Self-Monitoring of Blood Glucose Among Diabetes Patients Attending Government Health Clinics

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SUMMARY

The aims of this study were (i) to determine the prevalence of self-monitoring of blood glucose (SMBG) among Type 2 diabetes patients attending government health clinics and (ii) to ascertain the factors influencing SMBG. Five hundred and fifty-six Type 2 diabetes patients from two government health clinics in Selangor and Negeri Sembilan were interviewed using a structured questionnaire. The total subjects of the study were 556 patients. Eighty-five patients (15.3%) of patients; performed SMBG. However, 170 subjects were included in the statistical analysis, 85 patients who were not self-monitoring were randomly selected and was compared with 85 patients who were self-monitoring. Among those who performed SMBG, the majority (83.5%) monitored less than once per day and only 16.5% monitored at least once a day. One-third of patients adjusted their medications based on their SMBG results. The higher patient's level of education (p= 0.024, CI 1.29 – 35.3); the higher total family income (p= 0.041, CI 1.26 – 4.79); the longer duration of diabetes (p<0.01, CI 2.22 – 7.29); and treatment regime which includes insulin (p< 0.001, CI 2.05 – 9.24) were significant predictors of SMBG practice. Although SMBG is recognised to be useful and effective in achieving diabetes control, this study has found that only a minority of patients with diabetes performed SMBG. Hence healthcare personnel must increase awareness on the importance of SMBG and strongly promote the practice among diabetic patients.

KEY WORDS:
Self-monitoring of blood glucose, Diabetes mellitus, Primary health care

INTRODUCTION

Diabetes is expected to affect 350 million people worldwide by 2030[1-3]. The cost of managing diabetes and its complications is estimated to account for nearly 10% of all healthcare expenditure[2]. Controlled trials in patients with Type 1 and Type 2 diabetes have proved that improved control of blood glucose reduces the risk of diabetes complications[4-6].

Self-Monitoring of Blood Glucose (SMBG) is an important tool for assessing and improving the quality of diabetes control[7]. A higher frequency of SMBG was associated with better glycaemic control among insulin-treated Type 2 diabetes patients who were able to adjust their regimen[8].

Several meta-analysis with SMBG as part of a multi-component management strategy showed a mean HbA1c reduction of 0.4% compared to therapies that did not use self-testing[9,10]. The risk of microvascular complications decreases by 37% for every 1% decrease in HbA1c. It is suggested that multi-component management strategies that included SMBG can provide an additional 15% risk reduction from microvascular complications[4].

HbA1c value is a time-average result which limits it as a marker for glycaemic control. SMBG provides "real-time" feedback and will show deviations in blood glucose control, such as post-prandial hyperglycaemia or severe hypoglycaemia. It is useful for short-term treatment adjustment, improves patients' safety and motivates them to make appropriate changes in diet, exercise and treatment regime [11,12].

The American Diabetes Association (ADA) recommends SMBG to achieve glycaemic goals and patients on multiple insulin injections should be monitored three or more times daily. ADA also endorses efforts to teach people with diabetes to use SMBG data actively as part of a patient-centred self-management program[13].

SMBG was practiced by 52.6% to 75.0% of patients with diabetes in Germany and Northern California respectively[7,14]. However, in Malaysia, only 7-21% of diabetes patients self monitor their blood glucose[15].

A study conducted in New Zealand found that the reasons for poor glucose monitoring and barriers to SMBG were multi-factorial. The pain of constant finger-pricking and the cost and inconvenience of having to perform blood glucose measurements have been identified as significant barriers to SMBG[16]. To date, there is no published study done locally on barriers in performing SMBG.

The aims of this study were (i) to determine the prevalence of SMBG among Type 2 diabetes patients attending government health clinics and (ii) to ascertain the factors influencing SMBG.

MATERIALS AND METHODS

Study design

This is a cross-sectional survey using structured bilingual (Bahasa Malaysia and English) questionnaires which were

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administered through face-to-face interview by trained nurses. Information which were not obtained during the interview such as investigation results were collected from the patient's medical records.

The participants were established Type 2 diabetes patients who attended Ampangan Health Clinic in Seremban District, Negeri Sembilan and Kelana Jaya Health Clinic in Petaling Jaya, Selangor from March to May 2006. Patients who were recently diagnosed Type 2 diabetes for less than 6 months or were too ill were excluded from the study. Patients were recruited after they consented to participate in this study. Due to difficulties in contacting patients by mail or telephone, the patients were recruited every third patient who presented for treatment in the centres until the target number was achieved.

Study Sites
Both clinics are typical government health clinics in Malaysia that provide comprehensive and continuing medical care to urban and semi-urban populations. The average total outpatient attendances in Ampangan Health Clinic is about 60000 annually with 1500 registered as diabetics. The diabetes clinics are open three days in a week. About 35 diabetes patients are seen each day. Kelana Jaya Health Clinic received a total outpatient attendances of 110906 and 5375 were registered as diabetics in the year 2005. The diabetes clinics open every day with 80 patients seen each day.

