Self-monitoring of blood glucose among diabetic patients attending Al-Eskan Primary Health Care Center in Makkah Al-Mukarramah city

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Abstract

Background: Self-monitoring of blood glucose (SMBG) is recognized by leading medical organizations as an important tool in diabetes management, particularly in insulin-treated patients. However, some believe the utility of SMBG in non-insulin-treated type 2 diabetes mellitus (T2DM) remains controversial.

Objectives: To estimate the prevalence of SMBG, its frequency, and influencing factors among diabetic patients attending Al-Eskan Primary Health Care Center, Makkah Al-Mukarramah city.

Materials and Methods: A cross-sectional analytic study was conducted including a representative sample of diabetic Patients attending Al-Eskan Primary Health Care Center in Makkah Al-Mukarramah city. Every third patient who attended for follow-up in the center was recruited in the research until the target number was achieved. Two sets of questionnaires were developed in English language and validated in a Malaysian study, and consequently used in the present study. One set of questionnaire was for diabetic patients who performed self-monitoring consisted of five parts; personal data, information about the patient's diabetes and treatment, the patient's perception regarding diabetes and his health, the patient's belief and attitudes toward SMBG, and the patient's current SMBG practices. Another set of questionnaire was for those who did not perform self-monitoring. It was similar except in part 4 where different statements were used to assess the patient's perception and attitude toward SMBG.

Results: The study included 120 patients with T2DM. The prevalence of SMBG among them was 70.8%. Among those who are practicing SMBG, 28.2% practiced it on daily basis whereas 10.6% practiced it more than once daily. Almost one third of them (35.3%) recorded their blood glucose monitoring results. Only 22.4% showed their results to their physicians and 25.9% adjusted their diabetes treatment based on blood glucose results. Sixty-nine respondents (57.5%) needed further help and information regarding diabetes with no significant association with SMBG practice. It was found that younger (≤50 years), male, married, and higher educated diabetic patients were more likely to practice SMBG, regardless of its frequency. All information related to diabetes (duration, therapy, complications, hospitalization, recent HbA1C, and attending educational sessions) was not significantly associated with SMBG practice.

Conclusion: SMBG is widely used among patients with T2DM in Al-Eskan Primary Health Care Center in Makkah Al-Mukarramah city. However, its frequency and timing is suboptimal. As younger (≤50 years), male, married, and higher educated diabetic patients were more likely to practice SMBG.

KEY WORDS: Self-monitor blood glucose, glycated hemoglobin, type 2 diabetes, Saudi Arabia

Introduction

The burden of diabetes is increasing globally, particularly in developing countries. It is predicted to become the seventh leading cause of death in the world by the year 2030.[1]

New figures from the International Diabetes Federation (IDF) indicate that the number of people living with diabetes is expected to rise from371 million in 2012 to 552 million by

2030 if no urgent action is taken. This equates to approximately three new cases every 10 seconds or almost 10 million per year. IDF also estimates that as many as 187 million people are unaware that they have diabetes.[2,3]

In the Middle East and North Africa Region, one in nine adults have diabetes. In the 20–79 age groups, 34 million or 10.9% of the population in 2012 had diabetes and this number is expected to double in less than 20 years. Four out of the world's top 10 countries with the highest prevalence of diabetes are in the region.[3]

In the Saudi Arabia 20–79 age groups, 23.4% of the population in 2012 had diabetes. It is considered the seventh country with the highest prevalence of diabetes worldwide.[3]

Complications due to diabetes are a major cause of disability, reduced quality of life, and death. Diabetes complications can affect various parts of the body, manifesting in different ways for different people.[3]

There are no internationally agreed standards for diagnosing and assessing diabetes complications. Owing to different methods of assessing the presence of these complications, it is difficult to make comparisons between different populations. However, it is clear that they are very common, with at least one complication present in a large proportion of people (50% or more in some studies) at the time of diagnosis.[3]

The data from the Diabetes Control and Complications Trial and the UK Prospective Diabetes Study overwhelmingly support the fact that good control of blood glucose in diabetes can prevent or delay complications. This has been proven for both T1DM and T2DM.[4]

Two primary techniques are available for health providers and patients to assess the effectiveness of the management plan on glycemic control, patient self-monitoring of blood glucose (SMBG), and A1C.[5]

Although hemoglobin A1C is the gold standard for monitoring glycemic control and serves as a surrogate for diabetes-related complications. It does not provide information about day-to-day changes in glucose levels.[6]

Self-monitoring of blood glucose represents an important adjunct to A1C because it can distinguish among fasting, preprandial, and postprandial hyperglycemia; detect glycemic excursions; identify and assist in monitoring resolution of hypoglycemia; and provide immediate feedback to patients about the effect of food choices, activity, and medication on glycemic control.[6,7]

Self-monitoring of blood glucose is recognized by leading medical organizations as an important tool in diabetes management, particularly in insulin-treated patients.[5,8,9] However, some believe the utility of SMBG in non-insulin-treated T2DM remains controversial.[7,10–15]

Although many studies have reported negative findings regarding SMBG use in non-insulin-treated T2DM, they have simply shown that SMBG is valuable only when it is used effectively. Optimal SMBG use requires that both patients and health care professionals monitor, interpret, and respond appropriately to acute glucose excursions and patterns of glycemia identified through SMBG.[7,10,14]

This study aimed to determine the prevalence of factors influencing the frequency of SMBG among patients with T2DM.

