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PREVALENCE OF NON-COMPLIANCE OF ROUTINE BLOOD GLUCOSE MONITORING IN UNCONTROLLED TYPE 2 DIABETICS PRESENTING AT A TERTIARY CARE HOSPITAL.

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ABSTRACT

BACKGROUND: An important part of managing type 2 diabetes mellitus (T2DM) is self-monitoring of blood glucose (SMBG). The current study aimed to evaluate the frequency of routine SMBG non-compliance in patients with uncontrolled type 2 diabetes. **METHODS:** This cross-sectional study was carried out from July to December 2024 at the Hayatabad Medical Complex's Department of Diabetes & Endocrinology in Peshawar. 294 individuals with uncontrolled type 2 diabetes were included in the study. Based on adherence to the SMBG, participants were divided into groups that were compliant and those that were not. Structured questionnaires and medical records were used to gather information on demographics, disease features, SMBG practices, and clinical outcomes (diabetes ketoacidosis, hypoglycemia, neuropathy, retinopathy, and nephropathy). SPSS version 26.0 was used for the statistical analysis. **RESULTS:** Of 294 participants, 171 (58.2%) were non-compliant with SMBG. Non-compliance was significantly associated with higher incidence of diabetic ketoacidosis ($p = 0.002$), severe hypoglycemia ($p = 0.004$), neuropathy ($p = 0.003$), retinopathy ($p = 0.001$), and nephropathy ($p < 0.001$). Lower education level and income were also significantly linked to non-compliance ($p < 0.001$). **CONCLUSION:** Non-compliance with routine SMBG is prevalent among uncontrolled T2DM patients and is associated with significantly higher rates of acute and chronic complications. Targeted educational and economic interventions are urgently needed.

KEYWORDS: Diabetes Mellitus, Type 2; Self-Monitoring of Blood Glucose; Patient Compliance; Diabetic Ketoacidosis

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INTRODUCTION

One of the most common chronic conditions in the world is diabetes mellitus (DM), of which type 2 diabetes mellitus (T2DM) makes up over 90% of cases[1]. Chronic hyperglycemia is the outcome of this progressive metabolic disease, which is typified by insulin resistance and relative insulin insufficiency[2]. Rapid urbanization, sedentary lifestyles, and poor eating habits are all contributing factors to the rising global incidence of type 2 diabetes. Approximately 537 million persons worldwide had diabetes in 2021; if current trends continue, this figure is predicted to increase to 643 million by 2030[3].

A key component of managing diabetes is routine blood glucose monitoring, which allows patients and medical professionals to evaluate glycemic control and modify treatment regimens as necessary[4]. In addition to supporting adherence to treatment plans, self-monitoring of blood glucose (SMBG) aids in the detection of both hyperglycemia and hypoglycemia[5]. Non-compliance with routine blood glucose monitoring is still a major obstacle to the best possible control of diabetes, despite its well-established advantages[6].

Several studies have demonstrated how important SMBG is for reaching glycemic goals, especially for people on insulin[7-9]. Evidence, however, indicates that many groups continue to have low SMBG compliance rates, particularly those with uncontrolled diabetes[10]. According to a cross-sectional study carried out in Pakistan, only 34.5% of patients with type 2 diabetes followed the recommended blood glucose monitoring protocol[11]. Similarly, psychological resistance, financial limitations, needle phobia, and ignorance have all been connected to non-compliance[12].

The rate of non-compliance may be much higher in developing nations like Pakistan, where the healthcare sector suffers resource and infrastructure-related difficulties. Cost and insufficient patient education were identified as the main causes of diabetic patients' non-adherence to SMBG in a Karachi study[13]. Furthermore, retinopathy, nephropathy, and cardiovascular disease are among the microvascular and macrovascular consequences that are directly linked to inadequate glycemic control[14]. Psychosocial elements are also important. It has been determined that depression, diabetes distress, and a lack of family support are obstacles to routine glucose monitoring. Another factor contributing to poor SMBG adherence is health literacy, especially among older persons and those with less education[15].

Finding the prevalence and causes of non-compliance is essential for enhancing health outcomes because regular glucose monitoring is essential for managing diabetes. Since uncontrolled diabetics are

more likely to experience difficulties and require hospitalization, it is particularly crucial to comprehend these trends in these patients. The prevalence of non-compliance in uncontrolled type 2 diabetes is not well explored in Pakistani tertiary care settings, despite the availability of SMBG technologies. This study intends to close this gap and offer data that can guide educational initiatives and measures at the policy level to improve patient participation in self-care. This study sought to ascertain the frequency of routine blood glucose monitoring non-compliance among patients with uncontrolled type 2 diabetes who were admitted to a tertiary care hospital.

