.83, 5.83)	0.73	1.45 (-1.15, 4.05)	0.569	3.63 (1.04, 6.22)	0.183
30-60 years	4.63 (3.31, 5.95)		2.55 (1.04, 4.07)		0.78 (-0.79, 2.35)		4.75 (3.19, 6.32)	
>60 years	4.77 (3.47, 6.07)		2.48 (0.98, 3.98)		0.99 (-0.57, 2.54)		5.13 (3.58, 6.67)	
Gender								
Male	4.35 (2.95, 5.75)	0.014	2.92 (1.30, 4.53)	0.226	0.98 (-0.70, 2.65)	0.387	4.23 (2.57, 5.90)	0.014
Female	4.80 (3.39, 6.21)		2.66 (1.04, 4.28)		1.17 (-0.52, 2.85)		4.77 (3.10, 6.45)	
Ethnicity								
Malay	4.42 (3.08, 5.75)	0.178	2.66 (1.12, 4.20)	0.648	0.91 (-0.69, 2.50)	0.568	4.79 (3.20, 6.37)	0.04
Chinese	4.09 (2.66, 5.52)		2.48 (0.84, 4.13)		0.75 (-0.96, 2.45)		3.84 (2.15, 5.54)	
Indian	4.70 (3.35, 6.06)		2.87 (1.32, 4.43)		1.17 (-0.45, 2.79)		4.86 (3.25, 6.47)	
Others	5.10 (2.95, 7.26)		3.13 (0.66, 5.61)		1.47 (-1.10, 4.04)		4.52 (1.97, 7.09)	
Marital status								
Married	4.35 (2.97, 5.73)	0.142	3.03 (1.45, 4.62)	0.15	1.24 (-0.41, 2.89)	0.668	4.68 (3.04, 6.32)	
Single	3.86 (2.31, 5.41)		1.71 (-0.08, 3.49)		0.47 (-1.38, 2.32)		3.85 (2.01, 5.69)	
Divorce	5.40 (3.65, 7.14)		3.04 (1.04, 5.05)		1.21 (-0.87, 3.30)		5.42 (3.34, 7.49)	
Widow	4.70 (3.16, 6.25)		3.36 (1.59, 5.14)		1.37 (-0.48, 3.21)		4.06 (2.23, 5.90)	
Education level								
None	4.61 (3.00, 6.23)	0.11	2.90 (1.05, 4.76)	0.031	1.42 (-0.53, 3.36)	0.121	3.68 (1.76, 5.60)	
Primary	5.08 (3.60, 6.55)		3.58 (1.88, 5.27)		0.59 (-1.17, 2.35)		4.44 (2.69, 6.20)	
Secondary	4.36 (2.94, 5.77)		3.01 (1.39, 4.63)		1.05 (-0.64, 2.73)		4.73 (3.05, 6.40)	
Diploma/Degree	4.58 (2.65, 5.85)		2.90 (1.27, 4.52)		1.50 (-0.18, 3.19)		4.72 (3.05, 6.40)	

