



## Research article

## Proportion and predictors of SMBG use among type 2 diabetic subjects in three tertiary care hospitals in Dhaka City

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## ABSTRACT

**Aims:** The aim was to find out the proportion of Self-monitoring of Blood Glucose (SMBG) Users and factors affecting the nonuse in three large hospitals of Dhaka city.**Methods:** Under an observational cross-sectional design 598 type 2 diabetic subjects were recruited (convenient sampling) from the OPDs of 3 large tertiary care hospitals [one public hospital (PUBH), one Not-for-profit Hospital (NFPPH), and one For-profit private hospital (FPPH)] in Dhaka City. Data were analyzed by both univariate and multivariate analysis as appropriate.**Results:** Overall 71% of subjects were SMBG Nonusers (PUBH 86%, NFPPH 67%, and FPPH 46%). Monthly income status and advice showed the highest impact (OR 4.66 and 3.74 respectively) on the use. Physicians (54%), relatives (34%), and friends (8.2%) were the major sources of advice. Irregular diabetes check-up and distrust of results were also among the major reasons for not using SMBG among the Nonusers.**Conclusion:** Nearly three-fourth of type 2 diabetic patients in Dhaka city do not use SMBG and the proportion is especially high in public hospitals. Poor income status of patients, lack of coordinated advice/motivation by Caregivers, irregularity in diabetes checking, and distrust on results are major predictors for not using SMBG by the patients.

## 1. Introduction

Self-Monitoring of blood glucose (SMBG) has now been accepted as an integral part of diabetes management and it is recommended by the specialist associations worldwide [1]. A large proportion of diabetic patients, particularly in developing countries, still do not utilize the tool. Even in developed countries, SMBG is not practiced optimally. In Germany, the adherence to SMBG among diabetic patients is only 52.6% [2] and it was 75% in Northern California [3]. A study in Malaysia shows that only 15.3% of diabetic patients practice SMBG [4] and the proportion is 34% in Western Kenya [5]. Among the countries closest to Bangladesh, Pakistan shows a better proportion with 59% of the population sampled from Karachi hospitals using SMBG to check their blood glucose levels regularly [6]. According to IDF, Bangladesh already has about 8.3 million diabetic population [7]. The economy of the country is growing at a fairly rapid pace with consequent changes in sociocultural

and lifestyle habits. Accordingly, the burden of diabetes may even be worse than predicted by IDF. Judicious use of SMBG may greatly help in managing diabetes mellitus (DM) and thus preventing the secondary and tertiary complications of the disease among a large group of patients. Exploration of the magnitude of and factors affecting the use is important to design a rational evidence-based policy for the promotion of SMBG in a specific context. So far, there is only one published data [8] on the use of SMBG and factors affecting the use among Bangladeshi diabetic subjects. As per this study only 8.6% of the diabetic subjects use the technique and the affecting factors include financial stability, education, duration of diabetes, and public or private nature of specific the health care facility. The study, however, was conducted only on a rural population. The urban population has a much higher prevalence of DM in Bangladesh [9] and potential factors affecting SMBG use can be different among them. There is no published data yet on the extent of SMBG use in any patient group in urban areas of Bangladesh. From empirical experience, it

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appears that the potential of the tool is grossly underutilized even in urban areas of the country. Several socio-demographic, economic, cultural, ethical, and market-related factors may be associated with the popularization of the tool. Under this context, the present study was undertaken to find out the proportion of SMBG Users and factors affecting the nonuse of such devices in three tertiary care hospitals of Dhaka city, the capital of Bangladesh.

## 2. Material and methods

### 2.1. Research design

It was an observational study with a cross-sectional design.

