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Impact of structured patient education provided by clinical pharmacist on disease prognosis, adherence and quality of life in Type 2 Diabetes patients: An interventional study

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Type II Diabetes Mellitus (TIIDM) is a metabolic disease characterized by hyperglycemia. Patient adherence to treatment is important for the success of treatment and quality-of-life (QoL). This study aimed to evaluate the effect of patient education provided by a clinical pharmacist (CP) on treatment adherence, QoL, and disease prognosis. In this prospective pre-post intervention study, patients aged 18-65 years who applied to the Internal Medicine Outpatient Clinic of a university hospital in Istanbul and used SGLT-2 inhibitors for the treatment of type 2 diabetes in the last 24 months were included. The benefits of patient education provided by a CP to adherence and QoL was investigated. Adherence was measured by the Medication Adherence Report Scale (MARS) and QoL by EuroQol 5D-3L. As a result of the 6-month pre-post intervention, patient education provided by CP had positive effects on adherence, QoL, weight, and body mass index (p=0.038). Although HbA1c decreased, changes in fasting blood glucose, lipid profile, and blood pressure

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were not statistically significant. Following intervention, treatment adherence increased (p=0.012), along with an improvement in QoL (p=0.013). The contribution of CP in enhancing adherence and treating TIIDM was beneficial.

Keywords: clinical pharmacy, diabetes mellitus, patient education, treatment adherence, quality of life

INTRODUCTION

Type 2 Diabetes Mellitus (TIIDM) is a serious and widespread health problem that affects millions of people and can cause micro and macro complications. In type 2 diabetes, even if insulin can be produced in sufficient quantities, the sensitivity of cells to insulin and therefore the process of insulin action is impaired[1]. Although type 2 diabetes is generally seen in adults, it can also be seen in children and adolescents due to lifestyle changes, inactivity, unbalanced nutrition, and obesity in recent years. In Turkey, there are over 9 million people with diabetes and this number is estimated to increase to over 13 million in 2045. Approximately 4 million people worldwide die annually due to TIIDM and related diseases[2].

The treatment of TIIDM is complex, involving both pharmacological and non-pharmacological therapy. Effective management of TIIDM is medically complex, resources and time-sensitive and requires a multidisciplinary approach[3]. Treatment includes several elements such as continuous patient education, preventing acute complications, and reducing the risk of chronic complications[4,5]. Increased adherence to treatment for TIIDM is associated with improved glycemic control, reduced emergency department visits and hospitalizations, and lower health costs[6]. It has been shown that HbA1c, total cholesterol, blood pressure, body mass index, and adherence to medication regimens are improved when a clinical pharmacist (CP) provide pharmaceutical care to the treatment of diabetes to help patients, provide them with information regarding TIIDM management, encourage them to achieve therapeutic and lifestyle goals and support their adherence to medication regimens[7].

Clinical pharmacy is a field of pharmacy that applies pharmaceutical sciences such as pharmacology, biochemistry, and toxicology in a patient-oriented manner based on rational drug use. The main goal of clinical pharmacy is to ensure that the patient receives the right treatment correctly and effectively, in the most cost-effective and convenient manner. For this purpose, a CP takes the role of a consultant, especially in medication treatment, by transferring theoretical and practical knowledge to the healthcare system by communicating with physicians and other health personnel. CP not only connects the patient

with appropriate, effective, and safe treatments but also strives for outcomes that enhance the patient's Quality of Life (QoL)[7].

The duties of the CP include providing information about the medications used in TIIDM treatment, counseling the physician and patient about treatment when necessary, ensuring that treatment is administered rationally and safely, providing patient education, improving self-care, and monitoring the treatment. However, the role of the CP in the healthcare system is much broader than providing patient care. The role of the CP includes developing treatment guidelines and policies, advising on medication-related expenditures, advising other health professionals on special conditions, and providing necessary training[8].

Patient education is an important CP service aimed to increase the patient's knowledge about the patient's disease and the prescribed and over the counter medications used, the patients' adherence with the treatment, and thus the success of the treatment. The treatment goals may not be achieved if the treatment is not performed appropriately. The course of treatment, the dosage, frequency, route of administration, common side effects, potential drug-drug and drug-nutrient interactions of prescription and non-prescription medications, if any, are among the fundamental information for patient education. In addition, recommendations such as lifestyle changes, diet, and exercise can be provided depending on the patient's current health status[7].