Materials and Methods

A cross-sectional analytic study was conducted in Makkah Al-Mukarramah, which is a city in the Hijaz and the capital of Makkah province in Saudi Arabia. It is located in a narrow valley at a height of 277 m above sea level. Its resident population in 2008 was 1.7 million, although visitors more than double this number came here every year during Hajj period held in the twelfth Muslim lunar month of Dhu al-Hijjah.[16] Out of 84 primary health care centers (PHCs) located in Makkah Al-Mukarramahcity, Al-Eskan PHC is considered the main training center for family medicine board and it was accredited by Joint Commission International (JCI) on 26 June 2012.[17]

It included diabetic patients attending Al-Eskan PHC in Makkah Al-Mukarramah city. Those recently diagnosed for less than 6 months, too ill, and with impaired cognitive functions were excluded.

A total of 650 diabetic patients (327 men and 323 women) were registered in Al-Eskan PHC and scheduled each month to attend the center for follow-up and renew their medicines. During the working days (Saturday, Sunday, Monday, Tuesday, and Wednesday), approximately 10 patients were attending male clinic daily and same number for female clinic. Owing to difficulties in contacting patients by telephone, every third patient who attended for follow-up in the center was recruited in the research until the target number was achieved.

The calculated sample size was 115 patients using Raosoft sample size calculator with margin of error of 5%, confidence level of 95%, and expected frequency of 10%. The sample size of 120 (60 male and 60 female) patients was obtained due to technical and distribution purposes.

During the month of September, male clinic was covered on a rate of approximately three diabetic patients daily during working days whereas during the month of November, female clinic was covered on a rate of approximately three diabetic patients daily during working days. The month of October was skipped because of Hajj period.

Two sets of questionnaires were developed in English language and published in Malaysian study.[18] The main author was contacted through email for permission to apply the questionnaires for the current study. One set of questionnaire was for diabetic patients who performed self-monitoring and another set of questionnaire was for those who did not perform self-monitoring.[18] Questionnaire for diabetes patients who do SMBG consisted of six parts; the patient's personal data, information about the patient's diabetes and treatment, the patient's perception regarding diabetes and his/her health, the patient's belief and attitudes toward SMBG, the patient's current SMBG practices, and clinical Information. Questionnaire for patients who did not perform SMBG was similar except in part D, different statements were used to assess the patient's perception and attitude toward SMBG.[18]

Owing to data unavailability in the new file system to obtain clinical information, part F was not administered.

One question about the last result of HbA1C was added from another study.[19]

When the patients are attending to the center, they have first to register their arrival at reception area to insure about their eligibility and their file numbers by showing their national identification card. They have to wait at waiting area till their files are brought to nursing station and their turn time are reached. After that, they were invited by the nurse to check their vital signs at nursing station.

Diabetic patients have to go to diabetic clinic where a nurse reviews their files, insures about any missing data, checks for new investigations or requests, and educates them before referring the patients to the physician clinic. During that time, every third patient was informed about the study and was invited to participate by verbal consent. Then, patient was asked about performing SMBG or not and depending on that, the researcher and participating interns administered suitable questionnaire in a face-to-face interview. At the end, the patients had got our thanks for their participations and their times and advices about SMBG.

Approval of joint program of Family and Community Medicine at Makkah and permissions from Al-Eskan and Al-Hejrah PHCC directors were obtained. All collected data will be kept confidential.

Data analysis was carried out using Statistical Package for the Social Sciences, version 20 software. Descriptive statistics were performed in the form of frequencies and percentage test. Analytic statistics were obtained using χ^2-test to assess the association between SMBG practice and other categorical factors. A p-value <0.05 was considered statistically significant.

Results

As shown in Figure 1, the prevalence of SMBG among diabetic patients attending Al-Eskan PHCC in Makkah Al-Mukarramah is 70.8%.

