

Knowledge and practice of self home monitoring of blood glucose

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Original Article

ABSTRACT

Objectives: Both glycosylated haemoglobin and self-monitoring of blood glucose (SMBG) are necessary for optimal monitoring of glycaemic control in patients with diabetes mellitus. There is scanty information regarding the knowledge and practice of SMBG in Nigeria. The purpose of the study was to determine the knowledge and practice of SMBG, and its relationship with patients' demographic characteristics

Methods: A cross-sectional survey was conducted among patients attending the endocrine clinic of Ekiti State University Teaching Hospital, Ado-Ekiti. With the aid of interviewer administered questionnaire, demographic and other information on awareness of SMBG, ownership of glucometer, and practice of SMBG were obtained. The data was analysed with Statistical Package for Social Sciences (SPSS) version 16.

Results: One hundred and four patients comprising 29 males (27.9%) and 75 females (72.1%) were studied with a mean age of 59.6 ± 13.7 years. Twenty two (21.2%) subjects had no formal education, while 38 (36.5%), 16 (15.4%), 28(26.9%) subjects had primary, secondary and tertiary education respectively. Sixty seven patients (64.4%) were aware of SMBG. Out of these, only 19 subjects (18.3%) had glucometers. Age and level of education were significantly related to ownership of glucometer ($p < 0.01$), while income, gender, marital status and duration of diabetes were not. Only level of education predicted ownership of glucometer.

Conclusions: The awareness of SMBG was good but ownership of glucometer was poor. Age and level of education were determinants of ownership of glucometer. Only level of education predicted ownership of glucometer.

Key Words: Diabetes mellitus, blood glucose, self-monitoring, knowledge, practice

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La connaissance et la pratique de l'auto – surveillance à domicile de la glycémie

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Article Original

RÉSUMÉ

Objectif: Les deux hémoglobines glycosylées et l'auto-suive lance de la glycémie (ASG) sont nécessaires pour une surveillance optimale du contrôle glycémique chez les patients présentant un diabète sucre (DS). Il y a l'information insuffisante concernant la connaissance et la pratique de (ASG), et sa relation avec les caractéristiques démographiques des patients au Nigeria. Le but de cette étude était de déterminer la connaissance et la pratique de ASG, et sa relation avec les caractéristiques démographiques des patients.

Méthode: Une enquête transversale a été menée auprès de patients, qui fréquentent la Clinique endocrine de l' état d' Ekiti, Hôpital d'Enseignement de l'Université, Ado-Ekiti Avec l'aide d'un interviewer questionnaire administré, des données démographiques et d' autres sur la sensibilisation de ASG, possession de glucomètre et la pratique d' ASG ont été obtenus. Les données ont été analysées avec le paquet statistique pour les sciences sociales (PSSS) la version.

Résultats: 104 patients comprenant 29 hommes (27.9%) et 75 femmes (72.1%) ont été étudiés avec un âge moyen de 59.6 ± 13.7 ans 22 (21.2%) peuples n'avaient pas l'éducation formelle, alors que 38 (36.5%), 16 (15.4%), 28 (26.9%) peuples avaient l'éducation primaire, secondaire et tertiaire respectivement 67 patients (64.4%) étaient au courant de ASG. Parmi ceux-ci, seulement 19 (18.3%) peuples avaient glucomètre. Âge et niveau d'éducation étaient significativement liés à propriété de glucomètre ($P < 0.01$), alors que revenue, sexe, l'état matrimonial et la durée de diabète n'étaient pas seulement le niveau de scolarité qui prédit possession de glucomètre.

Conclusion: La connaissance de ASG était bon mais la possession de glucomètre n'était pas encouragée l'âge et le niveau de l'éducation étaient des déterminants de la propriété/possession de glucomètre. Seul le nucaux de l'éducation prédit la possession de glucomètre.

Mots Clés: Diabète sucre, la glycémie, auto – surveillance, connaissance, la pratique.

