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Effect of Family-centered Empowerment Model on Eating Habits, Weight, Hemoglobin A1C, and Blood Glucose in Iranian Patients with Type 2 Diabetes

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Abstract

Background: Families play a peculiar role in adherence to treatment in diabetic patients; therefore, it seems that interference in motivational, psychological, and self-issued characteristics based on the family-centered empowerment model (FCEM) affects this adherence.

Aim: The present study aimed to determine the effect of FCEM on eating habits, weight, hemoglobin A1C, and blood glucose control in Iranian patients with type 2 diabetes.

Method: This semi-experimental study was conducted on 70 participants with type 2 diabetes in a diabetes clinic in Birjand, Iran, in 2018. The participants were selected via purposive sampling and randomly assigned to two groups of control (n=35) and intervention (n=35) using block randomization. The intervention group received family-centered empowerment training for four weekly-held 90-min sessions. Data were collected using demographic and disease characteristics form and Azartel et al.'s Dietary Behaviors Questionnaire and analyzed in SPSS software (version 19).

Results: The mean age scores of participants in the intervention and control groups were 49.66±6.37and 49.46±5.98 years, respectively. The intervention group showed an increasing trend through time, where the mean scores for eating habits and blood glucose had insignificant improvement one month ($P>0.05$) and three months ($P<0.05$) after the intervention. Hemoglobin A1C level reduced significantly in the intervention group three months after the intervention ($P<0.05$), as compared to that in the control group ($P>0.05$).

Implications for Practice: The FCEM can improve nutritional behaviors, hemoglobin A1C, and blood glucose in type 2 diabetic patients. This intervention can guide health care providers on how to improve the eating habits of diabetic patients through family empowerment training.

Keywords: Blood glucose, Eating habits, Empowerment model, Family, Hemoglobin A1c, Type 2 diabetes

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Introduction

Today, diabetes has become a global epidemic with an increasing prevalence (1). In 2014, about 422 million people aged 18 years and above suffered from diabetes worldwide (2). It is estimated that 4.4% of the world's population will have diabetes by 2030. Concerning the Iranian context, studies indicated that diabetic patients in Iran constituted 7.7% of the total population in 2008(3). It is also estimated that by 2030, people with diabetes in Iran will rise to 9.2 million (4). These statistics point to the high prevalence of this disease in Iran.

Diabetes can lead to numerous problems, such as neuropathy, nephropathy, retinopathy, cardiovascular disease, stroke, peripheral vascular disease, or even amputation (5). In 2015, diabetes was the cause of approximately five million deaths worldwide. Moreover, in the same year, more than 12% of the global health expenditure was allocated to tackling diabetes and its complications (6).

Multiple factors contribute to the development and progression of diabetes, including poor eating habits and irregular blood glucose monitoring. It is estimated that every 20% increase in weight above the desired level can double the chances of developing type 2 diabetes (7, 8). Moreover, 51.8%, 42.2%, and 30.7% of diabetic patients do not have a regular plan for self-care, quit the routine dietary regime at parties or on travels, and are inconsiderate of their diets while their general health is beginning to improve, respectively (9). This may be due to the multiplicity of measures that should be observed as part of diabetes care, including blood glucose measurement or diet adherence, which is incorporated into these patients ' lifestyles (10).

Individual characteristics, the healthcare system, family, and social/work environment are the influential factors affecting self-care behaviors in individuals. Nevertheless, the patient's family performs a crucial role as the primary social context for disease management since diabetes management behaviors occur primarily in the family. The family is the strongest and most influential social network affecting health and the most important source of support for members. Self-care behaviors, such as exercise and provision of proper nutrition, are performed with the participation of family members, especially the spouse (10, 11). Family members have a substantial impact on a patient's psychological well-being, the decision to seek medical advice, as well as the ability to make changes in diet and exercises (12). Based on the related studies, adherence to blood glucose control is inversely associated with non-supportive behaviors of the family members of type 2 diabetic patients (13).