Table 1 presents the association between practicing of SMBG and demographic information of diabetic patients. Data of 25 diabetic patients (80.6%) aged 50 years or less compared to those of 23 patients (57.5%) aged over 60 years practicing SMBG. This difference was statistically significant ($p = 0.029$). Data of 49 male diabetic patients (81.7%) were compared to those of 36 female patients (60%) practicing SMBG. The difference was found to be statistically significant ($p = 0.008$). Data of 76 married diabetic patients (81.7%) and two single patients (66.7%) were compared to only five widowed patients (25%) practicing SMBG. The difference was statistically significant ($p < 0.001$). Data of 31 diabetic patients (83.8%) with secondary school education and those of 23 diabetic patients (76.7%) with university education were compared to only 13 patients (50%) with primary school education practicing SMBG. The difference was statistically significant ($p = 0.027$). Data of 20 diabetic patients (83.3%) having excellent monthly household income were compared to those of 16 patients (64%) with below-average monthly household
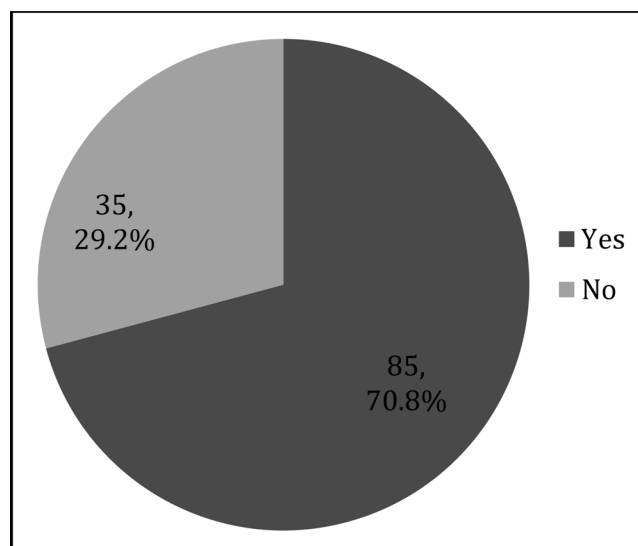

Figure 1: Prevalence of self-monitoring of blood glucose among diabetic patients attending Al-Eskan PHCC, Makkah Al-Mukarramah, 2012.

income practicing SMBG. However, this difference was not statistically significant ($p > 0.05$).

Table 2 shows the association between practicing of SMBG and personal information of diabetic patients. Data of four diabetic patients (80%) who rated their health as excellent were compared to those of one patient (25%) who rated his health as very bad but practicing SMBG. However, this difference was not statistically significant ($p > 0.05$). Data of 23 diabetic patients (85.2%) currently not smoker but used to smoke were compared to those of 46 patients (63%) who never smoke but practicing SMBG. However, this difference was not statistically significant ($p = 0.059$). There was no statistically significant association observed between frequency and duration of physical exercise and practicing SMBG ($p > 0.05$).

Table 3 shows the association between practicing of SMBG and diabetes-related information of patients. Data of 24 diabetic patients (80%) whose duration ranged between 6 and 10 years were compared to those of 17 patients (63%) whose age was 5 years or less but practicing SMBG. However, this difference was not statistically significant ($p > 0.05$). Although data of all five diabetic patients (100%) treated with insulin only were compared to those of 59 patients (66.3%) treated with tablets only and practicing SMBG, this difference was not statistically significant ($p > 0.05$). There is no statistically significant association between level of recent HbA1c and diabetic complications from one side and practicing SMBG from the other side, $p > 0.05$. Although 26 diabetic patients (78.8%) of those hospitalized due to DM compared to 59 (67.8%) of those not hospitalized due to DMare practicing SMBG, this difference was not statistically significant, $p > 0.05$. Although 36 diabetic patients (76.6%) of those attended diabetic education

Table 1: Association between practicing of SMBG and demographic information of diabetic patients attending Al-Eskan PHCC, Makkah Al-Mukarramah, 2012

Demographic information	SMBG		χ^2 (p)
	Yes (n = 85), N (%)	No (n = 35), N (%)	
Age (years)			
≤50 (n = 31)	25 (80.6)	6 (19.4)	
51–60 (n = 49)	37 (75.5)	12 (24.5)	4.79 (0.029)
>60 (n = 40)	23 (57.5)	17 (42.5)	
Gender			
Male (n = 60)	49 (81.7)	11 (18.3)	
Female (n = 60)	36 (60.0)	24 (40.0)	6.82 (0.008)
Marital status			
Single (n = 3)	2 (66.7)	1 (33.3)	
Married (93)	76 (81.7)	17 (18.3)	26.54 (<0.001)
Divorced (n = 4)	2 (50.0)	2 (50.0)	
Widowed (n = 20)	5 (25.0)	15 (75.0)	
Educational level			
No formal education (n = 27)	18 (66.7)	9 (33.3)	
Primary school (n = 26)	13 (50.0)	13(50.0)	
Secondary school (n = 37)	31 (83.8)	6 (16.2)	9.19 (0.027)
Tertiary education (n = 30)	23 (76.7)	7 (23.3)	
Monthly household income			
Below average (n = 25)	16 (64.0)	9 (36.0)	2.49 (0.287)
Average (n = 71)	49 (69.0)	22 (31.0)	
Excellent (n = 24)	20 (83.3)	4 (16.7)	

Table 2: Association between practicing of SMBG and personal information of diabetic patients attending Al-Eskan PHCC, Makkah Al-Mukarramah, 2012

