ORIGINAL ARTICLE

Poor glycemic control and associated factors among Type 2 Diabetes Mellitus patients at a Tertiary Health Care facility

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ABSTRACT

Background: Poor glycemic control in type 2 diabetes mellitus (T2DM) patients is a major concern, as it can lead to serious complications. Understanding the factors contributing to poor glycemic control is essential for developing interventions to improve diabetes management and patient outcomes. **Aim and Objective:** This study aims to identify the factors associated with poor glycemic control among T2DM patients attending a tertiary health care facility. **Setting and Design:** A cross-sectional study was conducted in the Medicine Outpatient Department (OPD) of a tertiary care hospital. The study included 179 T2DM patients, selected using systematic random sampling. **Material & Methods :** Data were collected on socio-demographic characteristics, dietary habits, physical activity, medication adherence, and clinical parameters, including HbA1c levels. The study evaluated how these factors influenced glycemic control among the participants. **Result**: Factors such as lower educational attainment, non-vegetarian diet, high fasting and postprandial blood sugar levels, and elevated BMI were associated with poor glycemic control. Multivariate analysis revealed that a non-vegetarian diet (aOR: 2.35), random blood sugar >140 mg/dl (aOR: 3.91), postprandial blood sugar >140 mg/dl (aOR: 5.13), and education up to junior school level (aOR: 7.04) were independently linked to poor glycemic control. **Conclusion:** Addressing these factors through targeted interventions, such as educational programs and dietary adjustments, is essential for improving glycemic control and overall patient outcomes.

KEYWORDS

Type 2 Diabetes Mellitus; Glycemic Control; Cross-Sectional Study; Socio-Demographic Factors; Dietary Habits.

INTRODUCTION

Diabetes Mellitus (DM) is an escalating global health issue, with projections indicating that 98 million Indians could have diabetes by 2030.(1) This prediction is driven by current figures, historical trends, changing risk factors such as diet and physical activity, and demographic shifts. Over the past five years, the global diabetes landscape has significantly evolved.(2) The COVID-19 pandemic in 2020 highlighted the increased vulnerability among diabetics, with cases rising to 465 million.(3) By 2021, the prevalence reached 9.6%, and research emphasized the link between obesity and type 2 diabetes, prompting public health initiatives aimed at lifestyle changes.(4) By 2023, the prevalence was 10.5%, with over 77 million adults in India diagnosed with diabetes, prompting increased

focus on early diagnosis and lifestyle modifications.(1)
By 2023, the prevalence rate reached 10.2%, with increased awareness of complications such as cardiovascular diseases and neuropathy prompting enhanced healthcare interventions.(1)
Effective diabetes management requires a combination of insulin for type 1 diabetes and oral hypoglycemic drugs for type 2, along with lifestyle modifications and dietary control. Self-management and education are critical components of diabetes care. Glycemic control is monitored through the HbA1c test, which measures average blood sugar levels over the past 2 to 3 months. The American Diabetes Association recommends an HbA1c goal of less than 6.5 % for adults.
Despite extensive research on diabetes prevalence and risk factors, there is limited data on poor glycemic control among treated diabetes patients.

Aims & Objectives: This study aims to determine the prevalence of poor glycemic control in type 2 diabetes patients at a tertiary healthcare facility and identify associated factors.

Material & Methods

This cross-sectional study focused on type 2 diabetes mellitus patients attending the Medicine OPD of a tertiary care hospital. The study aimed to enroll 179 participants, based on a previous study that reported a 38.9% prevalence of poor glycemic control among diagnosed diabetic patients. Assuming a similar prevalence with an allowable relative error of 20%, the sample size was calculated to be 153. To account for potential dropouts, an additional 15% was included, resulting in a total sample size of around 179.
Systematic random sampling was used, with approximately 20-25 patients attending the OPD daily for follow-up. To achieve the desired sample size, 5 consenting participants were selected each day with a sampling interval of 4. On the first day, the initial participant was chosen using a random number, and subsequently, every fourth patient meeting the inclusion criteria was enrolled.