The results of a study conducted by Wen et al. (2004) demonstrated that living with family members and receiving support lead to adherence to exercise and a healthy diet. As a result, these patients are able to control their blood glucose desirably (14). Nonetheless, supportive interaction of family members with diabetic patients can be counterproductive if the family is not first trained to avoid inhibitory behaviors, especially for patients with limited health literacy. Therefore, any supportive and inhibitory behavior of the family should be considered in family-based interventions to improve the conditions of patients (15). Therefore, education and empowerment of patients and family for self-care and adherence to the treatment regimen is an important part of diabetes care (16).

There are several ways to educate the patient and family. Traditional teaching methods are teacher-centered; however, in modern approaches, teachers are more of a designer and facilitator, rather than a mere speaker and information giver (17). According to studies, routine training programs do not lead to successful diabetes control(18). Therefore, the empowerment model was proposed as an educational method for better control of these patients(19). The main difference between an empowerment program and a traditional education program is that it is more of a guide for patients and health care providers, rather than a technique or strategy (20).

A practical method in empowering patients and their families is the implementation of the family-centered empowerment model (FCEM) since it helps the client and his/her families participate collaboratively in decision making. It promotes the sense of being worthy and facilitates a patient's control over his/her health. This control brings about positive changes in patients and improves their health level (21).In this model, the active presence of family is essential in the assessment and diagnosis of needs since it is believed that when a person is afflicted with a disease, all his/her family members will be involved in the disease cycle(22).

The FCEM aims primarily to empower the patients and their families so as to promote the health level of society. It was designed to emphasize the role of patients and their family members in the three dimensions of motivational, psychological, and self-issued characteristics. It involves the four stages

of understanding the threat, self-efficacy, self-esteem, and evaluations (23).
In this regard, the findings of a study by Atashzadeh et al. (2017) pointed to the effect of FCEM on lifestyle, self-efficacy, and hemoglobin A1C (HbA1c) of patients with type 2 diabetes. Nevertheless, since the mentioned research was performed only in one health service center, similar studies should be performed in other centers. In addition, this intervention has not been performed based on a specific empowerment program for patients with diabetes and appropriate assessment tools (24). Accordingly, the results of a review study by Taheri et al. (2016) on empowerment-based interventions in patients with diabetes referred to the absence of a theoretical framework of empowerment, attention to all dimensions of empowerment and the impact of demographic variables on patients' empowerment, and program follow-up(25). Furthermore, it is assumed that FCEM training can influence eating habits for weight control, HbA1c, and blood glucose in type 2 diabetic patients. In light of the aforementioned issues, the present study aimed to determine the effect of FCEM on eating habits as a mediator for weight, HbA1C, and blood glucose control in Iranian patients with type 2 diabetes.