Master/PhD	4.25 (2.65, 5.85)		1.55 (-0.29, 3.39)		0.81 (-1.10, 2.72)		4.94 (3.04, 6.84)	
Household income								
<RM 1,000	4.92 (3.51, 6.32)		3.07 (1.46, 4.69)		1.22 (-0.46, 2.90)		4.54 (2.87, 6.21)	
RM 1,001-RM 2,000	4.63 (3.18, 6.08)		2.63 (0.97, 4.30)		0.97 (-0.76, 2.70)		4.10 (2.38, 5.82)	
RM 2,001-RM 3,000	4.42 (3.00, 5.85)	0.442	2.85 (1.21, 4.48)	0.575	1.07 (-0.63, 2.78)	0.814	4.35 (2.66, 6.05)	0.174
RM 3,001-RM 5,000	4.54 (3.08, 5.99)		2.76 (1.09, 4.44)		1.22 (-0.53, 2.96)		4.46 (2.73, 6.20)	
>RM 5,000	4.38 (2.89, 5.86)		2.62 (0.91, 4.33)		0.88 (-0.89, 2.66)		5.06 (3.29, 6.83)	
Duration of diabetes diagnosis								
≤5 years	4.54 (3.12, 5.95)		2.74 (1.11, 4.37)		0.99 (-0.70, 2.69)		4.58 (2.90, 6.27)	
6-10 years	4.31 (2.87, 5.74)	0.051	2.71 (1.06, 4.36)	0.727	0.60 (-1.12, 2.31)	0.002	4.37 (2.67, 6.08)	0.679
>10 years	4.89 (3.49, 6.28)		2.92 (1.31, 4.52)		1.63 (-0.04, 3.30)		4.55 (2.89, 6.21)	
BMI								
Underweight	3.70 (1.34, 6.06)		1.55 (-1.16, 4.25)		0.06 (-2.76, 2.87)		4.45 (1.65, 7.25)	
Normal	5.21 (3.83, 6.58)		3.51 (1.93, 5.09)		1.49 (-0.15, 3.13)		4.67 (3.04, 6.31)	
Overweight	4.70 (3.40, 6.00)	0.231	3.36 (1.87, 4.85)	0.007	1.42 (-0.14, 2.97)	0.668	4.39 (2.84, 5.93)	0.874
Obese	4.70 (3.40, 6.00)		2.74 (1.24, 4.23)		1.33 (-0.22, 2.88)		4.50 (2.96, 6.05)	
Current treatment								
None (Diet and exercises)	3.81 (2.06, 5.56)		2.86 (0.85, 4.86)		0.56 (-1.52, 2.65)		4.04 (1.97, 6.12)	
Tablet (Oral anti-diabetic agent)	4.65 (3.30, 5.99)		2.51 (0.96, 4.06)		0.90 (-0.71, 2.52)		4.61 (3.01, 6.21)	
Tablet and insulin	4.34 (2.97, 5.72)	0.014	2.46 (0.88, 4.04)	0.274	1.54 (-0.10, 3.18)	0.078	4.73 (3.09, 6.36)	0.795
Insulin only	5.51 (3.95, 7.07)		3.32 (1.53, 5.11)		1.28 (-0.58, 3.15)		4.63 (2.78, 6.48)	
Specialist reference								
Yes	4.57 (3.22, 5.92)		2.93 (1.38, 4.48)		1.01 (-0.60, 2.62)		4.73 (3.13, 6.34)	
No	4.61 (3.20, 6.03)	0.971	2.84 (1.21, 4.47)	0.789	0.74 (-0.95, 2.43)	0.265	4.59 (2.91, 6.27)	0.552
Not sure	4.54 (2.94, 6.15)		2.60 (0.75, 4.44)		1.47 (-0.47, 3.41)		4.19 (2.27, 6.10)	
Attended diabetic course								
Yes	4.69 (3.26, 6.12)	0.495	2.78 (1.13, 4.42)	0.984	1.61 (-0.11, 3.32)	0.039	4.25 (2.55, 5.95)	0.46

No	4.79 (3.38, 6.20)		2.81 (1.19, 4.44)		1.15 (-0.54, 2.84)		4.48 (2.80, 6.16)	
Not sure	4.25 (2.70, 5.81)		2.77 (0.98, 4.56)		0.46 (-1.40, 2.32)		4.78 (2.93, 6.63)	
Clinical								
Hypertension								
Yes	4.58 (3.19, 5.97)	0.974	2.75 (1.15, 4.35)	0.727	1.05 (-0.62, 2.71)	0.826	4.53 (2.87, 6.19)	0.816
No	4.57 (3.16, 5.99)		2.83 (1.20, 4.46)		1.10 (-0.60, 2.80)		4.48 (2.79, 6.16)	
Dyslipidemia								
Yes	4.47 (3.07, 5.87)	0.203	2.67 (1.06, 4.28)	0.233	1.15 (-0.52, 2.83)	0.421	4.67 (3.01, 6.33)	0.099
No	4.68 (3.28, 6.09)		2.90 (1.29, 4.52)		0.99 (-0.69, 2.67)		4.34 (2.67, 6.01)	
Complications								
Retinopathy								
Yes	4.58 (3.07, 6.10)	0.97	2.48 (0.74, 4.22)	0.189	1.20 (-0.61, 3.01)	0.593	4.41 (2.61, 6.20)	0.688
No	4.57 (3.19, 5.95)		3.09 (1.51, 4.68)		0.94 (-0.71, 2.59)		4.60 (2.96, 6.24)	
Nephropathy								
Yes	4.85 (3.32, 6.37)	0.301	3.05 (1.30, 4.81)	0.373	1.50 (-0.32, 3.32)	0.169	4.79 (2.98, 6.60)	0.349
No	4.31 (2.87, 5.75)		2.52 (0.86, 4.18)		0.65 (-1.08, 2.37)		4.21 (2.50, 5.93)	
Neuropathy								
Yes	4.80 (2.80, 6.79)	0.619	3.28 (0.99, 5.57)	0.331	0.64 (-1.75, 3.02)	0.406	4.44 (2.07, 6.81)	0.9
No	4.36 (3.17, 5.54)		2.29 (0.93, 3.66)		1.51 (-0.09, 2.93)		4.57 (3.16, 5.98)	
Heart disease								
Yes	4.46 (2.94, 5.97)	0.585	2.44 (0.70, 4.18)	0.166	0.50 (-1.31, 2.31)	0.027	4.24 (2.44, 6.04)	0.309
No	4.70 (3.29, 6.10)		3.14 (1.53, 4.74)		1.65 (-0.25, 3.32)		4.77 (3.10, 6.43)	

