

Knowledge, Attitude and Practices of Self-Monitoring of Blood Glucose among Diabetic Patients attending NCD Clinic at a Tertiary Care Hospital in Chennai: A Cross-sectional study

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Abstract:

Introduction: Self-monitoring of blood glucose (SMBG) is a pivotal self-care measure in diabetes management, enabling better glycemic control and complication prevention. In India, however, the practice and awareness of SMBG remains limited, and factors influencing its use are insufficiently explored. **Objectives:** To assess the awareness, knowledge, attitude, and practices of self-monitoring of blood glucose and the factors associated with its awareness among type 2 diabetic patients. **Material Methods:** This study included 180 type 2 diabetic patients (≥ 18 years) attending the NCD clinic of a tertiary care hospital in Chennai using consecutive sampling. Socio-demographic and diabetic profile alongside awareness, knowledge, attitude and practices of SMBG were assessed using a pretested semi-structured questionnaire. Data were analyzed in SPSS v21.0, using frequencies/ proportions for categorical variables and exact tests for socio-demographic associations. **Results:** Only 48.9% of participants were aware of SMBG. Among those patients with awareness ($n=88$), healthcare professionals were the main source of information (52.6%), yet 35.9% of aware patients lacked practical knowledge on using a glucometer and 30.8% of them were unaware of the benefits. Also 88.5% ($n=88$) expressed willingness to use glucometers if subsidized. Only 57.9% of aware patients ever used a glucometer. Awareness of SMBG showed significant association with age ($p<0.001$) and education ($p<0.001$). **Conclusion:** The study highlights substantial gaps in knowledge and practice of SMBG among type 2 diabetics, significantly influenced by socio-demographic factors like age and education. Strengthening patient education, clearing misconceptions, and improving access to affordable resources are crucial to enhance diabetes management.

Keywords: Blood Glucose Self-monitoring; Diabetes Mellitus, Type 2

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Introduction:

Diabetes is a chronic metabolic disease characterized by elevated blood glucose levels when the body produces little or no insulin or becomes resistant to insulin.¹ Long-term diabetes can cause damage to the body's tissues and organs, mainly blood vessels and nerves. Globally, around 830 million individuals suffer from diabetes with increasing prevalence in low- and middle-income countries.¹ Effective management of diabetes, especially Type 2 Diabetes, involves many strategies like lifestyle modification, pharmacotherapy and regular monitoring of blood glucose.²

One of the most important components of diabetes self-care and treatment is self-monitoring of blood glucose (SMBG).³ By aiding in the modification of treatment doses, changes in lifestyle, and nutrition, SMBG provides optimal glycemic control and helps prevent hypoglycemia. The goal of SMBG is to measure blood sugar levels over a number of time points so that treatment can be adjusted to provide stable glucose levels.^{4,5} Despite its numerous advantages, adherence to SMBG is very low.⁶ Numerous studies have identified gaps in diabetic patients' knowledge, attitudes, and practices (KAP) about SMBG.⁷ Socio-demographic variables like age, gender, education, occupation and income, play a significant role in the awareness and use of SMBG among diabetic patients.^{8,9,10} The role of healthcare professional is also pivotal in improving the knowledge, attitude and practice of SMBG in diabetic patients by health education and counselling.

Understanding the awareness of SMBG and factors influencing its use is critical in creating effective education and intervention programs.⁴ This study was done to assess the awareness, knowledge, attitude, and practices of self-monitoring of blood glucose and to assess the socio-demographic factors associated with the awareness of SMBG among type 2 diabetic patients. The results will provide a basis for identifying enablers and barriers to SMBG use and for planning of interventions to enhance self-management of diabetes in the community.

Material and Methods:

This hospital-based cross-sectional study was conducted among Type II Diabetes patients visiting the Non-Communicable Disease (NCD) Clinic of a tertiary care center in Chennai. The sample size was calculated based on the primary outcome variable-awareness regarding self-monitoring of blood glucose (SMBG). Based on the findings from a previous study by V. Krishnan et al¹¹, which reported that 29.4% of individuals were aware of SMBG, and considering 7% margin of error, 10% non-response rate, the sample size calculated was 180 using the formula $n = Z^2p(1-p)/d^2$, adjusted for non-response. The study population includes patients aged 18 years or above who are diagnosed with Type 2 Diabetes Mellitus, are on treatment and follow up in the NCD clinic for a minimum duration of six months, are willing and able to understand and respond to the questionnaire in local language. Patients with Type 1 diabetes or gestational diabetes, critically ill, or with severe visual or motor disability, severe cognitive impairment or psychiatric illness which prevents self-monitoring of blood glucose were excluded. Ethical approval was obtained from the Institutional Ethics Committee (02/IEC/GOMC/2022) prior to data collection. The study participants were clearly explained about the study objectives, and written informed consent was obtained from all the participants.