#### 2.1.1. Subjects

Patients were selected from the Out-patient Departments (OPDs) of 3 tertiary care hospitals of Dhaka City. The first one was Dhaka Medical College Hospital [the largest public hospital (PUBH) in Bangladesh] which is attended by people from all over the country with mainly from upper-middle to lower socioeconomic background.; the second one was BIHS General Hospital [a 500 bed Not-for-profit hospital (NFPPH) owned by the Diabetic Association of Bangladesh] which serve people with diverse socioeconomic background and the third one was the Popular Diagnostic Center [200 bed, For-profit private hospital (FPPH) in the city] which is attended by people with mainly middle to upper socioeconomic status. These hospitals are prototypes of their respective categories. Following inclusion and exclusion criteria consecutive patients, attending the OPDs in these facilities during a period of month March 2019–April 2019, were recruited as subjects for this study.

#### 2.1.2. Sample size

Based on the plan to use logistic regression for analyzing the independent association of individual factors with the use of SMBG, the minimum sample size for each hospital category was calculated by the following formula:

$$n = 8 \times f + 50$$

Where n is the number of subjects in each hospital category; 8 is a multiplication factor, and f is the number of independent variables.

Using the formula the minimum sample size was calculated as 106; however, for higher confidence almost double the number of subjects were taken in each category (PUBH: 198, NFPPH: 200, and FPPH: 200).

Type 2 DM was diagnosed as per WHO Study Group criteria, aged between 30 to 60 years. Patients with GDM as well as patients with acute and chronic complications of DM or those with any major comorbidity were excluded. Educational level was grouped into ‘Up to SSC

(Secondary School Certificate, ie 10 years of education)’ and ‘Above SSC’ grades. Income level was categorized based on 2018 per capita Gross National Income (GNI) and World Bank (WB) calculations; the socioeconomic status of the respondents were considered as low-income: BDT (Bangladeshi Taka)  $\leq 83918$ ; lower-middle-income: BDT 83918–328504; and upper-middle- income: BDT 328504–1016718 per annum [10].

A pretested Questionnaire, written in the local language (Bengali), was used for data collection. It was divided into two parts: the first section comprised of demographic variables such as age, gender, ethnicity, and socioeconomic status. The proportion of SMBG users and factors which may influence the use of SMBG devices. Patients who did not use SMBG at all were termed as SMBG Nonusers. The SMBG Nonusers were asked about the reasons for not doing so. A written consent form was signed by every participant.

### 2.2. Statistical analysis

Categorical data were presented as frequency and percentages while continuous data were presented in terms of mean and standard deviations. Chi-square test was applied to test for differences between categorical variables. An Independent t-test was applied to test for difference between the groups. Binary logistic regression was done to explore the independent association of the factors with the use of SMBG.

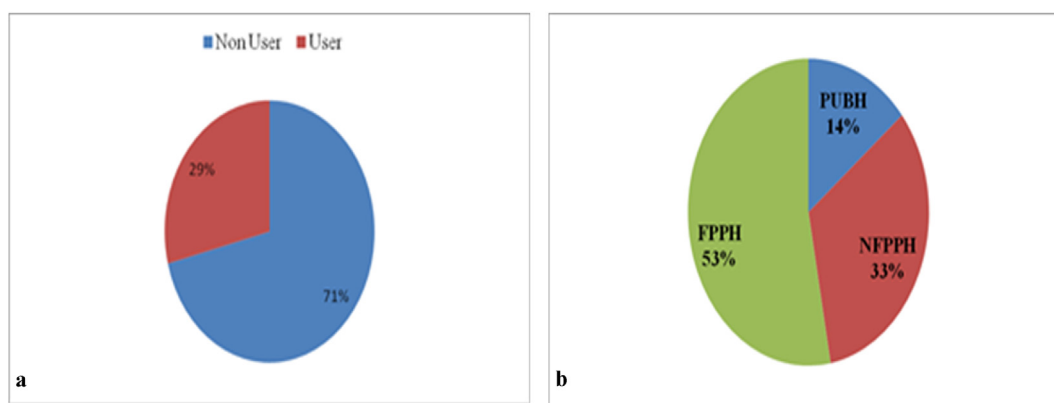
### 2.3. Ethical considerations

Approval for the study was taken from the Ethical Review Committee of BUHS. Informed written consent was taken from each participant.

