

Original Research Article

# The Prevalence of the Practice of Self-monitoring of Blood Glucose and Association with Glycemic Control: A Cross-sectional Study in a Tertiary Hospital in North Central Nigeria

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**Abstract:** **Background:** Self-monitoring of blood glucose (SMBG) is as an important aspect of the management of diabetes mellitus. There have been different studies with different SMBG prevalence and varied degrees of association between SMBG and glycaemic control. This study is therefore aimed at determining the prevalence of SMBG practice and the degree of association between SMBG and glycaemic control among persons with diabetes in a North Central Nigerian population. **Methods:** This was a cross-sectional study carried out at the Endocrinology clinic of the University of Abuja Teaching Hospital. The nature of the study was explained to the participants before informed consent was duly obtained from them. One hundred and forty five (145) participants were consecutively enrolled from the clinic. Data was collected using questionnaires administered to the participants by trained assistants. Analysis of data was conducted using IBM SPSS version 21 (IBM SPSS Co. LTD., New York, USA; June 6, 2012). Results were expressed as means and standard deviation (SD) at 95% confidence interval (CI). The significance level used was  $p < 0.05$ . **Results:** The mean fasting blood glucose (FBG) of persons who practised SMBG was lower than that of those who did not (7.2 vs 9.2 mmol/L,  $p=0.001$ ). The range of FBG was also lower for those that practised SMBG compared to persons that did not practise (3.6-14.4 vs 4.02-15.0 mmol/L,  $p=0.001$ ). Similarly, those who practised SMBG had a lower mean 2-hour postprandial glucose (2HrPP) compared to those who did not practise SMBG (9.6 vs 12.2 mmol/L,  $p=0.004$ ). Likewise, the 2HrPP range was lower among those that indulge in SMBG practice than those who did not (3.0-16.8 vs 5.8-20 mmol/L,  $p=0.004$ ). **Conclusion:** Persons who practised SMBG had better glycaemic control than those who don't. Most of them own their glucometers and the majority checked their blood glucose daily followed by those that checked thrice weekly.

**Keywords:** Fasting blood glucose, Glycaemic control, 2-Hour postprandial glucose, Self-monitoring of blood glucose.

## INTRODUCTION

Self-monitoring of blood glucose (SMBG) is recently being expounded as an essential part of the management of diabetes mellitus (DM). There are however various studies with varied prevalence of the practice of SMBG as well as different odds ratio, high and low, of SMBG resulting in good glycaemic control.

Lu *et al.*, [1] reported a high prevalence of SMBG practice and demonstrated that SMBG improved glycaemic control in a Taiwanese population.

This is in keeping with findings by Wang *et al.*, [2] and Nguyen *et al.*, [3] in studies involving some persons with diabetes of Chinese and Vietnamese origin respectively. Systematic reviews and meta-analyses have also shown the impact of SMBG as part of diabetes self management practices [4, 5].

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Concerning some populations in Africa, Ng'ang'a *et al.*, [6], Bizuayehu *et al.*, [7], and Oluma *et al.*, [8] showed high prevalence of SMBG and further demonstrated the positive impact of SMBG in blood glucose control in Rwanda, Ethiopia, and Western Ethiopia respectively. In the same vein, other African studies have shown that the prevalence of SMBG practice alone or as part of diabetes self management practices was high ranging from 60% to 80%. The practice of SMBG in these studies resulted in the reduction of glycated haemoglobin (HbA1c) levels [8-12].

Concerning similar studies conducted in Nigeria, Kolawole *et al.*, [13] submitted that various hindrances to SMBG led to the non-achievement of glycaemic targets. In the same vein, Okoye *et al.*, [14], Ojewale *et al.*, [15], Sowunmi *et al.*, [16] and Olusegun *et al.*, [17] though reported generally low prevalence of SMBG practice, analysed that the practice of SMBG alone or along with other diabetes self management practices was associated with good glycaemic control in different regions of Nigeria.

These studies portend varied prevalence of the practice of SMBG as well as different odds ratio, high and low, of SMBG association with glycaemic control. This study is therefore aimed at determining the prevalence of the practice of SMBG and the relationship between SMBG and glycaemic control among persons with diabetes in a North Central Nigerian population.

## MATERIALS AND METHODS

This was a cross-sectional study carried out at the Endocrinology clinic of the University of Abuja Teaching Hospital. The nature of the study was explained to the participants before informed consent was duly obtained from them. One hundred and forty five (145) participants were consecutively enrolled from the clinic. Data was collected using questionnaires administered to the participants by trained assistants. The data collected include personal details, duration of DM, type of antidiabetic medications, and education levels. Additional data obtained include whether they own a glucometer, previous education on SMBG, and whether they are involved in blood glucose record keeping.

