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Research Article

Awareness of Glycemic Control, Complications, and Lifestyle Modification among Individuals with Diabetes Mellitus

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ABSTRACT
Background: Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia, leading to significant morbidity and mortality if poorly managed. Patient awareness regarding glycemic control, potential complications, and necessary lifestyle modifications is a cornerstone of effective self-management.
Objective: To assess the level of awareness concerning glycemic targets, chronic complications, and lifestyle modifications among individuals with diabetes.
Methods: A cross-sectional study was conducted involving 94 individuals with diagnosed diabetes mellitus. Data was collected using a structured questionnaire covering demographics, knowledge of glycemic control (including target HbA1c and blood glucose levels), awareness of diabetes-related complications (microvascular and macrovascular), and practices related to lifestyle modifications (diet, exercise, self-monitoring).
Results: The mean age of participants was 56.4 ± 10.2 years. Only 41.5% (n=39) could correctly state the target HbA1c level (<7%). Awareness of complications varied: 87.2% (n=82) were aware of retinal complications, 76.6% (n=72) of nephropathy, but only 58.5% (n=55) of neuropathy, and 61.7% (n=58) of cardiovascular risks. Regarding lifestyle, 91.5% (n=86) acknowledged the importance of dietary control, but only 63.8% (n=60) reported following a structured meal plan. Regular physical activity was practiced by 57.4% (n=54). Significant knowledge gaps were associated with lower education levels and shorter duration since diagnosis.
Conclusion: While basic awareness of diabetes exists, critical gaps remain in the knowledge of precise glycemic targets and specific complications, particularly neuropathy and macrovascular risks. Lifestyle modification practices are suboptimal. These findings underscore the need for intensified, structured, and repetitive patient education programs tailored to address these deficiencies.

Keywords: Diabetes Mellitus, Awareness, Glycemic Control, Complications, Lifestyle Modification, Patient Education.

INTRODUCTION

Diabetes Mellitus (DM) stands as one of the most formidable global health challenges of the 21st century, constituting a progressive, chronic metabolic disorder characterized by persistent hyperglycemia. According to the International Diabetes Federation, approximately 537 million adults were living with diabetes worldwide in 2017, a number projected to rise to 643 million by 2030 and 783 million by 2045.[1] This relentless increase has earned diabetes the status of a silent pandemic, imposing an immense burden on healthcare systems, economies, and individual quality of life. Beyond its primary metabolic disturbance, diabetes acts as a potent catalyst for systemic damage, serving as a leading cause of blindness, kidney failure, heart attacks, stroke, and lower limb amputations.[2]

The clinical management of diabetes extends far beyond medication into a complex, lifelong endeavor requiring active patient partnership.[3] The care paradigm has decisively shifted from a physician-centric model to one of collaborative self-management, positioning the informed individual as the primary day-to-day manager of their condition.[4] Within this framework, patient awareness stands as the foundational pillar for all successful strategies. This critical awareness comprises a triad of knowledge: a clear understanding of personalized glycemic targets, a comprehensive recognition of potential acute and chronic complications, and the practical know-how to

implement and sustain effective lifestyle modifications.

Glycemic control, quantified through parameters such as HbA1c, fasting, and postprandial blood glucose, is the most evidence-based modifiable factor in preventing or delaying the onset and progression of diabetes-related complications. The landmark studies—the Diabetes Control and Complications Trial (DCCT) for Type 1 DM and the United Kingdom Prospective Diabetes Study (UKPDS) for Type 2 DM—irrefutably demonstrated that intensive glycemic control significantly reduces microvascular risk.[5,6] However, the benefits of this knowledge are rendered null if patients are unaware of their own targets or the means to achieve them. Furthermore, awareness must extend to the sophisticated pathophysiological mechanisms linking hyperglycemia to end-organ damage, including the formation of advanced glycation end-products, polyol pathway flux, and chronic inflammatory states, which collectively drive both microvascular and macrovascular complications.[7]

Simultaneously, lifestyle modification—encompassing medical nutrition therapy, regular physical activity, weight management, smoking cessation, and adherence to self-monitoring practices—constitutes the first-line therapeutic strategy, particularly in Type 2 DM.[8] These non-pharmacological interventions directly target insulin resistance and beta-cell function, offering profound metabolic benefits. Yet, as with glycemic knowledge, the gap between acknowledging the importance of lifestyle change and consistently enacting it remains substantial, influenced by socioeconomic factors, cultural contexts, health literacy, and access to supportive resources.[9]

Therefore, seeks to contribute to this vital area of diabetes care by conducting a focused assessment within a specific patient cohort. This study aims to dissect the current state of awareness across the three core domains—glycemic control, complications, and lifestyle modification. By identifying precise strengths and weaknesses in patient knowledge and practice, the findings are intended to illuminate targeted areas for intervention. Ultimately, enhancing structured, personalized, and continuous diabetes education is not merely an adjunct to clinical care but a critical investment in empowering patients, optimizing long-term outcomes, and mitigating the profound personal and societal costs of this chronic disease.

