

Original Research Article

Factors Affecting Glycemic Control among Patients with Type 2 Diabetes at a Tertiary Health Care Center of Western up Region: A Cross-Sectional Study

Dr. Jyoti Goyal^{1*}, Dr. Navin Kumar^{2**}, Dr. Mamta Sharma^{3**}, Ms. Seema Raghav^{4*}, Dr. Banwari Lal^{*},
Dr. Paramjeet Singh Bhatia^{*}

¹DNB, ²Biostatistician, ³Attending Consultant, ⁴Certified Diabetes Educator,

*Department of Internal Medicine, Nayati Healthcare and Research Centre, Mathura, India- 281003,

**Department of Biostatistics, Nayati Healthcare and Research Centre, Mathura, India-281003.

Corresponding Author: Dr. Jyoti Goyal

ABSTRACT

Background: Diabetes is a chronic disease requiring continuous medical care and patient self-management education to achieve good glycemic control and prevent long term complication Type II diabetes is approaching epidemic levels in India. More than 60% population suffering from diabetes comes from Asia of which china and India are the largest contributors. Though the benefit of good glycemic control is well established in prevention of diabetes related micro vascular complication however it has been reported that more than 60% of the patients still do not achieve the recommended glycemic target. As glycemic control is affected by many social, demographic, economic, disease and treatment related factors, it is tough to achieve glycemic control in routine clinical practice.

Materials and Methods: The present study is a cross-sectional study of retrospective data collected from the diabetic patients who attended the medical outdoor of Nayati Medicity, Mathura, Uttar Pradesh. Data was collected from January 2018 to June 2018. Data from 206 diabetic patients was collected retrospectively.

Results: 206 patients were included in this study, out of which (63%) were in the age group between 41 – 60 years. Among Drug utilization pattern 15.5% were as monotherapy, 47.1% were on combination therapy while 23.8% were receiving Insulin + OAD therapy. 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).

Conclusion: In this study glycemic control was affected by age, duration of diabetes, drug utilization patterns and BMI and a statistically significant association was found with these factors.

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

INTRODUCTION

Type II diabetes is approaching epidemic levels in India. More than 60% population suffering from diabetes comes from Asia of which china and India are the largest contributors and it is predicted that current prevalence of diabetes is expected to rise by 65% with more than 100 million people will be suffering from diabetes by 2030 and it is predicted that 1 out of every 5

person shall be diabetic in India. [1] The level of morbidity and mortality due to diabetes and its possible complication are enormous and cause significant health care problems for both the family and society.

Type 2 diabetes is a metabolic disorder characterizes by hyperglycemia due to defect in insulin secretion, insulin action or both. The main therapeutic goal of treating diabetic patients is to achieve and

maintain good glycemic control. UKPDS study has clearly shown the benefit of adequate glycemic control in prevention of diabetes related micro vascular complication. [2] Though the benefit of good glycemic control is proven in many studies but it has been reported that more than 60% of the patients still do not achieve the recommended glycemic target. [3] American diabetes association has provided a comprehensive approach for management of Type 2 Diabetes. Glycemic control is assessed with help of fasting blood glucose and HbA1c levels. Though the target glycemic control needs to be individualized considering the age, co-morbidity, duration and complication of diabetes but good control is considered when fasting sugar levels are less than 110mg/dl and HbA1c is less than 7%. [4]

Diabetes is a chronic disease requiring continuous medical care and patient self-management education to achieve good glycemic control and prevent long term complication. Comprehensive management of diabetes put ample emphasis on life style modification therapy. Apart from pharmacotherapy it is equally important to impart the knowledge about this disease to patients. In clinical practice the recommended glycemic control targets are difficult to achieve and is impacted by many factors. Socio-demographic factors like age, sex, body mass index (BMI), level of education, marital status, income and occupation, ethnicity and religion, history of smoking, history of alcohol intake, family history of DM, medication adherence, duration of therapy, and drug utilization pattern (monotherapy, combined oral therapy or oral therapy along with insulin), complexity of therapeutic regimen, association with comorbidities, fear of side effects, job related factors, psychological issues, maintaining regular follow up with doctors are among the many variables which affect the level of glycemic control. [5]

