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Factors affecting glycemic control in patients with type 2 diabetes mellitus using oral antidiabetics: A single-center experience

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Abstract

In this retrospective study, we aimed to investigate the factors affecting glycemic control in patients with type 2 diabetes mellitus (DM) treated with oral antidiabetic drugs (OADs). From 2019 to 2020, type 2 DM patients treated with OADs were included in this study. Patients less than 18 years old and those treated with insulin were excluded from the study. The patients were divided into two groups according to HbA1C levels as follows: good glycemic control (GGC) (<7%) or poor glycemic control (PGC) (≥7). Of the 505 type 2 DM patients, 270 (53.5%) were female. There were 194 (38.4%) patients in the GGC group and 311 (61.6%) in the PGC group. The rate of marriage and employment were higher in the GGC group than those in the PGC group. Likewise, education level and, and high-density lipoprotein were higher in the GGC group than those in the PGC group. In the multivariate analysis, being married (odds ratio [OR], 0.39), duration of DM (OR, 1.12), having a high-school graduate (OR, 0.43), triglyceride level (OR, 1.001), and high-density lipoprotein level (OR, 0.979) were the factors affecting glycemic control. In this study, we found that being married and having a higher education level and high-density lipoprotein level were associated with GGC in type 2 DM patients treated with OADs.

Keywords: Glycemic control, oral antidiabetic drugs, marital status, body mass index

Introduction

Diabetes is a major cause of death globally. The prevalence of type 2 diabetes mellitus (DM) is approximately 6.4% in adults, ranging from 3.8% to 10.2% by region. The incidence of undetected diabetes is estimated to be 50% in some areas. Type 2 DM is characterized by insulin resistance and relative impairment in insulin secretion, resulting in hyperglycemia. The prevalence of DM markedly increases by obesity and sedentary lifestyle [1-3].

DM is associated with a high prevalence of micro- and macro-vascular diseases. about %50 of patients experience one of the following vasculary complications which adversely impact employment, absenteeism, and business productivity; myocardial infarction, stroke, end-stage kidney disease, retinopathy, and foot ulcers, [4, 5].

In response to insulin resistance, Hyperinsulinemia may play an important role in formation of several abnormalities including hypertension, low serum high-density lipoprotein (HDL) level, and high serum low-density lipoprotein (LDL) level [6].

Good glycemic control (GGC) in DM is associated with a lower risk of microvascular complications. A lower glycated hemoglobin (HbA1C) level is associated with improved long-term outcomes. Several randomized trials have demonstrated a beneficial effect of intensive treatment on outcomes in DM. A reasonable treatment target for most DM patients is to lower the HbA1C level below 7.0% [7-9].

Aggressive multifactor risk reduction lowers the risk of micro- and macro-vascular complications. Cardiovascular risk reduction must be the most important priority for all patients. A decrease in serum lipids, smoking cessation, blood pressure control, exercise, diet, and weight-loss are important factors for a GGC [10, 11].

In addition to exercise, body mass index (BMI), antidiabetic drugs, sociocultural factors, education level, and economic conditions affect glycemic control. In this retrospective study, we aimed to investigate the factors affecting glycemic control in type 2 DM patients treated with oral antidiabetic drugs (OADs).

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Material and Methods

Study population

A total type 2 DM 505 patients treated and followed from 2019 through 2020 at Yüzüncü Yıl University Hospital were enrolled. Of these patients, 270 (53.5%) were female. The median age was 56 years (range, 30–85). Patients older than 18 years and were treated with OADs for type 2 DM were included.

Data collection

The patients' gender, age, marital status (married or unmarried), family history of DM, employment status (unemployed or employed), education level (illiterate, elementary, high school, or college), duration of DM, BMI, hypertension, and total cholesterol, triglyceride, LDL, HDL, HbA1C, and fasting plasma glucose (FPG) levels were obtained from the archive files. BMI was calculated by the weight divided by the height squared. The patients were divided into two groups according to HbA1C level as follows: GGC=HbA1C≤7% and poor glycemic control (PGC) =HbA1C>7%.

Ethics committee approval

This study was conducted in accordance with the Declaration of Helsinki, and it was approved by the Ethics Committee of Yüzüncü Yıl University (ID:2020/06-05).

Statistical analysis

The Statistical Package for Social Sciences 22.0 for Windows software (IBM Corp., Armonk NY, 2013) was used for all statistical analyses. Descriptive statistics are presented as the mean, standard deviation, minimum, and maximum for numerical variables and as the frequency and percentage for categorical variables. The Student t test was used to compare numerical variables with a normal distribution between two independent groups, whereas the Mann–Whitney U test was used to compare variables without a normal distribution. Chi-square analysis was used to compare the ratios between the groups. Monte Carlo simulation was applied when the conditions were not met. The determinant factors were examined by logistic regression analysis. The Enter model was used with parameters having a $p<0.05$. The statistical significance level was $p<0.05$.