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INTRODUCTION

Many studies have established that tight glycaemic control resulted in a significant reduction in chronic complications of diabetes mellitus. Among patients with type 1 diabetes mellitus, it has been shown that achievement of near normal blood glucose resulted in delay of the onset and reduction in the progression of microvascular complications(1). Similarly, the United Kingdom Prospective Diabetes Study (UKPDS) among subjects with Type 2 diabetes mellitus showed that each 1% reduction in glycosylated haemoglobin (HbA1C) was associated with reduction in microvascular complications (2).

Glycosylated haemoglobin remains the gold standard for assessing long-term glycaemic control. Nevertheless, it does not provide information on the moment by moment variation in plasma glucose. Unlike glycosylated haemoglobin (HbA1C), information provided by the use of glucose metres helps to differentiate pre-prandial and postprandial hyperglycaemia. It also helps to detect hypoglycaemia, and provide immediate feedback about the effect of meal, exercise, and drugs on glycaemic control (3). Results of SMBG enable patients to appropriately adjust their diet, diabetic medications and physical activity. In addition, it allows physicians to give patients the appropriate treatment advice, especially when there is an occurrence of asymptomatic hyperglycaemia or hypoglycaemia. Both HbA1c and SMBG are therefore necessary for optimal monitoring of glycaemic control in patients with DM.

There is scanty information regarding the knowledge and practice of SMBG in Nigeria, necessitating this study

METHODOLOGY

A cross-sectional survey was conducted between September 2010 and July 2011 on 107 patients attending the endocrine clinic of Ekiti State University Teaching Hospital. Informed consent was obtained from the

participants. Patients with both Type 1 and Type 2 diabetes mellitus were studied. Three patients were excluded due to lack of up to date data, occasioned by irregular clinic attendance.

With the aid of interviewer administered structured questionnaire, demographic and other information on awareness of SMBG and source of information, ownership of glucometer, practice and frequency of SMBG as well as utilisation of results obtained from the glucometer were obtained. Information was also obtained on the antihyperglycaemic agents and level of glycaemic control. Hospital records of the patients were cross-checked to ascertain the correctness of the information given and to document the average fasting plasma glucose in the previous 3 clinic visits. Good glycaemic control was defined as average fasting plasma glucose <7 mmol/L in three most current consecutive visits.

The data was analysed with Statistical Package for Social Sciences (SPSS) version 16 (SPSS, Chicago, Illinois). Accuracy of data was ensured by random checks for errors and outliers. Continuous variables were expressed as mean (standard deviation), while categorical variables were expressed as frequency (percentages). The Chi-Square Test or Fisher's Exact Test was used to determine the relationship between the demographic characteristic and patients' awareness and ownership of glucometer, as well as the relationship between ownership of glucometer and short term glycaemic control. Predictors of ownership of glucometer were determined by multivariate logistic regression model. Variables in the model included level of education (tertiary vs non-tertiary), monthly income (<N15, 000.00 vs >N15, 000.00), age (<60years {young} vs >60years {old) and gender (male vs female). Results were considered statistically significant if the p-value was less than 0.05.

RESULTS

Table 1 shows the socio-demographic and clinical characteristics of the study participants. One hundred and four patients comprising 29 males (27.9%) and 75 females (72.1%) were studied. Seventy five (81.7%) of the respondents were aged fifty years and above. Most (97.1%) of the study participants had type 2 DM. Eighty four (80.8%) of the subjects were on oral antidiabetic drug only, 10 (9.6%) people were on insulin only, 8 (7.7%) were on both oral agents and insulin while the remaining 2 (1.9%) were being managed with lifestyle modification only. Twenty two (21.2%) subjects had no formal education, while 38 (36.5%), 16 (15.4%), 28(26.9%) subjects had primary, secondary and tertiary education respectively. Most (67.3%) of the respondents earn not more than N15, 000.00 per month.