Data on glycemic control is sparse from our country and will be noteworthy in deciding and making policy for health care

delivery services so as to prevent acute and chronic complications related to poor glycemic control. There are some studies from India reflecting poor glycemic control in various urban as well as rural India, necessitating the need of increased awareness and better treatment strategies to achieve good glycemic control. [6-8] Unfortunately, UP being the largest state of India with maximum population, there has not been any study conducted on glycemic control and this study is a small attempt to know the status of glycemic control in a population attending tertiary care center at western UP region. In this study we have assessed the level of glycemic control and its contributing factors among adult patients with T2DM. Among all of the abovementioned contributory factors, we have studied only age, sex, duration of diabetes, BMI, comorbidities and drug utilization patterns.

MATERIALS AND METHODS

The present study is a cross-sectional study of retrospective data collected from the diabetic patients who attended the medical outdoor of Nayati Medicity, Mathura, Uttar Pradesh. Data was collected from January 2018 to June 2018. Data from 206 diabetic patients was collected retrospectively. Data was collected in terms of age, sex, BMI, duration of Diabetes, comorbidity and drug utilization pattern. Level of glycemic control was assessed with help of HbA1C and FBS levels. Levels of HbA1C <7% and FBS <110mg/dL were taken as good glycemic control. The outcome of HbA1C and FBS levels were collected from Hospital Information System. HbA1C was determined by High Performance Liquid Chromatography using Bio-Rad D 10. Fasting Blood Sugar levels were measured by enzymatic reference method with Hexokinase. The present study was approved by internal committee of research and thesis review of Nayati health care and research center.

The BMI was categorized in three groups

Category	BMI (kg/m ²)
1. Normal	18.5-25
2. Overweight	25-30
3. Obese	30-35

The duration of diabetes mellitus was categorized in three groups

1. < 5 years
2. 5-10 years
3. >10 years

Inclusion criteria:

- All patients with type 2 diabetes mellitus attending medicine OPD and >20 years old, receiving antidiabetics medications

Exclusion criteria:

- Type 1 Diabetics
- Those in whom the data mentioned above was not available completely.

Statistical Analysis: Statistical analysis was carried out using IBM SPSS 21.0 (Armonk, NY, USA). Categorical data, such as gender, age group, BMI, Comorbidity, drug utilization pattern and duration of diabetes are presented as number and percentage. Also Chi-square was used to assess the statistical significance of difference in the percent of good glycemic control according to the categorical variable; and was accepted at a 95% CI. Multiple variable Binary Logistic regression was used to identify factors associated with good glycemic control. A *P*-value less than 0.05 was considered significant.

RESULTS

Table 1 is showing the descriptive statistics of the age, duration of diabetes, BMI, Fasting blood Sugar and HbA1C of all the patients.

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

Table 2 represents that among 206 patients which were included in this study, 115(55.8%) were males and 91 (44.2%) were females. Majority were in the age group between 41-60 years (63%). 27% of patients were more than 60 years of age and only 10% were less than 40 years. Among BMI category 34 % had normal BMI, whereas 30 % were in obese category and 35.4% were coming in over weight category. Comorbidity was present only in 21% of patients. Among Drug utilization pattern 15.5% were treated with monotherapy, 47.1% were as combination therapy while 23.8% were receiving Insulin + OAD therapy. 44% of the patients were having diabetes for less than 5 years, 34% were having duration for 6-10 years and 22 % were having it for more than 10 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

Table 3 represents that gender does not affect glycemic control. Only 5% had

achieved good glycemic control in less than 40 years of age whereas, 20% had good glycemic control in 41 to 64 years and only 9% in more than 65 years of age. This was found to be statistically significant. Majority (60%) of diabetics who had good glycemic control had duration of diabetes less than 5 years, while 28% had duration between 6 to 10 years and only 9% had duration more than 10 years. Also 60% of diabetics with poor glycemic control had duration more than 5 years and this was statistically significant. Merely 12% of diabetics with

BMI >30 had good glycemic control whereas more than 60% of diabetics who had BMI more than 25 had poor glycemic control, which was again statistically significant. As majority of our patients had no comorbidity; we found that comorbidity has no major effect on glycemic control. More than 80% of Diabetics were on monotherapy or combination of OADs and had good glycemic control. Approximately 25% of patient despite of receiving insulin therapy had poor glycemic control and this was statistically significant.

