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ORIGINAL ARTICLE

Non-adherence to self-monitoring of blood glucose (SMBG) in poorly controlled type 1 and type 2 diabetes mellitus.

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ABSTRACT… Objective: To access non-adherence to self-monitoring blood glucose (SMBG) in poorly controlled type 1 and type 2 diabetes mellitus. **Study Design:** Prospective Descriptive study. **Setting:** Department of Diabetes and Endocrinology, Hayat Medical Complex Peshawar. **Period:** July 2023 to January 2024. **Methods:** The study comprised 296 patients, 50 patients had type 1 diabetes (T1DM) and 246 had type 2 diabetes (T2DM). Participants were selected based on defined criteria of poor glycemic control characterized by persistent hyperglycemia and raised HbA1c. SMBG profile was assessed and common factors recorded. **Results:** The patient mean age was 60 years with a standard deviation of 9.8. Non-adherence to SMBG was observed in 45.94%. Non-adherence to SMBG was 40% in Type 1 DM whereas in Type 2 DM it was 47.15%. Factors responsible for non-adherence were, not knowing about SMBG (60%), lack of glucometer (54%), the uselessness of SMBG (36%), costly strips (80%), inability to check SMBG (50%), painful procedure (30%), and SMBG inconvenient (40%). Short history of diabetes (55%) T2DM (47.15%), Illiteracy (52.94%), negative family history of diabetes (51%), and poor economic condition (73.52%) were common predictors. **Conclusion:** The research gives an important insight in to the demography, treatment modalities, non-adherence and adherence to self-monitoring blood glucose testing, various factors responsible and predicting non-adherence to SMBG.

Key words: Non-Adherence, Self-Monitoring Blood Glucose (SMBG), Type 1 Diabetes, Type 2 Diabetes.

INTRODUCTION

Diabetes mellitus is a complex syndrome of disordered glucose metabolism, manifesting acutely with osmotic symptoms and chronically by various complications like neuropathy, nephropathy, retinopathy, and weight loss.[1] According to IDF 2019, diabetes is affecting 463 million people worldwide, and this figure will rise to 700 million in 2045.[2] Pakistan has 19.4 million diabetic patients, and this figure is expected to reach 371 million in 2045.[3,4] There are different types of diabetes, like type 1, type 2 diabetes, MODY, GDM, and secondary DM.[5]

DM is treated by oral hypoglycemic drugs and insulin. The purpose of treatment is to alleviate the osmotic symptoms acutely and prevent long complications. Diabetic patients using insulin or oral hypoglycemic drugs should regularly monitor their glucose level.[6,7] SMBG is a process in which diabetic patients measure their blood glucose themselves using glycemic readers (glucometers). Based on their glucose reading, these patients usually adjust and modify their treatment by bringing changes in their diet, exercise, drugs, and insulin. SMBG provides real-time data on patient glycemic status (hyperglycemia, hypoglycemia, or euglycemia).[8,9]

Using SMBG profiles, patients can bring about positive changes in their day-to-day life, exercise, diet, drugs, and insulin. Thus, SMBG monitoring is an integral part of the management of diabetes.[10,11] SMBG monitoring is associated with a 15% risk reduction in microvascular complications.[12] ADA advises that T1DM using an intensive insulin regimen should check their sugar 4 times a day while T2DM patients using oral hypoglycemic

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medication and having poor control are required to check fasting and postprandial blood glucose.[13] Type 2 diabetic patients on oral and basal insulin are required to monitor SMBG 4 times per week; 2 FBS and 2 postprandial are appropriate.[14]

Despite SMBG being highly recommended in diabetic patients using insulin, its utilization remains low.[15] A study conducted in Karachi reveals that 26% of patients are practicing SMBG on once daily fashion, and 13% of patients are practicing it as a twice day basis.[16,17] Similarly, studies conducted in Australia, USA, and Malaysia show that SMBG frequency is 88%, 32%, and 6.2%, respectively.[18]

There is lack of evidence in this part of the world about the subject and its effects in terms of acute and chronic complications of diabetes mellitus. This study was conducted to assess the SMBG profile in both type 1 and type 2 diabetic patients, its frequency, adherence and non-adherence to SMBG. This study has also assessed various factors responsible for nonadherence, and its impact on acute and chronic microvascular and macro vascular complications.

METHODS

This Prospective descriptive study design was used to carry out this study at the department of endocrinology Hayatabad medical complex Peshawar during the period of 06 months from July 2023 to January 2024. A total sample size of 296 was calculated via WHO formula. Data was analyzed using SPSS version 25. Demographic characteristics were summarized using descriptive statistics. To compare categorical variables between SMBG no adherent and adherent groups, chi square tests were used. Continuous data was compared using student t test. A two-sided p value <0.05 was considered statistically significant. Throughout the study procedures, patients' confidentialities were respected and all data was anonymized for analysis. The research followed ethical values and was approved by the institutional review board (1401, 5, July 2023).

