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Achieving the target level of glycated haemoglobin in type 2 diabetes mellitus patients: method of treatment and body mass index in question.

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Abstract

Aim: The aim of this study is to assess the levels of glycated hemoglobin (HbA1C) and Fasting Blood Glucose (FBG) in type 2 Diabetes Mellitus (DM) patients with regard to method of treatment and patients' Body Mass Index (BMI), and to examine the factors that affect adherence to treatment.
Material and method: The participants of this study were selected from amongst DM patients admitted between March 2016 and June 2016 to Family Medicine Clinic or Endocrinology Clinic of Eskisehir Osmangazi University Hospital. The study was conducted with 420 patients, who were asked to provide their sociodemographic data as well as information on duration of diabetes, type of treatment they received, and the presence of any other chronic diseases. The patients' Glomerular Filtration Rates (GFR) and body mass indexes were calculated. The patients were asked whether they exercised, complied with dietary recommendations, smoked, and developed any complications. The study sought the relationship between metabolic values and level of motivation and knowledge measured by six-item Modified Morisky Scale. SPSS 21 was used for data analysis.
Findings: The distribution of 420 patients by gender was as follows: 167 men (39.8%) and 253 women (60.2%). The average age was 58.12 ± 9.91 years. The average duration of diabetes was 10.81 ± 7.49 years in patients. The level of knowledge was 11 times higher in patients that exercised than non-exercising patients, and 2.25 times higher in patients that had diabetes for ≥10 years than patients that had diabetes for ≤ 9 years. Furthermore, the level of motivation was 1.67 times higher in non-smoking patients than smoking patients, and 1.69 times higher in patients with upper secondary or higher degree than patients with primary school or lower degree.
Conclusion: Adherence to medication is questioned when target laboratory results are not achieved in DM treatment. Scales of adherence to treatment may play a guiding role in this process. Because of challenges in assessing medication adherence, it is advised to use several methods together.

Keywords: Diabetes mellitus, Modified Morisky scale, HbA1C.

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Introduction

Today there are 415 million adult DM patients across the world, and the number is estimated to increase to 642 million in 2040 [1]. The factors that play a role in the growing diabetes prevalence are aging resulting from population growth and increased life expectancy, and the increase in obesity and reduced physical activity mainly because of urbanization [2,3]. Type 2 DM requires the treatment of many comorbid diseases. In DM patients, main treatment goals are to regulate blood sugar, to control high blood pressure, and to cure dyslipidemia and obesity. Blood sugar regulation has resulted in a decrease in complications and total mortality. In diabetic patients, regulating blood sugar and preventing complications do not only depend on medical treatment but require regular clinical follow-up and patients' adherence to treatment [4,5].

The main focus in type 2 DM treatment is patients' adherence to treatment. Adherence to treatment relies on multiple interrelated factors. The complex nature of the disease and all possible side effects play an important role in adherence to treatment [6]. The success of treatment depends on behavioral changes in dietary and exercise habits [7].

The aim of this study is to assess the levels of glycated haemoglobin (HbA1C) and Fasting Blood Glucose (FBG) in type 2 Diabetes Mellitus (DM) patients with regard to method of treatment and Body Mass Index (BMI), and to examine the factors that affect adherence to treatment by Modified Morisky scale.

Materials and Method

After the research proposal was approved by the Clinical Research Ethics Committee of Eskisehir Osmangazi University Hospital (decision no. 1 of February 10, 2016), the participants were selected from amongst the DM patients aged over 18, admitted between March 2016 and June 2016 to Family Medicine Clinic or Endocrinology Clinic of Eskisehir Osmangazi University Hospital. An Informed Voluntary Consent Form was developed, and the patients were asked to read and sign the form. Pregnant patients were excluded from the research. The study was conducted with a total of 420 patients.