Sixty seven patients representing 64.4% of the respondents were aware of SMBG (Table 2). Fifty one (81.0%) out of the 67 subjects who knew about SMBG got the information in the hospital, while 11 (17.5%) and 1(1.6%) of the respondents got to know via friends/relatives and mass media respectively. Out of these, only 19 patients (18.3% of all the subjects studied or 28.4% of those who were aware of SMBG) had a glucometer. Most of the respondents who had glucose meter bought it in Nigeria: 7 (36.8%) by themselves and 7 (36.8%) by their children, while 5(26.3%) subjects got it through their children outside the country. Eight (44.4%) out of 18 patients checked their blood glucose with glucometer 2/week while 55.6% checked their blood glucose 3-5/week (Table 3). All the respondents who checked their blood glucose normally do so before breakfast. Half of those who checked their blood glucose stored the result in the glucometer memory, while the remaining 50% recorded the result in a diary. Most (89.5%) of those who checked their blood glucose act on high glucose

readings while 73.7% act on low glucose readings.

Table 4 shows that age and level of education were significantly associated with ownership of glucometer, while the other variables studied were not. Only level of education predicted ownership of glucometer (Table 5). There was no relationship between ownership of glucometer and short term glycaemic control (Fig. 1).

DISCUSSIONS

Awareness and Practice of SMBG

The awareness of SMBG was 64.4% in this study. This is better than 22.1% in a survey by Adisa *et al.* in South-western Nigeria (4). The improvement over the earlier study may be due to general improvement in awareness of SMBG over more than a decade interval between this study and theirs. Furthermore, many brands of glucometer are now available in Nigeria.

A study by Eregie *et al.* (5) revealed that only 11% of patients study practiced SMBG unlike in our study where 18.3% of the participants practiced SMBG. The difference may be to improved awareness about SMBG. A study by Unachukwu *et al.* (6) revealed that only 27% of the patients had glucometer, though not all of them monitor their blood glucose. However, those who practiced SMBG in our study were lower than testers in study conducted in countries with advanced medicare: most participants in Malaysia (7); 64.6% in a Chinese study (8) and 62.25 -75% in some studies conducted in the US (9, 10).

All testers in our study performed their test pre-breakfast similar to findings by Oki *et al.* (9) that 93% of testers in their study performed their test pre-meal. Also in a Malaysian study (7), 99.6% of the participants perform their test either in the fasting state, post meal or both. How often SMBG is done varies, depending on factors such as drug regimen and degree of glycaemic control. The cost of glucose meter

and strips may also influence practice of SMBG. Most participants in our study perform SMBG between 3-5times/week. This is less than the earlier recommended daily blood glucose check for patients with type 2 DM, by the American Diabetes Association, (11) and cost of glucometer strips may be responsible for this. Although our study did not find a significant association between income and ownership of glucometer, possessing a glucometer does not equate regular testing. Indeed, other workers found that cost of supplies influenced frequency of SMBG (7, 8, 9, 10). Due to lack of evidence, the most recent ADA guideline on SMBG in patients with type 2 DM on non-intensive regimen did not specify when or how often SMBG should be done (12).

Half of the patients who tested their blood glucose recorded the result in a diary while the remaining half left it in the glucometer memory. In the Malaysian study (7), 68.7% of the participants kept a record of every measurement. Recording and acting on the result of SMBG is the goal of self-testing, and most participants in our study reported that they acted on the results of SMBG. The actions taken depended on whether the blood glucose was low or high. When recommending SMBG, patients should be taught on the proper use of glucose metre, and how to utilize the result to modify their medications, meals and physical activity therapy (12).

Impact of SMBG on Short Term Glycaemic Control

Glycaemic control in this study, taken as the mean fasting blood sugar in three visits, was not different between those who practised SMBG and those who did not. The design of this study and non-availability of HbA1c may not allow us to accurately determine the impact of SMBG on glycaemic control. Moreover, most of the participants from our study were non-insulin treated

T2DM patients. Nevertheless, findings from previous studies on the impact of SMBG on glycaemic control were not consistent. Whereas some studies (13, 14, 15) reported improved long term glycaemic control with SMBG, others (9, 16, 17) did not. In view of the above inconsistencies, especially among non-insulin treated T2DM, the International Diabetes Federation (IDF) noted that there is need for more evidence on the usefulness of SMBG (18).