Providing patient education has an important effect on adherence. Adherence, which can also be defined as the patient's acceptance of the treatment, refers to the patient's participation within the treatment. Due to the complex nature of the treatment and the fact that it is a chronic disease, poor adherence is common in people with TIIDM. Since poor adherence can lead to treatment failure and serious complications and morbidity, the role of CPs in tailoring the treatment plans and improving adherence becomes even more important[7]. Increased adherence to treatment for TIIDM is associated with improved glycemic control, reduced emergency department visits and hospitalizations, and lower health expenditures[6]. Patient education can be done verbally in a face-to-face manner, in written form such as a brochure, or through audiovisual techniques. Depending on the patient's conditions and the disease, one or more appropriate methods may be used.

A pharmacist-led team has been shown to significantly improve treatment adherence and reduce hospitalizations in the intervention group as a result of medication therapy management interventions for a large proportion of patients[9]. It has also been demonstrated that CP interventions significantly reduce HbA1c and fasting blood glucose levels in TIIDM patients; in addition, CP increases the level of knowledge of patients about their disease and medi-

cations, improve adherence with treatment, and contribute to better performance of diabetes self-care activities[10].

Although it is possible to measure it with different methods, the patient's general health status and laboratory tests can provide general information about treatment adherence. Patients who have the necessary and sufficient information about the disease and its treatment tend to take more responsibility for their treatment and cooperate more with health professionals, having more knowledge about what to expect.

Successful treatment depends as much on the patient's ability to perform self-care activities correctly as on the right medication. Moreover, self-care activities play an important role in preventive health. It is important to understand and apply self-care activities correctly to prevent a complication that may develop due to an existing disease and to maintain and improve the current state of health. Hygiene, nutrition, and lifestyle form the basis of self-care activities and have a wide place in patient education. It is recognized that the success of treatment in many diseases is closely related to self-care[2].

Enhancing QoL is a primary objective of both treatment in general and specifically in the context of managing TIIDM. Due to its progressive nature, patients with TIIDM are exposed to various acute and chronic complications that affect life. In light of all these circumstances, successful treatment and the associated improvement in QoL are closely related to adherence to current treatment, patient education, and self-care activities, as well as the application of the correct treatment regimen[7].

This study aimed to investigate the effects of patient education provided by the CP on treatment adherence and QoL in TIIDM patients using SGLT-2 inhibitors.

METHODOLOGY

Design, sample size and participants

This study was designed as a prospective and cross-sectional study. Patients with TIIDM who were admitted to a university hospital in Istanbul as outpatients between September 2022 and May 2023 and who met the inclusion criteria and gave written informed consent were included. This study, which was conducted to measure the effect of CP intervention on treatment adherence and QoL, was reported to the STROBE (Strengthening of The Reporting of Observational Study in Epidemiology) guideline[11]. The effect size (ρ) was calculated as 0.82, considering the reference studies[12]. Alpha (α) was taken as 0.05 and beta (β) as 0.95 and it was calculated that the power of the study would be 95% with the inclusion of at least 22 participants. This study was approved by the local clinical research ethics committee with decision number 13/3.

The study included 18-65 years old patients with type 2 diabetes mellitus who had started an antidiabetic medication containing SGLT 2 inhibitor within the last 24 months and signed the consent form. Patients under 18 and over 65 years of age, pregnant women, people with oncologic diseases, people with a GFR below 60, people with systemic inflammatory diseases, and people with cognitive disorders were excluded.

Data collection

Patients participating in the study had face-to-face interviews with the CP after a routine interview with their physicians and written informed consent was obtained. During the first interviews, demographic data of the patients (educational status, marital status, employment status, etc.) were recorded. Each interview lasted an average of 20 minutes. At the first interview, 68 patients who met the inclusion criteria were reached. During the first interview, the CP provided structured standardized patient education about TIIDM, medications used in treatment, as well as treatment adherence, QoL, and self-care activities. The participants were informed about the complications that may occur if the treatment is not adhered to and the disease is not managed properly, the correct use of the medications they use for the treatment of TIIDM and the issues to be considered during the use of drugs, important points in the diet, the complementary role of exercise in the treatment and the benefit of reducing stress in disease management[13]. In this context, a patient education brochure, which was prepared in advance and contains general information about the TIIDM and diabetes medications, was disseminated to the patients. At the second interview, 34 patients continued to be participated the study. The process of including patients in the study is shown in Figure 1.