The patients were requested to provide their sociodemographic data as well as information on duration of diabetes and type of treatment they received. The patients were divided into two by level of education (upper secondary education and higher, primary education and lower), into two by duration of diabetes (≤ 9 years and ≥ 10 years), and into three by method of treatment (Oral Antidiabetic medication (OAD), oral antidiabetic medication+insulin, and only insulin). The patients were also asked whether they had any comorbid diseases. The patients were not required to have any laboratory tests done other than routine control tests. The values obtained in routine tests were recorded: fasting blood sugar, HbA1c, Low-Density Lipoprotein (LDL), Triglyceride (TG), High-Density Lipoprotein (HDL), Total Cholesterol (TC), Creatinine (CR), and Blood Urea Nitrogen (BUN). Furthermore, the patients' Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), weight and height were measured. Their GFR was calculated by MDRD and Cockroft methods. The patients' Body Mass Indexes (BMI) was calculated, and the patients with a BMI greater than or equal to 30 kg/m^2 were categorized as obese. Other factors taken into consideration were physical activity, compliance with dietary recommendations, and smoking. The presence of nephropathy and neuropathy was sought. Target values were defined as follows: HbA1c<6.5%, LDL ≤ 100 mg/dl, triglyceride ≤ 150 mg/dl, total cholesterol<200 mg/dl, HDL ≥ 40 mg/dl (for men), ≥ 50 mg/dl (for women). All values were compared with levels of motivation and knowledge (high-low). The study further looked at the relationship among method of treatment, body mass index and target HbA1C value (<6.5%) [8-10].

Six-item modified Morisky scale

Response choices are "yes" and "no" in the six-item Modified Morisky Scale. The score is 1 for "yes" option and 0 for "no" option in questions 2 and 5, and 0 for "no" option and 1 for "yes" option in questions 1, 3, 4 and 6. Subscale scores of 0 or 1 in questions 1, 2 and 6 refer to low motivation, and the score over 1 refers to high motivation. Subscale scores of 0 or 1 in questions 3, 4 and 5 suggest low level of knowledge, and the score over 1 suggests high level of knowledge. Vural et al. conducted a study to test reliability and validity of the Modified Morisky Scale, where they administered the Modified Morisky Scale as pre-test and post-test to a group of 35 patients taking medications for at least six months for the treatment of a chronic disease. They found out that the Turkish version of Modified Morisky Scale was a short and reliable tool that is easy to administer to test the levels of motivation and knowledge separately. That is why we used this scale in the present study [11].

Statistical analysis

SPSS 21 was used for statistical analysis of data. Descriptive statistics related to continuous variables were presented in the form of mean ± standard deviation or median (Q1-Q3). Categorical variables were presented in the form of frequencies and percentages. Shapiro-Wilk Test was used to find out whether continuous variables showed normal distribution. T-Test was used to compare the groups that had normal distribution, and Mann-Whitney U Test for the comparison of groups without normal distribution. Chi-square test and logistic regression analyses were performed to evaluate the relationship between categorical variables. The level of statistical significance was $p<0.05$.

Findings

The distribution of 420 patients by gender was as follows: 167 men (39.8%) and 253 women (60.2%).

The average age of 420 patients was 58.12 ± 9.91 years (min. 20 and max. 85 age).

With regard to marital status, the patients were distributed as follows: 19 patients (4.5%) were single, 362 patients (86.2%) were married, 12 patients (2.9%) were divorced, and 27 patients (6.4%) had lost their spouse.

The patients were divided into five categories by number of children: 22 patients (5.2%) had no children, 36 patients (8.6%) had one child, 175 patients (41.7%) had two children, 150 patients (35.7%) had three children, and 37 patients (8.8%) had four or more children.

With regard to level of education, the distribution of patients was as follows: 8 patients (1.9%) were illiterate, 241 patients (57.4%) had primary school degree, 92 patients (21.9%) had upper secondary school degree, and 79 patients (18.8%) had associate degree and/or university degree. Thus, 249 patients (59.3%) had primary school or lower degree while 171 patients (40.7%) had upper secondary or higher degree.

The patients were also asked their professional status. The results indicate that 182 patients (43.3%) were not working, 146 patients (34.8%) were retired, 40 patients (9.5%) were civil servants, 23 patients (5.5%) were employed in the private sector, 10 patients (2.4%) were farmers, and 19 patients (4.5%) had other professions.