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: 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

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.

DISCUSSION

In this study acceptable level of glycemic control was not achieved in most of the patients. HbA1c level which was used to assess the glycemic control was way above 7% in 65% of cases. These results are similar to the other studies conducted in various parts of the world especially in developing countries like Malaysia, Hong Kong and China. [9-11] In a study population of the Asian patients treated at diabetes

centers, more than 50% were not well controlled leading to higher microvascular complications in the group of patients with higher HbA1c. [12] National health and nutrition examination survey, United States in 2007-2010, the Healthy People 2020 objectives include a 10% reduction in the proportion of the diabetes population that has poor glycemic control (A1c >9%). [13] Studies on glycemic control from India are very few and there is only one large national representative population based study conducted by Indian council of Medical Research. Results of this study showed the evidence of poor glycemic control in a representative study subjects and found that good glycemic control (HbA1c <7%) was observed only in 31.1% of urban and 30.8% of rural subjects. This study was done in 3 states and one union territory of India covering population of 213 million. [14] The importance of good glycemic control in prevention of microvascular complications is well established in Diabetes Control and Complications Trial/ Epidemiology of Diabetes interventions and complications study and United Kingdom Prospective Diabetes study. [2, 15]

We have found glycemic control is significantly associated with age, duration of Diabetes, drug utilization patterns and BMI. In our study there was no significant association of glycemic control was found with sex and comorbidities.

The current study showed that that maximum good glycemic control was achieved in middle aged population between 41 to 64 years of age. People younger than 40 and more than 65 years had poor glycemic control. Poor glycemic control among young people is a matter of strong concern as initial diabetes control is extremely important in preventing long term complication of Diabetes being explained with concept of metabolic memory. [15, 16] If young people are not controlled adequately, chances of diabetes related complications are high, leading thereby huge economic burden and increased mortality and morbidity from the disease. High HbA1c

level in younger individuals shown in a study might be due to low or inadequate dosing or to occasional use of combination drug regimens, inertia in starting insulin therapy or because of increased incidence of obesity among young population. This further emphasize on the need of better education and treatment strategies to be directed towards younger age group. [17,18] Similarly, in elderly age group glycemic control was poor. In older age group fear of precipitation of hypoglycemia, lack of family support in current trend of nuclear families, inability to follow exercise regimens due to multiple comorbidities associated with this age might be contributing factors. This finding is contrary to finding in a study done in Malaysia showing better glycemic control in elderly. This was explained by better family set ups, increased adherence to medication because of family members being involved in care and reminding them for medication and taking care of their diets and regular follow-up, development of comorbidities like renal failure, better access to medical care, good compliance and motivation for glucose testing, regular physical activity and healthy eating. [19-21] There are many studies in which there was no association was found between age group and glycemic control. [22] Eventually, in view of these variable findings it is important that clinicians should focus on understanding of pathophysiology and management in every diabetic young as well old so as to achieve desired glycemic control in everyone.

Long Duration of diabetes was correlated with poor glycemic control and it was found that people having diabetes for less than 5 years had the best diabetic control and people with >10 years had the worst. These findings are similar to many studies done in various developing countries. In a study done in Hong Kong it was found that long disease duration and complexity of treatment regimens were associated with suboptimal glycemic control. [23-25] Long duration of diabetes had a negative impact on glycemic control

possibly because of progressive decrease in beta cell reserve with decrease in insulin secretion over time. [2] With increasing duration of diabetes, need of antidiabetic drugs increases as to maintain adequate glycemic control. This requires close follow ups and regular titration of medication further emphasizing the need of regular check-ups, self-monitoring of blood glucose, diabetes related education and regular optimization of medical management. Early intensification and optimization should be done to increase the effectiveness of treatment regimen.