Inclusion criteria included patients under treatment for more than six months, aged 40 to 65 years, and on oral anti-diabetic drugs. Exclusion criteria included patients on insulin therapy and those with diabetes-related complications. Prior to participation, informed consent was obtained from all patients, and ethical clearance was secured from the institutional review board.
Data on socio-demographic characteristics, physical activity (assessed using the WHO-STEPS questionnaire), dietary habits (assessed using a 24-hour recall), medications, and past treatment history were collected using a pre-designed schedule. Blood samples were collected in EDTA vials for HbA1c estimation, and laboratory analyses were conducted according to standardized protocols to ensure accuracy and reliability.

Data were collected daily and entered into an MS Excel sheet. Descriptive statistics, including frequencies, proportions, graphs, and cross-tabs, were used to present the study results. Statistical significance was tested at the 5% level using the Chi-Square test and multivariate logistic regression to determine associations between risk factors and poor glycemic control. The analysis was performed by using SPSS 26.0 version statistical software to ensure precise calculations and interpretation of results.

Results

A total of 179 eligible participants with type-2 diabetes mellitus were enrolled after giving their consent. The median age of the patients was 50 years, with 56.4% male and 43.6% female. The majority were married (95.53%), identified as Hindu (86.60%), and resided in urban areas (67.6%) with joint family setups (72.62%). Education levels varied, with 22.34% lacking formal education and 23.46% having only primary education. Most participants (82.68%) belonged to the upper socioeconomic class, with 39.66% being housewives and 40.22% retired professionals. Anthropometric measurements revealed high waist-hip ratios in males (89.1%) and females (98.7%), and 60.33% had a BMI exceeding 25. (Figure 1) Out of 179 Type 2 diabetic pts 69 (35%) had Hb1Ac >7.5%. Burden of UDM were 35% among diabetic pts. (Table 1) (Figure 2)

Figure 1 Anthropometric Measurements of People with Type 2 Diabetes Mellitus

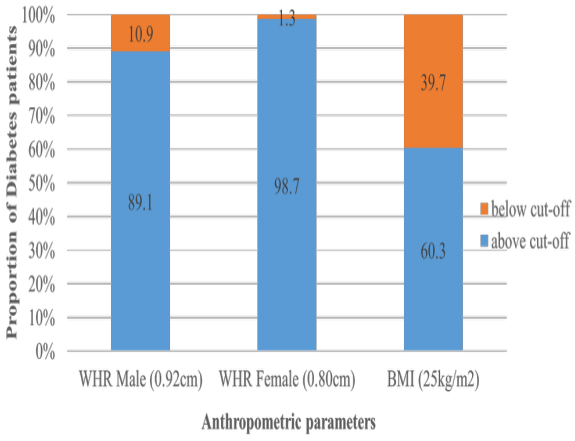
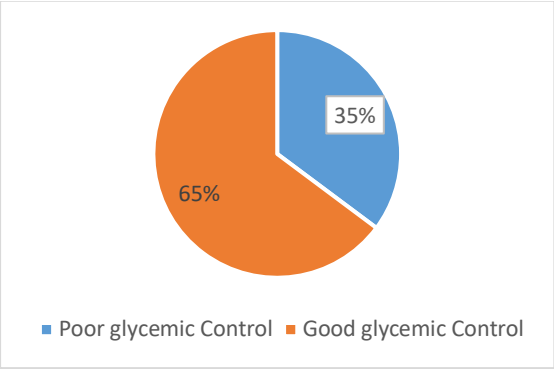


Figure 2 Prevalence of poor glycemic control in type 2 diabetes patients at a tertiary healthcare facility