RESULTS

This study was carried out on 296 diabetic patients of whom 50 patients had type 1 DM and 246 were suffering from Type 2 DM. Overall, patient age varied from 5 to 80 years. In Type 1DM, the age range was 5 to 40 years with a mean age of 15 years. The largest group 26 (52%) had an age range of 10 to 20 years. In the case of type 2DM the age range was 20 to 80 years with a mean age of 49.35 having SD of 9.8. The largest group was 65(26.42%) having an age range of 51 to 60 years. The majority of patients were male 171(57.77%) and the rest were female 125 (42.22%). Regarding treatment modalities, it is observed that all patients with T1DM were using insulin (100%). In the case of T2DM, there were three groups, 48(19.5%) patients were using insulin, 118 (48%) were using insulin and OAD, and 80 (32.52%) OAD only.

Regarding SMBG practice, we have detected that 45.94% of diabetic patients were non-adherent to SMBG whereas 54.15% of diabetic patients were adherent to SMBG practice. It is observed that 40% of T1DM were non-adherent to SMBG practice whereas 60% were adherent, whereas in the case of T2DM, 47.15% were nonadherent and 52.85% were adherent to SMBG.

The result also showed that among the SMBG nonadherent group 40% were having type1 DM, and 47.15% had T2DM. Similarly, among the SMBG adherent group 60% were T1DM where as 52.85% had T2DM. This is illustrated in Figure-2. Amongst the nonadherent group various reasons responsible for non-adherence were lack of knowledge about SMBG (60%), Don't have glucometer (54%), Cost of strips (80%), Don't know how to check sugar (50%), Painful Procedure (30%), Uselessness of SMBG (36%), inconvenience of SMBG (40%). (Table-I)

Reason	Type 1& Type 2 (%)	No
Don't Know About SMBG	60%	82
Don't have glucometer	54%	74
Uselessness of SMBG	36%	49
Strips are costly	80%	109
Don't know how to check sugar	50%	68
It is painful procedure	30%	41
Inconvenience of SMBG	40%	55

Table-I. Common reason responsible for non-adherence

Apart from this we have also detected various strong predictor of non-adherence to SMBG. These are short history of diabetes (55.88%), Type 2 DM (47.15%), Illiteracy (52.94%), Negative family history of diabetes (51.47%) and poor Occupation (73.52%) (Table-II). The study also observed various complication among the diabetic population. in this study we observed DKA (76%) hypoglycemia (60%). Diabetic Foot (40%), Peripheral neuropathy (32 %) diabetic retinopathy (42%), diabetic nephropathy (36%), IHD (42%) CVA (12%).

Predictors	Type 1 & Type 2 (%)	No
Short history of diabetes mellitus	55.88%	76
Type 2 DM	47.15%	64
Illiteracy	52.94%	72
Negative family history of diabetes	51.47%	70
Occupation (Poor People)	73.52%	100

Table-II. Predictor of non-adherence to SMBG practice

The study additionally compared various complication in both SMBG nonadherent and SMBG adherent group. The study observed that in T1DM patients, DKA was present in 70% vs 10%. Similarly, hypoglycemia was 40% vs20%, Diabetic Foot 30% vs 10 % in non-adherent group and adherent group respectively. Similarly, more microvascular and macro vascular complication were noticed in SMBG no adherent group than SMBG adherent group. Peripheral neuropathy 20% vs 12% diabetic retinopathy 30% vs 12% diabetic nephropathy 24% vs 12% IHD 30 % vs 12% CVA 8% vs 4% respectively in SMBG non-adherent group then SMBG adherent group (Table-III).

Complication	SMBG-NA (%) &No	SMBG-A (%)&No	Total (%)
DKA	70% (14)	16% (5)	86%
Hypoglycemia	40% (55)	20% (32)	60%
IHD	30% (41)	12% (19)	42%
CVA	8% (11)	4% (7)	12%
P Neuropathy	20% (27)	12% (19)	32%
D-Retinopathy	30% (41)	12% (19)	42%
D-Nephropathy	24% (33)	12% (19)	36%
Diabetic Foot	30% (41)	10% (16)	40%

Table-III. Comparison of complication B/W SMBG-NA & SMBG-A

DISCUSSION

In this study we found that overall nonadherence to SMBG practice was low compared to SMBG adherence. We observed the overall nonadherence to SMBG practice 45.94% compared to 54.04% of patients who were adherent to SMBG practice. Nonadherence to SMBG practice amongst type 1 diabetic patients was 40% where as it 48% in case of type 2 Diabetic patients.[19] This finding correlates well with observation done k.Khowja at all, Yaqoob at[14] all and Farhan at all.[20] They Also found that Nonadherence to SMBG practice was low than SMBG adherence practice.[21]

In term of demographic parameters, treatment modalities for DM, duration of diabetes, it was found that greater proportion of patients were having T2DM than T1DM with a comparable age and gender distribution. This observation correlates well with observation done by kabir MA at all[22], who also noticed that large no of people was having type 2 diabetes Mellitus than type 1 diabetes.