## 3. Results

The mean ( $\pm$ SD) age (year) of the subjects was  $47.4 \pm 12.4$ . Out of the 597 subjects, 62.5% were females and 37.5% males. The majority of the patients (63.7%) belonged to lower socioeconomic class; however, the majority of them (64%) had  $\leq$  SSC(Secondary School Certificate, ie 10 years of education) grade education. Overall 71% of the diabetic patients were found to be Nonusers of SMBG (Figure 1a). Regarding the type of healthcare facilities, only 14% of patients attending PUBH, 33% attending NFPPH and 53% of patients attending FPPH facilities were found to be Users of SMBG (Figure 1b).

On univariate analysis (Table 1) age, female gender, education, lower socioeconomic status and health care in Public (PUBH) vs Private (NFPPH & FPPH) facilities were found to affect the use of SMBG at a significant level. When the PUBH and NFPPH settings (not-for-profit facilities) were combined and compared with the FPPH (for-profit facility) setting it was found that the use of SMBG is significantly higher in a for-



**Figure 1.** a: Proportion of a) overall SMBG Users among the study subjects (n = 598). PUBH:Public hospital; NFPPH: Not-for-profit private hospital; FPPH: for-profit private hospital. b: Proportion of facility-wise SMBG Users among the study subjects (n = 598). PUBH: Public hospital; NFPPH: Not-for-profit private hospital; FPPH: for-profit private hospital.

**Table 1.** Comparison of SMBG Users and Nonusers concerning potential affecting factors (n = 598).

Variables	SMBG User (Mean ± SD)/n(%)	SMBG Nonuser (M±SD)/n(%)
<b>Age (years)</b>	48.3 ± 12.7	47 ± 12.2
t/p-value	-1.21/0.72	
<b>Gender</b>		
Male	61 (27)	163 (73)
Female	112 (30)	262 (70)
χ <sup>2</sup> /p-value	0.502/0.51	
<b>Educational Level</b>		
≤10 years	77 (20)	306 (80)
>10 years	96 (44)	119 (56)
χ <sup>2</sup> /p-value	40.3/<0.001	
<b>Monthly Income</b>		
≤ BDT 10,000	57 (15)	323 (85)
> BDT 10,000	116 (53)	102 (47)
χ <sup>2</sup> /p-value	98.3/<0.001	
<b>Hospital Setting</b>		
Public (PUBH)	39 (20)	161 (80)
Private (NFPH & FPPH)	133 (33)	264 (67)
χ <sup>2</sup> /p-value	12.7/<0.001	
Not for profit (PUBH + NFPPH)	80 (20)	318 (80)
For-profit (FPPH)	92 (46)	107 (54)
χ <sup>2</sup> /p-value	44.2/<0.001	
<b>Provider/Hospital Advice for SMBG Use</b>		
Yes	149 (38)	246 (62)
No	24 (12)	170 (88)
χ <sup>2</sup> /p-value	40.4/<0.001	

Results were expressed as Mean ± SD or number (percentage). Comparison between Users and Nonusers were done by Students't-test or Chi-square test, PUBH: Public hospital; NFPPH: Not-for-profit-private hospital; FPPH: for-profit-private hospital.

profit private hospital setting. Among the Users, the Physicians were found to be the most dominant source of advice (54%); however, relatives (34.1%) and friends (8.2%) were also important sources of advice for SMBG use (Table 4).

Binary logistic analysis (with use of SMBG as dependent variable) was performed to further clarify the independent role of the factors affecting the use of SMBG among the study subjects. On this analysis higher age, male gender, higher education, advice for SMBG use, and higher economic statuses were found to have a significant independent association with the use of SMBG (Table 2).