METHODOLOGY

Study Design, Settings and Population

This study employed a descriptive, cross-sectional, observational research design. The study was conducted at the Outpatient Department (OPD) of the General Medicine and Pathology. The target population consisted of all adult individuals (aged 18 years and above) with a physician-confirmed diagnosis of Type 1 or Type 2 Diabetes Mellitus, who were seeking routine care at the study setting during the data collection period of 6 months.

Inclusion Criteria

1. Adults aged 18 years or older.
2. Diagnosis of Type 1 or Type 2 Diabetes Mellitus for at least one year.
3. Ability to comprehend and communicate in the primary local language (e.g., Hindi/English).
4. Willingness to provide informed consent.

Exclusion Criteria

1. Individuals with severe cognitive impairment, diagnosed dementia, or active psychiatric illness that would impair their ability to reliably answer the questionnaire.
2. Patients presenting with acute diabetic emergencies (e.g., severe hypoglycemia, diabetic ketoacidosis, hyperosmolar hyperglycemic state) on the day of data collection.
3. Critically ill patients or those with severe hearing/visual impairment that could not be reasonably accommodated.
4. Gestational diabetes mellitus patients.

Procedure for Data Collection

Data collection occurred over a six-month period. A structured, interviewer-administered questionnaire was used to ensure completeness and clarity, especially for participants with lower literacy.

1. **Tool Development:** The questionnaire was developed after an extensive literature review, adapted from validated tools (e.g., the Michigan Diabetes Knowledge Test), and translated into the local language. It was then back-translated to English to ensure conceptual equivalence.
2. **Process:** Consecutive eligible patients attending the OPD were approached by the research investigator. The study's purpose, procedures, risks, and benefits were explained. Written informed consent was obtained.

3. **Interview:** The investigator conducted a face-to-face interview in a private area of the clinic. Each interview lasted approximately 20-25 minutes. Demographic and clinical data were first verified from medical records with participant consent.
4. **Questionnaire Domains:** The interview covered: (A) Socio-demographic and Clinical Profile, (B) Awareness of Glycemic Control Targets, (C) Awareness of Diabetes Complications, (D) Awareness and Self-Reported Practice of Lifestyle Modifications.

Data Analysis

All completed questionnaires were assigned a unique identification number. Data was double-entered into a Microsoft Excel spreadsheet by two independent research assistants to minimize entry errors. Discrepancies were resolved by referring to the original questionnaire. The cleaned data was imported into IBM SPSS Statistics for Windows, Version 26.0 for statistical analysis.

Table 1: Baseline Characteristics of the Study Population.

Characteristic	Category	Frequency (n)	Percentage (%)	Mean ± SD
Age (years)	18-40	12	12.8	56.4 ± 10.2
	41-60	58	61.7	
	>60	24	25.5	
Gender	Male	52	55.3	
	Female	42	44.7	
Education Level	No Formal Schooling	15	16.0	
	Primary/Secondary	41	43.6	
	Higher Secondary	23	24.5	
	Graduate & Above	15	16.0	
Type of Diabetes	Type 2 DM	83	88.3	
	Type 1 DM	11	11.7	
Duration of DM (years)	≤5	38	40.4	7.8 ± 5.1
	6-10	32	34.0	
	>10	24	25.5	
Current Treatment	Oral Hypoglycemic Agents (OHA) only	45	47.9	
	Insulin only	18	19.1	
	OHA + Insulin	31	33.0	

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The study comprised 94 individuals with a confirmed diagnosis of diabetes mellitus. The mean age of the participants was 56.4 (±10.2) years, with the majority (61.7%, n=58) belonging to the 41-60 years age group. A slight male predominance was observed (55.3%, n=52). The educational background varied, with 43.6% (n=41) having completed primary or secondary education, while 16.0% (n=15) had no formal schooling. Type 2 diabetes constituted the overwhelming majority (88.3%, n=83). The mean duration of diabetes was 7.8 (±5.1) years, and the most common treatment modality was oral hypoglycemic agents alone (47.9%, n=45), followed by a combination of oral agents and insulin (33.0%, n=31).