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MARTIAL AND METHOD

This cross-sectional study was carried out over the course of six months, from July 1, 2024, to December 30, 2024, at the Department of Diabetes & Endocrinology, Hayatabad Medical Complex, Peshawar. The Hayatabad Medical Complex in Peshawar's institutional review board (IRB) granted ethical approval (Approval No: 1701; Dated: 5th June 2024).

A prevalence of 25.7% for non-compliance with random blood sugar (RBS) monitoring was estimated using the WHO sample size calculator, with a 95% confidence interval and a 5% margin of error.[16] The necessary sample size was determined to be 294 people based on these characteristics.

A non-probability consecutive sampling strategy was used to choose participants from among patients who were seen in the endocrinology outpatient department. Patients who were 18 years of age or older, had been diagnosed with type 2 diabetes mellitus, had uncontrolled diabetes—defined as chronic hyperglycemia (HbA1c >7.5%) despite continuous medication treatment—and were prepared to give informed consent were all requirements for inclusion. Individuals who were hesitant to participate or had cognitive impairment, gestational diabetes, or type 1 diabetes mellitus were not included.

A structured, pre-tested questionnaire and patient medical records were used for data collection. Information gathered included Demographic data (age, gender, education, income, occupation), Clinical characteristics (duration of diabetes, comorbidities, treatment modality). Self-Monitoring of Blood Glucose (SMBG) adherence status based on patient self-reporting of frequency and regularity and documentation in medical records.

Participants were categorized into two groups based on their self-monitoring of blood glucose (SMBG) practices: the compliant group, comprising individuals who adhered to routine SMBG as per clinical recommendations, and the non-compliant group, consisting of those who reported irregular or absent SMBG practices. To assess the impact of SMBG adherence, both short-term and long-term clinical outcomes were recorded. Clinical outcomes were evaluated comprehensively to understand the relationship between SMBG compliance and the development of acute and chronic complications of diabetes.

Among the acute complications, particular focus was given to diabetic ketoacidosis (DKA) and hypoglycemic episodes. The incidence and severity of DKA were determined through a detailed review of patient medical records and confirmed by relevant laboratory investigations, including blood pH levels, serum

bicarbonate, and the presence of urinary or serum ketones. Hypoglycemia events were assessed based on patient-reported symptoms and documentation in clinical records, with attention to both symptomatic and asymptomatic occurrences, especially severe episodes requiring emergency medical attention or hospitalization. This stratified evaluation aimed to explore the clinical significance of SMBG practices in the overall management and complication profile of patients with uncontrolled type 2 diabetes mellitus.

Chronic microvascular complications were also assessed. Diabetic neuropathy was evaluated through detailed clinical examinations, including assessment of sensory deficits and reflexes, and confirmed with nerve conduction studies where available. Diabetic retinopathy was identified using fundoscopic examination, and in cases where further detail was needed, retinal imaging was conducted to determine the presence and stage of retinal changes. Diabetic nephropathy was assessed through laboratory investigations, particularly focusing on renal function markers such as the urinary albumin-to-creatinine ratio (ACR) and serum creatinine levels, which helped establish the degree of kidney involvement.

For statistical analysis, all gathered data was imported into SPSS version 26.0. We computed descriptive statistics, such as frequencies/percentages for categorical variables and means ± standard deviations for continuous data. The Chi-square test was employed for categorical data and the one-way ANOVA test for continuous variables. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

A total of 294 patients with uncontrolled type 2 diabetes mellitus were included in the study. Among them, 123 (41.8%) were compliant with routine self-monitoring of blood glucose (SMBG), while 171 (58.2%) were non-compliant. The mean age of participants was 52.3 ± 9.4 years in the compliant group and 54.7 ± 10.2 years in the non-compliant group, showing a statistically significant difference ($p = 0.040$). In terms of gender, males constituted 55.3% of the compliant group and 53.2% of the non-compliant group, while females represented 44.7% and 46.8%, respectively, with no significant difference ($p = 0.725$). The duration of diabetes was ≥5 years in 61.8% of the compliant group and 65.5% of the non-compliant group ($p = 0.513$). Insulin use was reported in 71.5% of the compliant group and 65.5% of the non-compliant group ($p = 0.290$). Significantly higher compliance was observed among participants with higher education levels (74.8% vs. 40.4%, $p < 0.001$) and those with monthly income above 30,000 PKR (76.4% vs. 42.7%, $p < 0.001$) (Table 1).