Sample size calculation
The Epi-Info 2000 StatCalc function for population survey was used to estimate the sample size in this study. Baseline SMBG rate was assumed to be about 10% (based on a previous study, DiabCare-Malaysia 1998)[15]. Therefore 276 Type 2 diabetes patients were screened to ensure the estimate of the SMBG rate had ± 5% precision. In order to perform subgroup analyses, the sample size were increased by about 80%. Thus the final sample size was 500 (250 from each clinic).

Questionnaires
Two sets of questionnaires in Bahasa Malaysia and English were developed. One set of questionnaire was for diabetes patients who performed self monitoring and another set of questionnaire was for those who did not perform self monitoring.

The following procedure was followed in the development of the questionnaires:
- Literature review followed by in-depth interview with six Type 2 diabetes patients using semi-structured questionnaire
- Focus group discussions
- Pilot testing of questionnaires followed by refinement of the questionnaire.
- Translation of English questionnaires to Bahasa Malaysia.

Questionnaire for diabetes patients who do self monitoring consisted of six parts:
A. The patient's personal data
B. Information about the patient's diabetes and treatment
C. The patient's perception regarding diabetes and his health
D. The patient's belief and attitudes towards SMBG
E. The patient's current SMBG practices
F. Clinical Information

Responses to Part C and D were ratings on a Likert Scale (1-Strongly agree, 2-Agree, 3 – Neutral, 4 - Disagree and 5-Strongly disagree). All clinical information was collected from the patient's diabetes record for the last six months.

Questionnaire for patients who did not perform SMBG was similar except a scenario was added to assess the patient's readiness to initiate SMBG and in Part D, different statements were used to assess the patient's perception and attitude towards SMBG.

Dependent Variables
The outcome of interest was the usage of SMBG among the respondents. Patients were classified as self-monitoring if they were current SMBG testers.

Independent Variables
Factors that were identified as being predictive of SMBG were gender, age, race, marital status, level of education and total family income[17,18,19].

Poor health outcomes were affected by body mass index (BMI), systolic and diastolic blood pressure, HbA1c, fasting blood glucose level, diabetes co-morbidities and complications.

Ethical Approval
This study was approved by the Research and Ethics Committee, International Medical University, Malaysia

Statistical analysis
The number of subjects of the study was 556. However 170 subjects were included in the statistical analysis, 85 patients who were not self-monitoring were taken at random and compared with 85 patients who were self-monitoring. For simplicity of analyses, the responses to questions in Part C and D of the questionnaires were collapsed into three response categories: Agree, Neutral and Disagree.

Values are given as means and percentages. A logistic regression model was built to identify predictors of SMBG use among the investigated. Dependent outcome was the likelihood of SMBG. We entered all variables that we believe are relevant to SMBG in this population or because there is strong evidence for their influence on SMBG from the literature (socio-economic status, perception towards general health and diabetes, and clinical status). $P < 0.05$ was considered statistically significant. Logistic regression with calculation of odds ratio ($p<0.05$, 95% CI) was performed in SPSS version 14.0

RESULTS

Characteristics of the sample
Five-hundred and sixty-nine Type 2 diabetic patients were recruited but three declined to participate due to other commitments. The response rate was 99.5%. Of the 566 participants, only 85 (15.3%) performed SMBG. An equal number (85) of respondents were randomly selected from the

non-SMBG testers for purposes of analysis. Hence, a total of 170 participants were analysed (Table I). Ethnic distribution in the study sample reflects the typical clinic attendances at these two government clinics.

Mean age of the participants was 54.7 years (SD =10.9). Mean age of onset of diabetes was 46.5 years (SD =10.7) and the mean duration of diabetes was 8.2 years (SD = 7.4).

Sixty (35.3%) patients had HbA1c results recorded in their diabetes database for the last six months of the study period. Mean HbA1c was 8.4% (SD =1.97); mean systolic blood pressure (BP) was 134.9 mmHg (SD =17.8); mean diastolic BP was 81.5 mmHg (SD =8.7); mean body mass index (BMI) was 27.6 kg/m^2 (SD =4.6) and mean FBS was 8.6 mmol/L (SD =3.2).

Perception and attitude towards general health and diabetes
Regarding perceived general health and diabetes, about a quarter of the respondents stated that they were inadequately informed about their health and were not confident to manage their diabetes. 79.4% of the respondents needed further help and information regarding diabetes. Slightly more than a third of the patients believed that diabetes could be cured by taking medication. Half of the patients gave history of defaulting on their diabetes medications. Although three quarter of the patients knew that regular exercise can improve blood glucose control, only a third regularly exercised.