Personal information	SMBG		χ^2 (p)
	Yes (n = 85), N (%)	No (n = 35), N (%)	
Health rating at present			
Very bad (n = 4)	1 (25.0)	3 (75.0)	
Poor (n = 22)	14 (63.6)	8 (36.4)	
Average (n = 57)	42 (73.7)	15 (26.3)	5.32 (0.256)
Good (n = 32)	24 (75.0)	8 (25.0)	
Excellent (n = 5)	4 (80.0)	1 (20.0)	
Smoking			
No, never (n = 73)	46 (63.0)	27 (37.0)	
No, but used to smoke (n = 27)	23 (85.2)	4 (14.8)	5.67 (0.059)
Yes (n = 20)	16 (80.0)	4 (20.0)	
Frequency of exercise			
Every day (n = 13)	8 (61.5)	5 (38.5)	
<3 times/week (14)	12 (85.7)	2 (14.3)	
3–5 times/week (n = 4)	4 (100)	0 (0)	4.44 (0.350)
Once/month (n = 13)	10 (76.9)	3 (23.1)	
Never exercise (n = 76)	51(67.1)	25 (32.9)	
Duration of exercise/session			
<30 min (n = 25)	20 (80.0)	5 (20.0)	
30–60 min (n = 16)	12 (75.0)	4 (25.0)	1.98 (0.577)
>60 min (n = 2)	1 (50.0)	1 (50.0)	
Not applicable (n = 77)	52 (67.5)	25 (32.5)	

Table 3: Association between practicing of SMBG and diabetes information among diabetic patients attending Al-Eskan PHCC, Makkah Al-Mukarramah, 2012

Diabetes information	SMBG		χ^2 (p)
	Yes (*n* = 85), *N* (%)	No (*n* = 35), *N* (%)	
Duration of diabetes (years)			
≤5 (*n* = 27)	17 (63.0)	10 (37.0)	
6–10 (*n* = 30)	24 (80.0)	6 (20.0)	2.96 (0.397)
11–15 (*n* = 22)	17 (77.3)	5 (22.7)	
>15 (*n* = 41)	27 (65.9)	14 (34.1)	
Diabetic therapy			
Tablets (*n* = 89)	59 (66.3)	30 (33.7)	
Tablets and insulin (*n* = 26)	21 (80.8)	5 (19.2)	4.19 (0.123)
Insulin only (*n* = 5)	5 (100)	0 (0)	
Recent HbA1c			
<7.5% (*n* = 5)	5 (100)	0 (0)	
>7.5% (*n* = 9)	8 (88.9)	1 (11.1)	3.90 (0.141)
Don`t remember (*n* = 106)	72 (67.9)	34 (32.1)	
Diabetic complications			
Yes (*n* = 49)	38 (77.6)	11 (22.4)	
No (*n* = 61)	43 (70.5)	18 (29.5)	5.68 (0.059)
Not sure (*n* = 10)	4 (40.0)	6 (60.0)	
Hospitalization due to DM			
Yes (*n* = 33)	26 (78.8)	7 (21.2)	
No (*n* = 87)	59 (67.8)	28 (32.2)	1.39 (0.170)
Attending diabetic education session			
Yes (*n* = 47)	36 (76.6)	11 (23.4)	
No (*n* = 73)	49 (67.1)	24 (32.9)	1.24 (0.182)

sessions compared to 49 patients (67.1%) of those did not attend such sessions are practicing SMBG, this difference was not statistically significant ($p > 0.05$).

Among 35 diabetic patients who did not practice SMBG, 21 patients (60%) and 5 patients (14.3%) perceived mild and moderate pain, respectively, when the nurse did the finger-prick to test blood glucose.

As shown in Table 4, of 120 patients, 46 patients (38.3%) stated that they were inadequately informed about their health and there was no significant association between their attitude toward health condition and practicing of SMBG. In addition, 57 patients (47.5%) were not confident to manage their diabetes, and their confidence in managing their diabetes was not significantly associated with practicing SMBG.

Most of the diabetic patients (96, 80%) agreed that a routine follow-up for diabetes every 1 or 2 months would help them stay healthy. However, there was no significant association between attitudes toward routine follow-up for diabetes and practicing SMBG. Similarly, 97 diabetic patients (80.8%) agreed that there is a high possibility for them to develop diabetes complications in future with no significant association with practicing SMBG.

Almost one-third of diabetic patients (41, 34.2%) agreed that it is difficult for them to find time to go to a doctor for follow-up. Among those who practiced SMBG, 56 patients (65.9%) disagreed with that compared to 18 patients (51.4%) who did not practice SMBG ($p = 0.003$, statistically significant).

Most of diabetic patients (96, 80%) agreed that they received satisfactory emotional support from family and friends. There was no significant association between receiving satisfactory emotional support from family and friends and practicing SMBG.

Sixty-nine diabetic patients (57.5%) needed further help and information regarding managing diabetes with no significant association with SMBG practice. Most of diabetic patients (101, 84.2%) agreed that there is a strong possibility of experiencing medical problems, with no significant association with SMBG practice.

Seventy-one diabetic patients (59.2%) agreed that there is a high possibility that diabetes patients will die earlier than others without diabetes. There was no significant association between attitude of diabetic patients toward earlier death and practicing SMBG.

