

Factors Affecting Glycemic Control among Patients with Type 2 Diabetes: A Cross-Sectional Study

Subhash Chandra Yadav¹, Kumar Mayank², Kaushal Kumar Mishra³, Deepak Kumar⁴

¹Tutor, Department of Pharmacology, Sri Krishna Medical College, Muzaffarpur, Bihar

²Tutor, Department of Pharmacology, Sri Krishna Medical College, Muzaffarpur, Bihar

³Assistant Professor, Department of Pharmacology, Sri Krishna Medical College, Muzaffarpur, Bihar

⁴Professor, Department of Pharmacology, Sri Krishna Medical College, Muzaffarpur, Bihar

Received: 25-06-2023 / Revised: 28-07-2023 / Accepted: 30-08-2023

Corresponding author: Dr. Kumar Mayank

Conflict of interest: Nil

Abstract:

Background: Diabetes is a chronic condition that needs on-going medical attention as well as patient education on self-management in order to achieve optimal glycemic control and avoid long-term complications. In India, type II diabetes is on the verge of becoming an epidemic. Asia is home to more than 60% of the world's diabetics, with China and India making up the majority of this region. In spite of the fact that the advantages of adequate glycemic control in preventing diabetes-related micro vascular complications are well recognized, it has been observed that more than 60% of patients still do not meet the advised glycemic target. Glycemic control is challenging to attain in standard clinical practice because it is influenced by several social, demographic, economic, illness, and treatment-related factors.

Methods: The data for the current investigation was collected from diabetic patients who visited the SKMCH, Muzaffarpur, Bihar, medical OPD in a cross-sectional retrospective analysis. Data was collected between December 2022 to May 2023. Retrospective data collection was done on 206 diabetic patients.

Results: In this study, 206 patients were included, and (63%) of them were between the ages of 41 to 60. 15.5% of drug use was for monotherapy, 47.1% was for combination therapy, and 23.8% was for insulin + OAD therapy. When compared to patients with a BMI of <25, patients with a BMI of >30 had a 4 times higher chance of having poor glycemic control (OR = 3.9, C.I. = 1.2–3.9, P = 0.02).

Conclusion: In this study, it was found that age, the duration of diabetes, drug use patterns, and BMI all had a statistically significant correlation with glycemic control.

Keywords: Type 2 Diabetes, HbA1C, glycemic control, Drug utilization pattern, BMI.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

In India, type II diabetes is on the verge of becoming an epidemic. More than 60% of the world's diabetic population is from Asia, with China and India making up the majority of this population. It is expected that by 2030, more than 100 million people will be affected by diabetes worldwide, with 1 in 5 people in India expected to have the disease.[1] Diabetes and its potential complications have a very high rate of morbidity and mortality, which poses serious health care issues for both the family and society.

A metabolic condition known as type 2 diabetes is characterized by hyperglycemia brought on by a deficiency in insulin secretion, action, or both. To achieve and maintain optimal glucose control is the primary treatment objective while treating diabetic patients. The UKPDS trial has unequivocally demonstrated the value of good glycemic

management in preventing micro vascular complications associated with diabetes.[2]

Despite the fact that numerous studies have demonstrated the advantages of effective glycemic management, it has been observed that more than 60% of patients still fail to meet the suggested glycemic target.[3] The American Diabetes Association has offered a thorough method for managing Type 2 Diabetes. With the use of fasting blood glucose and HbA1c readings, glycemic management is evaluated. Although the target glycemic control must be tailored to the patient's age, co-morbidity, length of diabetes, and complications, excellent control is considered when fasting blood sugar levels are under 110 mg/dl and HbA1c is under 7%.[4]

