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Prevalence and Determinants of poor Glycemic Control in adults with Type 2 Diabetes Mellitus: A study from an urban population in Nadia district

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ABSTRACT

Background

India is known as the "diabetic capital of the world" and has the second-highest rate of adult diabetes globally. One of the main causes of the diabetes epidemic in India is urbanisation. In patients with Type 2 diabetes, inadequate glycaemic management is a major public health concern and a major risk factor for the disease's progression and complications. Therefore, the purpose of this study is to evaluate the glycaemic control status and factors that contribute to poor glycaemic control in individuals with type 2 diabetes.

Materials and Methods

This is a cross-sectional study done over a period of four months, among patients with T2DM attending the College of Medicine and JNM hospital, Kalyani and UHTC Chakdah State General Hospital, Nadia district, West Bengal, using a pre-tested semi-structured questionnaire. A total of 200 patients with T2DM who had the latest reports of fasting blood sugar values were included in the study. SPSS version 26 was used to analyse the collected data and to identify the determinants and risk factors leading to poor glycaemic control.

Results

Of the 200 study participants, 62.5% had poor glycaemic control. The mean FBS value of the study group was 145.59 ± 42.57 mg/dL. Further, it was found that irregular check-ups, type of medication, and non-adherence to a diabetic diet were risk factors for poor glycaemic status.

Conclusion

It was shown that a significant number of diabetics had poor glycaemic control; therefore, to effectively manage this condition and lessen the burden of the disease, appropriate health education, diabetes counselling, and the planning of health awareness programs are required.

Keywords Diabetes, exercise, non-adherence, overweight, risk factors

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INTRODUCTION

Diabetes is a chronic medical disorder impacting 463 million individuals globally, with projections indicating an increase to 578 million by 2030 and 700 million by 2045. Approximately two-thirds of individuals with diabetes reside in metropolitan areas, and three-quarters belong to the working-age demographic. An estimated 136 million individuals aged 65 and older have diabetes. [1] India is commonly known as the "diabetic capital of the world" and has the second-highest population of adults with diabetes globally. Urbanisation is a primary factor contributing to the diabetes epidemic in India; yet, numerous studies indicate that South Asians exhibit heightened susceptibility to diabetes compared to other ethnicities. [2] Therefore, if we don't implement appropriate corrective measures by 2045, we project the population of individuals with diabetes to reach approximately 134 million. [3] Patients often perceive type 2 diabetes as a "silent disease," remaining asymptomatic for extended periods. Nonetheless, the prolonged undetection and lack of treatment for poor glucose metabolism exacerbate chronic organ problems. Consequently, early detection of diabetes is crucial to implement suitable measures and prevent severe organ problems. [4] Diabetes presents a range of potential long-term consequences on the vascular system, commonly categorised as microvascular and macrovascular problems. [5] Microvascular complications such as end-stage renal disease (ESRD), retinopathy, neuropathy, and lower-extremity amputations (LEA) significantly increase the burden of diabetes. [6] People with diabetes increasingly acknowledge a diverse array of causally linked illnesses, including malignancies, age-related outcomes (e.g., dementia), infections, and liver disease. The management of diabetes aims to delay the emergence of disease complications and inhibit its progression, chiefly by enhancing glycaemic control and mitigating the risk of cardiovascular disease. [7]

Effective glycaemic management can mitigate microvascular and macrovascular consequences of diabetes; nonetheless, over fifty per cent of patients globally exhibit inadequate glycaemic control. Prior research has indicated that numerous factors can influence inadequate glycaemic control, including age, gender, education, socioeconomic level, marital status, duration of diabetes, type of medication, and smoking and alcohol consumption. Nonetheless, it is challenging to ascertain which factors are most directly linked to inadequate glycaemic control, given that these factors change across nations and among various ethnic groups. [8] This study is to evaluate the glycaemic status of individuals with type 2 diabetes mellitus and identify the risk factors contributing to suboptimal glycaemic control in Kalyani city.