Most of diabetic patients (94, 78.3%) agreed that they are able to choose foods that are best for their health, with no significant association with SMBG practice.

Slightly more than half of diabetic patients (64, 53.3%) agreed that they are able to maintain a healthy eating pattern, with no significant association with practicing SMBG.

Table 4: Association between practicing of SMBG and attitude of diabetic patients regarding their general health and diabetes

Attitude of diabetic patients	SMBG		χ^2 (*p*)
	Yes *n* = 85 *N* (%)	No *n* = 35 *N* (%)	
I am not fully informed of my health conditions			
Strongly disagree (*n* = 45)	37 (82.2)	8 (17.8)	
Disagree (*n* = 18)	13 (72.2)	5 (27.8)	
Neutral (*n* = 11)	5 (45.5)	6 (54.5)	7.74 (0.102)
Agree (*n* = 22)	13 (59.1)	9 (40.9)	
Strongly agree (*n* = 24)	17 (70.8)	7 (29.2)	
At present, I am still not confident in managing my diabetes			
Strongly disagree (*n* = 33)	24 (72.7)	9 (27.3)	0.54 (0.970)
Disagree (*n* = 16)	12 (75.0)	4 (25.0)	
Neutral (*n* = 14)	9 (64.3)	5 (35.7)	
Agree (*n* = 28)	20 (71.4)	8 (28.6)	
Strongly agree (*n* = 29)	20 (69.0)	9 (31.0)	
A routine follow-up for my diabetes every 1 or 2 months would help me to stay healthy			
Strongly disagree (*n* = 12)	9 (75.0)	3 (25.0)	
Disagree (*n* = 10)	6 (60.0)	4 (40.0)	1.30 (0.861)
Neutral (*n* = 2)	1 (50.0)	1 (50.0)	
Agree (*n* = 36)	25 (69.4)	11 (30.6)	
Strongly agree (*n* = 60)	44 (73.3)	16 (26.7)	
There is a high possibility of me developing diabetes complications in future			
Strongly disagree (*n* = 5)	4 (80.0)	1 (20.0)	
Disagree (*n* = 12)	9 (75.0)	3 (25.0)	3.62 (0.459)
Neutral (*n* = 6)	3 (50.0)	3 (50.0)	
Agree (*n* = 16)	9 (56.3)	7 (43.8)	
Strongly agree (*n* = 81)	60 (74.1)	21 (25.9)	
It is difficult for me to find the time to go to the doctor for my diabetes follow-up			
Strongly disagree (*n* = 54)	40 (74.1)	14 (25.9)	
Disagree (*n* = 20)	16 (80.0)	4 (20.0)	16.06 (0.003)
Neutral (*n* = 5)	0 (0)	5 (100)	
Agree (*n* = 19)	11 (57.9)	8 (42.1)	
Strongly agree (*n* = 22)	18 (81.8)	4 (18.2)	
I receive satisfactory emotional support from family and friends			
Strongly disagree (*n* = 12)	10 (83.3)	2 (16.7)	
Disagree (*n* = 7)	6 (85.7)	1 (14.3)	3.90 (0.420)
Neutral (*n* = 5)	3 (60.0)	2 (40.0)	
Agree (*n* = 21)	12 (57.1)	9 (42.9)	
Strongly agree (*n* = 75)	54 (72.0)	21 (28.0)	
I need further help and information for my diabetes			
Strongly disagree (*n* = 24)	17 (70.8)	7 (29.2)	
Disagree (*n* = 22)	14 (63.6)	8 (36.4)	
Neutral (*n* = 5)	4 (80.0)	1 (20.0)	2.20 (0.700)
Agree (*n* = 32)	21 (65.6)	11 (34.4)	
Strongly agree (*n* = 37)	29 (78.4)	8 (21.6)	
Diabetes patients have a strong chance of experiencing medical problems			
Strongly disagree (*n* = 4)	3 (75.0)	1 (25.0)	
Disagree (*n* = 2)	2 (100)	0 (0)	3.01 (0.557)
Neutral (*n* = 13)	10 (76.9)	3 (23.1)	
Agree (*n* = 27)	16 (59.3)	11 (40.7)	
Strongly agree (*n* = 74)	54 (73.0)	20 (27.0)	
There is a high possibility that diabetes patients will die earlier than others without diabetes			
Strongly disagree (*n* = 11)	10 (90.9)	1 (9.1)	
Disagree (*n* = 7)	6 (85.7)	1 (14.3)	

Table 4 (*continued...*)