Fasting blood glucose (FBG) and 2-hour postprandial glucose (2HrPP) were recorded over a period of three (3) days. Respondents were asked to take normal diet without restriction of carbohydrate 72 hours prior to blood glucose test. They then fasted overnight for 8 to 12 hours before the test day. At 8:00 am of the test day, blood sample for FBG was drawn from the antecubital vein of each respondent. Each respondent was then asked to ingest within five (5) minutes, 75g anhydrous glucose dissolved in 250ml of water. Two hours after the ingestion of oral glucose, venous blood was drawn again from the antecubital vein of each respondent. The samples were sent for plasma glucose determination using the glucose oxidase method.

Analysis of data was conducted using IBM SPSS version 21 (IBM SPSS Co. LTD., New York, USA; June 6, 2012). Results were expressed as means and standard deviation (SD) at 95% confidence interval (CI). Student 't' test was used to compare continuous variables while chi square was used to compare categorical variables. The significance level used was  $p < 0.05$ .

## RESULTS

The prevalence of the practice of SMBG was 66.9%. The mean fasting blood glucose (FBG) of persons who practised SMBG was lower than that of those who did not (7.2 vs 9.2 mmol/L,  $p=0.001$ ). The range of FBG was also lower for those that practised SMBG compared to persons that did not practise (3.6-14.4 vs 4.02-15.0 mmol/L,  $p=0.001$ ). Similarly, those who practised SMBG had a lower mean 2-hour postprandial glucose (2HrPP) compared to those who did not practise SMBG (9.6 vs 12.2 mmol/L,  $p=0.004$ ). Likewise, the 2HrPP range was lower among those that indulged in SMBG practice than those who did not (3.0-16.8 vs 5.8-20 mmol/L,  $p=0.004$ ) (Table 1).

**Table 1: Mean age, duration of DM, how long you have owned glucometer, FBS, 2HPP according to SMBG**

Self-monitoring of blood sugar	values	Age (years)	Duration of DM (years)	How long have you owned a glucometer (years)	Average of 3 days monitoring of FBS	Average of 3 days monitoring of 2HPP
No ( $n=48$ , 33.1%)	Mean	51.8	5.9	0.47	9.0	12.2
	N	48	48	18	31	28
	SD	11.8	4.7	0.97	3.3	4.2
	Min	20	.30	0.00	4.02	5.8
	Max	81	19.0	3.00	15.0	20.0
Yes ( $n=97$ , 66.9%)	Mean	54.2	8.5	2.9	7.2	9.6
	N	96	95	97	83	64
	SD	10.8	6.5	3.3	2.2	3.8
	Min	22	.30	.08	3.60	3.0
	Max	80	30.0	22.00	14.40	16.8

Self-monitoring of blood sugar	values	Age (years)	Duration of DM (years)	How long have you owned a glucometer (years)	Average of 3 days monitoring of FBS	Average of 3 days monitoring of 2HPP
Total (n = 145)	Mean	53.4	7.6	2.5	7.7	10.4
	N	144	143	115	114	92
	SD	11.2	6.0	3.2	2.7	4.1
	Min	20	0.30	0.00	3.6	3.0
	Max	81	30.00	22.00	15.0	26.8
T test value; P		<b>1.233;</b> <b>0.020**</b>	<b>2.433;</b> <b>0.016**</b>	<b>3.066;</b> <b>0.003***</b>	<b>-3.315;</b> <b>0.001***</b>	<b>-2.948;</b> <b>0.004***</b>

\* - differences not statistically significant P > 0.05  
 \*\* - differences statistically significant P < 0.05  
 \*\*\* - differences statistically significant P < 0.01

Graphically, the average FBS monitored over 3 days was lower among persons who practised SMBG compared to those who did not practise SMBG (Figure 1).



Figure 1: A Plot of Self-monitoring of Blood Glucose against Average of 3 Days Monitoring of FBS

Logistic regression showed that significant determinants of SMBG practice include age (odds ratio [OR]=1.07, 95% Confidence Interval [CI]=1.01-1.15, p=0.020); SMBG education (OR 9.18, CI 3.52-23.97, p<0.0001); duration of diabetes (OR 1.08, CI 1.01-1.16, p=0.019); type of treatment (OR 1.91, CI 1.11-3.38, p=0.019); and owning a glucometer (OR 4.22, CI 1.64-10.84, p=0.003).

Table 2: Logistic Regression showing relationship between SMBG and other variables

Variable	B	S. E	P value	Exp B (OR)	95% CI
Age	0.070	0.020	0.020**	1.070	1.008- 1.153
Education on SMBG	2.217	0.490	<0.0001***	9.184	3.518 -23.974
Duration of diabetes	0.079	0.034	0.019**	1.083	1.013-1.157
Type of treatment	0.663	0.283	0.019**	1.914	1.114-3.383
Own a Glucometer	1.439	0.482	0.003***	4.216	1.640-10.841

\* - differences not statistically significant P > 0.05  
 \*\* - differences statistically significant P < 0.05  
 \*\*\* - differences statistically significant P < 0.01

B- Logistic regression value; S.E- standard error; CI – confidence interval

Among those that practise SMBG, the prevalence of glucometer use was highest (35.1%) among respondents that use glucometer daily, followed by those that use glucometer thrice weekly (27.8%) (Table 3).