Methodology

This cross-sectional study was conducted among 200 patients with Type 2 Diabetes Mellitus (T2DM) who attended the "Lifestyle Clinic" of a College of Medicine and JNM hospital, Kalyani and UHTC Chakdah State General Hospital, Nadia district, West Bengal, from October 2024 to January 2025.

The study included patients with type 2 diabetes mellitus aged over 18 years who underwent fasting blood glucose assessment using a glucometer. Exclusion criteria were patients with gestational diabetes and those with mental or physical disabilities. The Institutional Ethics Committee approved the study, and informed consent was acquired from participants following an explanation of the study's goal and procedure.Sample size: Considering a prevalence of 59% from a prior study in Karnataka [9], with a confidence interval of 95% and an absolute precision of 7%, the determined sample size is 182.

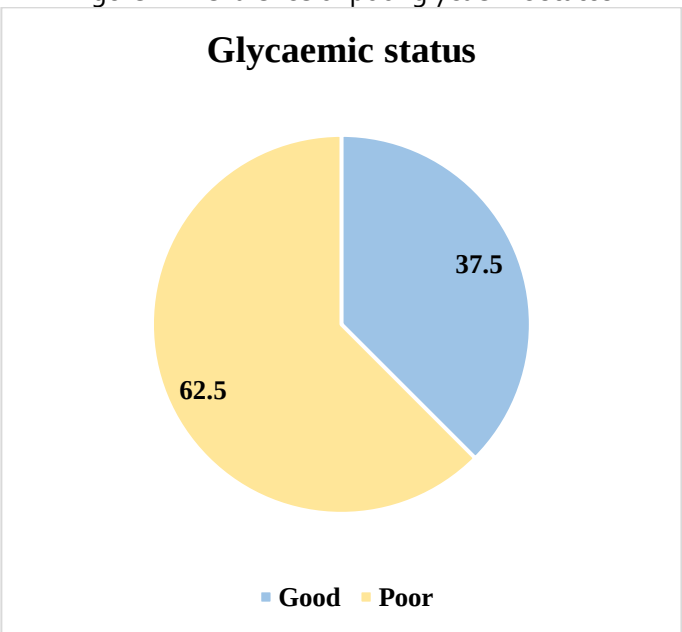
Thus, a sample size of 182 must be examined, which will be rounded to 200 diabetic patients. All patients who attended the 'Lifestyle clinic' and fulfilled the inclusion criteria will be chosen for the study until the necessary sample size is attained. The sampling technique used will be convenience sampling. Well-defined inclusion and exclusion criteria were applied to ensure a relevant and homogeneous study population, participants were recruited from two separate healthcare facilities, improving the diversity and representativeness of the sample, recruitment was done continuously until the target sample size was achieved, reducing

temporal or selective recruitment bias, a pre-tested, validated questionnaire (Cronbach's alpha = 0.723) was used to ensure consistency in data collection, a pilot study was conducted to refine the tool and methodology before final data collection, the limitations of the sampling method were acknowledged transparently in the manuscript. Data regarding age, gender, marital status, exercise habits, family history of diabetes, disease duration, and other comorbidities were gathered by a pre-tested semi-structured questionnaire via an interview approach. Subsequent to formulating the research questions, we executed a pilot study with 30 diabetic patients to validate the questionnaire, removing these participants from the final analysis. The Cronbach's alpha coefficient is 0.723. Consequently, we confirmed the validity and reliability of the questionnaire. The BMI was calculated using the Asian-Pacific cut-off values, classifying patients as underweight (<18.5 kg/m²), normal or lean BMI (18.5-22.9 kg/m²), overweight (23-24.9 kg/m²), and obese (>25 kg/m²).[10] The glycaemic state of patients with Type 2 diabetes mellitus was evaluated using recent fasting blood sugar as the criterion. Poor glycaemic control in the study was defined as a fasting blood sugar level of 130 or higher.[11] Statistical Analysis: The data collected were entered in a Microsoft Excel 2019 spreadsheet, followed by analysis using SPSS version 26. The demographic variables were represented using the arithmetic mean, standard deviation and percentages. The associations between the selected variables and diabetic status were found out using the Chi-Square test/ Fisher's Exact test. The data distribution was represented using appropriate tables. A p-value of less than 0.05 was considered statistically significant.

