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EFFECT OF MEDICAL NUTRITION KNOWLEDGE ON GLYCEMIC REGULATION IN PATIENTS WITH DIABETES MELLITUS

DIABETES MELLITUS TANILI HASTALARDA TIBBİ BESLENME TEDAVİSİ HAKKINDAKİ BİLGİ DÜZEYLERİNİN GLİSEMİK REGÜLASYON ÜZERİNE ETKİSİ

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ABSTRACT

Objective: To evaluate the effect of medical nutrition knowledge on glycemic control in patients with Diabetes Mellitus (DM).

Material and Methods: Type 1 and Type 2 DM patients (n: 105) who had received medical nutrition therapy (MNT) education at least once were recruited. Nutritional knowledge scores (NKS) were obtained from the NKS evaluation form and patients were classified into Group 1 (NKS ≤60, n:24) and Group 2 (NKS>60, n:81). Patients' socio-demographic characteristics, biochemical parameters, nutritional habits, anthropometric measurements, and 24-hour food consumption data were recruited.

Results: Mean age in Group 1 and Group 2 was 50.5±12.1 and 45.5±15.5, respectively. Mean NKS scores were higher in patients with type 1 DM (p=0.02). There was no significant relation between NKS and HbA1c (p=0.3). NKS was significantly associated with higher educational degrees, higher HDL, and lower frequency of neuropathy (p=0.03; 0.01; 0.01, respectively). NKS was negatively correlated with age, triglyceride, and neuropathy frequency (p=0.001, r=-0.35, p=0.004, r=-0.36; p=0.01, r=-0.24, respectively); positively correlated with HDL, educational degree, health literacy and presence of leisure time activities (p<0.001, r=0.38; p<0.001, r=0.53; p=0.01, r=0.26 and p<0.001, r=0.31, respectively). Logistic regression analysis revealed the relationship between NKS and educational degree (p=0.01, OR:0.17, CI:0.04-0.68).

Conclusion: Adequacy of nutritional knowledge may not be sufficient in achieving better glycemic regulation and patients should be motivated to reflect their nutritional knowledge in their daily living activities.

Keywords: Diabetes mellitus, HbA1c, medical nutrition therapy, nutrition knowledge level

ÖZ

Amaç: Diabetes mellitus (DM) tanılı hastalarda tıbbi beslenme tedavisi ile ilgili bilgi düzeyinin glisemik kontrol üzerine etkilerinin araştırılması.

Gereç ve Yöntemler: Diyabet Polikliniğinde takip edilen ve en az bir kez tıbbi beslenme tedavisi (TBT) eğitimi almış olan DM tanılı hastalar (n:105) çalışmaya dahil edilmiştir. Hastalar; beslenme bilgisi değerlendirme formundan (BBDF) elde edilen beslenme bilgisi skorlarının (BBS) ≤60'ın altında ya da >60 üzerinde olmasına göre sırasıyla Grup 1 (n:24) ve Grup 2 (n:81) olarak sınıflandırıldıktan sonra; sosyodemografik özellikleri, biyokimyasal bulguları, beslenme alışkanlıkları, antropometrik ölçümleri, TBT bilgisi ve 24 saatlik besin tüketim kayıtları değerlendirilmiştir.

Bulgular: Grup 1 ve Grup 2'de yaş ortalaması sırasıyla 50,5±12,1 ve 45,5±15,5 izlendi. Tip 1 DM tanılı hastalarda BBS ortalamaları daha yüksek tespit edildi (p=0,02). BBS ile HbA1c ortalamaları arasında anlamlı bir ilişki izlenmedi (p=0,3). BBS düzeyi yüksek olan hastalarda eğitim düzeyi ve ortalama HDL düzeylerinin daha yüksek, nöropati sıklığının ise daha düşük olduğu görüldü (p değerleri sırasıyla; 0,03, 0,01, 0,01). BBS ile ortalama yaş ve trigliserid düzeyleri ve nöropati sıklığı (p=0,001, r=-0,35; p=0,004, r=-0,36; p=0,01, r= -0,24; sırasıyla); ortalama HDL düzeyleri, eğitim düzeyi, sağlık okur yazarlığı ve hobilerle ilgilenme arasında ise pozitif korelasyon (p<0,001, r=0,38; p<0,001, r=0,53; p=0,01, r=0,26 ve p<0,001, r=0,31; sırasıyla) izlendi. Lojistik regresyon analizinde BBS ile eğitim düzeyi arasında ilişki görüldü (p=0,01, OR:0,17, CI:0,04-0,68).