Attitude of diabetic patients	SMBG		χ^2 (*p*)
	Yes *n* = 85 *N* (%)	No *n* = 35 *N* (%)	
Neutral (*n* = 31)	21 (67.7)	10 (32.3)	3.40 (0.493)
Agree (*n* = 22)	15 (68.2)	7 (41.8)	
Strongly agree (*n* = 49)	33 (67.3)	16 (32.7)	
I am able to choose foods that are best for my health			
Strongly disagree (*n* = 13)	8 (61.5)	5 (38.5)	
Disagree (*n* = 6)	3 (50.0)	3 (50.0)	5.15 (0.272)
Neutral (*n* = 7)	7 (100)	0 (0)	
Agree (*n* = 30)	20 (66.7)	10 (33.3)	
Strongly agree (*n* = 64)	47 (73.4)	17 (26.6)	
I am able to maintain a healthy eating pattern			
Strongly disagree (*n* = 27)	19 (70.4)	8 (29.6)	
Disagree (*n* = 17)	11 (64.7)	6 (35.3)	0.50 (0.973)
Neutral (*n* = 12)	9 (75.0)	3 (25.0)	
Agree (*n* = 30)	22 (73.3)	8 (26.7)	
Strongly agree (*n* = 34)	24 (70.6)	10 (29.4)	
I do miss some doses of diabetes medication at times			
Strongly disagree (*n* = 39)	26 (66.7)	13 (33.3)	
Disagree (*n* = 23)	18 (78.3)	5 (21.7)	3.25 (0.517)
Neutral (*n* = 5)	5 (100)	0 (0)	
Agree (*n* = 29)	20 (69.0)	9 (31.0)	
Strongly agree (*n* = 24)	16 (66.7)	8 (33.3)	
Diabetes can be cured by taking medication			
Strongly disagree (*n* = 55)	43 (78.2)	12 (21.8)	
Disagree (*n* = 12)	9 (75.0)	3 (25.0)	6.18 (0.186)
Neutral (*n* = 23)	15 (65.2)	8 (34.8)	
Agree (*n* = 15)	7 (46.7)	8 (53.3)	
Strongly agree (*n* = 15)	11 (73.3)	4 (26.7)	
I could exercise at least 3 times a week to improve my blood glucose control			
Strongly disagree (*n* = 44)	32 (72.7)	12 (27.3)	
Disagree (*n* = 10)	8 (80.0)	2 (20.0)	1.69 (0.793)
Neutral (*n* = 18)	13 (72.2)	5 (27.8)	
Agree (*n* = 17)	10 (58.8)	7 (41.2)	
Strongly agree (*n* = 31)	22 (71.0)	9 (29.0)	

Fifty-three diabetic patients (44.2%) reported missing some doses of diabetes medication at times with significant association with practicing SMBG. Exactly one-quarter of the patients (30, 25%) believed that diabetes could be cured by taking medication. The association between this belief and practicing SMBG was not statistically significant.

Only 48 diabetic patients (40%) showed their willingness to exercise at least 3 times a week to improve their blood glucose control. It was not significantly associated with practicing SMBG.

From Table 5, it is evident that most of diabetic patients practicing SMBG agreed that SMBG enable them to control their diabetes (72, 84.7%) and they are able to adjust their treatment regime based on their blood glucose result (64, 75.3%). However, 53 diabetic patients (62.4%) were not found to be anxious or worried when they self-monitor their blood glucose. More than half of them (46, 54.1%) were not able to check their blood glucose regularly at home as instructed by their doctor.

More than half of them (47, 55.3%) disagreed that they do not test their sugar levels as often as they have been told because its costs too much; 61 of them (71.7%) disagreed that they do not test their sugar levels as often as they have been told because it is too much trouble; 48 of them (56.5%) disagreed that they do not test for sugar as often as they have been told because they often forget to do it; 64 of them (75.3%) disagreed that they do not test for sugar as often as they have been told because they cannot do it by themselves; 53 of them (62.3%) disagreed that they do not test for sugar as often as they have been told because their sugar levels do not change very often; and 64 of them (75.3%) disagreed that they do not test their blood sugar as often as they have been told because it hurts to prick their fingers. More than half of them (48, 56.5%) disagreed that it is not necessary to self-monitor as often as they have been told because they take good care of themselves.

As illustrated in Table 6, slightly less than half of diabetic patients who did not practice SMBG (17, 48.5%) reported that

Table 5: Opinions of diabetic patients practicing SMBG (*n* = 85)

