Glycemic Control and Its associated Determinants among Type II Diabetic Patients at Tertiary Care Hospital in North India

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Abstract:

Introduction: Good glycemic control has been defined as achieving a target of fasting plasma glucose level of between 80 and 110 mg/dl, or glycosylated haemoglobin (HbA1C) of <7.0%. Poor glycemic control is highly correlated with chronic conditions related to the damaging effects of hyperglycaemia, resulting in serious complications. To restrict and delay the complications of diabetes mellitus, good glycemic control is essential. **Objective:** To identify the determinants associated with poor glycemic control among Type 2 diabetes mellitus patients. **Method:** A cross sectional study was conducted among 403 confirmed type 2 diabetic patients who attendedone of the tertiary care hospitals of North India over a period of six months (July- December 2021). The collected data was analysed using IBM SPSS version 28. Chi-square test was applied to compare various determinants of glycemic control. A p-value of <0.05 was considered to be statistically significant. **Results:** Out of 403 participants, 57.6% had poor glycemic control of diabetic condition. Higher age of participants, illiteracy, being overweight, having positive history of smoking and alcohol, longer duration of diabetes, participants taking both oral and insulin treatment for diabetes, taking medicine irregularly were the significant determinants of poor glycemic control. **Conclusion:** Higher percentage(57.6%) of poor glycemic control was observed in the study.To improve the glycemic control, efforts should be made towards improving modifiable factors like overweight, smoking, alcohol, regularity of medication etc. Good lifestyle interventions help in control of poor glycemic control.

Key Words : Determinants, Diabetes Mellitus (DM), Glycemic Control (GC), Glycosylated Haemoglobin (HbA1C)

Introduction:

Diabetes mellitus is rising more rapidly in the twenty-first century. Globally, it is affecting about 415 million adults, and it is projected to affect 642 million adults by 2040.[1] Diabetes, cardiovascular diseases, respiratory diseases, and cancer are the major contributors to the non-communicable disease epidemic. In India, among other non-communicable diseases, diabetes has the greatest increase (39.6%) in the age standardized disability-adjusted life years between 1990 and 2016.[2] The prevalence of diabetes in India is continuously rising. In 2019, India had the second largest population in the world with diabetes (77.0 million persons living with diabetes), which is expected to rise to 134.2 million persons by 2045. Additionally, a large number (42.2 million, 57.9%) of people living with diabetes in India remain undiagnosed. Diabetes is associated with a significant economic burden. In 2017, India had the fourth highest healthcare expenditure on diabetes in

the world.[3] Also, diabetes-related mortality rate in India in 2016 was 3.1% of all deaths, up from 0.98% deaths in 1990.[4] Between 2000 and 2019, there was a 3% increase in diabetes mortality rates by age. In 2019, diabetes and kidney disease due to diabetes caused an estimated 2 million deaths.[5] Long-term, uncontrolled diabetes causes metabolic changes and subsequently leads to development of macrovascular and microvascular complications.[6]

Glycemic control has been defined as achieving a target of fasting plasma glucose level of between 80 and 110 mg/dl, or glycosylated haemoglobin (HbA1C) of <7.0%.[7] HbA1c is a test that measures the average amount of diabetic control overall period of about 3 months (the average red blood cell lifetime) and used as a significant indicator and marker of glycemic control. Diabetics who manage to keep their HbA1c below 7.0% are considered to have good glycemic control while those above or equal 7.0% are considered to have a poor glycemic control.[8] Evidence suggests that every 1% increase in the glycated haemoglobin (HbA1c) level in persons living with diabetes is associated with approximately 40% increase in cardiovascular disease mortality and a 30% increase in all-cause mortality.[9] In contrast, every 1% reduction in HbA1c is associated with reduction in risk of 21% for any endpoint related to diabetes, 21% for deaths related to diabetes, 14% for myocardial infarction, 12% for stroke, 16% for heart failure, 43% for amputation or death from peripheral vascular disease, 37% for microvascular complications, 31% for retinopathy, and 33% for nephropathy.[10-12] Achieving good glycemic control is a critical metabolic goal because hyperglycaemia contributes to the progression of diabetes mellitus by affecting both ß-cell function and insulin sensitivity.

The objective of the study was to identify the determinants of poor glycemic control among Type 2 diabetes mellitus patients.

Method:

Using cross-sectional study design, this study was conducted in medicine outpatient department of a tertiary care hospital in north India catering patients from both urban and rural areas. The study was conducted over a period of six months i.e., July 2021 to Dec 2021.Type 2 diabetes mellitus patients aged more than 18 years who attended the medicine OPD were included in the inclusion criteria. Type 2 diabetes Patients who were not able to respond to the study tool because of their illness and patients who did not give consent were included in the exclusion criteria.Assuming that 50% population has adequate glycemic control and with 5% absolute error, the sample size is calculated as $n = z^2 p(1-p)/w^2 = 384$. By considering the 5% nonresponse rate, the sample size was 403, where n = sample size, p = proportion (50%), w= margin error (5%), z = 1.96.[13]

The study was approved by the Institutional Ethics Committee.A pre-validated pretested questionnaire was developed to fulfil aim of study.It has two sections (A and B). Section A contains general information of socio-demographic variables i.e., age, gender, education, place of living. Section B contains questions related with disease variables i.e., HbA1c, Family history, BMI, Smoking, Alcoholic, Duration of disease, Type of treatment, Regularity of medication.