Results

The mean FBS value of the study population was 145.6 ± 42.6 mg/dL. Among the 200 participants surveyed, 62.5% had a poor glycaemic status, whereas 37.5% demonstrated a controlled diabetic status. (Figure 1)

Figure 1: Prevalence of poor glycaemic status



The majority of the subjects were aged between 41 and 60 years (55%), followed by 61 and 80 years (32%), while only 12% were in the 20–40 years group and 1% were above 80 years. With regard to gender, 60% were females and 40% were males, showing a female predominance among the study population. Most of the participants were married (93%), while a small proportion were widowed (6%), and only 1% were unmarried. Socio-economic distribution indicated that 65% belonged to Above Poverty Line (APL) families, while 35% were from Below Poverty Line (BPL) households. Financial dependency was

noted in over half of the study population, with 53.5% dependent on others and 46.5% financially independent. Regarding cohabitation status, a larger share of participants (60%) were living without a spouse, while 40% were living with a spouse. (Table 1)

Table 1: Socio-demographic characteristics of study subjects

Variables	Category	Good Glycaemic control (%)	Poor Glycaemic control (%)	Total (%)
Age	20-40	10 (13.3)	14 (11.2)	24 (12)
	41-60	39 (52)	71 (56.8)	110 (55)
	61-80	26 (34.7)	38 (30.4)	64 (32)
	81≤	0 (0)	2 (1.6)	2 (1)
Gender	Male	32 (42.7)	48 (38.4)	80 (40)
	Female	43 (57.3)	77 (61.6)	120 (60)
Marital Status	Married	72 (96)	114 (91.2)	186 (93)
	Unmarried	1 (1.3)	1 (0.8)	2 (1)
	Widowed	2 (2.7)	10 (8)	12 (6)
Socio-economic status	BPL	25 (33.3)	45 (36)	70 (35)
	APL	50 (66.7)	80 (64)	130 (65)
Financial dependency	Ye	30 (40)	77 (61.6)	107 (53.5)
	No	45 (60)	48 (38.4)	93 (46.5)
Cohabitation status	Living with spouse	32 (42.7)	48 (38.4)	80 (40)
	Living without spouse	43 (57.3)	77 (61.6)	120 (60)

Approximately 111 participants (55.5%) regularly engaged in at least 150 minutes of exercise per week. 70.1% of the diabetic patients following a regular diabetic diet had a good glycemic status. 61.5% of diabetic patients had a familial history of Type 2 Diabetes Mellitus (T2DM). In 80 (40%) study participants, the disease duration was less than 5 years, whereas 38% had diabetes for at least 5 to 10 years. 68% of the patients with good glycemic status were doing regular follow-up visits to the healthcare facility. 67 diabetic patients were on oral hypoglycaemic agents (OHA); 14 of them were on insulin, 15 on both OHA and insulin, while 2 patients were taking Ayurvedic medications. 94.7% of patients exhibiting a good adherence to medication maintained a controlled diabetic state. (Table 2)

Table 2: Diabetic profile of study subjects

Variables	Category	Good Glycaemic control (%)	Poor Glycaemic control (%)	Chi-square value	p-value
Years with diabetes	<5	35 (43.8)	45 (56.3)	3.056	0.217
	5-10	23 (30.3)	53 (69.7)		
	>10	17 (38.6)	27 (61.4)		
Family history	Yes	45 (36.6)	78 (63.4)	0.114	0.736
	No	30 (39)	47 (61)		
Diabetic diet	Following	53 (46.1)	62 (53.9)	8.513	0.004*
	Not following	22 (25.9)	63 (74.1)		
Follow-up visits	≤3 months	51 (45.9)	60 (54.1)	7.592	0.006*
	>3 months	24 (27)	65 (73)		
Medications Adherence	Regularly	71 (39.7)	108 (60.3)	3.409	0.065
	Not regularly	4 (19)	17 (81)		
Facing difficulty in accessing treatment facility	Yes	50 (66.7)	80 (64)	2.015	0.098
	No	25 (33.3)	45 (36)		
Type of Medications	Insulin	0 (0)	14 (100)	14.021	0.002#
	OHA	67 (40.1)	100 (59.9)		
	OHA+ Insulin	5 (33.3)	10 (66.7)		
	Ayurvedic	2 (100)	0 (0)		
	Others	1 (50)	1 (50)		
Self-monitoring of blood glucose	Yes	22 (39.4)	38 (31.4)	1.114	0.115
	No	53 (70.6)	87 (69.6)		