	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly agree N (%)
Self-monitoring my blood glucose make me in control of my diabetes.	5 (5.9)	3 (3.5)	5 (5.9)	16 (18.8)	56 (65.9)
I am anxious and worried when I self-monitor my blood glucose	44 (51.8)	9 (10.6)	6 (7.1)	12 (14.1)	14 (16.5)
I am able to adjust my treatment regime based on my blood glucose result	8 (9.4)	9 (10.6)	4 (4.7)	14 (16.5)	50 (58.8)
I am able to check my blood glucose regularly at home as instructed by my doctor	25 (29.4)	21 (24.7)	4 (4.7)	12 (14.1)	23 (27.1)
I do not test for sugar as often as I have been told because I ran out of the materials.	40 (47.1)	8 (9.4)	4 (4.7)	16 (18.8)	17 (20.0)
I do not test for sugar as often as I have been told because its cost too much	43 (50.6)	4 (4.7)	4 (4.7)	19 (22.4)	15 (17.6)
I do not test for sugar as often as I have been told because it's too much trouble.	50 (58.8)	11 (12.9)	0 (0)	14 (16.5)	10 (11.8)
I do not test for sugar as often as I have been told because I often forgot to do it.	44 (51.8)	4 (4.7)	6 (7.1)	15 (17.6)	16 (18.8)
I do not test for sugar as often as I have been told because I can't do it by myself.	56 (65.9)	8 (9.4)	1 (1.2)	9 (10.6)	11 (12.9)
I do not test for sugar as often as I have been told because my levels don't change very often.	41 (48.2)	12 (14.1)	2 (2.4)	14 (16.5)	16 (18.8)
I do not test for sugar as often as I have been told because it hurts to prick my finger.	53 (62.4)	11 (12.9)	3 (3.5)	9 (10.6)	9 (10.6)
It is not necessary to self-monitor as often as I have been told since I take good care of myself.	46 (54.1)	2 (2.4)	2 (2.4)	15 (17.6)	20 (23.5)

Table 6: Opinions of diabetic patients, who did not practice SMBG on it (*n* = 35)

	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly agree N (%)
I was never told to do self-monitoring of blood glucose.	13 (37.1)	5 (14.3)	0 (0)	6 (17.1)	11 (31.4)
I am worried and nervous to monitor my blood glucose.	13 (37.1)	5 (14.3)	2 (5.7)	6 (17.1)	9 (25.7)
I am not scared to do finger prick to monitor my blood glucose.	7 (20.0)	3 (8.6)	4 (11.4)	7 (20.0)	14 (40.0)
I have financial problem in accessing the meter and strips supplies.	15 (42.9)	6 (17.1)	4 (11.4)	3 (8.6)	7 (20.0)
I do not know where to get the apparatus for self-monitoring blood glucose.	21 (60.0)	9 (25.7)	2 (5.7)	1 (2.9)	2 (5.7)
It is my right to refuse self-monitoring of my blood glucose.	13 (37.1)	4 (11.4)	4 (11.4)	4 (11.4)	10 (28.6)
My diabetes is under control. Hence, it is not necessary for me to self-monitor my blood glucose.	12 (34.3)	1 (2.9)	4 (11.4)	7 (20.0)	11 (31.4)
My health is under 'God's will' therefore it is not necessary for me to self-monitor.	10 (28.6)	3 (8.6)	1 (2.9)	11 (31.4)	10 (28.6)
I will not know how to use the self-monitoring blood glucose result.	14 (40.0)	3 (8.6)	3 (8.6)	5 (14.3)	10 (28.6)
I am not able to do it myself and need somebody to help me in self-monitoring blood glucose.	8 (22.9)	2 (5.7)	1 (29)	9 (25.7)	15 (42.9)
I do not worry about my day-to-day control since my doctor regularly tests my blood glucose every 1 to 2 months.	2 (5.7)	3 (8.6)	3 (8.6)	11 (31.4)	16 (45.7)
I am too busy to self-monitor my blood glucose.	17 (48.6)	9 (25.7)	2 (5.7)	2 (5.7)	5 (14.3)
If I do test, I doubt that I will do it regularly.	8 (22.9)	4 (11.4)	5 (14.3)	11 (31.4)	7 (20.0)

they were never told to do SMBG and 15 of them (42.8%) were worried and nervous about monitoring their blood glucose. Twenty-one of them (60%) agreed that they do not scared to do finger-prick to monitor their blood glucose and ten of them (28.6%) agreed that they have financial problem in accessing the meter and strips supplies. Most of them (30, 85.7%) disagreed that they do not know where to get the apparatus for SMBG. Fourteen of them (40%) agreed that it is their right to refuse SMBG.

More than half of them (18, 51.4%) agreed that their diabetes was under control. Hence, it was not necessary for them to self-monitor their blood glucose. Twenty-one of them (60%) agreed that their health was under "God's will," therefore it is not necessary for them to self-monitor.

Almost two-thirds of them (24, 68.6%) agreed that they were not able to do it themselves and needed somebody to help them in doing SMBG and 15 of them (42.9%) agreed that they do not know how to use the SMBG result.

Most of them (27, 77.1%) agreed that they do not worry about their day-to-day control because their doctors regularly test their blood glucose every 1–2 months. Twenty-six of them (74.3%) disagreed that they are too busy to self-monitor their blood glucose. More than half of them (18, 51.4%) agreed that if they do test, they doubt that they will do it regularly.