Personal face to face interviews were conducted. Patients were explained about the purpose of study. Written informed consent was taken and complete confidentiality was ensured. To confirm the clinical profile and treatment schedule, patient's record available with him/her was also referred. Average time of interview per participant was about 20-25 minutes.

Statistical analysis:

The data were entered into the excel sheet and analysed using IBM SPSS version 28.0. Qualitative variables were expressed as proportions and percentages. Quantitative variables were expressed as mean and standard deviation. Chi-square test was used to establish association (if any) among qualitative variables, p value < 0.05 was considered significant.

Results:

A total 403 patients with mean age of 51.4±14.84 years were included in final analysis. Among total, 232(57.5%) participants had poor glycemic control as compare to 171(42.5%) who had good glycemic control.(Figure 1) Around 59.4% offemale
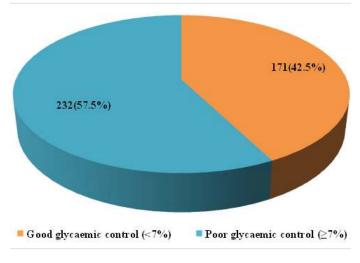
Table 1 : Association of Socio demographic and Treatment Variables with Glycemic Control among Type II Diabetes Patients (N=403)

Variables	Good control (n=171) N (%)	Poor control (n=232) N (%)	Total (N=403)	p value
Age group				
<40 years	110 (89.4%)	13 (10.6%)	123	<0.001
41-60 years	43 (27.2%)	115 (72.8%)	158	
>60 years	18 (14.8%)	104 (85.2%)	122	
Gender				
Male	119 (43.3%)	156 (56.7%)	275	0.617
Female	52 (40.6%)	76 (59.4%)	128	
Residence				
Rural	101 (44.7%)	125 (55.3%)	226	0.299
Urban	70 (39.5%)	107 (60.5%)	177	
Education				
Illiterate	12 (25%)	36 (75%)	48	<0.001
Primary and Secondary	12 (20.7%)	46 (79.3%)	58	
Higher Secondary	47 (44.3%)	59 (55.7%)	106	
Graduate and above	100 (52.4%)	91 (47.6%)	191	
BMI (kg/m^2)				
<18.5	3 (30%)	7 (70%)	10	<0.001
18.5-22.9	80 (72.8%)	30 (27.2%)	110	
23-24.9	70 (32.6%)	145 (67.4%)	215	
>25	18 (26.4%)	50 (73.6%)	68	
Smoking				
Yes	65 (32.7%)	134 (67.3%)	199	<0.001
No	106 (52%)	98 (48%)	204	
Alcoholic				
Yes	58 (29.4%)	139 (70.6%)	197	<0.001
No	113 (54.9%)	93 (45.1%)	206	
Family History				
Present	82 (38.1%)	133 (61.9%)	215	0.062
Absent	89 (47.3%)	99 (52.7%)	188	
Duration since diagnosis of Diabetes				
<5 year	96 (90.6%)	10 (9.4%)	106	<0.001
6-10 year	59 (60.2%)	39 (39.8%)	98	
11-15 year	6 (6.4%)	87 (93.6%)	93	
>15 year	12 (11.3%)	94 (88.7%)	106	
Type of Treatment at time of study				
Only Oral	159 (93%)	12 (7.0%)	171	<0.001
Only Insulin	6 (10.5%)	51 (89.5%)	57	
Both	6 (3.4%)	169 (96.6%)	175	
Regularity of Medication				
Yes	165 (51.5%)	156 (48.5%)	321	<0.001
No	6 (7.3%)	76 (92.7%)	82	

participants and 56.7% male participants had poor glycemic control although the difference is statistically insignificant. (p=0.617). Table 1 shows association of socio-demographic and clinical profile factors with glycemic control in type 2 diabetes patients.

The participants(61.9%) who had family history of diabetes had poor glycemic control but results were statistically insignificant.Participants with presence of longer duration of disease 11-15 years (93.6%) had poor glycemic control with results statistically significant (p value<0.001).Participants who were on both insulin and oral treatment (96.6%) and taking medicine irregularly (92.7%) had poor glycemic control of diabetic condition.

Figure 1 : Levels of Glycemic Control among Study Participants (N=403)

171(42.5%)
232(57.5%)

■ Good glycaemic control (<7%)   ■ Poor glycaemic control (≥7%)

Discussion:

In the present study poor glycemic control was found to be among 57.5% of participants. A study conducted by Pushpita De et al in south Indian population 63% patients were having poor glycemic control.[14] Similar results were observed in previous study conducted by Feleke et al, where poor glycemic control was found to be among 55.3%.[16]

In the present study participants>60 years of age groups (85.2%) had poor control of diabetic condition. The difference was found to be statistically significant (p<0.001). In the study conducted by Banerjee et al they found that 73.1% participants in 60-80 years of age had poor control of diabetic

condition.[15] In that study age was found to be a significant risk factor for poor glycemic control in diabetes patients.