Sonuç: Diyabetli hastalarda glisemik regülasyonun iyileştirilmesinde tıbbi beslenme bilgisinin iyi olması tek başına yeterli olmayabileceğinden hastaların beslenme ile ilgili bilgilerini günlük yaşam aktivitelerine yansıtabilmeleri açısından motive edilmesi hedeflenmelidir.

Anahtar Kelimeler: Diabetes Mellitus, HbA1c, tıbbi beslenme tedavisi, beslenme bilgi düzeyi

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INTRODUCTION

Diabetes mellitus (DM) is a chronic condition with hyperglycemia that occurs due to the insufficiency, absence, or ineffectiveness of the insulin hormone secreted by beta cells in the pancreas. In addition to acute metabolic complications, the disease causes vascular, renal, retinal, or neuropathic changes in the long term (1). It is a common disease with high morbidity and early mortality risk representing a significant medical and economic burden on both the society and the individual (2). According to the 2021 data of the International Diabetes Federation (IDF); the total number of diabetic patients around the world was announced as 537 million people, representing 10.5% of the global adult population (aged 20–79). It was estimated that this number may rise to 643 million by 2030 (11.3% of the population) and 783 million (12.2%) by 2045 (3). It is predicted that by the year 2045, Turkey will be among the top 10 countries with the highest number of diabetics in the adult population (3). DM is among the top causes of death and is responsible for 6.7 million deaths in 2021(3). According to the results of the "Turkey Diabetes Epidemiology study (TURDEP-II)" in 2013, the prevalence of DM in adults over the age of 20 was %13,7 translating to 6.5 million adults with DM indicating that the 2030 expectations regarding diabetes prevalence had already been exceeded (4).

Many risk factors affect the emergence of diabetes. While age, genetics, and race are non-modifiable risk factors; being overweight or obese, unhealthy dietary habits, smoking, and insufficient physical activity are modifiable risk factors. Additionally, a significant inverse relationship between educational level and the prevalence of diabetes especially among women has already been proposed (4). By modification of these risk factors, the management of diabetes can be improved, and diabetes complications may be reduced (3). It has been shown that lifestyle changes such as weight control, diet, and exercise may be beneficial for diabetes management (5,6). Medical nutrition therapy is the most important part of diabetes treatment and diabetes management, and it is recommended that individuals with diabetes be directed to a dietitian as soon as possible after diagnosis (7). According to the definition by the American Academy of Nutrition and Dietetics, medical nutrition therapy (MNT) is the provision of one or more of the stages of nutritional evaluation and intervention, resulting in the prevention, delay, or optimal of diseases (8).

Nutrition therapy aims to provide necessary information for self-management of individuals with diabetes, to develop self-management skills, solutions for existing problems, and as a result, to provide metabolic control and improve quality of life (9). HbA1c is one of the most important criteria in the diagnosis of diabetes. It reflects the average glucose value of diabetic patients in the last three months and indicates the risk of developing complications (10). In a study conducted in England, it was determined that a 1% decrease in the HbA1c values of diabetic individuals resulted in a 37% reduction in diabetes-related microvascular complications and a 21% reduction in mortality (11). Strong evidence supports the effectiveness of MNT interventions provided by RDNs for improving A1C, with absolute decreases up to 2.0% (in type 2 diabetes) and up to 1.9% (in type 1 diabetes) at 3-6 months (12). Various acute and chronic complications of diabetes can be prevented or delayed by controlling hyperglycemia (3,14,15). For this reason, to ensure glycemic regulation and prevent chronic complications of diabetes, having adequate knowledge of medical nutrition therapy and trying to eliminate potential information gaps by periodically reviewing medical nutrition training plays a very important role in management of DM. In this study, we aimed to evaluate the effect of medical nutrition knowledge on glycemic control in patients with DM.