Diabetes is a chronic condition that necessitates ongoing medical attention as well as patient education on self-management in order to achieve adequate glycemic control and avoid long-term complications. Life style adjustment therapy was given a lot of focus in comprehensive diabetes care. In addition to medicine, it is crucial to educate patients about their condition. The suggested glycemic control targets in clinical practice are challenging to reach and are influenced by a variety of factors. Age, sex, body mass index (BMI), education level, marital status, income and occupation, ethnicity and religion, history of smoking and alcohol consumption, family history of diabetes, medication adherence, length of therapy, and drug use pattern (monotherapy, combined oral therapy, or oral therapy combined with insulin), complexity of therapeutic regimen, association with comorbidities, fear of side effects, job-related factors, and psychological factors are socio-demographic factors.[5]

In order to minimize acute and chronic consequences linked to poor glycemic control, it will be important to consider the limited data on glycemic control available in our country when making decisions and developing policies for the delivery of healthcare services. Studies from India show that both urban and rural areas have poor glycemic control, calling for greater knowledge and more effective treatment plans to attain adequate glycemic control. [6-8]

In this study, we evaluated the degree of glycemic control and the factors that contributed to it in adult T2DM patients. We have only looked at age, sex, the length of diabetes, BMI, comorbidities, and patterns of drug use among all of the contributing factors indicated above.

Materials and Methods

Table 1: Descriptive statistics of characteristics

Characteristics	Mean±SD	Median	Mode	Range	Min	Max
Age (in years)	56.6±12.4	57.0	60	64	22	86
Duration of diabetes (in years)	8.1±6.9	6.0	10	29	1	30
BMI (kg/m ²)	28.1±6.7	27.4	25.1	42.4	15.0	57.4
FBS (mg/dL)	188.9±75.8	175.5	116	385.0	74.0	459.0
HbA1C (%)	9.1±11.6	8.6	8.4	11.6	5.0	15.6

According to Table 2, of the 206 patients who were enrolled in the study, 115 (55.7%) were men and 91 (44.2%) were women.

Those between the ages of 41 and 60 made up the majority (63%). Only 10% of patients were under the age of 40, while 27% were above the age of 60. 34% of BMI categories had normal BMI, compared to 30% who were obese and 35.4% who were

The present study is a cross-sectional study of retrospective data collected from the diabetic patients who attended the medical outdoor of Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar. Data was collected from December 2022 to May 2023. Retrospective data on 206 diabetic patients was gathered. Data on age, sex, BMI, the duration of diabetes, concomitant conditions, and drug use patterns were gathered. With the aid of HbA1C and FBS levels, the degree of glycemic control was evaluated. HbA1C <7% and FBS <110 mg/dL were considered to indicate satisfactory glycemic control. HbA1C and FBS results were obtained from hospital records. Using High Performance Liquid Chromatography, HbA1C was calculated. Hexokinase was used in an enzymatic reference method to measure fasting blood sugar levels. Patients with type 2 diabetes mellitus who were >20 years old and using diabetes medicines were included. The study did not include type 1 diabetes.

In order to do the statistical analysis, IBM SPSS 21.0 was used. Numbers and percentages are used to present categorical data, such as gender, age group, BMI, comorbidity, drug usage pattern, and length of diabetes. Additionally, the Chi-square test, which was accepted at a 95% CI, was performed to determine the statistical significance of the difference in the percentage of people with good glycemic control according to the categorical variable. Several variables In order to pinpoint the variables linked to effective glycemic management, binary logistic regression was performed. A P-value <0.05 was regarded as significant.

Results

Table 1 displays descriptive statistics for each patient's age, the length of their diabetes, their BMI, their fasting blood sugar, and their HbA1C.

overweight. Only 21% of patients had comorbidities. 15.5% of patients with drug use patterns received monotherapy, 47.1% received combination therapy, and 23.8% received insulin plus OAD therapy.

Diabetes was present in 44% of patients for less than five years, 34% for six to ten years, and 22% for longer than ten years.