Methods

This semi-experimental study was conducted on type 2 diabetes patients referring to a diabetes clinic in Birjand, Iran, in 2018. The sample size was estimated at 35 diabetic patients per group based on a study by Mataji Amirrood et al. [19], using the sample size formula with a 95% confidence and the power of 90% (d=76.5, s1=9.04, s2=6.04, 97, zx=1. 96, zb=0.84), and considering a 10% attrition rate. The participants were selected from a diabetes clinic by convenience sampling method and assigned into intervention and control groups via block randomization.
The inclusion criteria entailed informed consent for participation, definitive diagnosis of type 2 diabetes by the clinic physician, use of oral medications to treat and control diabetes, the age range of 30-60 years, living with family (at least one person), literacy to read and write, non-application of weight loss diet, and good mental health. On the other hand, the exclusion criterion comprised absence for two sessions or more. Data collection tools included demographic and disease characteristics form and Azartel et al.'s Dietary Behaviors Questionnaire.
The demographic and disease characteristics form, which collected information about the patient and his/her family, was firstly completed by the researcher through patient interviews. The information included age, gender, marital status, educational level, weight, height, place of residence, occupation, length of illness, and history of diabetes in first-degree family members. The information collected about the caregiver was related to age, gender, marital status, education, relationship with the patient, and duration of care provided to the diabetic patient. An individual's weight was measured using a Seca digital scale (0.1 kg) while the individual had the minimum dressing on. The scale was checked using a certain weight, and the accuracy of the scale was re-checked after weighing every 10 patients. The participants' height was measured using a Seca stadiometer (1 cm) while the participant was standing in an upright position with no shoes on. Moreover, Hb1ACwas measured using a kit (made by Pishtazteb Company, Tehran, Iran), where a score between 6 and 8 indicates a controlled HbA1c level, while a score above 8 signifies a pathological problem. Blood glucose was measured with a standard test kit in the laboratory of Imam Reza Hospital in Birjand.
The standard questionnaire developed by Azartel et al. was employed to assess the four dimensions of eating habits. This scale comprises 51 items, including general information on diabetes (n=12); planning, buying, and preparing food (n=6); eating (n=17); family support in eating habits (n=12); and general questions about eating habits (n=4). The items are scored on a 5-point Likert scale (1=never, 2=rarely, 3=occasionally, 4=often, and 5=always). The content validity of the questionnaire was confirmed by a panel of experts who obtained a content validity index (CVI) of 0.87 (26). The internal consistency of the scale was confirmed, rendering a Cronbach's alpha coefficient of 0.75; thereafter, the scale was completed by 10 participants.
After necessary coordination with the authorities and determination of sample size, the participants were assigned to two groups of control and intervention using block randomization. The demographics form and the dietary behavior questionnaire were completed by all the patients. Weight, HbA1c, and blood glucose were subsequently measured. The FCEM was conducted for the intervention group members by the first author in four 50-min sessions held on a weekly basis. The intervention was presented in three subgroups (n=9) and one subgroup (n=8) through group

discussion based on the steps outlined for this model (Table 1).
Meetings were held to enhance the patients 'knowledge of the disease (perceived threat) and self-esteem so that they would participate in problem-solving as the second step of the model. At this stage, the patient was deeply aware of the disease process and its complications. She/he was actively involved in the care plan with confidence and the feeling that "I can play a part in improving my condition." For the third step (i.e., educational participation), a set of study cards were prepared and given to the active member of the patient's family to participate in patient care. The fourth step involved process evaluation and summative evaluation. In the process evaluation, each session was evaluated to ensure subjective and practical participation in the care plan and to make sure that the patient is following the previously-mentioned instructions (21).
The control group received routine care in the diabetes clinic (e.g., periodic blood glucose and lipid control, nutrition counseling, free nursing care, and doctor's visit) and did not receive any intervention