MATERIALS and METHODS

This study was conducted in patients diagnosed with Type 1 and Type 2 diabetes mellitus (DM) between the ages of 18-65, who were being followed up in the Endocrinology and Diabetes Outpatient Clinic of Istanbul Medical Faculty between January and June 2022. A total of 105 DM patients (Type 1 DM: 33, Type 2 DM: 72) who had received medical nutrition therapy education at least once and who agreed to participate in the study were recruited.

Data collection tools

Interviewer-administered questionnaires were used to collect the socio-demographic characteristics of the patients, diabetes-related information, nutritional habits, 24-hour food consumption records, and nutritional information evaluation forms. Anthropometric measurements and body compositions of the patients were measured with the TANITA BC-418 MA analyzer. Patients were classified into two groups according to their nutritional knowledge scores (NKS) which they obtained from the nutritional knowledge evaluation form (NAKED) (13). Patients with scores below ≤60 or above >60 points were classified as Group 1 (n:24) and Group 2 (n:81), respectively. Socio-demographic characteristics, HbA1c, LDL, Triglyceride, HDL, LDL levels, frequency of hypoglycemia, retinopathy, nephropathy, neuropathy, diabetic foot ulcer, hypertension, and presence of cardiovascular disease were analysed through retrospective data. Blood glucose measurement data, HbA1c, LDL, HDL, and triglyceride levels were obtained from the registry records retrospectively during the last routine outpatient clinical control visit. Data on nutritional habits were obtained from the patient evaluation forms, 24-hour food consumption records, and three-day food consumption questionnaires which were completed by the patients. The patients' total daily energy intake, carbohydrate, protein, fat ratios, and nutritional components were calculated using the Nutrition Information System (BeBIS) 7.2 program.

This study was approved by the Clinical Research Ethics Committee of Istanbul Faculty of Medicine (Date: 24.12.2021, No: 23).

Statistical analysis

Data entry and analysis were performed by using SPSS version 23. Descriptive statistics, including frequency, percentages,

Table 1: Demographical and clinical features of the patients according to the nutritional knowledge scores

	Nutritional knowledge Score ≤60 (n:24)	Nutritional knowledge Score >60 (n:81)	p
Nutritional knowledge score	54.4±6.1	76.2±8.8	**0.001**
Gender			
Female (n)	11	44	0.3
Male (n)	13	37	
Age (mean±SD)	50.5±12.1	45.5±15.5	0.1
BMI (mean±SD)	28.1±5.2	27.0±5.1	0.3
DM Type			
Type 1 (n)	3	30	**0.02**
Type 2 (n)	21	51	
Educational status			
Elementary school (n)	14	22	
High school (n)	8	31	**0.03**
University (n)	2	28	
Family history of DM			
Absent (n)	8	21	0.6
Present (n)	16	60	
Diabetes duration (Year)	12.7±8.3	11.8±7.9	0.6
Marital status			
Single (n)	8	27	0.6
Married/Partnership (n)	16	54	
Occupational status			
Employed/Student (n)	6	25	0.4
Unemployed/Retired (n)	18	56	
Working Hours			
<8 hours	3	8	0.1
≥8 hours	3	17	
Smoking			
Absent (n)	17	59	0.3
Present (n)	7	22	
Alcohol			
Absent (n)	2	15	0.3
Present (n)	22	66	
Who do you live with	4	6	
Living alone (n)	20	75	0.4
Living with partner/family (n)			
Socioeconomic status			
Middle income (n)	20	75	0.2
Low income (n)	4	6	
Diagnosis of depression			
Absent	20	77	0.2
Present	4	4	
Regular physical activity			
Absent (n)	13	42	0.6
Present (n)	11	39	
Leisure time activity			
Absent	14	33	0.3
Present	10	48	
Health literacy			
Absent (n)	14	40	0.40
Present (n)	10	41	