The drug utilization pattern also influences the glycemic control and in our study it was found that patient receiving combination OAD had the good glycemic control in comparison to patients on monotherapy and patient receiving insulin plus OAD. Metformin is the first line of therapy for most of the diabetics as per the standard guidelines. [26] In our study though we have not analyzed the type of therapy in monotherapy however we can assume that patient receiving monotherapy usually would be on metformin monotherapy. It has proved in many studies that monotherapy is usually not sufficient to achieve good glycemic control in most patients especially with increased duration of the disease. More than 80% of patients fail to achieve glycemic goals with initial monotherapy whether metformin or sulfonylureas are given over 3 years. [27] Progressive deterioration of diabetes control was such that after 3 years approximately 50% of patients could attain the goal with monotherapy, and by 9 years this declined to approximately 25%. [28] The majority of patients need multiple therapies to attain these glycemic target levels in the longer term. In our study patient's on insulin plus OAD therapy were also found to have poor glycemic control. Usually when dual or triple oral antidiabetic therapy fails to achieve the targeted glycemic goals then insulin is added and by this time, many have lived 5 years with A1C levels greater than 8%, and 10 years with A1C levels greater

than 7%. [29] A therapeutic inertia in starting insulin might be the cause of poor glycemic control as delayed initiation of insulin with long duration of diabetes might not be able to control sugar levels the same way. Also is being explained by the poor titration of insulin regimen, poor self-monitoring of glucose, lack of training and education for empowering patients to optimize their sugar levels, poor storage and injection techniques of insulin and inconvenience to adhere to multiple therapeutic regimen. Contrary to this in some studies intensive insulin therapy and monitoring has led to excellent glycemic control. [30] In our study glycemic control was best achieved with combination of oral antidiabetic medication which could probably be related to good compliance in taking medications because of ease of taking it. Further combination is more effective because of different modes of action with greater potency and minimal side effects. Early introduction of combination therapy helps more patients to achieve glycemic targets and thereby reduce complications and delay disease progression. [31]

In our study Obese patients with BMI >30 had got poor glycemic control followed by overweight and normal weight subject. BMI has got significant association with glycemic control in our study. This is similar to study done by, [32] where strong correlation has been found between weight and sugar levels. On the other hand, many studies did not show any relationship with BMI and glycemic control. [33] Obesity, especially abdominal adiposity is not only an important risk factor for the development of type 2 diabetes but also impact glycemic control. Association of obesity with other comorbidities like dyslipidemia, hypertension, Insulin resistance might also be contributing in nonattainment of good glycemic control in obese subjects. [34] Hypertension and dyslipidemia are associated with insulin metabolism disturbance, hyperinsulinemia and poor glycemic control. [35] Lipid abnormalities are common in patients with diabetes. Dyslipidemia is associated with poor

glycemic control, and it is observed that better glycemic control is associated with lower levels of total cholesterol, low-density lipoprotein cholesterol and triglycerides Adham M In our study there was no statistical significant association was found between glycemic control and comorbidities like hypertension and dyslipidemia.

In our study glycemic control was not significantly different among males or females. In some studies, female sex is found to be a risk factor for poor glycemic control. It is being said that being an inferior sex specially in developing countries females are deprived for diabetes care, busy in providing more care to family and that is how neglect their own health. Hence females needs more attention during management of diabetes considering their nutritional, psychological and puberty issues also. [36]

CONCLUSION

The overall glycemic control in patients belonging to western UP region was found to be poor and it was seen that > 65% patients were not able to achieve glycemic control similar to many studies done in various developing countries, placing them at increased risk of developing diabetes related complications. Age, duration of diabetes, drug utilization patterns and BMI were the significant factors impacting glycemic control. Though we have not analyzed many other factors impacting glycemic control but we speculate from this study that young, overweight and obese individuals, patients with long duration of diabetes and those who were on complex drug regimens should be given special attention to achieve good glycemic control. Health care professionals and health agencies should emphasize on optimum utilization of all available resources. All-inclusive management of every diabetic with help of dieticians and counselors is fundamental in achieving the target glycemic control.

Conflict of interest:

The author(s) declared no conflicts of interests with respect to the research and publication of this article.

Declaration of funding:

The present study did not receive any specific grant from any funding agencies. No funding agency has participated in writing as well as in submission of the manuscript.