Discussion

This study investigated self-blood glucose monitoring practices among T2DM patients in Al-Eskan PHCC in Makkah Al-Mukarramah city and found that SMBG performance rate (70.8%) is comparable to the rates reported in the Western countries. It is incomparable to those reported in Najran (Saudi Arabia) with the rate of 1%. Low literacy rate and technical difficulties encountered in using the glucometer might be factors responsible for such poor self-care.[20]

In Norway, a rate of 70% has been reported.[21] In France among T2DM patients, 74% reported that they took at least 2 tests a day.[22] In Germany, 45.3% of T2DM patients began SMBG before an end point. This rate has increased to 47% after a non-fatal end point.[23]

However, the numbers are higher than those reported in Malaysian studies, which have found that the proportion of SMBG performers ranged from 6.9% among diabetic patients attending private clinics[24] to 26.8% among diabetic patients attending specialist clinics.[25]

Another Malaysian study found that 15.3% of patients practiced SMBG,[18] compared to earlier National Audit on Diabetes conducted in government health clinics in Malaysia where SMBG performers were 10.0%.[26]

SMBG performers were more likely to be younger (≤50 years), highly educated, married, and males. In another study conducted in Malaysia,[18] SMBG performers were more likely to be highly educated, had higher total family income, had diabetes for longer duration, and were on a treatment regime that included insulin. In the current study, diabetes-related factors were not significantly associated with practicing SMBG, although SMBG performers were more likely

having a duration of diabetes ranging between 6 and 10 years, treated with insulin only, having diabetic complications, hospitalized due to diabetes mellitus, and attended DM educational sessions. This could be attributed to relatively small sample size in the present study.

Although considered effective way for assessing glycemic control,[5] 88.3% of diabetic patients attending Al-Eskan PHCC in Makkah Al-Mukarramah city reported that they did not know or remember their most recent HbA1c readings compared to 30% in a UK study.[19]

The role of SMBG is well established in the management of diabetes.[5,8] This study has found that almost half of diabetic patients attending Al-Eskan PHCC in Makkah Al-Mukarramah city lack confidence in managing their condition due to poor understanding of the illness and more than half of them need more help and information. This finding is hardly surprising because only 39% of patients received diabetes education.

Although the rate of SMBG practice in the present study is satisfactory, its frequency as recommended is suboptimal. This low SMBG usage frequency may be due to inadequate counseling as patients need to know specific aspects of self-monitoring such as how, when, and what to do with their SMBG results. Proper interpretation of results and how to use the results to adjust nutrition therapy and exercise to achieve specific glycemic goals must be taught. By regular demonstration through SMBG of the positive effects that medications, diet, and exercise can have on blood glucose levels, self-monitoring can motivate patients to become active participants in their own care.[27]

A critical step in achieving optimal blood glucose monitoring behavioral goals is identifying and resolving barriers to blood glucose monitoring. A comprehensive diabetes management plan is essential in achieving good glycemic control through SMBG.[28,29]

Patient can learn accurate and reliable monitoring skills if diabetes self-management education is included as part of this plan. The Panel of Global Consensus Conference 2006 recommended glucose monitoring depending on glucose level, glycemic goal, and mode of treatment.[30]

This study observed that the more than 80% of patients tested their fasting blood glucose but postprandial blood glucose was tested by only a quarter of patients. Assessing postprandial blood glucose level is important because it is significantly associated with the risk of cardiovascular disease and death.[31]

In Pakistan, the frequency of blood sugar checking varied among all subjects in case group: 55% checked their blood sugar occasionally, 26% monitored daily, and 13% twice a day, and 3% checked their blood sugar before and after each meal.[32]

A longitudinal 12-month study found that easier availability (fully subsidized) of self-monitoring supplies increased frequency of use and improved glycemic control.[33]

Regular home monitoring is being encouraged by government subsidies to purchase glucose meters and test strips in the developed countries such as Australia, Sweden, and the USA.[34,35]

Health education is one of the areas that need to be addressed immediately.[36] DM has been cited as a model disease in which patient education makes a big difference.[37] Home monitoring of blood glucose is considered a major requirement for long-term glycemic control, thereby postponing, if not avoiding, long-term complications. Diabetic patients have to make very important and crucial decisions daily. A poor level of knowledge and self-care has been reported from Al-Qassim[38] and the Eastern Province.[39]

Reducing the financial burden of patients can increase self-monitoring, thus resulting in better glycemic control and reduced complications. Hence it is recommended that the Saudi government provide subsidies to diabetic patients to purchase these vital monitoring tools. This study found almost a quarter of the patients believed that diabetes could be cured by taking medication. Almost half of the patients defaulted on their diabetes medications. A comprehensive strategy is required to remove misconceptions, improve drug compliance, transform knowledge to action, and provide/improve existing facilities for health education and health promotion.

Study limitations

A self-report on regularity of SMBG may not reflect actual performance; the number of test strips dispensed is likely to be more accurate.[40] However, test strip counting could not be done as the patients purchased their test strips from various sources. Evaluation of the role of recent reading of HbA1C on SMBG is not satisfactory as data were obtained from patients and the majority of them did not know or remember their glucose values. Finally, the patients were recruited from one PHCC in Makkah, which could affect the generalizability of the results.

Conclusion

SMBG is widely used among T2DM patients in Al-Eskan PHC in Makkah Al-Mukarramah city. However, its frequency and timing is suboptimal as younger (≤50 years), male, married, and higher educated diabetic patients were more likely to practice SMBG.

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