Results

Of the 505 DM patients, 270 (53.5%) patients were female, and 235 (46.5%) were male, with a median age of 56 years (range, 30–82). About 91.5% of the patients were married and 394 (78%) patients had a family history of DM. The median duration of DM was 6.6 years. About 362 (71.7%) patients had hypertension. The mean HbA1C and FPG levels were 8.0% and 153 mg/dl respectively. The lipid levels are shown in Table 1.

Table 1. Patients data.

Characteristics		n	&
Gender	Female	270	53.5
	Male	235	46.5
Age(years)	Median (min-max)	56 (30-85)	
Marital status	Unmarried	43	8.5
	Married	462	91.5
Family history of DM	Absence	111	22.0
	Presence	394	78.0
Employment status	Unemployed	349	69.1
	Employed	156	30.9
Education level	Illiterate	65	12.9
	Elementary education	289	57.2
	High school	104	20.6
	College	47	9.3
Duration of DM	Mean + SD (median)	6.6+6.3 (5.0)	
BMI	Overweight	59	11.7
	Normal weight	219	43.4
	Obese	227	45.0
Hypertension	Absence	143	28.3
	Presence	362	71.7
Total cholesterol	mg/dL	208.2+46.6 (202.0)	
Triglycerides	mg/dL	180.5+121.0 (157.0)	
Low-density lipoprotein	mg/dL	125.7+39.1 (120.0)	
High-density lipoprotein	mg/dL	47.4+13.4 (46.0)	
HBA1C		8.0+2.1 (7.4)	
Fasting plasma glucose	mg/dL	153.0+64.8 (131.0)	

Abbreviations: BMI, Body mass index; DM, Diabetes mellitus

Among 505 patients, 194 (38.4%) were in the GGC group, and 311 (61.6%) were in the PGC group. There were no statistically significant differences between the groups in terms of gender, age, BMI, total cholesterol levels, and LDL levels. The family history of DM, employment status, education level, duration of DM, hypertension status, triglyceride levels, HDL levels, HbA1c levels, and fasting plasma glucose levels significantly differed between the groups (Table 2).

In the multivariate analysis, the duration of DM (p<0.001), marital status (p=0.027), education level (p<0.001), triglyceride level (p=0.029), and HDL level (p=0.010) were the factors affecting glycemic control (Table 3).

Table 1. Patients data according to glycemic control status.

Characteristics		Good glycemic control		Poor glycemic control		p
		n	%	n	%	
Gender	Women	108	55.7	162	52.1	0.433
	Male	86	44.3	149	47.9	
Age(years)	Median (min-max)	56.0 (30-85)		57.0 (30-85)		0.763
Marital status	Unmarried	9	4.6	34	10.9	0.014
	Married	185	95.4	277	89.1	
Family history of DM	Absence	57	29.4	54	17.4	0.002
	Presence	137	70.6	257	82.6	
Employment status	Unemployed	120	61.9	229	73.6	0.005
	Employed	74	38.1	82	26.4	
Education level	Illiterate	19	9.8	46	14.8	<0.001
	Elementary education	87	44.8	202	65.0	
	High school	61	31.4	43	13.8	
	College	27	13.9	20	6.4	
Duration of DM	Mean + SD (median)	4.5+5.0		7.9+6.7		<0.001
BMI	Overweight	26	13.4	33	10.6	0.433
	Normal weight	87	44.8	132	42.4	
	Obese	81	41.8	146	46.9	
Hypertension	Absence	74	38.1	69	22.2	<0.001
	Presence	120	61.9	242	77.8	
Total cholesterol	mg/dL	205.5+43.2(198)		209.8+48.7(48.7)		0.463
Triglycerides	mg/dL	152.2+83.1(136.5)		195+137.7(170.0)		<0.001
Low-density lipoprotein	mg/dL	122.2+39.3(119.5)		127.5+38.8(123.0)		0.209
High-density lipoprotein	mg/dL	49.7+12.5(48)		45.9+13.7(45.0)		<0.001
HBA1C		6.3+0.3(6.4)		9.0+2.0(8.4)		<0.001
Fasting plasma glucose	mg/dL	109.2+17.6(108.0)		180.3+68.4(165.0)		<0.001

Abbreviations: BMI, Body mass index; DM, Diabetes mellitus

Table 3. Multivariate analysis for glycemic control.