Table 3: Factors associated with diabetes self-care activities. *Data was analyzed using Multifactorial Analysis of Variance (ANOVA); Statistically significant at p value <0.05; BMI-body mass index.

In terms of self-blood glucose testing, we found three contributing factors which are duration of diabetes (p=0.002), attended diabetic course (p=0.039) and having heart disease (p=0.027). Frequency of blood glucose testing was the highest among those with diabetes duration of >10 years. Those with ≤ 5 years of diabetes on average tested their blood glucose once a week. In comparison, patients who had diabetes for 6-10 years tested themselves least frequently. Patients who attended the diabetic course and having no heart disease were more frequent in testing blood glucose.

Gender (p=0.014) and ethnicity (p=0.040) are the two factors that significant towards foot care. Women had higher score in foot care. While Chinese scored significantly lower regards foot care.

Table 4 shows the correlation between HbA1c and the domains in SDSCA. Among all four domains, blood glucose testing has weak correlation with HbA1c (r=0.21, p<0.001). The factors show significance effect towards HbA1c are age (p=0.009), ethnicity (p=0.016), current treatment (p<0.001) and specialist reference (p=0.025) (Table 5).

Variable	n	Median (IQR)	r	p value*
Diet	512	4.33 (2.50)	-0.1	0.113
Exercise	507	3.00 (2.50)	-0	0.322
Blood glucose testing	504	1.00 (3.00)	0.21	<0.001
Foot care	507	7.00 (3.00)	0.06	0.213
*Spearman's correlation Statistically significant at p value <0.05.				

Table 4: Correlation between diabetes self-care activities and glycemic control.

Parameters	HbA1c p value*
Profile	
Age (in year)	0.009
Gender	0.762**
Ethnicity	0.016
Marital status	0.550**
Education level	0.462**
Household income	0.759**
Duration of diabetes diagnosis	0.694**
BMI	0.264**
Current treatment	<0.001
Specialist reference	0.025
Attended diabetic course	0.488**
Scores on blood glucose testing	0.083**
Clinical	
Hypertension	0.386**
Dyslipidemia	0.552**
Complications	
Retinopathy	0.536**
Nephropathy	0.718**
Neuropathy	0.937**
Heart disease	0.247**
*Analysis of Covariance (ANCOVA), Statistically significant at p value <0.05, BMI-body mass index	

Table 5: Factors associated with glycemic control.

Discussion

This study showed that diabetic patients had moderate self-care activities with exercise and blood glucose testing were the least frequent of self-care activities. Besides, most respondents also had poor glycaemic control.

The present study proved that respondents had moderate self-care management (with mean (SD)=3.82 (± 1.18) days) based on the 7-point scales derived from the SDSCA questionnaire. This result is in agreement with the study by Siti Khuzaimah et al. 2014

[14] which reported moderate self-care behavior with mean score 38.94 based on the 70-point scales. However, a study from India showed that their patients had poor self-care behaviors [21]. The present study and previous studies indicate that most Malaysian diabetic patients had moderate self-care management regardless of their culture and ethnicity. Thus, more strategies need to be implemented in order to improve self-care activities, control blood glucose as well as prevent complication.