Retinopathy			
Absent (n)	11	54	0.1
Present (n)	13	27	
Nephropathy			
Absent (n)	20	71	0.3
Present (n)	4	10	
Neuropathy			
Absent (n)	9	53	**0.01**
Present (n)	15	28	
Foot ulcers			
Absent (n)	18	69	0.3
Present (n)	6	12	
Hypertension			
Absent (n)	16	58	0.2
Present (n)	8	23	
Cardiovascular disease			
Absent (n)	16	55	0.2
Present (n)	8	26	
Dyslipidemia			
Absent (n)	13	48	0.3
Present (n)	11	33	
DM treatment			
OAD (n)	5	18	0.4
Insulin (n)	7	37	
OAD+ Insulin (n)	12	26	
Frequency of SMBG			
Irregular (Less than once a month) (n)	8	22	0.8
Once-twice a week (n)	3	12	
Once- twice a day (n)	13	47	
Frequency of hypoglycemia in the last month			
None (n)	15	37	
1-3 times (n)	8	34	
≥4 times (n)	1	10	0.3
Hospitalisation in previous year			
Absent	20	74	0.4
Present	4	7	
Regular sleeping schedule			
Absent	4	21	0.3
Present	20	60	
Unhealthy nutritional habits			
Skipping main meals (n)	7	15	0.4
Skipping snacks (n)	6	32	0.6
Nocturnal eating (n)	5	12	0.2
Fast food consumption (n)	12	46	0.6
Emotional eating (n)	8	42	0.2
HbA1c (mean±SD)	7.9±1.8	8.4±1.9	0.3
LDL (mean±SD)	113.0±39.8	97.6±43.3	0.1
HDL (mean±SD)	42.5±14	52.6±16.3	**0.01**
Triglyceride (mean±SD)	169.4±130.8	144±89.4	0.2

SD: Standard deviation, BMI: Body Mass Index, DM: Diabetes mellitus, OAD: Oral antidiabetic drugs, SMBG: Self-monitoring of blood glucose, LDL: Low density lipoprotein, HDL: High density lipoprotein, n: Number of participants, p significance <0.05

mean, and median values were used to evaluate the distribution of data. Pearson correlation analysis method was used to evaluate correlations between parameters. Student t-test was used to evaluate the normally distributed variables in the comparative statistical analysis, and the chi-square test was used to compare the categorical variables. Logistic regression analysis was performed in the evaluation of the effect of independent variables. The results were accepted as statistically significant when p level was <0.05.

RESULTS

The mean age for the patients in Group 1 and Group 2 was 50.5±12.1 and 45.5±15.5, respectively. Mean Nutritional Know-

Table 2: Correlation analysis of clinical features based on nutritional knowledge score

	p	r
Age	**0.001**	**-0.35**
BMI	0.3	-0.1
Diabetes duration	0.1	0.3
HbA1c	0.3	-0.14
LDL	0.2	0.11
HDL	**0.001**	**0.38**
Triglyceride	**0.004**	**-0.36**
Educational status	**0.001**	**0.53**
Frequency of SMBG	**0.6**	**0.23**
Health literacy	**0.01**	**0.26**
Leisure Time Activities	**0.001**	**0.31**
Regular physical activity	0.1	0.22
Regular sleeping schedule	0.8	0.02
Diagnosis of depression anxiety	0.06	0.18
Unhealthy nutritional habits	0.2	0.12
Hospitalization in previous year	0.8	-0.02
Retinopathy	0.6	0.21
Nephropathy	0.1	0.05
Neuropathy	**0.01**	**-0.24**
Socioeconomic status	0.2	0.13
Working hours	0.3	0.04
Diabetes management education in previous year	0.6	0.04

BMI: Body Mass Index, LDL: Low density lipoprotein, HDL: High density lipoprotein, SMBG: Self-monitoring of blood glucose, p significance <0.05 , r: Correlation coefficient