After an extensive literature review and consultation with subject experts, a semi-structured questionnaire was developed in alignment with the study objectives. The questionnaire was pre-tested and refined based on expert feedback. It has two main sections: (i) Socio-Demographic profile, which includes variables such as age, gender, education and total family income. (ii) Assessment of Knowledge, Attitude, and Practice (KAP) of SMBG covering aspects related to self-monitoring of blood glucose, including frequency of testing, awareness of normal blood glucose levels, and reasons for not engaging in self-monitoring.

The participants were recruited from the NCD clinic using consecutive sampling until the target sample size was reached. Data collection was done through face-to-

face interviews using the semi-structured questionnaire. Responses were collected electronically via Google forms. Data analysis was performed using SPSS software version 21.0. Categorical variables were summarized as frequencies and proportions. Fisher's exact test was used to assess association between socio-demographic factors and awareness of self-monitoring of blood glucose.

Results:

Table 1 shows, among the 180 study subjects interviewed, majority of them (48.9%) were in the age group of 50-70 years. Almost 42.8% had education up to higher secondary or diploma. Nearly half of them (50.6%) had monthly income in the range of Rs.10,000 to Rs.30,000 with a mean income of Rs. 25,556 ($\pm 14,364$).

The mean duration of diabetes among study participants is 2.52 years (± 1.16 years). Majority of them ($n=131$, 72.8%) were treated with oral anti diabetic drugs and most patients ($n=61$, 33.9%) preferred monitoring their blood glucose every third month (Table 2).

Figure 1 shows, only 48.9% of the study participants ($n=88$) were aware of self-monitoring of blood glucose, while 51.1% ($n=92$) were unaware.

Among 88 diabetic patients with awareness about SMBG, almost half the participants (52.6%) reported that they acquired knowledge about it through health care professionals. Of these, 56 patients (64.1%) knew how to use a blood glucose meter, while 32 patients (35.9%) did not. Additionally, 61 patients (69.2%) were aware of the benefits of SMBG, while 27 patients (30.8%) were not (Table 3).

Table 1: Socio-demographic profile of the study participants (N =180)

Socio-demographic profile		Frequency (n)	Percentage (%)
Age Group(in years)	<30	17	9.5
	30-50	62	34.4
	50-70	88	48.9
	>70	13	7.2
Gender	Male	92	51.1
	Female	88	48.9
Education	Illiterate	12	6.7
	Up to high school	36	20
	Higher secondary/ Diploma	77	42.8
	Graduate	55	30.5
Monthly income (in Rupees)	<10,000	28	15.6
	10,000 - 30,000	91	50.6
	30,000-50,000	51	28.3
	>50,000	10	5.5

Table 2: Distribution based on Diabetic profile of study participants (N=180)

Diabetic Profile		Frequency(n)	Percentage (%)
Duration of Diabetes(in years)	6 months to <1year	34	18.8
	1 to <3 Years	93	51.9
	3 to <5 Years	34	18.8
	≥ 5 Years	19	10.5
Treatment	OHA	131	72.8
	Insulin	14	7.8
	Both (OHA & Insulin)	35	19.4
Frequency of monitoring blood glucose	Monthly Once	23	12.8
	3 Months Once	61	33.9
	6 Months Once	43	23.9
	Yearly Once	27	15
	Not monitoring until symptomatic	26	14.4

Fig 1: Awareness about self -monitoring of blood glucose in study participants (N=180)

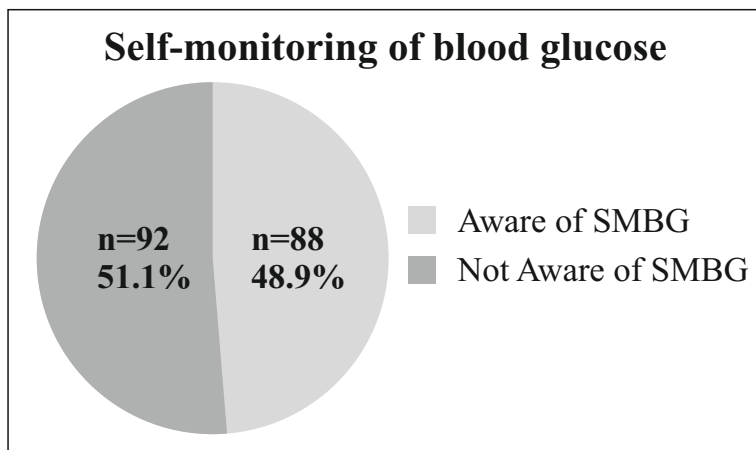


Table 3: Distribution of study participants based on Knowledge about SMBG (n = 88)