Diet

Our study found that more than half of our diabetic patients followed the recommended eating plan where they ate balance of carbohydrate such as rice and bread and also five serving of fruits and vegetables for four days per week. Similar studies from Malaysia found that diabetic patients had moderate to high score in diet self-management [14,22]. In contrast, the study by Institute for Public Health (IPH) [23] found that 94% Malaysian diabetic patients did not adhere to consuming the recommended serving of fruits and vegetables in their diet. Tol et al. [24] from Iran also reported poor diet self-care. These findings suggest that diet management should be emphasized among diabetic patients. Steadfast approach should be arranged so that diabetic patients will adhere to balanced diet.

Moreover, there were some factors that may contribute to efficient diet self-management. The present study indicated that there was significant difference between genders where females had better diet management compared to males. Study by IPH [23] reported that females consumed enough serving of fruits and vegetables as suggested by the World Health Organization (WHO) compared to males. In addition, females were believed to be more conscious about their body appearance and more sensitive about their weight. Therefore, they became more careful in food choice.

Another contributing factor in diet is the current treatment regime. Patients on insulin had better diet plan than patients who were taking tablet only or combination of tablet and insulin as well as patients who did not take any medicine.

Other than gender and current treatment, previous study showed that age, ethnicity and educational level also played essential role in effectiveness of diet self-care activities [14]. Elderly, Indian and primary level of education had better diet management compared to other groups. They consumed less amount of calorie burning food and eat high in grains, vegetables and fruits.

Exercise

Exercise influences blood glucose control by increasing sensitivity towards insulin. Many studies emphasized on the importance of exercise [3,25,26]. However, this study showed that diabetic patients did not frequently performed physical activities. Similarly, study conducted by Freitas et al. [27] among a Brazilian population found that 50% of the respondents did not perform any physical activity in the whole week.

The present study showed that education level and BMI were associated with frequency of exercise in the study population. Respondents with primary level of education exercised most frequently. In contrast, study by Suguna et al. [28] found that respondents with higher education more frequent in exercising.

Obese patients were observed to be less likely to perform physical activities than normal and overweight patients. This result supports the work by Dixon et al. [25] in which the tendency to achieve target of health diet and exercise was found to worsen with increasing BMI from to and .

We found that males were more likely to exercise compared to females. A study by Raithatha et al. in India reported the same finding [29]. This may be due to most of the female had to take care of their family and may not have enough time to perform physical activities.

Blood glucose testing

Blood glucose testing reading as well as [30]. It is advisable for patients to check their glucose three to four times daily [26]. However, results from present study showed that blood glucose testing was the least performed diabetes self-care activities among the respondents (2 days/weeks). Previous study in Malaysia also showed almost similar result with 1 day per week [22].

Duration of diabetes since diagnosis and participation in a diabetes course were found to be contributing factors for effective blood glucose testing in this study. Respondents with more than 10 years of diabetes and those who attended a diabetes course conducted more frequent blood glucose testing. This situation may be due to the higher level of awareness about the importance of blood glucose testing. However, previous study showed that current treatment was also one of the associated factors. Patients on insulin performed better in blood glucose testing [14]. Financial constraint could be one of the reasons why SMBG was not done more often as the self-blood glucose testing devices are costly. Moreover, not all patients need to check their blood glucose daily. Patients who were only on oral medication or diet and lifestyle control were allowed to have less frequent than daily glucose check.

Foot care

Another diabetes self-care activity in this study is foot care. It is an essential activity for diabetic patients in preventing complication and ulcer that could lead to amputation. Diabetic patients with amputation have three times risk to death compared to patients without amputation [31]. Current study showed that foot care was the most frequently performed self-care activities among the respondents. Most of them washed their feet and dried between their toes after washing for a frequency of 5 days per week. This finding is in keeping with previous observational studies [29].