The patients were divided into four groups with regard to their monthly income (below 850 Turkish liras, between 850 and 1500 Turkish liras, between 1501 and 3000 Turkish liras, and over 3000 Turkish liras). There were 2 patients (0.5%) whose income was lower than 850 TL, 122 patients (29.0%) whose income was between 850 and 1500 TL, 250 patients (59.5%)

whose income was between 1501 and 3000 TL, and 46 patients (11.0%) whose income was greater than 3000 TL.

All 420 patients had been diagnosed with type 2 DM. The average duration of DM was 10.81 ± 7.49 years (min. 1 year and max. 40 years). There were 201 patients (47.9%) who had diabetes for ≤ 9 years, and 219 patients (52.1%) who had diabetes for ≥ 10 years.

The methods of treatment used for diabetes were as follows: 212 patients (50.5%) were receiving OAD treatment, 140 patients (33.3%) were receiving OAD and insulin treatment, and 68 patients (16.2%) were receiving only insulin treatment.

With regard to complications, it was found out that 60 patients (14.3%) developed neuropathy, and 42 patients (10.0%) developed nephropathy.

When the patients were also asked about comorbid diseases, it was found out that 271 patients (64.5%) had at least one additional disease. The diseases were as follows: high blood pressure in 201 patients (47.9%), coronary artery disease in 56 patients (13.3%), cancer in 37 patients (8.8%), Chronic Obstructive Pulmonary Disease (COPD) in 11 patients (2.6%), osteoporosis in 21 patients (5.0%), cerebral hemorrhage and/or paralysis in 13 patients (3.1%), asthma in 23 patients (5.5%), psychiatric disorders in 25 patients (6.0%), inflammatory rheumatism in 6 patients (1.4%), and hyperlipidemia in 28 patients (6.7%). 149 patients (35.5%) had no chronic diseases except diabetes.

The patients were asked whether they smoked. In the group, 112 patients (26.7%) reported that they smoked. With regard to package/year proportion, the lowest consumption was one package per year while the highest consumption was 85 packages per year. The mean was 24.24 ± 16.30 packages/year. 308 patients (73.3%) were not smoking. Of smokers, 61.6% were men, and 38.4% were women.

The patients were asked whether they exercised. In the group, 95 patients (22.6%) reported that they exercised, and 74 patients (17.6%) reported that they exercised regularly, i.e. three or more days a week. With regard to frequency of exercising, the lowest frequency was one day per week, and the highest was seven days per week. The mean was 4 ± 2.14 days/week. With regard to the duration of exercising per day, the shortest duration was 20 minutes/day, and the longest was 90 minutes/day. The mean was 37.73 ± 10.71 minutes/day. 325 patients (77.4%) reported that they did not exercise.

The patients were asked whether they complied with dietary recommendations. In the group, 124 patients (29.5%) reported that they complied with, 153 patients (36.4%) reported that they sometimes complied with, and 143 patients (34.1%) reported that they never complied with dietary recommendations.

The patients were asked whether they adhered to medication treatment. In the group, 346 patients (82.4%) reported that they used medications regularly while 74 patients (17.6%) reported that they did not use medications regularly.

The laboratory test results are presented in Table 1.

Table 1. *Laboratory test results of patients in the group.*

Values	Number	Min-Max (Q1-Q3)	Mean ± SD
SBP (mmHg)	420	100-180	135.92 ± 15.27
DBP (mmHg)	420	50-120	81.80 ± 8.66
BMI (kg/m^2)	420	19.8-51.9	30.91 ± 5.42
APG (mg/dl)	420	60-437	154.45 ± 59.12
HbA1c (%)	420	4.04-13.16	7.57 ± 1.68
LDL (mg/dl)	415	46-250	127.72 ± 36.39
TG (mg/dl)	417	37-764	173.21 ± 100.74
TC (mg/dl)	415	89-372	206 ± 43.9
HDL (mg/dl)	415	19-106	47.25 ± 11.85
BUN (mg/dl)	418	5.70-45	14.27 ± 5.21
CR (mg/dl)	420	0.22-4.17	0.80 ± 0.27
GFR (MDRD) (ml/min)	420	12.20-499.80	97.52 ± 36.26
GFR (Cockroft) (ml/min)	420	11.80-439.30	115.69 ± 46.68