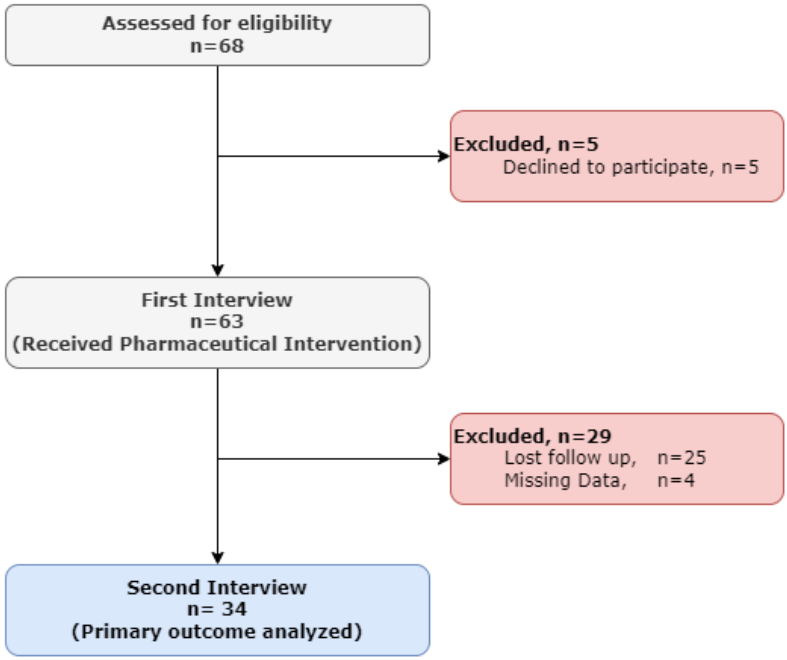

Figure 1. Study flowchart

To avoid biases during the study, the same CP administered the treatment adherence (MARS) questionnaire to all patients in both interviews[14] and the quality-of-life test (EQ 5D-3L)[15] and structured written and oral patient education was provided by the same CP.

Clinical pharmacist intervention and patient education

To examine the role of the CP in diabetes treatment, demographic data (age, gender, marital status, educational status, occupation, smoking, and alcohol use), Hemoglobin A1c (HbA1c) level, fasting blood glucose value, weight, body mass index, eGFR value, adherence level, QoL level were documented. Following the first interview, structured written and oral patient education was provided by the CP. The content of the education given by the CP at the first interview consisted of information about the TIIDM, and participants' other diseases, treatment processes, complications, medications used, diet program, and exercise. The Medication Adherence Report Scale (MARS)[14] and the quality-of-life test (EQ 5D-3L)[15] were used to measure participants' treatment adherence. In the second interview conducted six months after the first interview, the MARS and EQ (EuroQol) 5D-3L test were administered for the second time to determine the changes in treatment adherence and QoL.

The MARS test was applied in face-to-face interviews to determine the medication adherence of TIIDM patients who participated in the study. This scale, developed by Thompson et al. in 2000 to measure patients' adherence to their medications, consists of 10 questions, and answers are given as Yes/No. The questions investigate aspects such as carelessness in taking medication and forgetting to take it on time, discontinuation of medication if the patient feels well or unwell, opinions about medication use, whether the patient believes that taking medication protects from illness, whether the patient feels tired, sluggish, and strange after taking medication. Each 'Yes' answer to the question earns 1 point, while a 'No' answer corresponds to 0 points. Thus, a higher the score on a 10-point scale, indicates greater adherence to medication treatment.

In 1987, the EuroQol team convened with the aim of creating a standardized, non-disease-specific tool to assess health-related quality of life (HRQoL). They developed several tests to fulfill this objective. One of these, the EQ 5D-3L test, was developed in 1990[15].