In the present study, 59.4% female participants had poor control of diabetic condition. The association between gender and glycemic control were found to be statistically insignificant (p=0.616). The study conducted by Feleke et al mentioned that 67% female participants were having poor glycemic control of diabetic condition.[16] and the results were statistically significant (p<0.01).

In the study 60.5% participants living in urban area had poor control of diabetic condition. This difference was found to be statistically insignificant (p=0.299). In the study conducted by Banerjee et al, 71.5% rural population had poor glycemic control.[15] The difference was found to be statistically significant (p<0.001).This may be due to different geographical region of the study.

In the current study, participants who were illiterate (75%) and studied upto secondary education (79.3%) had poor control of diabetic condition as compare to those having higher secondary education (55.7%) and graduation and above (47.6%). This difference was found to be statistically significant (p<0.001).Similar results were observed in a previous study conducted by Banerjee et al found that who were educated from VI and above levelhad good control of diabetic condition than illiterate.[15] This difference was found to be statistically significant. The possible explanation for this state of affairs might be inadequate knowledge on treatment protocols, inactivity and poor diet among things.In another study conducted by Goudswaard et al, it was found that lower level of education was associated with poor glycemic control and the relation was found to be statistically insignificant (p=0.015).[17]

In this study participants who were having obesity (73.6%) and were overweight (67.4%) had poor control of diabetic condition. This difference was found to be statistically significant (p<0.001). In the study conducted by Benoit et al, it was found that overweight and obesity(56.8%) with (BMI>30) among participants were significantly associated

with poor glycemic control (p value=0.003).[18] In another study conducted by Banerjee et al[15] it was found that 59.4% overweight participants and 68.8% obese participants had poor glycemic control. The difference found to be statistically significant (p=0.002).[15]

In the present study participants having positive history of smoking (67.3%) had poor control of diabetic condition. This difference was found to be statistically significant (p<0.001). In the study conducted by Oluma et al, it was found that 76.1% smoker participants had poor glycemic control.[19]

In the current study participants having positive history of alcohol intake (70.6%) had poor control of diabetic condition. This difference was found to be statistically significant(p<0.001). In the study conducted by Mideska et al it was found that 75.4% participants with alcoholic history had poor glycemic control. This difference found to be statistically insignificant (p=0.343).[20]

In this study participants having family history of diabetes (61.9%) had poor control of diabetic condition. This difference was found to be statistically insignificant (p=0.062). In the study conducted by Musenge et al, they found that 65.5% participants who were having family history of diabetes had poor glycemic control.[21] Meanwhile, in current study there was an insignificant association between family history of diabetes mellitus and poor glycemic control (p value=0.062)

In the current study participant shaving duration of illness 11-15 years and above 15 years had poor control of diabetic condition i.e., (93.6%) and (88.7%) respectively. This difference was found to be statistically significant(p<0.001). In the study conducted by Ufomaet al they found that patients having diabetes duration more than 10 years (60%) were having poor glycemic control.[22] The difference was found to be statistically significant (p=0.003). In our study patients with poor glycemic control were found to increase with increase in duration of disease. Longer duration of diabetes is known to be

associated with poor control, possibly because of progressive impairment of insulin secretion with time because of cell failure, which makes the response to diet alone or oral agents unlikely (UK Prospective Diabetes Study (UKPDS).[23]

In the present study participants taking either insulin (89.5%) or both oral and insulin (96.6%) as a treatment therapy had poor control of diabetic condition. This difference was found to be statistically significant(p<0.001). In the study conducted by Azzam et al, they found that 76.1% participants who were taking only insulin and 67.8% taking both oral and insulin as a treatment had poor glycemic control.[24]This difference was found to be statistically insignificant (p<0.061). This finding is consistent with study conducted by Haghighatpanah M et al in which patients receiving insulin plus Oral hypoglycemic agents were more likely to have poor glycemic control compared to patients who were on only oral diabetes medicationor insulin.[25]

In the present study, participants taking medicine irregularly had poor control (92.7%) of diabetic condition. This difference was found to be statistically significant(p<0.05). Similar finding was observed in study conducted by Fseha B et al.[26]

Conclusion:

Proportion of diabetic patients having poor glycemic control was higher in the present study. As per the findings of the study, factors significantly associated with poor glycemic control were, age group, educational status, BMI, smoking, alcoholic intake, duration of diabetes treatment, regularity/adherence to treatment.

Recommendation:

To improve glycemic control effort should be made towards reducing modifiable factors including cessation of smoking, maintaining optimum body weight and strictly adhering to prescribed medications. The importance of good glycemic control in diabetic patients should be ensured so that patients can be protected from the complications of diabetes and potentially avoidable glycemic burden.

Declaration:

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Conflict of Interest: Nil

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