For the purpose of this study, it was considered that the factors that affect low/high motivation and low/high level of knowledge, as measured by the Modified Morisky Scale, would be age, sex, marital status (single, married, divorced, lost their spouse), level of education (illiterate, primary school degree, upper secondary school degree, associate/undergraduate degree), monthly income (lower than 1500 TL, between 1501 and 3000 TL, higher than 3000 TL), presence of a comorbid disease, diagnosis of a psychiatric disorder, BMI, physical activity, and adherence to dietary recommendations.

The rate of exercising was higher in patients with higher level of knowledge (98.9% of the patients exercising had high level of knowledge), and the result was statistically significant (p=0.003). The patients that answered "yes" to the question whether they complied with dietary recommendations had high level of knowledge (99.2%) and high motivation (83.1%), and the results were statistically significant (p<0.001, p<0.001). The rate of motivation was higher in patients with asthma and cancer, and the results were statistically significant (p=0.013; p=0.024). The differences between groups were not statistically significant with regard to other factors.

The factors that are expected to affect the level of knowledge and motivation are as follows: level of education (primary school and lower degree, upper secondary school and higher degree), exercising, age, sex, BMI (lower than 30 kg/m^2 and greater than 30 kg/m^2), average monthly income (lower than 1500 TL, between 1501 and 3000 TL, higher than 3000 TL), presence of a chronic disease, diagnosis of a psychiatric disorder, smoking, presence of high blood pressure, and duration of DM (≤ 9 years, ≥ 10 years). The logistic regression analyses of these factors generated the following results: The level of knowledge was 11 times higher in patients that

exercised than non-exercising patients, and 2.25 times higher in patients that had diabetes for ≥ 10 years than patients that had diabetes for ≤ 9 years. Furthermore, the level of motivation was 1.67 times higher in non-smoking patients than smoking patients, and 1.69 times higher in patients with upper secondary or higher degree than patients with primary school or lower degree.

Analyses were conducted to determine the relationship between mean values of variables and level of motivation. The results suggest that the mean values of diastolic blood pressure, HbA1c, and GFR (calculated by MDRD and Cockroft formulae) were significantly lower (in statistical terms) in high motivation (p=0.002; p=0.008; p=0.014; p=0.042;). In other variables, the difference was not statistically significant with regard to the level of motivation. The details are provided in Table 2.

Table 2. *The relationship between variables and high/low motivation.*

	High motivation	**Low motivation**	**p**
	Median (Q1-Q3)	**Median (Q1-Q3)**	
Age (years)	58.00 (52.00-65.00)	58 (51.5-64)	0.822
SBP (mmHg)	130 (130-140)	140 (130-150)	0.12
DBP (mmHg)	80 (80-90)	80 (80-90)	0.002
Height (cm)	163 (157-170)	162 (157.5-170)	0.728
Weight (kg)	80 (72-90)	82 (74-92.5)	0.19
BMI (kg/m^2)	30.00 (26.70-33.80)	30.90 (27.45-34.15)	0.2
APG (mg/dl)	138 (111-178.50)	142 (110-179)	0.547
HbA1c (%)	7.04 (6.20-8.39)	7.47 (6.5-8.96)	0.008
CR (mg/dl)	0.76 (0.66-0.92)	0.73 (0.61-0.89)	0.235
BUN (mg/dl)	13.50 (11.00-17.00)	13 (10.55-16.00)	0.414
MDRD (ml/min)	89.95 (77.85-109.80)	100.50 (84.25-118.40)	0.014
Cockroft (ml/min)	106.60 (83.42-132.50)	115 (91.95-146.65)	0.042
LDL (mg/dl)	128 (100.25-150)	130 (101.5-148)	0.708
TG (mg/dl)	138 (107.50-205.75)	158 (98.50-225.50)	0.328
HDL (mg/dl)	46 (39-56)	46 (40.5-53)	0.876
TC (mg/dl) Mean ± SD	205.39 ± 43.98	207.41 ± 44.07	0.661

Analyses were also conducted to determine the relationship between mean values of variables and level of knowledge. The results suggest that the mean value of diastolic blood pressure was significantly lower (in statistical terms) in high level of knowledge (p=0.006). In other variables, the difference was not statistically significant with regard to the level of knowledge. The details are provided in Table 3.