OHA- Oral-Hypoglycaemic Agents, *- Significant p value, # - Fisher's Exact Test

96 (48%) study participants had a history of hypertension, while around 16.5% of participants were still smokers, while 9% of subjects consumed alcohol. (Table 3)

Table 3: Comorbidities and risk factors of study subjects

Variables	Category	Good Glycaemic control (%)	Poor Glycaemic control (%)	Total (%)
Hypertension	Yes	38 (39.6)	58 (60.4)	96 (48)
	No	37 (35.6)	67 (64.4)	104 (52)
Alcohol	Yes	3 (16.7)	15 (83.3)	18 (9)
	No	72 (39.6)	110 (60.4)	182 (91)
Smoking	Yes	12 (36.4)	21 (63.6)	33 (16.5)
	No	63 (37.7)	104 (62.3)	167 (83.5)

Discussion

Diabetes is a significant contributor to mortality and disability. The elevated rates of mortality and morbidity associated with diabetes, together with its chronic consequences, provide a significant healthcare challenge for both individuals and society. The current study identified multiple factors affecting inadequate glycaemic control, including medication types, follow-up visits, and dietary practices for diabetics. In this study, 62.5% of patients with Type 2 diabetes mellitus had unsatisfactory control of their diabetes. This figure was marginally lower than the prevalence of 63.7% reported by Anil et al. in Mysuru, Karnataka, in 2021,[9] and the 65.4% prevalence for uncontrolled blood sugar levels documented by Ganesh S Anusuya et al. in South Chennai in 2017. [12] Jaya Pasad Tripathy et al. conducted a study in Punjab and reported a similar finding, indicating a 65% prevalence of uncontrolled diabetes. [13] A significant correlation was observed between glycaemic control and the type of medication provided. The findings aligned with previous studies by Mohammad Haghighatpanah et al. [14] and Roy et al. Nearly all the patients on insulin exhibited poor glycemic control. Shahad et al., in their study investigating the problems and risk factors associated with T2DM patients in Saudi Arabia, obtained similar results. [15] According to Yusuf et al. [16] and Valerija et al.'s [17] findings, approximately 74.8% of patients who did not adhere to a prescribed diabetic diet and 82.8% of those who used alcohol had an uncontrolled diabetes state. This study found no significant relationship between family history of diabetes, medication adherence, years of diabetes, inadequate physical activity, and BMI, which contrasts with findings from prior studies. [18]

Limitations

The study possessed a few constraints. Diabetic status was assessed solely through fasting blood glucose measured with a glucometer rather than venous blood glucose estimation, which may have limited accuracy. In addition, factors such as detailed dietary patterns, educational status, and psychosocial variables were not analyzed, which could have provided deeper insights into determinants of glycaemic control. Another important limitation is the use of convenient sampling, which, although practical for a hospital-based cross-sectional study, may have introduced selection bias. Since the participants were only those attending the selected health facilities, the findings may not be fully generalizable to the wider community population of type 2 diabetics.

Conclusion

This study reported a higher prevalence of uncontrolled diabetes among the patients visiting the tertiary care hospital in the Nadia district, West Bengal. Poor glycaemic control was more prevalent in individuals with extended intervals between check-ups and those not adhering to appropriate diabetic diets. The significant incidence of uncontrolled diabetes indicates the necessity to enhance counseling for diabetics regarding lifestyle modifications and potential complications arising from poor blood glucose management. Comprehensive health education and awareness initiatives should be implemented for the general populace to enhance their understanding of diabetes and its management, thereby alleviating the disease's burden.

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