**Table 3: Frequency of use of glucometer among those who monitored their blood sugar and those who did not**

	Own a glucometer		Total N (%)
	Self-monitoring of blood sugar No N (%)	Self-monitoring of blood sugar Yes N (%)	
<i>Daily</i>	1 (20.0)	34 (35.1)	35 (34.3)
<i>Once a week</i>	1 (20.0)	6 (6.2)	7 (6.9)
<i>Twice/week</i>	0 (0.0)	3 (3.1)	3 (2.9)
<i>Three times/week</i>	3 (60.0)	27 (27.8)	30 (29.4)
<i>Five times/week</i>	0 (0.0)	8 (8.2)	8 (7.8)
<i>Occasionally</i>	0 (0.0)	17 (17.5)	17 (16.7)
<i>Never</i>	0 (0.0)	2 (2.1)	2 (2.0)
<b>Total</b>	<b>5 (100.0)</b>	<b>97 (100.0)</b>	<b>102 (100.0)</b>

## DISCUSSION

This study was aimed at determining the prevalence of SMBG practice as well as the association between SMBG practice and glycaemic control in a North Central population in Nigeria. The prevalence of the practice of SMBG was 66.9% which was moderately high and at par with the reports from some of the studies in some African countries, Asia and Western climes [1-10]. However, the prevalence of the practice of SMBG in our study was higher than the prevalence in some studies in Nigeria [13-17]. The relatively higher prevalence of SMBG practice in this study may be due to the fact that the respondents attend diabetes clinic in the tertiary hospital where SMBG knowledge is readily acquired during routine clinic diabetes education sessions.

In terms of the frequency of SMBG, the majority of the respondents checked their blood glucose once daily, followed by those that checked thrice weekly. This is in keeping with the frequency of SMBG reported from several studies [4-8]. Our study showed that persons who practised SMBG had significantly lower fasting blood glucose (FBG) and 2-hour postprandial glucose (2HrPP) compared to those who don't practise SMBG. This is in keeping with the reports by several studies [2-9]. Some of the studies have also shown that SMBG was a part of several diabetes self management practices that resulted in the improvement in glycaemic control [11-17]. In line with this, our study has also shown independent associations between SMBG and other diabetes self management practices e.g., diary keeping, and owning a glucometer. This therefore means that SMBG can independently and in association with other factors, result in glycaemic control.

One of the enhancer of SMBG in our study is insulin therapy which encouraged the respondents to check their blood glucose regularly. This also align with several studies showing association between insulin therapy and higher frequency of SMBG. One may argue that insulin therapy resulted in good glycaemic control. However, other studies have shown that persons on insulin who do not practice SMBG tend to have poor glycaemic control, or erratic blood glucose control ranging from hypoglycaemia to hyperglycemia. This may be explained by erratic insulin use due to fear for hypoglycaemia since there is lack of frequent blood glucose checks. This further strengthens the importance of SMBG in independently influencing a better glycaemic control.

Persons who owned glucometers for longer period were found to have higher frequency of blood glucose checks resulting in better glycaemic control. This is because owning a glucometer encourages the practice of SMBG especially for those who have been trained on SMBG alongside owning glucometers. Our analysis has shown owning a glucometer and SMBG education as independent predictors of SMBG. This is in keeping with the reports from some studies [7-11].

Advanced age was associated with better glycaemic control in our study. This may be related to the fact that older people may be more experienced and responsible in the practice of SMBG. Advanced age was noted to be a determinant of SMBG in our study. Therefore, advanced age may have positively influenced glycaemic control via a better practice of SMBG. This aligns with the report of some studies [6-10]. In a likewise manner, longer duration of diabetes was associated with better glycaemic control in our study. Our study has also shown an association between longer duration of diabetes and SMBG practice. This may be due to the fear for complications or worsening of complications that come with longer duration of diabetes. This is in tandem with observations from several studies [1-6, 9-13]. Therefore, the link between longer duration of DM and good glycaemic control may also be related in part to good SMBG practice among persons with longer duration of DM.

The limitation of this study include the fact that it is a cross-sectional study, therefore absolute benefit of an intervention can not be ascertained. In addition, larger sample size would have improved the accuracy of the analysis.

## CONCLUSION

The practice of SMBG was moderately high most likely due to the conduct of the study in a tertiary hospital where SMBG education is readily acquired. Persons who practised SMBG had better glycaemic control than those who do not. Most of the respondents own their glucometers and the majority checked their blood glucose daily followed by those that checked thrice weekly.

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