The factors that associated with foot care are gender and ethnicity. Females had higher frequency of adhering to foot self-care than males. A possible explanation may be that females were more concerned about having beautiful feet. Thus, they have tendency to care more about their feet. Besides, Indians and Malays were observed to have better practice on foot care compared to other ethnic groups. For the Malays who were Muslim, in their religious teaching, washing foot is one of the ritual ablutions in order to perform the obligatory ritual prayer five times per day. On the contrary, the study by Misliza and Mas Ayu [32] found that Malay and Indian patients had three times higher risk of diabetic foot ulcer compared to Chinese. Thus, Malay and Indian patients might be given more accentuation on foot care.

Gycemic control *vs* self-care activities

Suboptimal glycaemic control is a global issue. Many developed and developing countries failed to achieve optimal targeted reading. This study also showed that among the 536 respondents, half of them had

poor glycaemic control with median 7.70 ± 2.40% (61 ± 26.2 mmol/mol). Likewise, two studies from Malaysia by Siti Khuzaimah et al. [14] and Ahmad et al. [33] found that 57.7% and 77% of the respondents had poor HbA1c level respectively. The reduction in HbA1c is very precious as it had been reported that the reduction of HbA1c by 1% is associated with reductions in the risk of any end point related to diabetes by 21%, deaths related to diabetes by 21%, myocardial infarction by 14% and micro vascular complications by 37% [34]. Reduction of HbA1c could be achieved by many strategies. One of the effective strategies is through diabetes self-care management. Diabetes self-care management has been proven by Singh et al. [35] to improve glycaemic control by 0.36% (95% Cl 0.21-0.51). Although the reduction of 0.36% was modest, the number is large enough to reduce the risk of development and progression of diabetes complications. Thus, self-care activities among diabetic patients should be emphasized to improve their control of blood glucose.

In this study, only one self-care activity correlates with HbA1c which is blood glucose testing ($r=0.21$, $p<0.001$). This finding was unexpected and suggested that respondents with poor glycaemic control check their blood glucose more frequently than respondents with good glycaemic control. This could be that the patients were worried about their high HbA1c readings and thus had increased tendency to have more frequent blood glucose testing. Another study found that the means of HbA1c has strongest correlation with special diet for diabetes while other factors are seem to have mediated influence with glycaemic level [36]. Next, the present study showed that the factors that may influence HbA1c were age, ethnicity, current treatment and specialist referral after age was adjusted. Likewise, Ahmad et al. [33] found that age, duration of diabetes since diagnosis and current treatment were correlated with poor glycaemic control. However, study by Sana Taher Ashur et al. [37] showed that gender, marital status and educational level had significant association with glycaemic control.

Limitation and Recommendations

There are several limitations to this study. The use of a cross sectional design was unable to identify the causal relationships between variables. Besides, this study used convenience sampling which may cause selection bias. However, this study had a relatively large sample size (n>500). Previous studies had shown that results derived from a sample size of more than 500 can still be very likely to provide statistical inferences which closely mimic those from the intended population [38,39]. Thus, results derived from this study could still be used to infer on the larger population.

The study on self-care activities and the associated factors would be worthwhile in the future by using qualitative and mix-method approaches to explore patients' natural feeling and behaviors. Other than that, further study in forms of longitudinal study or intervention study in this field would be of great help in observing trends of diabetes self-care and understanding the direction of contributing factors that may affect the changes of self-care activities in long term period. Apart from that, investigating to what extent the self-care activities are associated with HbA1c and quality of life using path analysis is also useful to determine the impact of self-care activities not only on clinical outcome but also patients' outcome [40].

Conclusion

The noteworthy outcome from this study suggests that self-care activities among diabetic patients are moderate. Exercise and blood glucose testing were the least frequently performed self-care activities with most respondents had poor glycaemic control. Particular attention needs to be given to exercise and blood glucose testing among diabetic patients, and some strategies should be implemented to improve glycaemic level towards better control. Other than that, the associated factors also should be emphasized in order to have effective self-care activities because patients from different background have different perspective and attitude towards self-care.

Therefore, more strategies need to be explored to make sure patients adhere to self-care activities. Malay version of Summary Diabetes Self-care Activities can be used among diabetic patients in Malaysia in order to investigate their self-care practices. With this, medical practitioners could identify patients who practice self-care activities less and give more attention to them.

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