Knowledge related to SMBG		Frequency(n)	Percentage (%)
Source of information about SMBG	Healthcare professional	46	52.6
	Family/ Friends	17	19.2
	Media	17	19.2
	Pharmacist	8	9
Knowledge about how to use a glucometer for SMBG	Present	56	64.1
	Absent	32	35.9
Knowledge about benefits of SMBG	Present	61	69.2
	Absent	27	30.8

Table 4: Attitude of study participants towards SMBG (n = 88)

Attitude towards self-monitoring of blood glucose		Frequency (n)	Percentage (%)
Fear of self-pricking	Present	53	60.3
	Absent	35	39.7
Self -monitoring is only for patients on insulin	Yes	39	44.9
	No	49	55.1
Willingness to use a glucometer for SMBG if available at a subsidized cost	Yes	78	88.5
	No	10	11.5

Fig 2: Practice of self-monitoring of blood glucose among study participants (n=88)

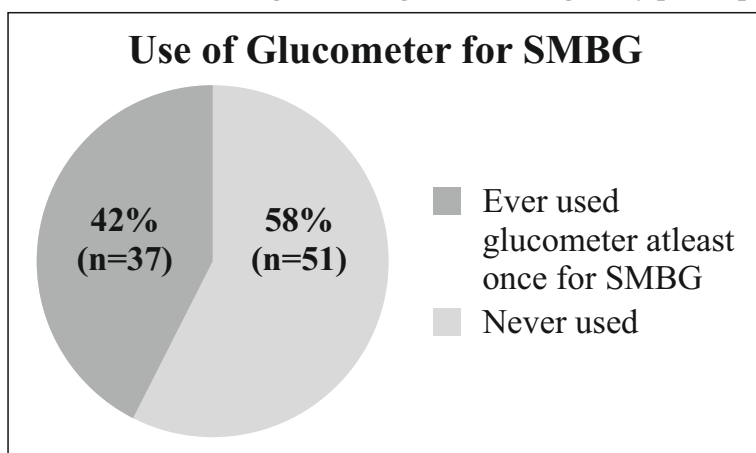


Table 5: Practice of self-monitoring of blood glucose among study participants (n=51)

Practice of self-monitoring of blood glucose		Frequency (n)	Percentage (%)
Reasons for SMBG	Randomly every 3 months to monitor	12	23.5
	As per doctors' advice	15	29.4
	During illness	15	29.4
	During hypoglycemic symptoms	9	17.7
Response to an abnormal blood glucose value in SMBG	Consult a doctor	21	41.2
	Modify the diet	20	39.2
	Self-adjust medication	6	11.8
	No action	4	7.8

Table 6: Association between socio-demographic characteristics and awareness of SMBG among the study participants

Socio-Demographic variables		Awareness of SMBG		P value
		Present(n=88)	Absent(n=92)	
Age (in years)	<30	16 (18.2%)	1 (1.1%)	<0.001*
	30-50	38 (43.2%)	24 (26.1%)	
	50-70	30 (34.1%)	58 (63%)	
	>70	4 (4.5%)	9 (9.8%)	
Gender	Male	46 (52.3%)	46 (50%)	0.768
	Female	42 (47.7%)	46 (50%)	
Education	Illiterate	6 (6.8%)	6 (6.6%)	<0.001*
	Up to primary	9 (10.2%)	27 (29.3%)	
	Up to middle school	25 (28.4%)	52 (56.5%)	
	Graduate	48 (54.6%)	7 (7.6%)	
Monthly income(in Rupees)	<10,000	16 (18.1%)	12 (13%)	0.09
	10,000- 30,000	38 (43.3%)	53 (57.6%)	
	30,000- 50,000	26 (29.5%)	25 (27.2%)	
	>50,000	8 (9.1%)	2 (2.2%)	

Note: Fisher's exact test (*P value ≤ 0.05 is statistically significant)

On questioning about their attitude towards not considering using glucometer on a regular basis for self-monitoring, we found that 53 participants (60.3%) were afraid of self-pricking and 39 participants (44.9%) thought that self-monitoring using glucometer is only for patients on insulin therapy. Majority patients (n=78, 88.5%) expressed a positive attitude on using a blood glucose meter if it's available at subsidized cost (Table 4).

Among the 88 diabetic patients with awareness about SMBG, only 51 (57.9%) patients reported using glucometer at least once in their lifetime (Fig 2).

The common reasons for checking blood glucose were during illness (29.4%), as per doctors' advice when

required (29.4%). Majority patients (41.2%) consult a doctor or modify their diet (39.2%) when abnormal values were reported in the glucometer (Table 5).

Table 6 shows the association between awareness of SMBG with the socio-demographic variables of the study participants. Participants' awareness of SMBG was significantly associated with age (X^2 24.64, df=3, $p<0.001$) and also with their level of education (X^2 45.35, df=3, $p<0.001$).