The majority were on oral hypoglycemic treatment (84.12%), with some on insulin therapy (9.52%) or both (6.34%). Hypertension was a common comorbidity (50.79%), and 68.25% received treatment from government hospitals.(Table3)
Univariable analysis showed significant associations between uncontrolled diabetes mellitus (UDM) and certain factors. Participants without formal education had a higher likelihood of UDM (23.8%, p=0.02). Addiction (23.08%, p=0.05) and adherence to a vegetarian diet (49.20%, p=0.006) were notable factors influencing blood sugar control.(Table 2) Elevated fasting blood sugar levels above 126 mg/dl (p=0.007), random blood sugar levels over 200 mg/dl (p ≤0.02), and postprandial blood sugar levels greater than 200 mg/dl (p=0.01) were significant biochemical parameters associated with UDM.(Table4)
Among UDM Pts 23.8% forget to take medicine on time. About 13% not taken Medicine without consulting Doctor. 95% carry medicine while going to travel. (Table 5)
Multivariable logistic regression analysis identified several independent factors associated with UDM. Consuming a non-vegetarian diet (aOR: 2.35, 95% CI: 1.11-5.09), random blood sugar levels greater than 140 mg/dl (aOR: 3.91, 95% CI: 1.48-11.98), postprandial blood sugar levels above 140 mg/dl (aOR: 5.13, 95% CI: 1.36-27.14), and education up to junior school level (aOR: 7.04, 95% CI: 1.87-30.54) were independently associated with UDM. These findings suggest that dietary choices, blood sugar levels, and educational background significantly contribute to the likelihood of developing UDM.(Table 6)

Table 1 Anthropometric measurements of people with type 2 diabetes mellitus

	Anthropometric measurements	Uncontrolled diabetics (63) N (%)	Controlled diabetics (116) N (%)	Total (179)	P value
Waist hip ratio (Male)	>0.92	32 (82.05)	58 (93.5)	90 (89.1)	0.14
	≤0.92	7 (17.94)	4 (6.5)	11 (10.9)	
Waist hip ratio (Female)	>0.80	24 (100.0)	53 (98.1)	77 (98.7)	0.99
	≤0.80	0	1 (1.9)	1 (1.3)	
Body Mass Index (Kg/m2)	<19.5	1 (01.58)	6 (5.17)	7 (3.91)	0.216
	19.5- 22.9	17 (26.98)	18 (15.51)	35 (19.55)	
	23.0- 24.9	10 (15.87)	19 (16.37)	29 (16.20)	
	≥ 25	35 (55.55)	73 (62.93)	108 (60.33)	

Table 2: Factors affecting control of blood sugar in people with type 2 diabetes mellitus

Associated factors	Uncontrolled diabetics (63) N (%)	Controlled diabetics (116) N (%)	Total (179)	P value
Addiction present	15 (23.80)	22 (18.96)	37 (20.67)	0.05
Sleep >7 hours	28 (44.44)	54 (46.55)	82 (45.81)	0.91
Waking >2 times at night	9 (14.28)	23 (19.82)	32 (17.87)	0.47
Daily physical activity	23 (36.50)	38 (32.75)	61 (34.07)	0.73
Taking food on time	49 (77.77)	98 (84.48)	147 (82.13)	0.36
Using unrefined flour	55 (87.30)	102 (87.93)	157 (87.70)	0.91
Consuming fruits & veggies daily	30 (47.61)	50 (43.10)	80 (44.69)	0.67
Vegetarian foods only	31 (49.20)	81 (69.82)	112 (62.56)	0.006
Consuming junk food	47 (74.60)	97 (83.62)	144 (80.44)	0.21
Consuming sugar in tea/ coffee	43 (68.25)	82 (70.68)	125 (69.83)	0.73
Consuming sweet items	16 (25.39)	28 (24.13)	44 (24.58)	0.99

Table 3: Treatment history and comorbidities in people with type 2 diabetes mellitus

Treatment history and comorbidities	Uncontrolled diabetics (63) N (%)	Controlled diabetics (116) N (%)	Total (179)	P value
Treatment started with				
Oral hypoglycaemic agents only	53 (84.12)	101 (87.06)	154 (86.04)	0.69
Insulin only	6 (9.52)	7 (6.03)	13 (7.26)	
Both	4 (6.34)	8 (6.89)	12 (6.70)	
Taking any other modality of treatment	10 (15.87)	12 (10.34)	22 (12.29)	0.40
Comorbidities				
Hypertension (>140/90mmHg)	32 (50.79)	56 (48.27)	88 (49.17)	
Place of treatment				
Government hospital	43 (68.25)	73 (62.93)	116 (64.8)	0.54
Medical store/online	21 (33.33)	40 (34.48)	61 (34.08)	