Table 3: Logistic regression analysis of the factors affecting nutrition knowledge score

	p	OR	CI
DM type	0.06	7.2	0.89-38
Educational status	**0.01**	**0.17**	**0.04-0.68**
Age	0.1	0.3	0.06-1.5
Health literacy	0.9	1.0	0.35-3.0
Leisure time activities	0.8	0.9	0.32-3.0
Frequency of SMBG	0.3	0.46	0.1-1.7
Neuropathy	0.7	0.38	0.13-1.0

DM: Diabetes mellitus, SMBG: Self-monitoring of blood glucose, OR: Odds ratios, 95% CI: Confidence intervals, p significance <0.05.

ledge Scores were higher in patients with type 1 DM (p=0.02). NKS levels were significantly associated with higher educational degrees, higher HDL levels, and lower frequency of neuropathy (p=0.03, 0.01, 0.01, respectively). Demographic and clinical features of the patients according to the nutritional knowledge scores (NKS) are demonstrated in Table 1. NHS levels were negatively correlated with age, triglyceride levels, and frequency of neuropathy (p=0.001, r=-0.35, p=0.004, r=-0.36, p=0.01, r=-0.24, respectively); and positively correlated with HDL, educational degree, health literacy and presence of leisure time hobbies (p<0.001, r=0.38, p<0.001, r=0.53, p=0.01, r=0.26 and p<0.001, r=0.31, respectively) Correlation analysis of

Table 4: Correlation analysis of clinical features based on HbA1c Levels

	p	r
Age	0.4	-0.1
BMI	0.8	0.02
Nutritional knowledge score	0.6	-0.6
Diabetes duration	0.6	0.05
Working hours	**0.01**	**0.27**
Educational status	0.1	-0.25
Socioeconomic status	0.1	-0.21
Frequency of SMBG	0.4	-0.1
Regular sleeping schedule	0.4	-0.1
Diagnosis of depression anxiety	0.1	0.15
Health literacy	0.2	-0.1
Regular physical activity	**0.03**	**-0.22**
Unhealthy nutritional habits	**0.02**	**0.23**
Presence of diabetes management education in the previous year	**0.003**	**-0.3**
Retinopathy	**0.001**	**0.32**
Nephropathy	**0.004**	**0.27**
Neuropathy	**0.02**	**0.22**
LDL	0.2	0.1
HDL	0.4	-0.1
Triglyceride	0.2	0.13

BMI: Body Mass Index, SMBG: Self-monitoring of blood glucose, LDL: Low density lipoprotein, HDL: High density lipoprotein, p significance <0.05, r: Correlation coefficient.

Table 5: Logistic regression analysis of the factors affecting HbA1c levels

	p	OR	CI
Regular physical activity	**0.01**	**0.3**	**0.12-0.73**
Unhealthy nutritional habits	**0.4**	**0.7**	**0.31-1.01**
Presence of diabetes management education in previous year	**0.03**	**0.2**	**0.03-0.88**
Educational status	**0.5**	**0.7**	**0.4-1.3**
Socioeconomic status	**0.7**	**0.2**	**0.05-1.12**
Hospitalizations in previous year	**0.6**	**0.9**	**0.3-2.1**

OR: Odds ratios, 95%, CI: Confidence intervals, p significance <0.05.

clinical features based on NKS is revealed in Table2. Logistic regression analysis revealed that the strongest factor affecting the NHS was educational degree (p=0.01; OR:0.17; CI:0.04-0.68) (Table 3). Correlation analysis of clinical features based on HbA1c levels and logistic regression analysis of the factors affecting Hba1c levels are demonstrated in Table 4 and Table 5, respectively.

DISCUSSION

The most important aspect of treating and managing diabetes is medical nutrition therapy (16). Type 2 diabetes constitutes 90-95% of diabetes cases in the world and Turkey (17). In line with these facts, we investigated the effect of NKS on glycemic regulation in our patient group which consisted of 68% type 2 DM patients with a diabetes duration of 1-10 years in 52% of the study group. It is known that there is a strong relationship between family history and diabetes risk (17-19). It was seen that 72.4% of the patients in this study had diabetes in their families.