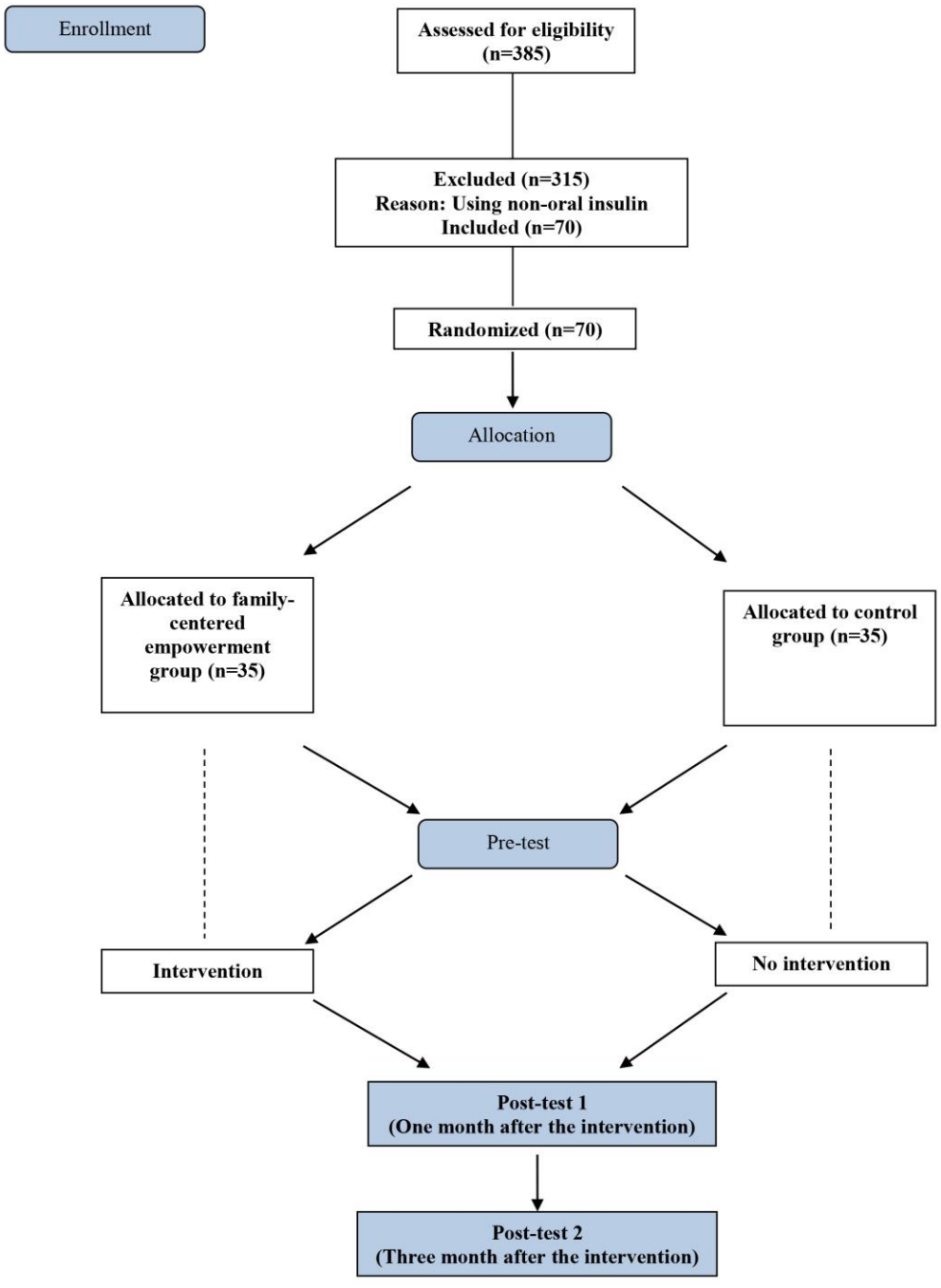

Figure 1. CONSORT flow diagram of study

Table 1. Steps and contents of the training the program based on the family-centered empowerment model

Session	Contents of the session
1	Establishing familiarity between the researcher and participants; building trust by accurately explaining the goals and the procedure of the study; describing the roles and responsibilities of each individual in the study; and sensitizing the participants by explaining the nature of the study and the likelihood of developing complications from the disease and treatment, the necessity of treatment, the prognosis, symptoms and complications and care of it, and the short-term effects of treatment plans at levels two and three of prevention
2	Teaching people through lectures and group discussions about increasing self-efficacy through familiarity with the problem-solving process in order to address the issues (regarding dietary behaviors, weight control, and regular blood sugar control)
3	At this stage, educational pamphlets were prepared to increase self-esteem and self-control. At the end of each session, the participants were asked to participate in training their active family members on understanding diabetes-related issues and to encourage the family members to help them.
4	The evaluation included process evaluation (the previous session being assessed via asking questions), and summative evaluation was performed immediately after the last session of the intervention (one month) and three months after the intervention.

in this field. According to the plan of visit, one month after the intervention, weight and blood glucose, and three months after the intervention, HbA1c, blood glucose, and weight were controlled, and dietary behavior forms were completed in person by research participants.