Discussion:

The current study assessed the socio-demographic variables, diabetic profile, awareness, knowledge, attitude and practices of Self-Monitoring of Blood Glucose among 180 type 2 diabetic patients. Majority

participants (48.9%) were in the age group between 50-70 years, reflecting a higher prevalence of Type 2 diabetes in that age group. The mean diabetes duration of 2.52 years is notably short and may not represent longer-term patient behaviour and practices. Participants had varied education levels. In almost half of them, the monthly income ranged between Rs.10000-30000 which may influence their access to SMBG devices.

In developed nations with robust healthcare systems, SMBG is widely practiced whereas in India it's limited¹². In this study, only 48.9% of the study participants (n=88) were aware of self-monitoring of blood glucose, while 51.1% (n=92) were unaware of SMBG. Among those aware (n=88), 52.6% participants reported that their primary source of information on SMBG were healthcare professionals. Despite the awareness, 35.9% lacked practical knowledge as they did not know how to use a glucometer and 30.8% were unaware of the benefits of SMBG. These findings are comparable with results of a community based cross-sectional study by Krishnan. V. et al in Tamil Nadu¹¹, where only 24.1% had adequate knowledge on SMBG and 47.5% learnt about it from physician. These results highlight the significant gap in diabetes self-care education.

On further analysis, we also found that there is significant association between age (X^2 24.64, df=3, $p<0.001$) and level of education (X^2 45.35, df=3, $p<0.001$) with the awareness of self-monitoring of blood glucose. Similar results have been observed in Indian studies by Krishnan. V. et al¹¹ and Mathur et al¹² where young individuals and people with high education level had a positive attitude towards self-care behaviour and diabetes awareness. The study carried out by Gupta et al¹³ in rural areas of Punjab indicated the same effect on the diabetes self-management behaviour in Indians. A study done in urban Bengaluru by Dasappa et al¹⁴ also reported that younger age and formal education significantly influenced adherence to diabetes self-care practices among diabetic patients.

In this study, we also found that 60.3% individuals reported fear of self-pricking which could deter the use of SMBG. Many studies have comparable findings suggesting anxiety associated with finger pricking impact glycemic control and hampers overall self-management^{15,16,17}. In this study, 44.9% patients believed that self-monitoring using glucometer is only for patients on insulin therapy, reflecting misconceptions regarding the use of SMBG in those with oral drugs. But majority patients (88.5%) expressed willingness to use blood glucose meter if it's available at a subsidized rate. These findings are similar to a study done by Basu et al¹⁸, majority patients (82.4%) lacked access to glucometer and nearly half (48.3%) mentioned that cost of glucose strips as a barrier to glucose self-monitoring.

Among those with awareness, only 57.9% had ever used a glucometer which was often irregular. Many checked blood glucose levels only during illness (29.4%) or as per doctors' advice when required (29.4%). These findings suggest use of SMBG is symptom driven rather than proactive or preventive use⁴. When there are abnormal readings, most patients had either consulted a doctor (41.2%) or modified their diet (39.2%).

These findings suggest the need for targeted educational programs regarding self-monitoring of blood glucose use and benefits, especially to older and less educated diabetics¹⁹.

Limitations:

Since this was a hospital-based cross-sectional study conducted at a single tertiary care centre, the findings may not be fully representative of the general population. Consecutive non-random sampling may have introduced selection bias. As the sample size was calculated primarily based on SMBG awareness, the study may have had limited statistical power for secondary outcomes such as knowledge, attitude, practices, and subgroup associations. Although the questionnaire was pretested, formal reliability and validity assessments were not performed. SMBG practices were self-reported without objective

verification, which may have introduced recall and social desirability bias. In addition, multivariate analysis was not performed.

Conclusions:

This study reveals significant gap in awareness, and practice of self-monitoring of blood glucose among type 2 diabetic patients. The socio-demographic factors, especially age and education level affects the awareness on SMBG. Healthcare providers should integrate structured, culturally tailored SMBG education into routine NCD clinic visits, with particular attention to older and less-educated patients who showed significantly lower awareness. Education should specifically address the correct use of glucometers and the relevance of SMBG for patients on oral anti-diabetic drugs, as nearly 45% held misconceptions that SMBG is only for insulin users²⁰. Addressing misconceptions about SMBG through counselling should be an integral part of each clinical consultation. Given that 88.5% of aware patients expressed willingness to use glucometers if subsidized, policy efforts to reduce the cost of glucose test strips and devices may improve uptake; however, this must be coupled with training, follow-up support, and logistical access to ensure willingness translates into actual practice^{21,22}.

Recommendations:

To address these challenges effectively, it is necessary to strengthen patient education tailored to diverse populations and policy initiatives to increase the affordability and accessibility of SMBG devices.

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Declaration:

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