ADHERENCE TO SELF–MONITORING OF BLOOD GLUCOSE AMONG TYPE 1 DIABETICS AND ITS IMPACT ON DIABETIC KETOACIDOSIS IN THE REAL WORLD

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ABSTRACT

Objective: To determine the frequency of self-monitoring of blood glucose (SMBG) in type-1 diabetes mellitus (T1DM) patients, to find out factors that affect SMBG practice and to know SMBG influence on the frequency of diabetic ketoacidosis (DKA).

Methodology: Using cross sectional study design and convenience non-probability sampling technique, 371 patients were interviewed regarding SMBG and factors that affect SMBG practice through a structured questionnaire in a single tertiary care center. Selected patients were having diabetes for 6 months or more and having age 10 years or above.

Results: Among 371 patients, 59.3% were practicing SMBG using home glucometer but only 18.9% were monitoring their blood glucose level on daily basis. A sizeable proportion (37.2%) of patients stopped SMBG mainly due to financial restraints. Higher level of patient and family education as well as higher family income were independent predictors of SMBG practice. DKA frequency was significantly less (p =0.001) in SMBG adherent patients (64 per 100 patients per year) compared to non-adherent patients (92 per 100 patients per year) and was even more lower in patients who were performing multiple checks per day.

Conclusion: This study has found that a significant number of patients were not performing SMBG at the recommended frequency due to financial constraints. SMBG was found useful and effective method to prevent DKA, a life threating complication of diabetes mellitus.

Key Words: Type 1 diabetes mellitus, Diabetic ketoacidosis, Self-monitoring of blood glucose

INTRODUCTION

China, India and Diabetes Mellitus (DM) would be the world top three populated countries if all diabetic patients around the world are gathered together according to World Health organization (WHO), a disease of such a gigantic magnitude[1]. Globally, 425 million people worldwide have diabetes mellitus and over 629 million are predicted to have DM by 2045[2].

In 2016, WHO estimated 9.8% prevalence of DM in Pakistan which is expected to increase in near future[1]. Recently, second National Diabetes Survey of Pakistan has been published and the overall prevalence of diabetes in Pakistan was estimated as 26.3%; out of which 19.2% was diagnosed as DM while 7.1% were unaware of their disease and were newly diagnosed. Prevalence of DM in urban and rural areas was estimated as 28.3% and 25.3%, respectively. Prevalence of pre-diabetes was estimated as 14.4%[3]. The cost of managing DM and its complications is tremendous and according to one study it accounts for nearly 10% of all health care expenditures. Controlled trials in T1DM have shown that improvement in glycemic control reduced the risks of micro-vascular and macro-vascular diabetic complications[4,5].

The role of SMBG is well established in the management of diabetes and in reducing acute complications like DKA[6]. Self-monitoring of blood glucose (SMBG) is recommended at least 4 times per day[7]. SMBG is an important tool for assessing and improving the quality of diabetic control[8]. SMBG empowers diabetic patients to assess effects of life style changes and medi-

cations on their glycemic control[9]. As shown by several meta-analyses, SMBG being part of multi component management strategy, reduces HbA1c by 0.4% compared to non SMBG management strategies. The risk of micro-vascular complications decreases by 37% for any 1% decrease in HbA1c. It is suggested that SMBG can provide additional 15% risk reduction in micro-vascular complications[10].

As compared to time average result of HbA1c, SMBG provides "real time" feedback and detects blood glucose deviations like hypo or hyperglycemias. It is useful for treatment adjustments, patient safety, motivation and making appropriate changes in diet and exercise[11-14]. American Diabetes Association (ADA) recommends patients on multiple daily insulin injections, to monitor their blood glucose four times daily and even 6-10 times daily for better metabolic control. ADA also endorses to use SMBG data actively as part of patient centered self-management program[13,14]. SMBG was practiced by 88%, 39%, 32%, 26% and 6.2% diabetic patients in Australia, China, Korea, USA and Malaysia respectively[15-17]. A study in Karachi Pakistan showed 59% of type 2 diabetic patients practiced SMBG who were visiting a tertiary care hospital[18]. To date, there is no published local study available on SMBG frequency in type-1 diabetic patients.