Factors Associated with Ownership of Glucometer

Studies on ownership of glucose meters are scanty. Most studies evaluated the practice of SMBG rather than ownership of glucose meters because they were available as part of the health insurance, unlike in Nigeria where it is usually purchased by the patient or their relations. Among all the participants, older age, higher income and higher educational level were significantly associated with ownership of glucometer. However, analysis of the 67 patients who knew about SMBG revealed that only age and level of education were significantly associated with ownership of glucometer, while income was not. The lack of association between income and ownership of glucometer may be due to the fact that only 36.8% of those who had glucometer bought it by themselves whereas most of them got it through their children, either in Nigeria or overseas. Thus, income per month may not be a true reflection of the purchasing power of the participants. Other workers found that scarce resources, level of education and age of patients were associated with practice of SMBG (6, 8, 10). In Nigeria, scarce resources may prevent patients from buying glucometer strips, even though they have meters. Previous study revealed that patients still spend significant amount despite health insurance (10). Other factors found to influence SMBG practice by other workers include gender, longer DM duration, ethnic background, smoking and alcohol (8, 10).

In our study, multivariate logistic regression revealed that only educational level predicted the ownership of glucometer, while other variables did not. A study by Huri et al (7) also revealed that level of education was the major determinant of patients' attitude to diabetes care (including SMBG knowledge) and outcome.

Limitations

This study has some limitations. The skills and techniques of patients in performing glucose checks were not assessed. Correct technical skills in performing SMBG may determine the accuracy and usefulness of the value obtained, and technical errors tend to lower the blood glucose value. Secondly, the quality of life of the patients studied was not evaluated. The design of this study and non-availability of HbA1c may not allow us to accurately determine the impact of SMBG on glycaemic control. Glycosylated haemoglobin was not performed because its assay was not available as at the time the study was conducted. A normal fasting blood sugar does not necessarily translate to good long term glycaemic control.

CONCLUSION

The study showed that age and level of education were significantly related to ownership of glucometer while income, gender, marital status and duration of diabetes were not. Only level of education predicted ownership of glucometer. There was no relationship between ownership of glucometer and short term glycaemic control.

Conflict of interest: There is no conflict of interest declared.

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Table 1: Socio-demographic characteristic of the participants

VARIABLE (n=104)	FREQUENCY	PERCENTAGE
AGE (yrs)		
20-29	2	1.9
30-39	7	6.7
40-49	10	9.6
50-59	29	27.9
60-69	28	26.9
≥70	28	26.9
SEX		
Male	29	27.9
Female	75	72.1
EDUCATIONAL LEVEL		
None	22	21.2
Primary	38	36.5
Secondary	16	15.4
Tertiary	28	26.9
INCOME (per month)		
<N7500	28	26.9
N7500 -N15000	42	40.4
>N15000- N50000	27	26.0
>N50000	7	6.7
DM TYPE		
Type 1	3	2.9
Type 2	101	97.1

** The mean age of the respondents was 59.63±13.7 years.

Table 2: Knowledge of SMBG and ownership of glucose meter

VARIABLE	FREQUENCY	PERCENTAGE (%)
AWARENESS (n=104)		
Aware	67	64.4
Not aware	37	35.6
INFORMATION SOURCE (n=63)		
Mass media	1	1.6
Friends/relatives	11	17.5
Hospital	51	81.0
INFORMATION SOURCE IN HOSPITAL (n=57)		
Nurse	21	36.8
Doctor	32	56.1
Lab. Scientist	1	1.8
Others	3	5.3
OWNERSHIP OF GLUCOSE METER (n=104)		
Yes	19	18.3
No	85	81.7
HOW GLUCOMETER WAS OBTAINED (n=19)		
Self-bought	7	36.8
Children (in Nigeria)	7	36.8
Children (overseas)	5	26.3

Table 3: Practice of self monitoring of blood glucose

VARIABLE	FREQUENCY	PERCENTAGE
Frequency of BG testing/week		
2	8	44.4
3-5	10	55.6
>5	0	0
Storage of BG result		
Glucometer memory	9	50
Diary	9	50
Action if BG high		
YES	17	89.5
NO	2	10.5
Action if BG low		
YES	14	73.7
NO	5	26.3