Data were analyzed in SPSS software (version 19). Descriptive statistics, including mean, standard deviation, and frequency, were first reported. The normality assumption in the two groups was evaluated by the Kolmogorov-Smirnov test. Independent t-test or Mann-Whitney U test was used to compare the variables in the two groups. Repeated-measures ANOVA or its nonparametric counterpart, the Friedman test, was employed to compare the mean values of the three-time points in each group. The Bonferroni post hoc test and Wilcoxon test were utilized to compare each time point between the groups. Chi-square or Fisher's exact tests were employed for demographic variables. A 95% confidence interval and a p-value of less than 0.05 were considered statistically significant in all tests.

The Ethics and Research Committee affiliated with Birjand University of Medical Sciences approved the study protocol (Identifier: IR.BUMS.REC.1397.92). The aims of the study were explained to the participants; thereafter, they signed written consent forms. They were informed that participation in the study was voluntary, and they could withdraw at any stage of the study. They were also assured that their personal information would remain confidential and be used only for research purposes.

Results

The mean age scores of participants in the intervention and control groups were reported as 47.17±15.62 and 47.37±9.12 years, respectively. The results of the statistical test revealed no statistically significant difference between the two groups in terms of age, gender, mean body mass index, the number of family members, marital status, level of education, and residence (P>0.05; Table 2).

The results of the repeated-measures ANOVA suggested that the mean blood glucose score in the intervention group decreased significantly over time (P<0.001). However, the mean blood glucose score in the control group did not change significantly over time (P=0.32). Bonferroni post hoc test pointed out that there was a significant difference in mean blood glucose score in the intervention group before and after three months (P=0.03), as well as one month and three months after the intervention (P=0.004; Table 3). Furthermore, the results of the independent t-test showed no significant difference between the two groups before and one month after the intervention (P>0.05). Nevertheless, there was a significant difference between the two groups three months after the intervention (P=0.01).

Based on the results of Paired t-test, the mean HbA1clevel in the intervention group decreased

significantly over time (P=0.001), while that of the control group did not change significantly over time (P=0.06). Moreover, the results of the independent t-test demonstrated no significant difference (P>0.92) between the groups in terms of HbA1c score before the intervention (P>0.92), whereas the difference was significant between the groups three months after the intervention (P=0.04; Table 3).
Based on the results of the Friedman test, the mean weight score in the intervention group showed a significant decrease through time (P<0.001), while that of the control group did not change significantly through time (P=0.06; Table 3). Follow-up with the Wilcoxon test illustrated that there was a significant difference in the mean blood glucose score in the intervention group before and three months after the intervention, as well as one month after the intervention (P<0.001). In addition, the results of the Mann-Whitney test showed no significant difference in weight scores between the groups before the intervention, one month after the intervention, and three months after the intervention (P>0.05).
The results also indicated that the mean score of eating habits in the intervention group increased

Table 2. Comparison of demographic variables of participants in intervention and control groups

Variable	Total	Intervention group	Control group	Test result
Age	49.56±6.17	49.66±6.37	49.46±5.98	t=0.14, P=0.89
Body mass index	28.69±4.12	29.60±3.80	27.78±4.44	t=1.84, P=0.07
Number of family members	3.54±1.19	3.37±1.03	3.71±1.36	t=1.19, P=0.24
Gender				
Male	29 (41.4%)	12 (34.3%)	17 (48.6%)	χ^2=1.47 P=0.23
Female	41 (58.6%)	23 (65.7%)	18 (51.4%)	
Marital status				
Single	2 (2.9%)	2(5.7%)	0 (0%)	P=0.23
Married	68 (97.1%)	33(94.3%)	35 (100.0%)	
Residence				
Urban	62 (88.6%)	31(88.6%)	31 (88.6%)	P=1.0
Rural	8 (11.4%)	4(11.4%)	4 (11.4%)	
Education level				
Elementary school	35 (50.0%)	21 (60.0%)	14 (40.0%)	χ^2=3.51
Secondary or high school	22 (31.4%)	10 (28.6%)	12 (34.3%)	p=0.17
Associate degree or above	13 (18.6%)	4 (11.4%)	9 (25.7%)	