Many studies have identified several barriers to SMBG under-utilization like distressing emotions, finger prick pain, discouragement about poor glucose readings, lack of awareness and difficulty in results interpretations[19-20]. The aims of this study were to determine frequency of SMBG in type-1 DM, to ascertain factors affecting SMBG and to find out how SMBG affects DKA in type-1 DM. Through results of this study, we will be able to promote SMBG practice by integrated educational programs involving patients, families, physicians, diabetic educators and other relevant authorities.

METHODOLOGY

This observational cross sectional study was conducted in the Departments of Endocrinology and Internal medicine at Hayatabad Medical Complex, Peshawar between January 2017 and February 2018 using a pre-tested questionnaire administered through face to face interviews by the researchers after verbal consent. The average number of patients visiting diabetic clinic is more than 1500 per month. Cochran formula was used to calculate sample size taking prevalence of diabetes as 9.8% and at 95% confidence interval with 3% margin of error. Non-probability convenience sampling technique was employed and 377 T1DM patients were interviewed and their record reviewed.

Standard protocol was followed for interviewing to eliminate interviewer bias. Six patients didn't cooper-

ate so final sample size was 371. Study was approved from hospital ethical committee. All T1DM patients with more than 6 months duration of DM and age 10 years or above were included while patients with established chronic renal failure were excluded. Patients having glucometers and monitoring their plasma glucose level, were considered for SMBG practice and adherence. Uneducated were those having attended grades 5 or less while college and above were those having attended grades 12 or higher. Families with Rs 60000 or more monthly income were considered having high socioeconomic status while those having less than Rs 60000 monthly income, were considered as low. DKA found less than 70%, was considered as good impact of SMBG on DKA frequency. Important variables were having glucometers, education, socioeconomic status, DM duration, HbA1c and DKA. HbA1c was taken from recent records or measured from hospital.

Categorical data were presented as frequency and percentages while continuous data were presented in terms of means and SD. Chi-square test was applied to find differences between categorical variables. $P<0.05$ was considered as statistically significant. Statistical analysis was performed using SPSS Version 20. Tables were constructed using Microsoft Excel 2016.

RESULTS

Total 371 patients were included. Mean age was 16.4 ±4.7 years and mean diabetes duration was 5.9 ±2.33 years. The demographic characteristics of study population are shown in Table 1.

Only 59.3% subjects were having glucometers and practicing SMBG. Among them 9.4% patients were checking their blood glucose multiple times while others didn't (Table 2). Frequency of multiple checks per day was found 25% in educated (college or above) and only 6.8% in uneducated participants. HbA1c <8% was recorded in 41% of SMBG adherent and only 3.36% of non-adherent patients. Similarly HbA1c <8% was found in 26% of educated (college/above) and only 13.8% of uneducated subjects. Among those who practiced SMBG, the timing varied a lot. However majority (35.8%) were monitoring fasting blood glucose while few patients (7%) were checking only when unwell. SMBG behaviors differed minimally between male and female patients. Proportion of subjects who were maintaining and not maintaining a record of SMBG was almost equal (29.9% and 29.4% respectively). Awareness regarding SMBG importance was only 52.8%. Only 43.7% patients adjusted their insulin dose based on SMBG record while 37.2% participants stopped SMBG practice commonly due to higher cost.

Common reason for admission was DKA and common reason for DKA was stopping insulin due to higher

Table 1: Demographic Characteristics of Study Population (n=371)

Characteristics		Frequency	Percentage
Gender	Male	203	54.7
	Female	168	45.3
Age groups	10-25 Years	340	91.8
	26-35 Years	31	8.3
Duration of DM	≤ 5	162	43.7
	>5	209	56.3

Table 2: Frequency of SMBG (n=371)

Variable	Frequency	Percentage
Multiple checks per Day	35	9.4%
Once Daily	14	3.8%
Twice Daily	21	5.7%
Once Weekly	33	8.9%
Once in 2 Weeks	54	14.6%
Monthly	40	10.8%
Only When Unwell	26	7.0%