Table 4: Biochemical parameters in people with type 2 diabetes mellitus

Biochemical parameters (Blood sugar testing)	Uncontrolled diabetics (63) N (%)	Controlled diabetics (116) N (%)	Total (179)	P value
Home	10 (28.57)	25 (21.55)	35 (19.55)	0.36
Laboratory	53 (36.81)	91 (78.44)	144 (80.45)	
Fasting >126	54 (41.54)	76 (65.51)	130 (72.63)	0.007
Random blood sugar >200	35 (45.45)	42 (36.20)	77 (43.0)	0.02
Post prandial >200	47 (46.07)	55 (47.41)	102 (57.0)	0.01

Table 5: Medication adherence in people with type 2 diabetes mellitus

Medication adherence	Uncontrolled diabetics (63) N (%)	Controlled diabetics (116) N (%)	Total (179)	P value
Forget to take Medicine	15 (23.80)	22 (18.96)	37 (20.67)	0.45
Not taken Medicine without consult Doctor	8 (12.69)	13 (11.20)	21 (11.3)	0.77
Taken Medicine while going to travel	60 (95.23)	107 (92.24)	167 (93.30)	0.44
Do you take yesterday medicine	58 (92.06)	109 (93.9)	167 (93.3)	0.63
Irregular Medicine due to long duration of treatment	15 (23.80)	20 (17.24)	35 (19.55)	0.29
Difficult to Remember to take Medicine	40 (63.49)	82 (70.68)	122 (68.16)	0.38

Table 6: Multilogistic Regression Analysis of Predictors for Uncontrolled diabetes Mellitus

Variable	Univariate Logistic Regression Analysis			Multivariate Logistic Regression Analysis			P value
	Odds Ratio (OR)	95% Confidence Interval		Adjusted Odds Ratio (OR)	95% Confidence Interval		
		Lower Limit	Upper Limit		Lower Limit	Upper Limit	
Veg and non-Veg diet							
Non-Veg	2.19	1.17	4.12	2.35	1.11	5.09	0.028
Veg	Reference						
Random Blood Sugar							
>140	4.01	1.68	11.16	3.91	1.48	11.98	0.011
<=140	Reference						
Post Prandial Blood Sugar							
>140	4.40	1.43	19.22	5.13	1.36	27.14	0.032
<=140	Reference						
Education							
Junior	4.46	1.02	23.85	8.25	1.63	53.34	0.018
Primary	Reference						
High School	5.35	1.64	19.88	7.04	1.87	30.54	0.006
Junior	Reference						

DISCUSSION

This study provides important insights into the socio-demographic and clinical characteristics associated with uncontrolled diabetes mellitus (UDM) in a cohort of type 2 diabetes patients attending a tertiary care hospital. A notable finding is that a significant portion of the study participants lacked formal education (22.34%) or had only primary education (23.46%). This aligns with previous studies that have identified low educational attainment as a risk factor for poor diabetes management and control. Education is a critical factor in understanding and managing chronic diseases, and lower educational levels are often associated with limited health literacy, which can hinder effective self-management of diabetes, as shown in studies by Alang et al. in 2019 and Zhang et al. in 2017. (7,8)

The median age of participants was 50 years, with a higher prevalence of male participants (56.4%). These demographics are consistent with the general epidemiology of type 2 diabetes, which often presents in middle-aged and older adults and has a slightly higher prevalence in males, according to Cho et al. in 2018.9 However, gender differences in diabetes management and outcomes require further investigation to develop gender-specific interventions, as noted by Kautzky-Willer et al. in 2016.(10) The overwhelming majority of participants were married (95.53%) and predominantly Hindu (86.60%), reflecting the general demographics of the region. Marital status has been linked to better health outcomes in chronic diseases, including diabetes, possibly due to spousal support in disease management, as indicated by Rapp et al. in 2017.(11)