Among the factors, higher-income status was found to have a very high impact (p < 0.001; odds ratio 4.295) on the use. When the effects of all these confounding variables were adjusted, the factor related to the attendance in PUBH, NFPPH, or FPPH settings did not show any significant association with SMBG use.

Exploration of the factors for not using the SMBG devices, only among the Nonusers, revealed that high price, not knowing about the advantage of the test, and discomfort in doing the test played a minor role (only among 12.4%, 9.8%, and 8.6% of the subjects respectively) in this case. Irregular diabetes checkup (35.8%) and distrust on SMBG results (33.4%) were found to be the major reasons for not using SMBG among Nonusers (Table 3).

#### 4. Discussions

SMBG is now regarded as an invaluable tool in the management of diabetes and thus prevention of diabetic complications [11, 12, 13]. The tool, however, is still grossly underutilized particularly in developing and underdeveloped countries. Data from the present study also conform to this notion. Even at hospital settings in the capital city of Bangladesh

**Table 2.** Logistic regression analysis considering SMBG Use as the dependent variable (n = 598).

Variables	β	p-value	Odds Ratio (OR)	95% C.I	
				Lower	Upper
Age	0.018	0.037	1.018	1.001	1.036
Gender (female)	0.432	0.063	1.541	0.976	2.431
Education in year	0.563	<b>0.028</b>	1.756	1.064	2.897
Monthly Income	1.540	<b>0.001</b>	4.662	2.673	8.132
PUBH vs NFPH & FPPH	-0.103	0.721	.902	0.512	1.588
PUBH & NFPH vs FPPH	0.066	0.818	1.069	0.608	1.878
Hospital Advice for SMBG use	1.320	<b>0.001</b>	3.743	2.227	6.292
Constant	-7.263	0.001	0.001		

Reference group, β for standardized regression coefficient, significant at p-value <0.05, level of confidence interval 95%.

nearly three-fourth of the diabetic patients does not use SMBG (Table 1). With almost similar socioeconomic status and type 2 diabetes burdens, Pakistan (a regional country) has a substantially lower proportion (41%) of SMBG nonusers in two different hospital settings like Government and Private hospitals in Karachi [14]. A proportion (66%), almost comparable to Bangladesh, has been reported from an African country, Western Kenya [5]. In Malaysia, where the economy is much more developed, the proportion of nonusers is higher (84.7%) [4] as compared to Bangladesh. In Bangladesh, there is no study reported yet on the use of SMBG in urban hospitals; however, a study in a rural community reported that 91.4% of the diabetic patients do not use SMBG [9].

In the present study, the income status of the patients is the most dominant factors underlying the use of SMBG. A similar finding has been reported from the previous study in rural Bangladesh [9] and also from a study conducted in Karachi, Pakistan [14]. Thus, it seems that diabetes health care financing is a major issue in the overall improvement for diabetes care especially in resource-poor settings and promotion of SMBG needs to be considered from this overall perspective. The second most important predictor of SMBG use among the Dhaka city patients, as revealed in the present study, is the advice pattern of the service providers. About one-third of the patients were not advised at all by the service providers regarding the use of SMBG although it has been found that the advice has a significant positive impact on the use of the tool. Nearly 73% of the users in public hospitals are advised for SMBG whereas the proportion is only 49% in the NFPPH hospitals. In contrast, the proportion is 79% in the FPPH hospitals. In Malaysia, the proportion of SMBG performers were 6.9% among diabetic patients attending private clinics and 21.0% among diabetic patients attending specialist clinics [15]. The indifference of the health care providers in advising SMBG (especially in public hospitals), resulting in a large proportion of nonusers, is obvious from the present data. It is worthwhile to note that a larger proportion (62%) of the subjects who were advised for SMBG use by the hospitals are still nonusers. It may indicate that the advice is probably not that coordinated and there is a lack of proper follow-up systems. Inadequate counseling is a major factor for the nonuse of SMBG among diabetic subjects in Malaysia [4] as it is in Bangladesh. It is encouraging to see that a good proportion of patients were advised by relatives and friends in all types of facilities. Special programs to create further awareness among friends and relatives may be taken as a strategy to promote the use of SMBG among patients.