Table 3. *The relationship between variables and high/low level of knowledge.*

	High level of knowledge	**Low level of knowledge**	**p**
	Median (Q1-Q3)	**Median (Q1-Q3)**	
Age (years)	58 (52-65)	58 (51-62)	0.286
SBP (mmHg)	130 (130-140)	140 (130-150)	0.129
DBP (mmHg)	80 (80-90)	80 (80-90)	0.006
Height (cm)	163 (157-170)	165 (160-170)	0.405
Weight (kg)	80 (72-90)	82 (75-90)	0.696
BMI (kg/m^2)	30.25 (26.80-34)	30 (27.10-33.30)	0.963
APG (mg/dl)	139 (111-178)	169 (115-191)	0.192
HbA1c (%)	7.15 (6.28-8.5)	7.93 (6.64-8.95)	0.091
CR (mg/dl)	0.75 (0.64-0.91)	0.75 (0.62-0.85)	0.328
BUN (mg/dl)	13 (11-17)	12.50 (10.20-15)	0.11
MDRD (ml/min)	92.75 (78.25-112.42)	99 (86-116)	0.11
Cockroft (ml/min)	108.40 (84.07-135.20)	115 (101.40-141.10)	0.102
LDL (mg/dl)	128 (100-149)	131 (107.50-159)	0.499
TG (mg/dl)	147 (106-211)	155 (109-217.50)	0.23
HDL (mg/dl)	46 (39-55)	46 (42-52)	0.909
TC (mg/dl) Mean ± SD	205.22 ± 44.30	214.69 ± 39.77	0.217

Target values were compared with variable parameters of the Modified Morisky Scale. With respect to BMI, the rate of achieving the target value (lower than 30 kg/m^2) was higher in individuals with high motivation and lower in individuals with high level of knowledge. However, the difference was not statistically significant in neither of the groups (p=0.522; p=0.920).

With regard to APG, the rate of achieving the target value (lower than 100 mg/dl) was lower individuals with high motivation and high level of knowledge, but the difference was statistically significant in neither of the groups (p=0252; p=0.701).

With regard to HbA1c, the rate of achieving the target value (<6.5%) was higher in individuals with high motivation, and the difference was statistically significant (p=0.028). The rate of achieving the target value was higher in individuals with high level of knowledge, however the result was not statistically significant (p=0.140).

With regard to LDL, the rate of achieving the target value (below 100 mg/dl) was higher in individuals with high motivation and high level of knowledge; however, the results were statistically significant in neither case (p=0.967; p=0.239).

With regard to triglyceride, the rate of achieving the target value (below 150 mg/dl) was higher in individuals with high motivation, and the difference was statistically significant (p=0.032). The rate of achieving the target value was also higher n individuals with high level of knowledge, but the difference between the groups was not statistically significant (p=0.282).

With regard to total cholesterol, the rate of achieving the target value (below 200 mg/dl) was higher in individuals with high motivation and high level of knowledge; however, the results were statistically significant in neither case (p=0.821; p=0.226).

With regard to HDL, the rate of achieving the target value (over 40 mg/dl for women, and over 50 mg/dl for men) was higher in individuals with high motivation and high level of knowledge; however, the results were statistically significant in neither case (p=0.252; p=0.501).

The details related to other parameters are provided in Tables 4 and 5.