Amongst the non-adherent group of patients, we found various reasons responsible for nonadherence to SMBG practice. Common reason responsible for nonadherence were found to be lack of glucometer, cost of strips, Lack of knowledge about SMBG practice, inconvenience of SMBG, and illiteracy. This result correlates with the study conducted by Farhan et al, who also noticed similar kind of factors responsible for nonadherence to SMBG practice.

It was also noticed that high rate of illiteracy, poor economic condition, lack of knowledge about diabetes, short duration of diabetes, negative family history of Diabetes are all strong predictors of nonadherence to SMBG practice. These observations correlates with study by j.naeem et al who also observed similar factors as predictors of nonadherence to SMBG practice.[23] This study also identified various acute and chronic complications in the diabetic cohort. Acute complications DKA and hypoglycemia occurred in 76% and 60% patients respectively. Similarly, chronic complications occurred in the form of P. Neuropath in 32%, diabetic nephropathy in 36%

and diabetic retinopathy in 42%. Similarly, IHD and CVA occurred in 42% and 12% respectively. These findings correlate with finding of shear as et al who also observed similar microvascular and macro vascular complication with comparable frequency.[24]

We noticed that DKA occurred in 70% vs 16% and hypoglycemia occurred in 40% vs 20% in non SMBG group than SMBG adherent group respectively. Similarly, chronic microvascular complications like neuropathy occurred in 20% vs 12%, diabetic retinopathy 20% v 12% and diabetic nephropathy in 24% vs 12% occurred more in non SMBG group than SMBG group. Similarly, macro vascular complication was more common amongst SMBG non adherent group than SMBG adherent group, IHD 30% Vs 12% and CVA 8% Vs 4%. The observation is similar to those by a Thomas at all who also found that complication was prevalent among SMBG nonadherent group than SMBG adherent group and support the fact that nonadherence to SMBG practice can lead to poor glycemic control in short term and lot of complications in long term.[25]

CONCLUSION

This research gives an important insight into the demographic characteristic of DM, treatment regimen, Adherence and Nonadherence to SAMBG practice. The research discloses most common modifiable factors responsible for Nonadherence to SMBG and give us opportunity to take necessary action and intervention to reduce the non-adherence to SMBG practice. The results of the research demand the need for improvement in patient education, and knowledge about disease, complications of disease SMBG and its importance. The research also highlights the need for Supporting the patients to comply with SMBG practice through various governmental and nongovernmental means. The research also through light on different complications of DM in non-adherent group and demands for compliance with SMBG practices.

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REFERENCES

1. Akhter J, Jabbar A, Islam N, Khan MA. **Diabetic ketoacidosis in a hospital-based population in Pakistan.** J Pak Med Assoc. 1993; 43(7):137-139.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. **Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas.** Diabetes Research and Clinical Practice. 2019 Nov 1; 157:107843.
3. Azeem S, Khan U, Liaquat A. **The increasing rate of diabetes in Pakistan: A silent killer.** Ann Med Surg (Lond). 2022; 79:103901. Published 2022 Jun 3. doi:10.1016/j.amsu.2022.103901
4. Aamir AH, Ul-Haq Z, Mahar SA, Qureshi FM, Ahmad I, Jawa A, et al. **Diabetes Prevalence Survey of Pakistan (DPS-PAK): prevalence of type 2 diabetes mellitus and prediabetes using HbA1c: a population-based survey from Pakistan.** BMJ open. 2019 Feb 1;9(2):e025300.
5. Resmini E, Minuto F, Colao A, Ferone D. **Secondary diabetes associated with principal endocrinopathies: The impact of new treatment modalities.** Acta diabetologica. 2009 Jun; 46:85-95.
6. Saeed Ahmed Mahar, Muhammad Shahid. **Diabetes Care in Pakistan - A Real Challenge.** JLUMHS January-April 2014; 13(01):1-2.
7. Ahmed A, Jabbar A, Zuberi L, Islam M, Shamim K. **Diabetes related knowledge among residents and nurses: a multicenter study in Karachi, Pakistan.** BMC Endocr Disord. 2012; 11(12):12-18. Published 2012 Sep 11. doi:10.1186/1472-6823-12-18
8. **American Diabetes Association. Standards of medical care in diabetes—2014.** Diabetes Care. 2014 Jan 1; 37(Supplement_1):S14-80.
9. Basit A, Khan A, Khan RA. **BRIGHT guidelines on self-monitoring of blood glucose.** Pak J Med Sci. 2014; 30(5):1150-1155. doi:10.12669/pjms.305.6006
10. Mansouri D, Khayat E, Khayat M, Aboawja M, Aseeri A, Banah F, et al. **Self-monitoring of blood glucose and hypoglycemia association during fasting in Ramadan among patients with diabetes.** Diabetes, Metabolic Syndrome and Obesity. 2020 Apr 5:1035-41.