The EQ 5D-3L scale is a tool with 5 sub-dimensions (domains) and a 3-point Likert scale. The first part of the EQ 5D-3L test, which consists of two parts, is descriptive; the second part consists of a visual analog scale in which the patient evaluates his/her general condition. The first part, the descriptive part, includes 5 domains: mobility, self-care, daily activities, pain/discomfort, and depression/anxiety. Participants have three different options for their answers on these five domains: no problems, some problems, and a lot of problems. For each question, the participant is asked to choose the option they feel closest to in terms of these options. Depending on the answers, patients receive different scores.

In the second part of the scale, the participant is asked to give himself/herself a score between 0 and 100 according to his/her health condition on that day and mark it on the scale. Thanks to this test, which measures the patient's QoL from different perspectives, the areas where the patient has problems about the disease can be identified and interventions can be planned accordingly.

Main outcome measure

The independent variables of the study were age, gender, marital status, educational status, occupation, smoking, and alcohol use, and the dependent variables were Hemoglobin A1c (HbA1c) level, fasting blood glucose value, weight, body mass index, eGFR value, patient's medication adherence level and patient's QoL level.

Statistical analysis

Demographic data were expressed as percentages and ratios. Variables presented as mean, standard deviation, median, and interquartile distribution. Data distribution was determined by Kolmogorov-Smirnov, Shapiro-Wilk tests, and histogram analysis. Data with parametric distribution were analyzed using Student's t-test; for those with nonparametric distribution, the Mann-Whitney U test was used. Chi-Square or Fisher Exact tests were applied to analyze discrete variables. Pearson correlation analysis or Spearman correlation analysis was used to determine the level of relationship between quantitative variables. $p<0.05$ was accepted as the statistical significance level.

RESULTS and DISCUSSION

TIIDM is a lifelong disease that often involves complex treatment. In addition to the correct administration of appropriate drug therapy, lifestyle changes, and self-care activities constitute an important part of the treatment. Treatment requires continuous follow-up; patient education should be provided to prevent acute complications, reduce the risk of chronic complications, and improve overall QoL. The importance of patient education and treatment adherence is especially evident when the incidence of acute complications such as hypoglycemia and chronic complications such as neuropathy, retinopathy, and nephropathy are considered. Managing diabetes treatment with a multidisciplinary team has positive effects on the course of the disease, patient adherence with treatment, improving QoL, and reducing health expenditures[16]. In such a team, CPs play a key role not only in administering the right treatment but also in providing patient education and improving self-care activities[7,12].

As in many diseases with complex treatment plans, TIIDM patients often experience treatment failure due to lack of adherence. By choosing the right treatment plan and adequate patient education, it is possible to increase treatment adherence and thus ensure better management of the disease. Considering its chronic nature, the impact of successful type 2 diabetes treatment on patients' QoL is significant. At this point, communication, cooperation, and harmony between the physician, CP, and patient are highly effective in increasing the success of treatment, preventing the development of side effects, and complications; and reducing the cost of treatment[7-10].

Sociodemographic data

Sociodemographic data of the patients participating in the study were collected at the first interview. Of the 34 patients included in the study to measure treatment adherence and QoL, 16 (47%) were female and 18 (53%) were male. The

mean age of the patients included in the study was 51.8 ± 9.06 years and 30 (88.2%) were married and 4 (11.8%) were single. While 15 (44.1%) participants were employed, 19 (55.9%) were retired or unemployed. Out of 34 patients 28 (82.35%) had family history of diabetes. The sociodemographic characteristics of the participants are shown in Table 1.

Table 1. Sociodemographic characteristics of participants

Parameters	**n=34**
Gender (n, %)	
Female	16 (47%)
Male	18 (53%)
Age (Mean ± SD)	51.8 ± 9.06
Marital Status (n, %)	
Married	30 (88.2%)
Single	4 (11.8%)
Education Level (n, %)	
Primary School	20 (58.8%)
Middle School	5 (14.7%)
High School	8 (23.5%)
University	1 (3%)
Occupation (n, %)	
Employed	15 (44.1%)
Unemployed	19 (55.9%)
Duration of diabetes (years) (Mean ± SD)	11.8 ± 7.4
Herbal Product Use (n, %)	
Yes	7 (21%)
No	27 (79%)
Smoking (n, %)	
Yes	6 (18%)
No	28 (82%)
Alcohol Use (n, %)	
Yes	1 (3%)
No	33 (97%)

Family History of Diabetes	
Yes	28 (82%)
No	6 (18%)
Comorbidities (n, %)	
Hyperlipidemia	17 (50%)
Hypertension	14 (41.18%)
Coronary artery disease	9 (26.47%)
Asthma	4 (11.75%)
Neuropathy	3 (8.82%)
Other	8 (23.53%)
SD: Standard Deviation	

The mean body weight of the patients at the first interview was 84.9 ± 15.8 kg. The mean height of the patients was 166.9 ± 9.7 cm. The mean duration of diabetes mellitus was 11.8 ± 7.4 years. The baseline clinical characteristics of the participants in the first and second interviews are shown in Table 2.