The reasons for not using SMBG were also explored in the present study from the nonuser consumers' points of view (Table 4). In contrast to the common-sense notion that high cost, ignorance, and discomfort in doing the test are predominant factors for nonuse, only 12.4%, 9.8%, and 8.6% of the subjects cited those causes, respectively, as reasons for nonuse. Rather, a large proportion (64%) of the subjects revealed that irregularity in diabetes checkups and distrust of the SMBG results are the main reasons for not using this tool. The last two reasons were more prominent in the case of FPPH hospitals where 86% of Nonusers provided these reasons which indicate that patients from the higher socioeconomic class are more prone to these factors. The proportions, however, are also substantial in PUBH (58.4%) and NFPPH (36.2%) hospitals. The present

**Table 3.** Reasons for not using SMBG as expressed by the Nonusers (n = 419).

Variables	No (%)
Discomfort in the test	36 (8.6)
High price	52 (12.4)
Not knowing the advantage of SMBG	41 (9.8)
Irregular DM checkup	150 (35.8)
Distrust on SMBG result	140 (33.4)

Results were expressed as number (percentage).

**Table 4.** Additional issues related to SMBG use.

Issues	No (%)
<b>Source of advice regarding SMBG use</b>	
Doctor	93 (54.7)
Relative	58 (34.1)
Friend	14 (8.2)
<b>Users' priority preference in SMBG buying (n = 164)</b>	
Price	64 (37.6)
Quality	100 (58.8)
<b>Management of DM depending on SMBG result (n = 169)</b>	
Yes	165 (97.1)
No	4 (2.4)
<b>Correct procedure of SMBG use</b>	
Yes	163 (95.9)
No	6 (3.5)
<b>Recording of the SMBG result</b>	
Yes	109 (64.1)
No	60 (35.3)

Results were expressed as number (percentage).

data show that price remains a dominant factor in the Users' priority for SMBG, as also found in a previous study [16]. Overall 38% of the subjects do not prioritize quality over price and this is the highest (59%) in PUBH followed by about 45% in the NFPPH hospitals where patients come from a relatively poorer background. The cost of SMBG has also been cited as a major barrier to SMBG use among Pakistani patients [14].

Consideration of all the factors having a negative impact on SMBG use leads to the obvious suggestion of the need for comprehensive government policies and program in this important area of diabetes health care. The government intervention should include both the supply side (provider training and awareness availability and affordability of the monitor) and demand-side (eg' education and awareness campaign among patients and Caregivers) of the SMBG spectrum.

In conclusion, nearly three-fourth of type 2 diabetic patients in Dhaka city do not use SMBG and the proportion is especially high in public hospitals. Poor income status of patients, lack of coordinated advice/motivation by Caregivers (especially physicians), irregularity in diabetes checking and lack of trust in the results are among the major predictors for not using SMBG in these patients.

Although the three large hospitals, where the study was conducted attract patients from diverse demographic and socioeconomic background, caution is required to generalize the finding even for the whole urban context of the country. Also, the independent impact of all determinants could not be explored by proper multivariate analysis due to limitations in the sample size. Further limitations of the study include the non-inclusion of other potential modulators of SMBG like governmental policy, mass-communicating strategies and accessibility. Further large scale studies should be conducted to address these issues.

**Declarations**

*Author contribution statement*

Jannatul Nayeem: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Liaquat Ali: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Hasina Akhter Chowdhury: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Nowrin Afroze and Umme Sadia Mili: Performed the experiments.

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Data included in article/supplementary material/referenced in article.

*Declaration of interests statement*

The authors declare no conflict of interest.

*Additional information*

No additional information is available for this paper.

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