Table 2: Background profile of study subjects for type 2 Diabetes Mellitus

Characteristics	Number of patients (n)	Percentage (%)
Gender		
Male	115	55.8
Female	91	44.2
Age group		
≤40	20	9.7
41-60	130	63.1
>60	56	27.2
BMI		
<25	71	34.5
25-30	73	35.4
>30	62	30.1
Comorbidity		
No	163	79.1
Yes	43	20.9
Drug utilization pattern		
Monotherapy	32	15.5
Combination	97	47.1
Insulin + OAD	49	23.8
Ayurvedic/home-based	28	13.6
Duration of diabetes (yrs.)		
≤5	91	44.2
6-10	70	34.0
>10	45	21.8

According to Table 3, gender has little impact on glycemic control. Only 5% of people under the age of 40 had good glycemic control, compared to 20% of people between the ages of 41 and 64 and only 9% of people beyond the age of 65.

It was discovered that this was statistically significant. The majority (60%) of diabetics with good glycemic control had diabetes for less than five years, compared to 28% for diabetes was lasting between six and ten years and only 9% for diabetes lasting longer than ten years.

Additionally, it was statistically significant that 60% of diabetics with poor glycemic control had

duration of more than 5 years. Only 12% of diabetics with BMI >30 had good glycemic control, compared to more than 60% of diabetics with BMI >25, which was statistically significant once more.

We discovered that comorbidity has little to no impact on glycemic control because the majority of our patients had no comorbidities. More than 80% of diabetics were taking an OAD alone or in combination, and their blood sugar levels were under control.

It was statistically significant that 25% of patients had poor glycemic control despite taking insulin therapy.

Table 3: Factors affecting Glycemic control of type 2 Diabetes patients

Characteristic	Good glycemic control n (%)	Poor glycemic control n (%)	P-value
Gender			
Male	17(53.1)	98(56.3)	0.7
Female	15(46.9)	76(43.7)	
Age group			
≤40	1(3.1)	19(10.9)	0.05*
41-64	26(81.3)	104(59.8)	
≥65	5(15.6)	51(29.3)	
Duration of diabetes mellitus (yrs.)			
≤5	20(62.5)	71(40.8)	0.05*
6-10	9(28.1)	61(35.1)	
≥11	3(9.4)	42(24.1)	
BMI			
≤24.9	15(46.9)	56(32.2)	0.05*
25-29.9	13(40.6)	60(34.5)	
≥30	4(12.5)	58(33.3)	

Comorbidity			
No	26(81.3)	137(78.7)	0.7
Yes	6(18.8)	37(21.3)	
Drug utilization pattern			
Monotherapy	7(21.9)	25(14.4)	0.04*
Combination of OAD	20(62.5)	77(44.3)	
Insulin+ OAD	4(12.5)	45(25.9)	
Ayurvedic / home-based	1(3.1)	27(15.5)	

Table 4 represents that patients with BMI more than 30 had 4 times risk of having poor glycemic control as compared to those with BMI <25 (OR = 3.9, C.I. = 1.2-3.9, P = 0.02). In this study it was also observed that with 1 year increase in duration of diabetes, the Odds of having poor glycemic control was increased by 7% (OR = 1.07, C.I. = 0.99-1.14, P = 0.05). More than 40 years of age had 1.5 times odds of having poor glycemic control as compared to <40 years, but it was not statistically significant.

Table 4: Binary logistic regression analysis of factors affecting glycemic control

Predictor variables	Odds ratio	95% CI	P value
BMI			
≤24.9	®		
25-29.9	1.2	0.5-2.8	0.61
≥30	3.9	1.2-12.4	0.02*
Duration of diabetes (yrs.)	1.07	1.01-2.1	0.04*
Age Group			
<40	®		
41-64	1.5	0.5-4.3	0.39
>65	3.2	0.8-11.8	0.07