NB: all the respondents check their BG pre-breakfast

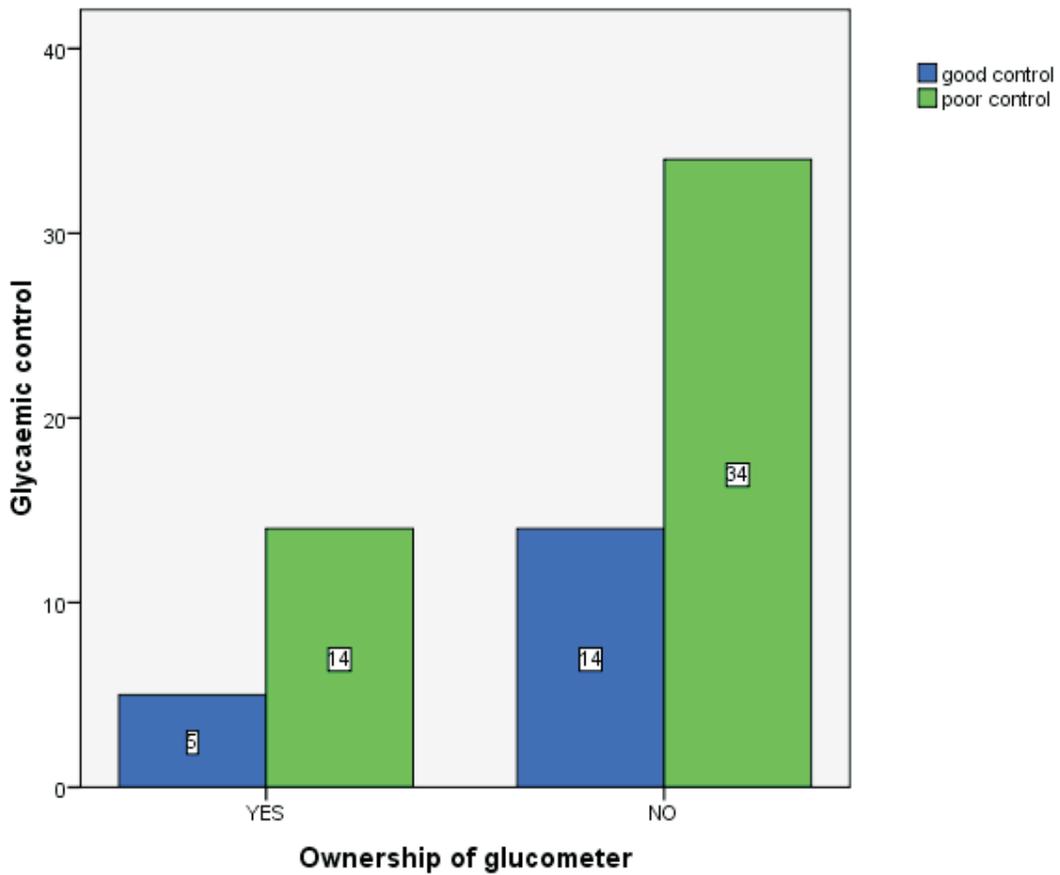
Table 4: Relationship between ownership of glucometer and socio - demographic and clinical characteristics of the participants

ATTRIBUTES (n=67)	CHI-SQUARE	SIGNIFICANT (p value)
Age	11.4	**
Income level	7.39	0.06
Education level	9.6	0.02**
Marital Status	0.69	0.71
Gender	0.004	0.95
Duration of diabetes	0.95	0.62

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Table 5: Logistic regression showing predictors of ownership of glucometer

Predictor Variable	Categories of Variable	p-value	OR	CI (95%)	
				L	U
Sex	Male (ref)	0.296	2.114	0.519	8.616
Income	Low (ref)	0.567	1.455	0.404	5.245
Educational Level	Tertiary (ref)	0.006	0.155	0.041	0.586
Age	Young (ref)	0.614	1.391	0.386	5.015



$X^2=0.054$ $p=0.82$

Figure. 1: Relationship between ownership of glucometer and short term glycaemic control (good glycaemic control was defined as average fasting plasma glucose <7 mmol/L in three most current consecutive visits).