ACKNOWLEDGEMENTS

We would like to show our gratitude to Ms. Niira Radia for her continuous support and guidance during the course of this research project. We are also thankful to Ms. Purnima Bajpai for helping us in data collection and compilation.

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 Diabetes 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. 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.
10. 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.
11. Xu Y, Wang L, He J, et al. Prevalence and control of diabetes in Chinese adults. 2010 China Noncommunicable Disease Surveillance Group. *JAMA*. 2013 Sep 4; 310(9):948-59.
12. 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.
13. Ali MK, Bullard KM, Imperator G, et al. Characteristics associated with poor glycemic control among adults with self-reported diagnosed diabetes—National Health and Nutrition Examination Survey, United States, 2007–2010. *MMWR Morb Mortal Wkly Rep*. 2012;61(2):32–37.
14. Unnikrishnan R, Anjana RM, Deepa M et al. Glycemic control among individuals with self-reported Diabetes in India - The ICMR - INDIAB Study. *Diabetes Technology & Therapeutics* 2014; 16 (9): 596-603.
15. Nathan DM; DCCT/EDIC Research Group: The Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Study at 30 years: overview. *Diabetes Care* 2014;37:9–16.
16. Stratton IM, Adler AI, Neil HA, et al.: Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ* 2000;321:405–412.
17. Goudswaard A 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.
18. Imad M. 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.
19. Yeung WJJ. Asian fatherhood. *J Fam Issues* 2013; 34: 143–160.
20. 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.
21. 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.
22. 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.
23. 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.
24. 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.
25. Temesgen Fiseha, Ermiyas Alemayehu, Wongelawit Kassahun, et al. Factors associated with glycemic control among diabetic adult out-patients in Northeast Ethiopia.
26. 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). *Buse Diabetes Care* 2018 Dec; 41(12):2669-2701.
27. 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.
28. Turner RC, Cull CA, Frighi V, et al Glycemic control with diet, sulfonylurea, metformin, or insulin in patients with type 2 diabetes mellitus progressive requirement for multiple therapies (UKPDS 49). *JAMA*

- 1999; 281: 2005–2012.
29. Brown JB, Nichols GA, Perry A. The burden of treatment failure in type 2 diabetes. *Diabetes Care* 2004; 27:1535-1540.
 30. DeFronzo RA. Pharmacologic therapy for type 2 diabetes mellitus. *Ann Intern Med* 1999; 131: 281–303.
 31. Bailey CJ, Prato SD, Eddy D, et al Earlier intervention in type 2 diabetes: the case for achieving early and sustained glycemic control. *Int J ClinPract* 2005; 59: 1309–1316.
 32. Lotfi Z1, Aboussaleh Y1, Sbaibi R1, et al. The overweight, the obesity and the glycemic control among diabetics of the provincial reference center of diabetes (CRD), Kenitra, Morocco]. *Pan Afr Med J.* 2017 Jul 11;27:189.
 33. Luis A Vázquez, Ángel Rodríguez, Javier Salvador, et al. Relationships between obesity, glycemic control, and cardiovascular risk factors: a pooled analysis of cross-sectional data from Spanish patients with type 2 diabetes in the preinsulin stage. *BMC Cardiovasc Disord.* 2014; 14: 153.
 34. GoyalJ., KumarN, ManiR.K. et al. Association of body mass index (Obesity) with diabetes, hypercholesterolemia, hypertriglyceridemia, low HDL levels and hypothyroidism in adult population in a tertiary care hospital of western Uttar Pradesh: A cross sectional study. *WWJMRD* 2018; 4(6): 175-180.
 35. Mohammad Haghghatpanah, Amir Sasan MozaffariNejad, Maryam Haghghatpanah, et al. Factors that Correlate with Poor Glycemic Control in Type 2 Diabetes Mellitus Patients with Complications. *Osong Public Health Res Perspect* 2018 Aug; 9(4): 167–174.
 36. 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 KlinWochenschr* 2012 Nov;124(21-22):742-9.

How to cite this article: Goyal J, Kumar N, Sharma M et.al. Factors affecting glycemic control among patients with type 2 diabetes at a tertiary health care center of western UP region: a cross-sectional study. *Int J Health Sci Res.* 2019; 9(3):12-20.