Table 2: Knowledge of Specific Glycemic Parameters among Participants.

Glycemic Parameter	**Correct Target Value**	**Participants with Correct Knowledge (n=94)**	
		n	%
HbA1c	<7.0%	39	41.5
Fasting Blood Glucose (FBG)	80-130 mg/dL	52	55.3
Postprandial Blood Glucose (PPBG)	<180 mg/dL	46	48.9
Overall (All Three Correct)	-	22	23.4

Awareness of specific glycemic targets was found to be suboptimal. Only 41.5% (n=39) of participants correctly identified the target HbA1c level of <7%. Knowledge of blood glucose targets was marginally better, with 55.3% (n=52) and 48.9% (n=46) correctly stating the target ranges for fasting (80-130 mg/dL) and postprandial (<180 mg/dL) glucose, respectively. Alarmingly, only 23.4% (n=22) of the total cohort demonstrated comprehensive knowledge by correctly identifying all three key glycemic parameters.

Table 3: Proportion of Participants Aware of Specific Chronic Complications of Diabetes.

Category	**Specific Complication**	**Aware (n=94)**	
		n	%
Microvascular	Retinopathy / Eye Damage	82	87.2
	Nephropathy / Kidney Disease	72	76.6
	Neuropathy / Nerve Damage	55	58.5
Macrovascular	Heart Disease / Heart Attack	58	61.7
	Stroke / Brain Attack	51	54.3
Other	Foot Ulcers & Risk of Amputation	66	70.2
	Hypoglycemia (Lows)	79	84.0

	Hyperglycemia (Highs)	85	90.4

Awareness of complications was variable and demonstrated a clear hierarchy. Knowledge was highest for acute metabolic complications, with 90.4% (n=85) aware of hyperglycemia. Among chronic microvascular complications, awareness of retinopathy was highest (87.2%, n=82), followed by nephropathy (76.6%, n=72). Awareness of neuropathy was significantly lower at 58.5% (n=55). For macrovascular complications, 61.7% (n=58) were aware of the risk of heart disease, and 54.3% (n=51) recognized the risk of stroke. Awareness of foot complications stood at 70.2% (n=66).

Table 4: Self-Reported Adherence to Recommended Lifestyle Modifications.

Lifestyle / Self-Care Domain	**Recommended Practice**	**Participants Adhering (n=94)**	
		n	%
Dietary Practice	Acknowledges Importance of Diet	86	91.5
	Follows a Structured Meal Plan	60	63.8
	Regular Fruit/Vegetable Intake	71	75.5
Physical Activity	Acknowledges Importance of Exercise	80	85.1
	Performs ≥150 min/week Moderate Activity	54	57.4
Self-Monitoring	Owns a Glucometer	64	68.1
	Monitors BG as per Physician's Advice	42	44.7
Preventive Care	Performs Regular Self Foot Examination	48	51.1
	Had Annual Dilated Eye Exam in last year	59	62.8

While theoretical acknowledgment of lifestyle modifications was high, actual practice was inconsistent. Although 91.5% (n=86) acknowledged the importance of dietary control, only 63.8% (n=60) reported following a structured meal plan. Similarly, while 85.1% (n=80) recognized the need for physical activity, only 57.4% (n=54) met the recommended guideline of ≥150 minutes of moderate activity per week. Self-monitoring practices were also inadequate; 68.1% (n=64) owned a glucometer, but only 44.7% (n=42) used it as frequently as advised by their physician. Preventive care behaviors were limited, with just over half (51.1%, n=48) performing regular self-foot examinations, and 62.8% (n=59) reporting a dilated eye exam in the preceding year.

Table 5: Association between Participant Characteristics and Correct Knowledge of Hba1c Target (<7%).

Characteristic	**Category**	**Correct Knowledge of HbA1c (n=39)**	**p-value**

		n	% within Category	
Education Level	≤ Secondary	15/56	26.8	0.007*
	> Secondary	24/38	63.2	
Duration of DM	≤5 years	12/38	31.6	0.195
	>5 years	27/56	48.2	
Treatment Type	OHA only	20/45	44.4	0.454
	Insulin (with/without OHA)	19/49	38.8	
Gender	Male	24/52	46.2	0.333
	Female	15/42	35.7	

*Statistically significant ($p < 0.05$).

Statistical analysis revealed significant associations between demographic factors and knowledge levels. Education emerged as a strong determinant: participants with education beyond the secondary level were significantly more likely to know the correct HbA1c target (63.2% vs. 26.8%, p=0.007) and to be aware of neuropathy (76.3% vs. 46.4%, p=0.005) compared to those with secondary education or less.