Table 2. Clinical characteristics of the participants

Parameters (Mean ± SD)	**1st Interview**	**2nd Interview**	**p-value**
Body Weight (kg)	84.9 ± 15.8	83.7 ± 15.0	**0.038**
Height length (cm)	166.9 ± 9.7		NA
Body Mass Index	30.4 ± 4.8	30 ± 4.6	**0.048**
Systolic Blood Pressure Value	122 ± 6.7	121.4 ± 4.9	>0.05
Diastolic Blood Pressure Value	80.7 ± 7.4	79.8 ± 6.0	>0.05
HbA1c (mmol/L)	7.77 ± 1.1	7.55 ± 1.1	>0.05
Fasting Blood Glucose (mg/dl)	159.6 ± 41.6	148.4 ± 35.5	>0.05
HDL Cholesterol (mg/dL)	44.4 ± 8.5	44.06 ± 8.3	>0.05
LDL Cholesterol (mg/dL)	114.6 ± 35.7	109.6 ± 39.8	>0.05
Triglycerides (mg/dL)	202.4 ± 114.7	198.5 ± 39.8	>0.05
eGFR (ml/min/1.73m2)	92 ± 14.4	95 ± 15.1	>0.05

eGFR: Estimated Glomerular Filtration Rate, HbA1c: Hemoglobin A1C, HDL: High-Density Lipoprotein, LDL: Low-Density Lipoprotein

Body weights were measured, and body mass index was calculated after the first and second interviews. Accordingly, there was a significant decrease in body weight (p=0.038) and body mass index (p=0.048) in the second interview. A significance was not observed in body mass index in our study which was consistent by literature[17]. Some other studies showed no significant reduction in body mass index in patients after CP intervention[10,18]. However, in a study investigating the effect of pharmacist education on type 2 diabetes patients in a community pharmacy setting in Türkiye, a significant decrease in body weight and body mass index of the participants was obtained[12]. In another study, similar to our study, a significant difference was observed in the body mass index of patients after CP intervention[7].

In our study, although statistically significant results were not obtained (p>0.05), there was a nominal decrease in the mean HbA1c values measured pre and post intervention (first measurement 7.77 mmol/L; second measurement 7.54 mmol/L). Similarly, fasting blood glucose levels decreased at the second interview (first measurement 160 mg/dl; second measurement 148 mg/dl), however this decrease was not statistically significant (p>0.05). Laboratory data (such as HbA1c, fasting blood glucose, lipid profile, and eGFR) recorded after the first and second interviews of the patients are presented in Table 2.

Unlike our findings, there are studies in which CP intervention and patient education practice had a significant effect on HbA1c and fasting blood glucose levels[7,12,17-20]. In the study conducted by Wishah et al. in Jordan, a significant decrease in HbA1c and fasting blood glucose levels was observed in the intervention group after CP interventions[10]. The study conducted by Wu et al. in the United States had similar results to our study and no significant change was found in HbA1c levels[16]. We think that the lack of a significant change in HbA1c and fasting blood glucose in our study is due to the relatively low number of participants.

In our study, no significant change was observed in the lipid profile of the patients after the first and second interviews (Table 2). The mean HDL cholesterol levels of the patients were increased, while the mean LDL cholesterol and triglyceride levels decreased, but these changes were not statistically significant. Similar to our results, some studies did not show a significant difference in LDL cholesterol and other lipid profiles[10,16,18]. Chan et al. observed a significant decrease in LDL cholesterol, but not in HDL cholesterol and triglyceride levels[17].