The study found a high prevalence of urban residency (67.6%) and joint family setups (72.62%) among participants. Urban living may offer better access to healthcare facilities but also presents challenges such as lifestyle changes that can negatively impact diabetes control, as highlighted by Ramachandran et al. in 2018.(12) Joint family setups may provide better social support, which can be beneficial for managing chronic illnesses, according to Deepa et al. in 2014.(13) A majority of participants (82.68%) belonged to the upper socioeconomic class, with a substantial portion being housewives (39.66%) or retired professionals (40.22%). This might reflect a selection bias inherent in the hospital's patient population. Socioeconomic status influences access to healthcare, quality of diet, and opportunities for physical activity, all of which are crucial for diabetes management, as discussed by Agardh et al. in 2011. (14)

The study also highlights that a high waist-hip ratio was prevalent among males (89.1%) and females (98.7%), and a significant proportion of participants had a BMI exceeding 25 (60.33%). These findings underscore the well-established association between obesity and poor glycemic control, as described by Lakka et al. in 2002.(15) This emphasizes the need for targeted interventions to address obesity in diabetes management programs. Most participants were on oral hypoglycemic agents (84.12%), with a smaller proportion on insulin therapy (9.52%) or both (6.34%). This distribution is typical for type 2 diabetes management but suggests potential gaps in optimizing therapy to achieve better glycemic control, as identified by Nathan et al. in 2009.16 Hypertension, a common comorbidity (50.79%), aligns with the known association between diabetes and cardiovascular risk factors. Effective management of comorbid conditions is essential for reducing the overall disease burden and improving patient outcomes, as discussed by Stamler et al. in 1993.(17)

Univariable analysis revealed significant associations between UDM and factors such as lack of formal education, addiction, and adherence to a vegetarian diet. These findings are consistent with other studies highlighting the impact of socio-demographic and lifestyle factors on diabetes control, such as those by Kirkman et al. in 2012.(18) Multivariable logistic regression analysis further identified that a non-vegetarian diet, high random blood sugar, high postprandial blood sugar, and lower education levels were independently associated with UDM. These findings suggest that dietary choices and blood sugar levels are critical factors in managing diabetes effectively. Previous research supports the role of diet in glycemic control, reinforcing the need for dietary modifications in diabetes management, as evidenced by Barnard et al. in 2009.(19)

CONCLUSION

This study highlights critical factors influencing uncontrolled diabetes mellitus (UDM) among type 2 diabetes patients, including low educational attainment, non-vegetarian diet, and elevated blood sugar levels. Key findings indicate that lower education levels, high waist-hip ratios, and non-vegetarian diets are significantly associated with UDM.

RECOMMENDATION

The prevalence of obesity and poor glycemic control emphasizes the need for targeted

interventions such as educational programs, dietary counseling, and obesity management to improve patient outcomes. Addressing these factors through adapted strategies could enhance diabetes management and ease complications associated with uncontrolled diabetes.

LIMITATION OF THE STUDY

The study has several limitations, including its cross-sectional design, which limits causal inference, and the potential for selection bias due to the hospital-based setting. Additionally, the reliance on self-reported data for some variables may introduce reporting bias.

RELEVANCE OF THE STUDY

The study underscores the importance of addressing socio-demographic factors, optimizing therapeutic interventions, and promoting lifestyle modifications, including dietary changes, to effectively manage diabetes and reduce the prevalence of uncontrolled diabetes mellitus in the patient population. Addressing these factors through comprehensive diabetes education, lifestyle modifications, and optimized treatment regimens is essential for improving outcomes in type 2 diabetes patients. These findings provide valuable insights for healthcare providers to enhance diabetes management and patient outcomes.

AUTHORS CONTRIBUTION

Concept & Design RK, editing NS, Investigation RK, Manuscript Writing CS & SU, statistical Ananlysis KAS & editing SDK.

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Nil

CONFLICT OF INTEREST

Nil

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DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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