Table 4. *The relationship between achieving target values and high/low motivation.*

		High motivation N (%)	Low motivation N (%)	p
HbA1C (%)	<6.5	95 (74.8%)	32 (25.2%)	0.028
	≥ 6.5	187 (63.8%)	106 (36.2%)	
APG (mg/dl)	<100	30 (60.0%)	20 (40.0%)	0.252
	≥ 100	252 (68.1%)	118 (31.9%)	
BMI (kg/m^2)	<30	134 (68.7%)	61 (31.3%)	0.522
	≥ 30	148 (65.8) %	77 (34.2%)	
LDL (mg/dl)	<100	70 (67.3%)	34 (32.7%)	0.967
	≥ 100	212 (67.1%)	104 (32.9%)	
TG (mg/dl)	<150	152 (72.0%)	59 (28.0%)	0.032
	≥ 150	130 (62.2%)	79 (37.8%)	
TC (mg/dl)	<200	130 (67.7%)	62 (32.3%)	0.821
	≥ 200	152 (66.7%)	76 (33.3%)	
HDL (mg/dl)	>40	168 (69.7%)	73 (30.3%)	0.252
	>50			
	<40	112 (64.4%)	62 (35.6%)	
	<50			

Table 5. *The relationship between achieving target values and high/low level of knowledge.*

		High motivation N (%)	Low motivation N (%)	p
HbA1C (%)	<6.5	120 (94.5%)	7 (5.5%)	0.14
	≥ 6.5	264 (90.1%)	29 (9.9%)	
APG (mg/dl)	<100	264 (90.1%)	5 (9.9%)	0.701
	≥ 100	45 (90.0%)	31 (10.0%)	
BMI (kg/m^2)	<30	178 (91.3%)	17 (8.7%)	0.92
	≥ 30	206 (91.6%)	19 (8.4%)	
LDL (mg/dl)	<100	98 (94.2%)	6 (5.8%)	0.239
	≥ 100	286 (90.5%)	30 (9.5%)	
TG (mg/dl)	<150	196 (92.9%)	15 (7.1%)	0.282
	≥ 150	188 (90.0%)	21 (10.0%)	
TC (mg/dl)	<200	179 (93.2%)	13 (6.8%)	0.226
	≥ 200	205 (89.9%)	23 (10.1%)	
HDL (mg/dl)	>40	222(92.1%)	19 (7.9%)	0.501
	>50			
	<40	157 (90.2%)	17 (9.8%)	
	<50			

Diabetic patients' BMI (<30 kg/m^2, and ≥ 30 kg/m^2) was compared with respect to the method of treatment they received (OAD, OAD + insulin, insulin), and the result was not statistically significant (p=0.620). The BMI (<30 kg/m^2, and ≥ 30 kg/m^2) of patients with HbA1c of <6.5% was compared with respect to the method of treatment they received (OAD, OAD+insulin, insulin), and the result was not statistically significant (p=0.419, p=0.663). The results indicate that 47.5% of the patients receiving OAD treatment, 13.6% of the patients receiving OAD+insulin treatment, and 16.2% of the patients

receiving insulin treatment achieved the target HbA1c value of <6.5%.

Discussion

The aim of this study was to analyse the relationship of sociodemographic data, duration of diabetes, method of treatment, presence of a chronic comorbid disease, development of complications, body mass index, physical activity, smoking and laboratory test results related to diabetic patients with categories of the Modified Morisky Scale and factors that affect adherence to treatment.

One of the important results of this study is that patients with higher motivation-as measured by the Modified Morisky Scale-had significantly better levels of Hb1Ac and diastolic blood pressure as well as GFR measured by MDRD and Cockroft formulae, and had significantly higher rate of achieving target HbA1c and TG values. In patients with higher level of knowledge, the diastolic blood pressure was significantly better. Research suggests that as adherence to treatment increases, the rate of achieving metabolic targets increases [12].

The study sought the factors that affect high/low level of motivation and knowledge, determined by the Modified Morisky Scale. The result indicates that level of education and smoking are the factors that affect motivation. Lower level of education (i.e. primary school or lower degree) and smoking are associated with lower level of motivation. Offering continuous diabetes training for diabetic patients may play a role in improving adherence to treatment, especially in patients with lower motivation [13]. Smoking cessation should be a focus of interest in diabetic patients. These patients are faced with additional risks due to smoking, as well as cardiovascular risks posed by diabetes. That is why there is a need to take smoking cessation actions and adopt more supportive attitudes to diabetic patients [14,15].