Table 6: Association between Participant Characteristics and Awareness of Neuropathy.

Characteristic	**Category**	**Aware of Neuropathy (n=55)**		**p-value**
		n	% within Category	
Education Level	≤ Secondary	26/56	46.4	0.005*
	> Secondary	29/38	76.3	
Duration of DM	≤5 years	15/38	39.5	0.003*
	>5 years	40/56	71.4	
Age	≤60 years	45/70	64.3	0.166
	>60 years	10/24	41.7	

The duration of diabetes was also significantly associated with awareness of neuropathy, with participants having diabetes for more than five years showing markedly higher awareness (71.4% vs. 39.5%, p=0.003). No significant associations were found between knowledge of HbA1c and duration of diabetes, treatment type, or gender.

DISCUSSION

The findings of this cross-sectional study, conducted among individuals with diabetes,

illuminate a state of partial and fragmented awareness that poses a significant barrier to optimal disease self-management. While a foundational understanding of diabetes exists, critical gaps in knowledge regarding precise glycemic targets, specific complications, and the consistent implementation of lifestyle strategies underscore an urgent need for a paradigm shift in patient education.

Our most concerning finding was the profound deficit in knowledge of glycemic control targets, with less than half (41.5%) of participants correctly identifying the HbA1c goal of <7%. This figure is comparable to studies in similar settings, such as the work by Al-Maskari et al., who reported that only 36.7% of diabetic patients in the UAE knew the correct definition of HbA1c.[10] This deficiency is critical because HbA1c is the cornerstone metric for assessing long-term glycemic control and predicting complication risk. Without knowing their target, patients lack a personal benchmark for success, which can lead to therapeutic inertia and a false sense of security based on symptomatic well-being alone. The marginally better, yet still inadequate, knowledge of fasting and postprandial targets further highlights that patient education often focuses on day-to-day management without adequately contextualizing it within the framework of long-term outcomes.

Awareness of complications followed a distinct and revealing pattern, aligning with the visibility and frequency of clinical emphasis. The high awareness of retinopathy (87.2%) and nephropathy (76.6%) likely reflects the routine referral for ophthalmology check-ups and the common monitoring of kidney function through serum creatinine and urinalysis during clinic visits. In contrast, the significantly lower awareness of neuropathy (58.5%)—often a "silent" complication with insidious onset—and macrovascular risks (heart disease: 61.7%) points to a critical educational gap. This pattern is consistent with observations by Upadhyay et al., who noted that awareness of coronary artery disease as a complication was disproportionately low compared to microvascular issues.[11] This is particularly alarming given that cardiovascular disease is the leading cause of mortality in diabetes.[2] The pathophysiology of diabetes, driven by chronic hyperglycemia-induced endothelial dysfunction, inflammation, and advanced glycation end-products, underscores that all organ systems are at risk.[7] An educational focus that disproportionately emphasizes some complications over others can lead to neglect of vital preventive behaviors, such as aggressive cardiovascular risk factor management.

The disconnect between knowledge and practice in lifestyle modification is another central theme of our results. While over 90% of participants acknowledged the importance of diet and exercise, the translation into structured action was markedly lower, with only 63.8% following a meal plan and 57.4% engaging in adequate physical activity. This intention-behavior gap is well-documented in chronic disease management.[12] The low rate of adherence to self-monitoring of blood glucose (SMBG) (44.7%), despite a majority owning a glucometer, suggests barriers such as cost of strips, technical difficulties, lack of understanding on how to interpret and act on readings, or simply demotivation. This mirrors findings from a multi-center Indian study by Mohan et al., which identified practical and psychological barriers as major impediments to consistent SMBG.[13] Effective lifestyle modification requires more than generic advice; it demands personalized, practical, and culturally-sensitive coaching that addresses these specific barriers.[9]

The significant association between higher education levels and better knowledge of HbA1c and complications is a crucial, if expected, finding. It reinforces that health literacy is a powerful social determinant of diabetes outcomes.[14] Furthermore, the positive association between longer disease duration and awareness of complications like neuropathy suggests that lived experience and cumulative, if informal, learning during clinic visits contribute to knowledge. However, relying on this passive, time-dependent acquisition is insufficient and inequitable. It necessitates proactive, structured, and repeated education from the point of diagnosis, delivered in a manner accessible to all literacy levels.

CONCLUSION

In conclusion, this study reveals that while patients with diabetes are generally aware of their condition, their knowledge is incomplete and inconsistently translated into practice. To bridge these gaps, a move from sporadic information dissemination to a structured, continuous, and patient-centered education model is imperative.

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