Table 3. Mean scores of blood glucose, weight, HbA1c, and dietary behaviors before, one month, and three months after the intervention in the control and experimental groups

Variable	Group	Before the intervention Mean±SD	One month after the intervention Mean±SD	Three months after the intervention Mean±SD	Repeated-measures ANOVA
Blood Glucose	Intervention	147.51±49.42	144.86±23.17	129.31±25.14	F=33.00,P < .001
	Control	152.29±48.56	149.03±52.94	158.09±51.30	F=1.16, P=0.32
Independent t test		t=0.56, P=0.57	t=0.50, P=0.62	t=2.55, P=0.01	
Weight	Intervention	76.63±15.40	75.64±15.45	74.71±15.63	χ^2=44.98, P<0.001
	Control	72.29±12.71	72.74±13.18	72.23±13.05	F= 2.92, P= 0.06
Mann-Whitney test		z=1.04, P= .30	z = 0.53, P= 0.60	z=0.17, P= 0.87	
HbA1c	Intervention	8.20±2.01		7.04±1.62	t=4.02, P=0.001
	Control	8.15±1.79		7.78±1.62	t=1.92, P=0.06
Independent t test		t=0.10, P=0.92		t=2.07, p=0.04	
Dietary behaviors total score	Intervention	138.14±16.32	144.71±12.24	148.85±11.10	F=11.35, P<0.001
	Control	138.00 ±18.25	141.09±16.94	141.51±13.78	F=1.17, P= 0.3
Independent t test		t=0.03, P=0.97	t=1.01, P=0.32	t=2.39, P= 0.02	

significantly over time (P<0.001). However, that of the control group did not change significantly over time (P=0.32). Follow-up of this result pointed out that there was a significant difference in the mean score of total eating habits in the intervention group before the intervention and three months after the intervention (P<0.001), as well as one month and three months after the intervention (P=0.01; Table 3). Furthermore, the results of the independent t-test suggested no significant difference (P> 0.05) in the total score of eating habits between the two groups before and one month after the intervention (P> 0.05). However, there was a significant difference between the two groups three months after the intervention (P=0.02; Table 3).

Discussion

The present study aimed to determine the effect of FCEM on eating habits, weight, hemoglobin A1C, and blood glucose control in Iranian patients with type 2 diabetes. As evidenced by the obtained results, the total mean score of eating habits in the intervention group was significantly higher three months after the intervention, as compared to that in the control group. In addition, there was a significant increase in the total mean score of eating habits in the intervention group three months after the intervention, as compared to that obtained before or one month after the intervention.

In their study, Mataji Amirrood et al. (2013) used family empowerment training to modify obesity-related nutritional behaviors, acknowledging that this approach could be used in behavior change interventions to improve family and community health (27). The FCEM helps patients' families to identify their lifestyle problems, improve their patient support skills, and gain the ability to change family situations and lifestyles. Since the FCEM is associated with the patient's self-participation, it can also improve self-efficacy and self-esteem. Some studies have shown a significant positive relationship between self-efficacy and improved eating habits in patients (28, 29).

Saeidinejat et al. (2014) suggested that the empowerment of patients' families improves family support, enhances patient self-efficacy, and consequently, improves patient lifestyle and management (30). Some studies have demonstrated that family-centered interventions contributed greatly to a healthy diet, physical activity, better disease control, and improved self-care skills in patients with diabetes (31-33). The training of family members on disease control and prevention is of paramount significance since individuals rely on their family members, and their attitudes are directly influenced by their, especially in chronic diseases, such as diabetes (34). Moreover, the family environment can have a great contribution to a diabetic patient's adaptation to lifestyle changes in order to properly control blood glucose and prevent complications(35). Therefore, it can be stated that empowering the family has positive effects on one's care behaviors and better control of the disease.