® Reference, * Significant

Discussion

According to the current study, middle-aged people between the ages of 41 and 64 had the best glycemic control. People with glycemic control problems were younger than 40 and older than 65. Young people's poor glycemic control is a cause for serious concern because early diabetes control is crucial for preventing long-term complications of diabetes, which can be explained by the idea of metabolic memory.[9,10] If diabetes in young individuals is not effectively treated, there is a high likelihood of complications, which would result in a significant economic burden as well as increased mortality and morbidity from the condition. Younger people who have high HbA1c levels may have low or insufficient dosage, infrequent usage of combination medication regimens, resistance to starting insulin therapy, or a higher incidence of obesity in the general population. This underlines even more the need for effective prevention and treatment programs targeted at younger age groups.[11,12] The same was true of the older age group's glycemic control. Fear of hypoglycemia precipitating in older age groups, a lack of family support due to the present trend of nuclear families, and an inability to stick to exercise routines because of several comorbidities related to this age may all be contributing reasons. This result conflicts with one from a Malaysian study that showed older people had better glycemic control. The development of comorbidities like renal failure, improved access to medical care, good

compliance and motivation for glucose testing, regular physical activity and healthy eating, and increased medication adherence due to family members being involved in care and reminding patients to take their medications and take care of their diets all contributed to this.[13-16] There are numerous research where no correlation between age group and glycemic control was discovered.[17] Finally, in light of these inconsistent results, it is crucial that doctors concentrate on gaining an understanding of the pathophysiology and managing every diabetic, both young and elderly, in order to achieve the optimal glycemic control in everyone.

It was discovered that those with diabetes for less than 5 years had the best diabetic control, while those with diabetes for more than 10 years had the worst. Longer diabetes duration was associated with poor glycemic control. These findings echo those of several studies carried out in numerous underdeveloped nations. Long disease duration and complex treatment regimens were linked to inadequate glycemic control, according to a Hong Kong study.[18-20] Long-term diabetes had a deleterious effect on glycemic control, possibly because beta cell reserve gradually declined over time along with decreased insulin output.[2] Anti-diabetic medications are required to maintain sufficient glycemic control as the duration of diabetes rises. This necessitates constant monitoring and drug adjustment, underscoring the importance of routine checkups, blood glucose self-

monitoring, diabetes education, and ongoing medical treatment optimization. To improve the efficacy of the treatment plan, early intensification and optimization should be carried out.

Glycemic control is influenced by drug use patterns as well, and in our study, we observed that patients getting combination OAD had better glycemic control than those receiving monotherapy or insulin plus OAD. According to established recommendations, metformin is the first line of treatment for the majority of diabetics.[19] Although we did not examine the type of therapy used in monotherapy in our trial, we may presume that patients undergoing monotherapy would typically be taking metformin alone. Numerous studies have shown that monotherapy frequently is insufficient for the majority of patients to achieve effective glycemic control, particularly when the condition has been present for a longer time. Whether metformin or sulfonylureas are administered over a 3-year period, more than 80% of patients do not meet glycemic targets with initial monotherapy. [20]

In our investigation, there was no discernible difference in glycemic control between males and females. According to several research, having a female partner increases your likelihood of having poor glycemic control. As the inferior sex, women are allegedly denied access to diabetes treatment in developing nations, preoccupied with taking care of their families at the expense of their own health. Therefore, women need additional care when managing their diabetes because of their nutritional, psychological, and puberty concerns. [21]

Conclusion

According to numerous studies conducted in different developing countries, patients from the western UP region had poor overall glycemic control and > 65% of them were unable to achieve glycemic control, which put them at an increased risk of developing complications from diabetes. Age, diabetes duration, drug use patterns, and BMI were the main variables affecting glycemic control. Although there are many other factors that affect glycemic control that we have not examined, we infer from this study that young, overweight, and obese people, patients with long histories of diabetes, and those on complicated drug regimens should receive special attention if good glycemic control is to be achieved. The best possible use of all resources should be emphasized by healthcare practitioners and organizations. In order to achieve the desired glycemic control, comprehensive management of every diabetic with the aid of dietitians and counselors is essential.