After CP intervention an increase observed in patients eGFR levels, but this increase was not statistically significant (Table 2). In comparison of the blood pressure measurements before and after CP intervention no significant difference recorded. Two different studies conducted in the USA and China that evaluated the beneficial effects of a CP within the multidisciplinary healthcare team on blood pressure did not show a significant reduction in blood pressure, similar to our study[16,17]. However, there are studies reported significant reductions in blood pressure after CPs involvement into the team[7,12,21,22].

Patients' level of treatment adherence

In our study, the answers given to the MARS by the patients after the first interview, averaged 7.38 points out of 10. Among the MARS items, the item with the highest score was Question 5 ('*I only take my medication when I feel sick*') with an average score of 0.91 and the item with the lowest score was Question 1 ('*Have you ever forgotten to take your medication?*') with an average score of 0.5. In the second interview, the patients' responses to the MARS had an average score of 8.06 out of 10. In the second interview, the item with the highest score was item 9 with an average score of 0.94, while the lowest score was item 1 with an average score of 0.67. The responses of the patients to the MARS for the first and second interviews are presented in Table 3.

Table 3. Patients' responses to the medication adherence rating scale test at the first and second interview (n=34)

Medication Adherence Rating Scale (MARS)	1st Interview		2nd Interview		p-value
	Yes	No	Yes	No	
Do you ever forget to take your medication?	17	17	11	23	**0.041**
Are you careless at times about taking your medication?	16	18	10	24	**0.020**
When you feel better, do you sometimes stop taking your medication?	9	25	4	30	>0.05
Sometimes if you feel worse when you take the medication, do you stop taking it?	6	28	6	28	>0.05
I take my medication only when I am sick.	4	31	4	31	>0.05
It is unnatural for my mind and body to be controlled by medication.	14	20	14	20	>0.05
My thoughts are clearer on medication.	23	11	25	9	>0.05
By staying on medication, I can prevent getting sick.	30	4	30	4	>0.05
I feel weird, like a 'zombie' on medication.	5	29	2	32	>0.05
Medication makes me feel tired and sluggish.	4	30	31	3	>0.05
Total	**128**	**213**	**137**	**204**	**0.012**

MARS: Medication Adherence Rating Scale

As a result of the CP intervention, a significant increase was observed in patients' QoL ($p<0.05$) and treatment adherence ($p=0.012$). When evaluated on item basis, the items that showed a statistically significant difference were '*Do you ever forget to take your medication?*' ($p=0.041$) and '*Are you careless at times about taking your medication?*' ($p=0.02$). Although there was an increase in the number of answers regarding adherence at other items, however this difference was not statistically significant. For example, compared to the first interview, more patients reported that they continued to take their medication regularly even when they feel better (first interview-25 patients, second interview-30 patients). Similarly, the number of patients who felt tired and sluggish after taking their medication was lower compared to the first interview ($p>0.05$). According to these results, it is seen that the items on taking medications regularly and correctly, which constitute an important part of patient education, have influential effect on the patients and they started to take their medications more regularly.

Considering studies conducted in different countries and different healthcare settings, the involvement of CP in to the healthcare team has been shown to beneficial on fasting blood glucose and HbA1c levels, QoL, healthcare expenditures, and incidence of adverse events[7,19]. In the study by Erku et al., it was observed that treatment adherence increased significantly in the group in which the CP was included in the treatment compared to the control group[9].

In another study, researchers showed that TIIDM treatment managed by a healthcare team including a CP resulted in higher adherence, and significantly lower HbA1c and LDL cholesterol compared to the control group. The risk of cardiovascular disease was also significantly reduced in the intervention group. However, there was no significant difference in HDL cholesterol, triglycerides, total cholesterol, blood pressure, and body mass index during the study period[17]. Another study conducted in Malaysia investigated the effect of patient education provided by a CP on HbA1c value, treatment adherence, and QoL. The study results showed that patient education significantly decreased HbA1c value and significantly increased treatment adherence compared to the control group[20]. In the study by Wishah et al. held in Jordan, there was a significant decrease in HbA1c and fasting blood glucose in the intervention group after 6 months of follow-up, as well as an increase in patients' knowledge about diabetes, treatment adherence, and self-care activities compared to the control group. However, there was no significant difference in lipid profile and body mass index between the two groups[10]. According to the results of a Chinese study, a statistically significant reduction in HbA1c and fasting blood glucose were obtained in the intervention group after patient education provided by the CP, while there was no significant difference between the two groups in body mass index and lipid profile[18]. In this study, a significant increase in treatment adherence was observed in the intervention group because of training.