Table 1: Baseline Characteristics of Study Participants (n = 294)

Variable	Compliant (n = 123)	Non-Compliant (n = 171)	p-value
Age (Mean ± SD)	51.6 ± 0.78	54.7 ± 10.2	0.040
Gender			0.725
Male	68 (55.3%)	91 (53.2%)	
Female	55 (44.7%)	80 (46.8%)	
Duration of Diabetes			0.513
≥ 5 years	76 (61.8%)	112 (65.5%)	
< 5 years	47 (38.2%)	59 (34.5%)	
Insulin Use			0.273
Yes	88 (71.5%)	112 (65.5%)	
No	35 (28.5%)	59 (34.5%)	
Education Level			0.0001*
High	92 (74.8%)	69 (40.4%)	
Low	31 (25.2%)	102 (59.6%)	
Monthly Income			0.0001*
≥ 30,000 PKR	94 (76.4%)	73 (42.7%)	
< 30,000 PKR	29 (23.6%)	98 (57.3%)	
**Statistically significant at $p < 0.05$*			

Self-monitoring of blood glucose (SMBG) frequency varied significantly between the compliant and non-compliant groups (Table 2). Among the compliant participants (n = 123), the majority (43.9%) reported monitoring their blood glucose daily, while 39.8% performed SMBG 2–3 times per week, and 16.3% checked once per week. In contrast, among the non-compliant group (n = 171), 65.5% reported rarely or never monitoring their blood glucose, and only 7.0% performed SMBG 2–3 times per week, while 27.5% reported checking their blood sugar just once per week. Notably, none of the non-compliant patients performed daily SMBG, highlighting a substantial gap in adherence to recommended glucose monitoring practices. Overall, only 18.4% of the total study population practiced daily monitoring, while 38.1% rarely or never monitored their blood glucose levels. These findings underscore the urgent need for behavioral and educational interventions to improve SMBG compliance in patients with uncontrolled diabetes. (Table 2)

Table 2: Self-Monitoring of Blood Glucose (SMBG) Frequency of Study Participants (n = 294)

SMBG Frequency	Compliant (n = 123)	Non-Compliant (n = 171)	p=value
Daily	54 (43.9%)	0 (0%)	0.0001
2–3 times per week	49 (39.8%)	12 (7.0%)	
Once per week	20 (16.3%)	47 (27.5%)	
Rarely/Never	0 (0%)	112 (65.5%)	

Analysis of acute and chronic complications revealed statistically significant differences between the two groups. Diabetic ketoacidosis (DKA) was more common among non-compliant patients (17.0%) compared to compliant patients (5.7%, $p = 0.002$). Severe hypoglycemia occurred in 21.1% of non-compliant patients versus 8.9% in the compliant group ($p = 0.004$). Regarding chronic microvascular complications, neuropathy was reported in 32.7% of non-compliant participants and 17.1% of compliant ones ($p = 0.003$). Similarly, diabetic retinopathy was significantly more prevalent in the non-compliant group (28.7%) than in the compliant group (12.2%, $p = 0.001$). Diabetic nephropathy was present in 24.0% of non-compliant patients, compared to only 8.1% of compliant patients ($p < 0.001$) (Table 3).

Table 3: Clinical Outcomes by SMBG Adherence of Study Participants (n = 294)

Clinical Outcome	Compliant (n = 123)	Non-Compliant (n = 171)	p-value
Diabetic Ketoacidosis (DKA)			0.002*
Yes	7 (5.7%)	29 (17.0%)	
No	116 (94.3%)	142 (83.0%)	
Severe Hypoglycemia			0.004*
Yes	11 (8.9%)	36 (21.1%)	
No	112 (91.1%)	135 (78.9%)	
Diabetic Neuropathy			0.003*
Yes	21 (17.1%)	56 (32.7%)	
No	102 (82.9%)	115 (67.3%)	
Diabetic Retinopathy			0.001*
Yes	15 (12.2%)	49 (28.7%)	

No	108 (87.8%)	122 (71.3%)	
Diabetic Nephropathy			<0.001*
Yes	10 (8.1%)	41 (24.0%)	
No	113 (91.9%)	130 (76.0%)	
**Statistically significant at p < 0.05*			

DISCUSSION

This study aimed to evaluate the prevalence of non-compliance with self-monitoring of blood glucose (SMBG) among patients with uncontrolled type 2 diabetes mellitus and to assess its association with acute and chronic diabetic complications. The findings revealed that a substantial proportion (58.2%) of participants were non-compliant with routine SMBG, and this non-compliance was significantly associated with a higher incidence of diabetic ketoacidosis (DKA), severe hypoglycemia, and chronic microvascular complications including neuropathy, retinopathy, and nephropathy.