Characteristics		OR	%95 CI	p
DM time	**Year**	1.120	1.071-1.172	<0.001
Marital status	**Married vs. Unmarried**	0.393	0.172-0.899	0.027
Family history of DM	**Presence vs. Absence**	1.523	0.940-2.456	0.087
Employment status	**Employed vs. Unemployed**	0.975	0.615-1.544	0.913
Education level	**Illiterate(Ref.)**			<0.001
	Elementary education	1.410	0.728-2.728	0.308
	High school	0.431	0.202-0.919	0.029
	College	0.571	0.236-1.382	0.214
Triglycerides	**mg/dL**	1.003	1.000-1.005	0.029
High-density lipoprotein	**mg/dL**	0.979	0.962-0.995	0.010

Abbreviations: DM, Diabetes mellitus

Discussion

In the present study which represents real-life data, we aimed to evaluate the factors affecting glycemic control in type 2 DM patients treated with OADs, using. We observed that glycemic control was better in patients who were married and had a shorter duration of DM, a higher education level, a low triglyceride level, and a high HDL level .

Diabetes is a chronic disease with a rapidly increasing prevalence worldwide due to genetic factors and negative changes in lifestyle, such as obesity and physical inactivity. As of 2010, the prevalence of diabetes was 6.4% in the adult population and it is expected to reach 7.7% in 2030. DM is a main cause of morbidity and mortality in the world and in our country, with an increasing frequency despite new advances in its treatment [12, 13].

Since sedentary lifestyle and obesity are the two most important determinants of diabetes, lifestyle changes are the main approach to prevent and treat the disease. Lifestyle changes also have a positive effect on all risk factors, including hyperglycemia. It is indispensable in all stages of the disease [14-16]. Previous studies have shown that healthy lifestyle changes can prevent or delay DM and reduce the risk by 44-58%, emphasizing that regular exercise is critical in preventing complications and achieving GGC [16-19].

In a study conducted by Yanik et al., 57.0% of the patients were treated with OADs. The average time to diagnosis in individuals with diabetes was 9.5 years, and 60.4% of the patients had a family history of DM. In this study, it was determined that self-sufficiency increased when the education level of individuals increased. However, no statistically significant differences were found in the self-sufficiency level according to gender, marital status, or employment status of individuals with diabetes [20].

In the study of Çıtıl et al., there was no statistically significant difference between the genders in terms of metabolic control level; as the duration of the disease progressed, the rate of patients with good metabolic control decreased; and as the education level increased, the rate of patients with good metabolic control increased significantly. In the study, 71.8% of the DM patients had another chronic disease, with hypertension, hyperlipidemia and coronary artery diseases being the most prevalent [21]. In our study, patients with low glycemic control were found to have HT more frequently.

Previous studies have shown that the frequency of diabetes decreases when the education level increase [22, 23]. In other studies, the DM prevalence was higher among those with a family history of diabetes [24-26]. Additionally, some studies have shown that hypertension increases the incidence of DM [27, 28]. In our study, the relationship between these factors and glycemic control was examined and we found that glycemic control was better in patients who had a shorter duration of DM, were married, and had a high school education.

Mahato et al. found that in patients with HbA1c greater than 7%, the total cholesterol, LDL, and triglyceride levels were higher than in those with HbA1c less than 7%; however, the HDL cholesterol level did not significantly differ between the two groups[29]. Khan et al. found a positive correlation between HbA1c and triglycerides and a negative correlation between HDL cholesterol and HbA1C. However, there were no significant correlations among LDL, total cholesterol, and HbA1C [27]. In our study, glycemic control was better in patients with a low triglyceride level and high HDL level and there was no relationship between total cholesterol and LDL. Our study has some limitations. It was a single-centered retrospective study. In addition, we did not know which OADs were used for DM.

Conclusion

In conclusion, we found that glycemic control was better in patients who were married and had a shorter duration of DM, high school education, low triglyceride level, and high HDL level. In these patients, we recommend that more efforts should be paid to lower the triglyceride level. Increasing the HDL level may help improve glycemic control.

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Conflict of interests
The authors declare that they have no competing interests.

Financial Disclosure
The financial support no have.

Ethical approval
This study and all relevant procedures were performed in accordance with the Helsinki Declaration after obtaining the ethical board approval from the Yüzüncü Yıl University Ethics Committee (ID:2020/06-05).