Patients' level of quality of life

The response to the EQ 5D-3L test applied in the first interview to determine the QoL of the patients was 8.24 ± 1.35 out of 10. In the second interview, this score increased to 8.56 ± 1.26. The domain with the highest score (1.88 points) in the first interview was the self-care domain, while the domain with the lowest score (1.12 points) was the anxiety/depression. In the second interview, the item with the highest score (1.91) was self-care activities and daily activities, while the lowest score for anxiety/depression domain (1.18). Table 4 shows the average scores obtained by domains in the EQ-5D-3L test applied to determine the level of QoL in the first and second interviews.

Table 4. Mean scores of European Quality of Life 5 Dimensions 3 Level Version (EQ5D-3L) questions at the first and second interviews

EQ5D-3L Domains	1st Interview	2nd Interview	p-value
Mobility	1.71	1.82	>0.05
Self-Care	1.88	1.91	>0.05
Usual Activities	1.85	1.91	>0.05
Pain / Discomfort	1.68	1.74	>0.05
Anxiety/Depression	1.12	1.18	>0.05
Total	8.24	8.56	0.013

EQ5D-3L: European Quality of Life 5 Dimensions 3 Level Version

In our study, there was a significant increase in the total score obtained from the EQ 5D-3L test applied to measure the QoL of TIDM patients after the CP intervention in second interview (p=0.013) (Table 4). However, when evaluated on a domain-by-domain basis, the scores of the patients from each question increased, however this increase was not statistically significant. The domains that patients scored high in both interviews were '*Ability to take care of oneself*' and '*Ability to do daily tasks*'. The domain with the lowest common score in both interviews was anxiety/depression.

There are various studies to measure the QoL of diabetic patients. In a study, the EQ5D-3L test was used to measure QoL as in our study, and in this study, found no superiority in the intervention group over the control group in terms of the effect of patient education on QoL. However, there were significant changes in mobility and anxiety domains in the intervention group when the baseline and endpoints were compared[20].

A study conducted in Northern Cyprus, Körceğez et al. revealed that the healthcare team with a CP involved had positive effects on the treatment of TIIDM. As a result of the CP's interventions such as adjusting medication therapy and providing patient education to increase treatment adherence and improve self-care activities, the intervention group had a decrease in HbA1c level compared to the control group, systolic and diastolic pressure, body mass index and waist circumference, and an increase in self-care activities such as foot care, diet and home blood glucose measurement[7].

It is concluded that addition of the CP into the healthcare team increases QoL and treatment adherence, and also has a positive impact on certain treatment outcomes. Therefore, we strongly recommend collaboration between healthcare providers, especially physicians and CPs to establish effective communication with patients, manage diabetes treatment, enhance medication adherence and QoL, and prevent acute and chronic complications of TIIDM. Although various studies have found different results on the effects of CP on adherence and QoL cannot be standardized due to the lack of gold standard to measure these improvements[20].

All healthcare professionals involved in the treatment of diabetes, especially physicians and CPs, should take the initiative to increase the level of knowledge of patients; structured treatment plans according to patient needs by focusing on the patient's conditions and keep the communication channels open with patients and their relatives. This communication is crucial to determine the patient's status, evaluate treatment outcomes, and make necessary changes when needed. As shown in our study, proper education with patients and patient education can result to an increase in clinical outcomes, adherence, and QoL. In this context, our study demonstrated the contribution of physicians and CPs working in collaboration with an interdisciplinary approach to the treatment outcomes and QoL of patients in the management of type 2 diabetes.

STATEMENT OF ETHICS

The study received ethical approval from the Bezmialem Vakif University local Ethics Committee, with a decision number of 13/3.

CONFLICT OF INTEREST STATEMENT

The authors affirm that the research was carried out without any affiliations or financial associations that could be perceived as a possible conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: SD, MYB, and FVI; methodology: SD, MYB, AS, and FVI; formal analysis and investigation: SD and MYB; writing-original draft preparation: SD and MYB; writing-review and editing: SD and MYB; resources: SD, MYB, and AS; supervision: MYB, AS, and FVI.

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