Table 3: Hospital admissions in type 1 diabetes mellitus (n=371)

Characteristics		Frequency	Percentage
Reasons for Hospital Admission in T1DM	DKA	281	75.5
	Hyperglycemia	59	15.9
	Hypoglycemia	30	8.1
Reasons for DKA	Stopping insulin	183	65.1
	Fever	71	25.2
	Do not know	27	9.6

Table 4: Comparison of various clinical variables for adherence to SMBG

Characteristics		SMBG	
		Adherence	Non-adherence
Parents Education	Uneducated	49%	51%
	College/Above	90%	10%
Duration Of Diabetes	≤5	66.7%	33%
	>5	57%	43%
Socioeconomic Status	≤ 15,000 Rs/Month	44%	56%
	> 60,000 Rs/Month	94%%	6%

expenses (Table 3). DKA frequency was observed 64% in glucometer users and 92% in non-users and the difference was statistically significant (p 0.001). DKA frequency varied with SMBG frequency, as 51% in those having multiple checks per day (≥3 times per day), and 65% in those who checked once monthly (p =0.002).

Higher patient and family level of education, higher family income and shorter duration of diabetes were independent predictors of SMBG practice (Table 4).

DISCUSSION

We found that only 59.3% type 1 DM were having glucometers and practicing SMBG. However only18.9% subjects were monitoring daily their glucose level. Out of daily monitoring participants only 9.4% were having multiple checks per day. Farhan et al[18] found that 59% of DM patients check their blood glucose using glucometer; however mean check was found 3 times per week which is slightly lower than found in our study mainly because they included both type 1 and type 2 DM patients where majority of T2DM patients were using oral hypoglycemic agents as well. On the contrary other researcher found significantly lower proportion of DM patients using glucometers[21-22].

Common reason for not using glucometer was found to be the cost of SMBG. Another finding was that significant proportion of subjects (37.2%) stopped SMBG due to higher expenses. Similar factors were observed in Bangladesh population based diabetes and eye study (BPDES) by Islam et al[21]. Even 12.9% patients were unable to operate glucometer.

When asked about importance of SMBG, only 52.8% participants were aware. Again only 29.9% patients were keeping SMBG record and communicating with their physicians. Previously, researchers found that 63.4% (n=210) of patients performing SMBG adjusted their insulin regimen[18]. On the contrary, we found that most of the diabetic patients lack confidence in managing their condition due to poor understanding of their disease and making any adjustment to their treatment.

Certain factors found by other researchers like higher level of education, high socioeconomic status, being treated in private sector hospitals, duration of DM and having a family member with DM, were significantly associated with SMBG adherence. Similarly we found that level of education, socioeconomic status and duration of DM in bivariate analysis were independent factors associated with use of glucometer[18].

Moström et al[14], found positive correlation between frequent SMBG in T1DM and preventing micro-vascular, macro-vascular and acute complications like DKA. Higher frequency of SMBG was associated with lower HbA1c levels in T1DM. Similar findings were replicated in our study. DKA was observed less in those having glucometers (p =0.002) and even less in those who were checking their glucose level more frequently (p =0.001).

Commonest reason of admission was DKA, commonly due to stopping insulin out of poor economics. Moström et al[14] observed DKA precipitated by infections as common reason for admission.

LIMITATIONS

Our study had few limitations. Patients were selected from one tertiary care facility through non-probability sampling; so the results cannot be generalized to general population. Another limitation was that self-report on SMBG regularity may not reflect actual practice. Also the intra and inter examiner reliability of data collection was weak.

CONCLUSION

This study shows that far less number of patients were actually practicing SMBG and at a lower frequency than recommended. This behavior could be responsible for the higher incidence of DKA and poor overall glycemic control.

RECOMMENDATIONS

Our study findings indicate a need to further support and enhance SMBG practice by development of educational programs for patients and insulin educators, goal setting and motivational interviewing. Moreover, price reduction of glucometers and blood glucose strips and user friendly advanced glucose monitoring devices needs consideration.

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