11. Basit A, Khan A, Khan RA. **BRIGHT guidelines on self-monitoring of blood glucose.** Pak J Med Sci. 2014 Sep; 30(5):1150-5. doi: 10.12669/pjms.305.6006. PMID: 25225546; PMCID: PMC4163252.
12. Karter AJ. **Role of self-monitoring of blood glucose in glycemic control.** Endocrine Practice. 2006 Jan 1; 12:110-7.
13. Harashima SI, Fukushima T, Sasaki M, Nishi Y, Fujimoto S, Ogura M, et al. **Self□monitoring of blood glucose (SMBG) improves glycaemic control in oral hypoglycaemic agent (OHA)□treated type 2 diabetes (SMBG□OHA study).** Diabetes/metabolism Research and Reviews. 2013 Jan; 29(1):77-84.
14. Khan MY, Ullah F, Ghaffar T, Ahmed I, Usman K, Aamir AU. **Adherence to self–monitoring of blood glucose among type 1 diabetics and its impact on diabetic ketoacidosis in the real world.** Journal of Postgraduate Medical Institute. 2019 Nov 6; 33(3):194-98.
15. Benjamin EM. **Self-monitoring of blood glucose: The basics.** Clinical diabetes. 2002 Jan 1; 20(1):45-7.
16. Bookwalter CM. **Unlocking the full potential of self-monitoring of blood glucose.** US Pharm. 2019; 44(10):29-32.
17. Khowaja K, Waheed H. **Self-glucose monitoring and glycaemic control at a tertiary care university hospital, Karachi, Pakistan.** Journal of the Pakistan Medical Association. 2010; 60(12):1035.
18. Brohi AH, Hakim A, Khan M, Malik E, Mugheri D, Shaikh F, et al. **Facilitators and barriers to self-monitoring of blood glucose (SMBG) in diabetic patients visiting family medicine clinics at Akuh.** Research Square. 2020; 1-16.
19. Khowaja K, Waheed H. **Self-glucose monitoring and glycaemic control at a tertiary care university hospital, Karachi, Pakistan.** J Pak Med Assoc. 2010; 60(12):1035-1038.
20. Farhan SA, Shaikh AT, Zia M, Kahara BR, Muneer R, Rehman M, et al. **Prevalence and predictors of home use of glucometers in diabetic patients.** Cureus. 2017; 9(6):e1330. Published 2017 Jun 10. doi:10.7759/cureus.1330
21. Mastura I, Mimi O, Piterman L, Teng CL, Wijesinha S. **Self-monitoring of blood glucose among diabetes patients attending government health clinics.** Med J Malaysia. 2007; 62(2):147-151.
22. Kabir MA, Ahmed S, Abedin M, Mallick S, Dhar A, Islam AS, et al. **Prevalence and Predictors of Home Use Blood Glucose Meters Among the People with Diabetes in Bangladesh and Relation with HbA1c: A Multicenter Cross-Sectional Study.** Global Journal of Diabetes, Endocrinology & Metabolic Disorders. 2022; 1(2):5-22.
23. Nayeem J, Chowdhury HA, Afroze N, Mili US, Ali L. **Proportion and predictors of SMBG use among type 2 diabetic subjects in three tertiary care hospitals in Dhaka City.** Heliyon. 2021 Jul 16; 7(7):e07619.
24. Shera AS, Jawad F, Maqsood A, Jamal S, Azfar M, Ahmed U. **Prevalence of chronic complications and associated factors in type 2 diabetes.** JPMA. The Journal of the Pakistan Medical Association. 2004 Feb 1; 54(2):54-9.
25. Thomas A, Shenoy MT, Shenoy KT, George N. **Glucometers for patients with type 2 diabetes mellitus: Are they helpful?** International Journal of Medical Students. 2021 Jun 22; 9(2):140-4.

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2	Sajida Riaz	Discussion writing.	
3	Fasih Iqbal	Methods & materials.	
4	Muhammad Salman Aamir	Critical review.	
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