In 2020, 3.2 million diabetics (approximately 1% of the total diabetic population) were reported to have moderate or severe visual impairment due to diabetic retinopathy (20). As the duration of diabetes increases, the frequency and degree of retinopathy increase. In a multicenter study, the frequency of diabetic retinopathy was found to be 20% (21). Diabetic neuropathy is the most common form resulting in pain, poor quality of life, gait disturbances, and depressive symptoms in approximately 30% of people with type 2 diabetes (22,23). Studies are reporting the prevalence of neuropathy in DM is between 5% and 60% (24). Clinical and subclinical diabetic neuropathy can be seen in 10% of diabetic patients (25). In a study conducted in Izmir, 34.8% of the most common complications were neuropathy, and 28.1% were retinopathy (26). In our study, the relationship between diabetic complications and NKS was only significant for the presence of diabetic neuropathy. The presence of neuropathy is inclined to be less frequent in patients with higher NKS. However, the association was no longer statistically significant after adjustment with the other confounding factors in regression analysis. The most effective factor in NKS was found to be the educational degree of the patients. The lack of association between NKS and glycemic regulation indices such as HbA1c and presence of diabetic complications may be interpreted as that patients might not be regulating their nutritional habits in line with their level of nutrional knowledge.

Studies have also reported controversial results about the effect of lifestyle changes and regular physical activity on better glycemic control and improved triglyceride levels in individuals with DM (27-29). In this study, as the NKS of the patients increased, HDL levels tenden to be higher and triglyceride levels were lower. Although HbA1c levels were not significantly affected with better NKS degree of dyslipidemia tended to be positively affected in our study. The NKS of the patients in our study was positively correlated with their educational levels and negatively correlated with age. This may be interpreted as that elderly patients might need more intensive and more frequent repetition in diabetes education. In the study of Ozkarabulut et al, there was a significant relationship between the NKS and employment status, and income levels of the patients (30). In this study, NKS was not significantly associated with occupational status or income levels. This might be related to the similar employment status and socioeconomic levels in the study population. However, the most influential factor on NKS was found to be educational status which may be interpreted as diabetes education should be emphasized and reviewed more frequently in people with lower educational degrees to ensure better NKS levels.

Tulek et al demonstrated a significant correlation between NKS and HbA1c levels, where patients with higher NKS had lower HbA1c levels (31). However, in this study, there was no significant correlation between NKS and HbA1c levels. The controversial findings might be related to the content and frequency of the diabetes education program. Patients in this study were selected randomly from the outpatient clinic who had received medical nutrition therapy education at least once in the previous year. However, the patient population in Tulek et al.'s study consisted of patients who had actively participated and completed a diabetes patient school (31). It might be possible that a single diabetes education session has a limited impact on HbA1c levels and periodical repetition of diabetes education may be more helpful to ensure patients' comprehension in building healthy lifestyle habits that would restore better glycemic regulation.

In this study, there was no significant relationship between the patient's HbA1c and educational status, employment status, and income levels which was also compatible with previous findings in the literature (32). However, in our study, HbA1c levels were significantly correlated with regular physical activity which was also previously reported (33). In our study, the most influential factors on HbA1c levels were regular physical activity and the presence of diabetes management education in the previous year. Although NKS is not significantly effective on HbA1c levels, rehearsal of diabetes education once a year might improve glycemic regulation and HbA1c levels. This might particularly be valid in elderly patients or patients with lower educational status who have lower NKS.

The limitation of this study is that the number of the patient population was limited, and the reproducibility of these results may be investigated through larger-scale studies.

In conclusion, our study has shown that adequate levels of nutritional knowledge are not sufficient to maintain good glycemic regulation in patients with DM. Patients probably experience difficulties in applying their theoretical knowledge into their daily life practices. Therefore, it may be beneficial if the clinicians would pay special attention to motivating DM patients to build regular physical activity and healthy nutritional habits, reflecting their nutritional knowledge in daily living activities to improve glycemic regulation and diabetes management.

Ethics Committee Approval: This study was approved by the Clinical Research Ethics Committee of Istanbul Faculty of Medicine (Date: 24.12.2021, No: 23).

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