SMBG practices
Mean duration of performing SMBG was 2.9 years (SD.=2.5). Fourteen (16.4%) patients were monitoring at least once per day; 40 (47.1%) monitored more than once per week and 31 (36.5%) monitored less than once per week. Fifty-two (61.2%) patients recorded their SMBG results but only 28 (32.9%) showed their SMBG results to their doctors. Twenty-seven (31.8%) altered their treatment based on their SMBG results. Fifty-five (64.7%) performed SMBG after eight hours of fasting, 32 (37.6%) before main meals and 26 (30.6%) after main meals. Eleven (12.9%) participants performed SMBG when having hypoglycaemic symptoms and 7 (8.2%) when sick. Only 9% of SMBG performers find the task difficult and 13% experienced moderate to severe pain.

Predictors of SMBG practice
The higher patient's level of education; higher total family income; longer duration of diabetes; and be on treatment regime which include insulin were significant independent predictors of SMBG practice (p= 0.024 [CI 1.29 – 35.3]; p= 0.04 [CI 1.26 – 4.79]; p= 0.00 [CI 2.22 – 7.29]; and p= 0.00 [CI 2.05 – 9.24] respectively).

DISCUSSION

This study observed self blood glucose monitoring practices among Type 2 diabetes patients in two government health clinics in Malaysia and has found that SMBG performers were much lower than in Western countries. Malaysian studies have found that SMBG performers ranged from 6.9% among diabetic patients attending private clinics and 21.0% among diabetic patients attending specialist clinics[15].

This study found 15.3% of patients practise SMBG, compared to earlier National Audit on Diabetes conducted in government health clinics in Malaysia where SMBG performers were 10.0%[20].

SMBG performers were more likely to be highly educated, have higher total family income, have diabetes for longer duration, and be on a treatment regime which includes insulin.

The role of SMBG is well established in the management of diabetes[21 22]. This study has found that a quarter of diabetic patients attending these government health clinics lack confidence in managing their condition due to poor

Table I: Socio-demographic distribution and self-monitoring of blood glucose

Characteristics	Self-monitoring blood glucose	
	Yes n (%)	No n (%)
Gender		
Female	46 (27.1)	46 (27.1)
Male	39 (22.9)	39 (22.9)
Ethnic Group		
Malays	60 (35.3)	56 (32.9)
Chinese	6 (3.5)	4 (2.3)
Indians	17 (10.0)	25 (14.7)
Others	2 (1.2)	0 (0)
Marital status		
Married	68 (40.0)	72 (42.4)
Single/widow/widower	17 (10.0)	13 (7.6)
Education level		
No formal education	2 (1.2)	5 (3.0)
Primary school	21 (12.3)	29 (17.1)
Secondary school	39 (22.9)	43 (25.3)
Tertiary education	23 (13.5)	8 (4.7)
Total family income		
< RM1000	20 (11.8)	41 (24.1)
RM1001-2000	36 (21.2)	25 (14.7)
RM2001-3000	14 (8.2)	8 (4.7)
> RM3001	15 (8.8)	11 (6.5)

understanding of the illness and the majority needs more help and information. This finding is hardly surprising since only a third of patients received diabetes education. Low SMBG usage may be due to inadequate counselling 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, exercise to achieve specific glycaemic 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[21].

A critical step in achieving optimal blood glucose monitoring behavioural goals is identifying and resolving barriers to blood glucose monitoring.

A comprehensive diabetes management plan is essential in achieving good glycaemic control through SMBG[23,24,25]. 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 recommends glucose monitoring depending on glucose level, glycaemic goal and mode of treatment[3]. This study observed that the majority of patients tested their fasting blood glucose but postprandial blood glucose was tested in only a third of patients. Postprandial blood glucose level is important because it significantly increases the risk of cardiovascular disease and death[26].

A longitudinal 12-month study found that easier availability (fully subsidised) of self-monitoring supplies increased frequency of use and improved glycaemic control[27]. Regular home monitoring is being encouraged by government subsidies to purchase glucose meters and test strips in developed countries like Australia, Sweden and USA[7,28]. Reducing the financial burden of patients can increase self-monitoring, thus resulting in better glycaemic control and reduced complications. Hence it is recommended that the Malaysian government provide subsidies to diabetic patients to purchase these vital monitoring tools.

This study found that slightly more than a third of the patients believed that diabetes could be cured by taking medication. Half of the patients defaulted on their diabetes medications. Although three quarters of the patients knew that regular exercise can improve blood glucose control, only a third regularly exercised. A comprehensive strategy is required to remove misconceptions, improve drug compliance, to transform knowledge to action and provide/improve existing facilities for health education and health promotion. Paramedics play an important role to educate the patients since in Malaysia there is still inadequate credentialed Diabetes Educators compared to developed countries.

Study limitation

Self-report on regularity of SMBG may not reflect actual performance, the number of test strips dispensed are likely to be more accurate[29]. However test strip counting could not be done as the patients purchased their test strips from various sources.

CONCLUSIONS

Assessment of blood glucose control is a critical component of diabetes treatment and management. SMBG provide real-time measurement of glycaemic status and could detect hypoglycaemic excursions – yet SMBG is not widely used in urban government clinics in our country. This study showed that only 15.3% patients were monitoring their blood glucose. Healthcare professionals and patients must work together to encourage SMBG usage.

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