References

1. Sullivan PW, Morrato EH, Ghushchyan V, et al. Obesity, inactivity, and the prevalence of diabetes and diabetes-related cardiovascular comorbidities in the U.S., 2000-2002. Diabetes Care. 2005;28:1599-603.
2. American Diabetes A. 2. Classification and diagnosis of diabetes. Diabetes Care. 2017;40(Suppl 1):11-24.
3. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. JAMA. 2003;289:76-9.
4. Katon WJ, Rutter C, Simon G, et al. The association of comorbid depression with mortality in patients with type 2 diabetes. Diabetes Care. 2005;28:2668-72.
5. Tunceli K, Bradley CJ, Nerenz D, et al. The impact of diabetes on employment and work productivity. Diabetes Care. 2005;28:2662-7.
6. DeFronzo RA, Ferrannini E. Insulin resistance. A multifaceted syndrome responsible for NIDDM, obesity, hypertension, dyslipidemia, and atherosclerotic cardiovascular disease. Diabetes Care. 1991;14:173-94.
7. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. Lancet. 1998;352:837-53.
8. Holman RR, Paul SK, Bethel MA, et al. 10-year follow-up of intensive glucose control in type 2 diabetes. N Engl J Med. 2008;359:1577-89.
9. Hayward RA, Reaven PD, Wiitala WL, et al. Follow-up of glycemic control and cardiovascular outcomes in type 2 diabetes. N Engl J Med. 2015;372:2197-206.
10. Gaede P, Vedel P, Larsen N, et al. Multifactorial intervention and cardiovascular disease in patients with type 2 diabetes. N Engl J Med. 2003;348:383-93.
11. Pal K, Eastwood SV, Michie S, et al. Computer-based diabetes selfmanagement interventions for adults with type 2 diabetes mellitus. Cochrane Database Syst Rev. 2013:CD008776.
12. Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet Med. 1998;15:539-53.

13. Onat A, Ozhan H, Esen AM, et al. Prospective epidemiologic evidence of a "protective" effect of smoking on metabolic syndrome and diabetes among doi: 10.5455/medscience.2020.09.179 Med Science 2021;10(1):46-50 50 Turkish women--without associated overall health benefit. Atherosclerosis. 2007;193:380-8.

14. Pan XR, Li GW, Hu YH, et al. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance. The Da Qing IGT and Diabetes Study. Diabetes Care. 1997;20:537-44.

15. Gong Q, Zhang P, Wang J, et al. Morbidity and mortality after lifestyle intervention for people with impaired glucose tolerance: 30-year results of the da qing diabetes prevention outcome study. Lancet Diabetes Endocrinol. 2019;7:452-61.

16. Association AD. 1. Improving care and promoting health in populations: standards of medical care in diabetes-2020. Diabetes Care. 2020;43(Suppl 1):7-13.

17. Clark CM, Jr., Kinney ED. Standards for the care of diabetes. Origins, uses and implications for third-party payment. Diabetes Care. 1992;15 Suppl 1:10-4.

18. Kirk A, Mutrie N, MacIntyre P, Fisher M. Increasing physical activity in people with type 2 diabetes. Diabetes Care. 2003;26:1186-92.

19. Amanat S, Ghahri S, Dianatinasab A, et al. Exercise and type 2 diabetes. Adv Exp Med Biol. 2020;1228:91-105.

20. Tekin Yanık Y, Erol Ö. Tip 2 diyabetli bireylerin öz-yeterlilik düzeylerinin değerlendirilmesi. J Anatolia Nursing Health Sci. 2016;19:166-74.

21. Rıza çitil YÖ, Osman Günay. Kayseri il merkezinde bir sağlık ocağında başvuran diyabetik hastalarda metabolik kontrol durumu ve eşlik eden faktörler. Erciyes Tıp Dergisi. 32:111-22.

22. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser. 1995;854:1-452.

23. Navaneethan SD, Kirwan JP, Remer EM, et al. Adiposity, Physical Function, and Their Associations With Insulin Resistance, Inflammation, and Adipokines in CKD. Am J Kidney Dis. 2021;77:44-55.

24. Mahley RW, Palaoglu KE, Atak Z, et al. Turkish Heart Study: lipids, lipoproteins, and apolipoproteins. J Lipid Res. 1995;36:839-59.

25. Bo S, Gentile L, Cavallo-Perin P, et al. Sex- and BMI-related differences in risk factors for coronary artery disease in patients with type 2 diabetes mellitus. Acta Diabetol. 1999;36:147-53.

26. Haffner SM, Mykkanen L, Festa A, et al. Insulin-resistant prediabetic subjects have more atherogenic risk factors than insulin-sensitive prediabetic subjects: implications for preventing coronary heart disease during the prediabetic state. Circulation. 2000;101:975-80.

27. Khan HA, Sobki SH, Khan SA. Association between glycaemic control and serum lipids profile in type 2 diabetic patients: HbA1c predicts dyslipidaemia. Clin Exp Med. 2007;7:24-9.

28. Urrea C, Mignogna A. Development of an expert system for pre-diagnosis of hypertension, diabetes mellitus type 2 and metabolic syndrome. Health Informatics J. 2020:1460458220937095.

29. Mahato PG RV, Raut P Psd, Regmi P, et al Association between glycaemic control and serum lipid profile in type 2 diabetic patients: Glycated haemoglobin as a dual biomarker. Biomedical Research. 2011;22:375-80.