The results further suggest that exercising and duration of DM are associated with high/low level of knowledge. The risk of having lower level of knowledge was higher in patients that did not exercise and that had diabetes for ≤ 9 years. Physical activity, self-care and lifestyle are the factors that increase adherence to treatment in diabetic patients and enable them to achieve target metabolic values [16-18]. Although the literature suggests that the duration of diabetes is not a factor affecting adherence to diabetes treatment, our results demonstrate higher level of knowledge in patients with diabetes for over 10 years. One of the studies in the literature divided the duration of diabetes into four categories while another study did not provide details on the assessment process [19,20].

The results indicate that, in diabetes treatment, patients should be well-informed about severity of disease and treatment procedures, patients' level of education should be taken into consideration in information providing, and patients should be provided with booklets or brochures regarding the effects of smoking cessation and physical activity on the course of disease. Projects such as "smoke-free zone", which reduce patients' exposure to smoke and help them quit smoking, should be supported. Opening smoking cessation clinics in hospitals that offer training in family medicine is likely to enable family physicians to play more effective roles in encouraging patients to quit smoking.

There are various factors that motivate patients to make changes in lifestyle and to adhere to medical treatment.

In diseases that require short-term treatment, the adherence to medical treatment is greater than long-term diseases. Among the causes of non-adherence to treatment are forgetfulness, unstable working hours and conditions, and changes in daily life. There are also some other causes, including psychiatric diseases, lack of information about disease and method of treatment, lack of persuasion in the use of medical treatment and recommendations, complexity of medication treatment, and side effects. Patients are more inclined to adhere to medications prescribed by physicians than recommendations regarding diet, physical activity, smoking cessation, and self-monitoring of blood sugar [7].

In case of chronic diseases such as DM, healthcare professionals are required to inform patients about treatment and receive patients' feedback about whether they fully understand medical recommendations, in order to increase adherence to treatment. Patients should be encouraged to monitor any changes in their body. They should be advised about easy methods of medication use and any methods that remind them to take medications.

Primary healthcare services and family physicians can play an effective role in this process given that Family Healthcare Centers and family physicians are more easily accessible by patients. Among the clinical indicators of non-adherence to treatment are elevated HbA1c level, fluctuations in the level of blood sugar, failure to undergo regular medical checks, failure to have medical tests, failure to do self-monitoring of blood sugar, failure to comply with dietary and physical activity recommendations, weight gain, frequent diabetic crises, and development of complications [21].

In diabetic patients, adherence to treatment ensures blood sugar regulation, prevents the development of acute complications, and delays the development of chronic complications. Non-adherence to treatment increases the rate of hospitalization and treatment costs. Glycemic control proved to reduce microvascular complications, cardiovascular diseases, and total mortality. Healthcare providers should prefer cost-effective medications that have low side-effect profile and are appropriate to patients' characteristics in treatment [22]. Other factors associated with non-adherence are complex nature of treatment and negative effects of the patient's entourage [23].

Adherence is an important factor in treatment of diseases. In assessment of patients' adherence to treatment, the factors that need to be considered are the patient's feedback, the physician's opinion, medications used by the patient, the patient's weight and blood pressure, and laboratory test results. Patients' feedback cannot always be reliable, and it is hard to count medications used by a patient. Non-adherence to

medications should be questioned when target values are not achieved in DM treatment. Adherence to treatment scales may provide objective results. Because of challenges in adherence assessment, it is advised to combine several methods. Low level of education should be a factor to be considered in informing, training, and providing counselling to patients. There is a need to ensure that all diabetic patients attend training programs. Dietary training should be given by a specialist team experienced in diabetes diet, and patients should be advised about changes in life style in every office appointment.

Primary healthcare services and family physicians assume the greatest responsibility in ensuring patients' adherence to treatment, since they are in continuous contact with patients. Family physicians should mention the importance of adherence to treatment, question whether the patient takes medications regularly, and advise and encourage patients to exercise, comply with the diet and quit smoking in every visit.

To enable family physicians to fight smoking addiction more effectively, smoking cessation clinics should be opened in hospitals that offer family medicine training.

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