The observed non-compliance rate aligns with findings from a study conducted in a South Asian population, which reported that more than half of diabetic patients failed to monitor their blood glucose regularly[17]. The association between SMBG non-adherence and higher frequency of DKA observed in this study is also consistent with another study that found significantly increased DKA episodes among patients who did not monitor their blood glucose levels routinely[18]. It was suggested that failure to detect early hyperglycemia due to poor monitoring increases the risk of progression to DKA.

The present study also found a significantly higher rate of severe hypoglycemia among non-compliant patients (21.1%) compared to those who were compliant (8.9%). This trend is supported by a study in a tertiary care setting that demonstrated increased risk of undetected hypoglycemic episodes in patients with poor SMBG practices, emphasizing the role of regular monitoring in preventing hypoglycemia-related hospitalizations[19]. Another study reported that patients who engaged in structured SMBG were more capable of detecting asymptomatic hypoglycemia and initiating timely corrective measures[20].

Regarding chronic complications, the current study showed a markedly higher prevalence of diabetic neuropathy in non-compliant individuals (32.7%) than in compliant ones (17.1%). Similar results were reported in a regional study where SMBG compliance was inversely related to the development of peripheral neuropathy[21]. The consistent monitoring of glucose levels likely allows for tighter glycemic control, which is known to delay the onset of neuropathic changes[6].

The incidence of diabetic retinopathy was also significantly greater in the non-compliant group (28.7%) compared to the compliant group (12.2%). These results mirror those of another study where a higher retinopathy burden was seen among patients with poor self-monitoring habits[22]. In contrast, patients with regular SMBG were shown to have better visual outcomes

due to early intervention and glycemic adjustment.

The rate of diabetic nephropathy among non-compliant patients (24%) was almost threefold higher than that among compliant patients (8.1%). A study conducted in a similar low-resource healthcare setting identified a strong association between poor glucose monitoring and declining renal function, which they attributed to prolonged periods of hyperglycemia going unnoticed[23]. Another study confirmed that consistent SMBG played a pivotal role in maintaining microalbuminuria within control, thereby reducing the risk of progression to end-stage renal disease[24].

Demographic differences between the two groups, especially in terms of education and income, were statistically significant and appear to influence SMBG practices. A study on health literacy reported that patients with lower educational attainment were less likely to adhere to self-monitoring protocols, often due to limited understanding of the importance of glucose control[25, 26].

The findings of this study highlight the critical role of self-monitoring of blood glucose (SMBG) in the prevention of both acute and chronic complications among patients with uncontrolled type 2 diabetes mellitus. The significant association between non-compliance with SMBG and higher rates of diabetic ketoacidosis, hypoglycemia, neuropathy, retinopathy, and nephropathy underscores the need for integrating SMBG education into routine diabetic care. These results call for healthcare providers to emphasize SMBG adherence as a key behavioral target, especially in low-literacy and low-income populations where non-compliance rates tend to be higher. Furthermore, interventions such as subsidized glucose meters and strips, personalized counseling, and family involvement may enhance SMBG compliance and improve long-term glycemic outcomes.

There are various restrictions on this study. First, it was only carried out at one tertiary care facility, which might have limited how broadly the results can be applied. Second, self-reported information and medical records—which could be prone to inadequate recordkeeping and recollection bias—were used to evaluate SMBG compliance. Third, it is unable to determine a causal relationship between SMBG practices and clinical results due to the cross-sectional methodology. Finally, possible confounding variables like nutrition, physical exercise, and medication adherence were not completely taken into consideration.

CONCLUSION

According to this study, individuals with uncontrolled type 2 diabetes frequently fail to do routine self-monitoring of their blood glucose levels, which is strongly linked to an elevated risk of both acute and long-term problems. The two main factors influencing compliance were monthly income and educational attainment. In order to lower the burden of diabetic complications and enhance patient outcomes, these data highlight the necessity of focused interventions to increase SMBG adherence.

ETHICAL APPROVAL: The ERC gave Ethical Review approval.

CONSENT TO PARTICIPATE: Verbal Consent was taken from subject.

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AUTHOR'S CONTRIBUTION: All persons who meet authorship criteria are listed as authors, and all author's certify that they participated in work to take public responsibility of this manuscript. All author's read and approved the final manuscript.

RECOMMENDATION: The study's findings will provide insights into the prevalence of TT coverage among young female of sindh. This knowledge will be curcial for evidence-based recommendations to enhance the prevention of Tetanus Diseases through awareness about TT vaccination and hygiene birth practices.

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