References

1. Chuang LM, Tsai ST, Huang BY, et al The status of diabetes control in Asia - a cross-sectional survey of 24317 patients with diabetes mellitus in 1998. *Diabet Med.* 2002; 19: 978–985.
2. UKPDS Group. Intensive blood glucose control with sulphonylurea or insulin compared with conventional treatment and risk of complication in patients with type 2 diabetes (UKPDS 33). *Lancet.* 1998;352:837-853.
3. Eid M, Mafauzy M, Faridah AR. Non-achievement of clinical targets in patients with type 2 diabetes mellitus. *Med J Malaysia.* 2004; 59: 177–184.
4. Melanie J. Davies, David A. D'Alessio, Judith Walter N. Kernan, et al. Management of Hyperglycemia in Type 2 Diabetes. 2018. ADA.
5. Standards of Medical Care in Diabetesd 2014. American Diabetes Association Diabetes Care. 2014 Jan; 37(Supplement 1): S14-S80.
6. Mohan V, Shah S, Saboo B: Current glycemic status and diabetes related complications among type 2 diabetes patients in India: data from the A1chieve Study. *J Assoc Physicians India* 2013; 61(Supplement 1):12–15.
7. Menon VU, Guruprasad U, Sundaram KR, et al.: Glycemic status and prevalence of comorbid conditions among people with diabetes in Kerala. *Natl Med J India.* 2008; 21:112–115.
8. Nagpal J, Bhartia A: Quality of diabetes care in the middle- and high-income group populace: the Delhi Diabetes Community (DEDICOM) survey. *Diabetes Care.* 2006; 29:2341–2348.
9. Stratton IM, Adler AI, Neil HA, et al.: Association of glycaemia with macro vascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ.* 2000; 321:405–412.
10. GoudswaardA N, stolk R P, Zuithoff P, et al. Patient characteristics do not predict glycemic control in type 2 diabetes patients treated in primary care. *Euro journal of Epidemiology.* 2004; 19:541-545.
11. ImadM. El-Kebbi, Curtiss B. Cook, David C. Ziemer, et al. Association of Younger Age With Poor Glycemic Control and Obesity in Urban African Americans With Type 2 Diabetes *Arch Intern Med.* 2003;163(1):69-75.
12. Yeung WJJ. Asian fatherhood. *J Fam Issues* 2013; 34: 143–160.
13. NurSufiza Ahmad, Farida Islahudin, Thomas Paraidathathu. Factors associated with good glycemic control among patients with type 2 diabetes mellitus, 2014 Sep; 5(5): 563–569.
14. Glasgow RE, Hampson SE, Strycker LA, et al. Personal-model beliefs and social-

- environmental barriers related to diabetes self-management. *Diabetes Care*. 1997; 20(4): 556-561.
15. Shorr RI, Franse LV, Resnick HE, et al. Glycemic control of older adults with type 2 diabetes: findings from the Third National Health and Nutrition Examination Survey, 1988-1994. *J Am Geriatr Soc*. 2000; 48(3): 264- 267.
 16. Tong PC, Ko GT, So WY, et al. Use of anti-diabetic drugs and glycemic control in type 2 diabetes. *The Hong Kong Diabetes Registry. Diabetes Res ClinPract*. 2008; 82: 346–352.
 17. Verma M, Paneri S, Badi P, et al. Effect of increasing duration of diabetes mellitus type 2 on glycated hemoglobin and insulin sensitivity. 2006 Mar; 21(1):142-6.
 18. Temesgen Fiseha, Ermiyas Alemayehu, Wongelawit Kassahun, et al. Factors associated with glycemic control among diabetic adult out-patients in Northeast Ethiopia.
 19. Melanie J. Davies, David A. D’ Alessio, Judith Fradkin, et al. Management of Hyperglycemia in Type 2 Diabetes, 2018. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care*. 2018 Dec; 41(12):2669-2701.
 20. Cook MN, Girman CJ, Stein PP, et al Initial monotherapy with either metformin or sulphonylureas often fails to achieve or maintain current glycemic goals in patients with Type 2 diabetes in UK primary care. *Diabetes Care*. 2007; 24: 350–358.
 21. Göbl C, Bozkurt L, Lueck J, et al. Sex-specific differences in long-term glycemic control and cardiometabolic parameters in patients with type 1 diabetes treated at a tertiary care centre. *Wien Klin Wochenschr*. 2012 Nov; 124(21-22):742-9.