As mentioned earlier, the mean total score of eating habits enhanced better in the intervention group after the intervention, compared to that in the control group; nonetheless, the increase was not significant. In this regard, Sánchez et al. (2013) stated that changes in the dietary pattern of individuals with type 2 diabetes require further time(36). In the present study, the mean weight in the intervention group decreased significantly over time. The groups significantly differed in terms of changes made in the mean weight one month and three months after the intervention, compared to that obtained before the intervention, with the changes being less significant in the intervention group.

Along the same lines, the results of a meta-analysis by Cradock et al. (2017) pointed out that although eating habits in diabetic patients may lead to weight loss, weight changes may occur over time and require a longer time (37) as mentioned above. The empowerment of the patient's family results in both family support and self-efficacy. In their study, Wamsteker et al. (2005) stated that people with lower self-efficacy had less weight loss. Therefore, it can be maintained that increased self-efficacy in this method may lead to higher weight loss (38). It also seems evident that the improvement of eating habits in individuals can lead to weight loss. In the present study, the mean blood glucose level in the intervention group decreased significantly over time. It also decreased significantly in the intervention group three months after the intervention, compared to the control group. The findings of a study by Cheraghi et al. (2015) showed that empowering adolescents with type 1 diabetes and their caregivers in home-centered care can help manage blood glucose levels in these patients and allow them to adhere to a diet at home(39).

Furthermore, a study by Mayberry et al. aimed to determine the relationship between family support, blood glucose control, and drug adherence in adults with type 2 diabetes. The results of the referred study indicated that families with more knowledge about diabetes would perform more supportive

behavior. Patients who were less adherent to treatment and had poor blood glucose control reported more familial non-supportive behaviors (40). Suppapitiporn et al. (2005) believed that the family played a peculiar role in treating these patients, and higher family performance was associated with better blood glucose control, suggesting that families participate in the educational programs of these patients(41).

As evidenced by the results, the mean HbA1c level was significantly decreased in the intervention group three months after the intervention, compared to that in the control group. In the same context, Armour et al. (2005) in a review of 10 studies, assessed the impact of family-centered interventions on diabetic patients and reported that family-centered interventions generally resulted in a 0.6% reduction in the HbA1c index (42). The findings of a study by Cheraghi et al. illustrated that the empowerment of diabetic patients and their families in home-centered care reduced HbA1c levels (39). It stands to reason that modified eating habits and adherence to healthy diets can result in a reduced level of HbA1c in individuals. The results of a study by Atashzadeh et al. (2017) showed that the amount of hemoglobin decreased in both groups after the intervention, and this decrease was higher in the intervention group(24). This can be ascribed to the fact that both groups received training based on the empowerment model (control group without family participation and intervention group with family participation).

The main limitation of this study was a mere reliance on the tool of nutritional behaviors; therefore, it is needed that more studies be conducted using multiple measurement criteria in other centers. Furthermore, studies with longer intervention periods may lead to different results. On the other hand, it was tried to minimize the effect of respondents' mental interpretations, as well as different economic, social, and cultural characteristics, on the results by random assignment of participants.

Implications for Practice

Education based on the FCEM can improve nutritional behaviors, hemoglobin A1C, and blood glucose in type 2 diabetic patients. As evidenced by the results of the present study, the FCEM can be considered an effective strategy by health care professionals, especially public health nurses, to improve the eating habits of type 2 diabetes patients. It is recommended to investigate the impact of implementing the FCEM on the components influencing diabetes control, such as lifestyle and medication adherence.

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Conflicts of Interest

The authors declare that they have no conflict of interest regarding the publication of the present article.

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