



# Effects of Education Based on Roy Adaptation Model on Diabetes Care Profile of Patients with Type 2 Diabetes Mellitus

Esin Kavuran<sup>1</sup> and Afife Yurttaş<sup>1,\*</sup>

<sup>1</sup>Faculty of Nursing, Ataturk University, Erzurum, Turkey

\*Corresponding author: Afife Yurttaş, Assistant Professor, Faculty of Nursing, Ataturk University, Erzurum, Turkey. Tel: +90-4422313042, Fax: +90-4422360984, E-mail: affe-72@hotmail.com

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## Abstract

**Background:** In type 2 diabetes, adaptation to the disease and the treatment process is extremely important. The main methods employed to treat and manage type 2 diabetes are education, medication, nutrition, exercise, and insulin therapy.

**Objectives:** The current study aimed at determining the effects of education based the Roy adaptation model on diabetes care profile (DCP) of patients with type 2 diabetes.

**Methods:** The current clinical and experimental study was conducted on 130 patients with type 2 diabetes referred to Atatürk University Research Hospital Endocrinology Polyclinic, Erzurum, Turkey from April 2015 to August 2016, possessing the inclusion (N = 388). The study was conducted as a pre-test post-test control group. The study was conducted on 61 patients in the experimental and 65 in the control groups. The experimental group referred on Monday, Wednesday, and Friday. Control group referred on Tuesdays and Thursdays. The patient identification form and Turkish version of diabetes care profile scale, developed by Ozcan were employed for data collection. The education and follow-up processes were completed in 12 weeks. The percentile, distribution, Chi-square, and the t-tests were employed to evaluate the data of the independent and paired groups.  $P < 0.05$  was considered as significant.

**Results:** The patients in the control group had pre-test and post-test scores of  $2.43 \pm 0.16$  and  $2.44 \pm 0.15$  in medical barriers, respectively ( $P = 0.269$ ). In the experimental group, the scores of medical barriers were  $2.45 \pm 0.17$  in the pre-test and  $2.23 \pm 0.37$  in post-test ( $P < 0.05$ ). Further, the patients in the control group had the pre-test and post-test scores of  $2.49 \pm 0.32$  and  $2.55 \pm 0.31$  in supportive attitude, respectively ( $P = 0.136$ ). In the experimental group, the pre-test and post-test scores of supportive attitude were  $2.55 \pm 0.33$  and  $2.89 \pm 0.48$ , respectively ( $P < 0.05$ ).

**Conclusions:** A positive impact was observed in the education of DCP based on Roy's adaptation model.

**Keywords:** Care, Diabetes Mellitus, Education, Nursing, Roy Adaptation, Type 2

## 1. Background

The primary methods used to treat and manage type 2 diabetes are education, medication, nutrition, exercise, and insulin therapy (1, 2). Education is the cornerstone of the treatment of type 2 diabetes, and there is a vital importance in integrating type 2 diabetes into the society. It is reported that type 2 diabetes education programs are effective to reduce diabetic complications and length of stay in the hospital and change the lifestyle of individuals (3). In type 2 diabetes education, it is aimed to understand emotional and physical stress sources, exercise, diet, and drugs in relation to glycemic control. Individual and group education methods are used in diabetes education (3).

The nurses play an essential role in such educational programs. Nurses can provide diabetes education using nursing models. By the employment of these models, nursing activities shift away from being service-centered to serving in a patient-focused manner (4). Nursing made a

phenomenal achievement in the last century that led to the recognition of nursing as an academic discipline and a profession. The need for the knowledge to guide professional nursing practice is realized. In this way, nurses focus on the role of nursing and its applications rather than medical practice (5).

In Turkey, the use of models in nursing practice and research projects gained importance in the recent years (6-8). Nurses provide care to patients using a holistic care model. Nursing models serve to guide nursing practices. This guidance provides a way of thinking of nurses. Nursing theories enable nurses to focus on nursing practices rather than on medical implementations and they ensure that nursing care is systematic, controlled, and efficient since the models help to notice the factors influencing behaviors and identify the ways to reach a certain target. One of the efficient nursing models in this regard is Roy's adaptation model (RAM) (9) widely used owing to its simplicity and accessibility (10). The innate theory of this model has a

great capability to describe different individuals, embracing a broader scope compared with other adaptation theories. Therefore, clinical managers are increasingly turning to the application of this model in clinical settings (11-16).

The aim of the RAM is to facilitate, develop, and increase individuals' adaptation time on health and disease (17-19). The RAM has four adaptation modes including physiological mode, role function mode, self-concept mode, and interdependence mode. Nurses have a significant role in sustaining, improving, and rehabilitating health, and help individuals to meet their needs in such modes (20-22).

In type 2 diabetes, adaptation to the disease and treatment process is extremely critical. Type 2 diabetes is a chronic disease that arises from the insufficient secretion or inefficient use of insulin hormone and is associated with physiological, emotional, and social problems (23). Individuals with the disease are expected to arrange their diet and physical activities according to the restrictions necessary to manage diabetes, implement the medication treatment correctly, and self-monitor (24). Nursing care and education is crucial in changing the lifestyles and habits of patients with type 2 diabetes, and in adapting them to the treatment process (25, 26).

The diabetes care profile (DCP) is a valid and reliable measurement instrument used to analyze the factors, caregiving, and social and psychological dimensions of type 2 diabetes treatment. The scale includes factors that both aggravate and alleviate diabetes control; therefore, it facilitates the identification of social, psychological, and educational needs of patients with diabetes (27). In Turkey, according to a literature review, no study was conducted on the results of structured education to improve compliance of patients with type 2 diabetes and RAM.

## 2. Objectives

The current study aimed at determining the effects of education, based on RAM, on diabetes care profile of patients with type 2 diabetes.

## 3. Methods

### 3.1. The Research Universe

The current study was a clinical and experimental study. Eight hundred and fifty-nine patients with type 2 diabetes referred to Atatürk University Research Hospital Endocrinology Polyclinic, Erzurum, Turkey from April 2015 to August 2016. However, 96 patients lived in the districts, 66 were hospitalized, 88 were illiterate, 102 had a new diagnosis, 26 were insulin users, and 93 had complications (retinopathy, diabetic foot). In the end, the research universe included 388 patients.

### 3.2. The Research Sample and Design

The patients unable to complete active education due to any reasons and voluntarily departed the study were excluded. Inclusion criteria were age above 18 years, having type 2 diabetes for at least 6 months, knowing his/her diagnosis, and being literate. The study was conducted with a pre-test post-test and control group design. It was intended to select these groups using the simple random method. The sample of the study consisted of 130 patients, 65 controls and 65 experimental subjects. The experimental group referred on Monday, Wednesday, and Friday. Control group referred on Tuesdays and Thursdays. The subjects were blinded to grouping, and the patients in the control group were not aware of the training process. For this reason, the single-blind method was used in the study. Finally, 126 patients completed the study (65 controls and 61 experimental subjects, without a physical and mental barrier to answer questions and to live in the city center). The flow chart of the study is as follows.

### 3.3. Data Collection/Procedure

Patients meeting the inclusion criteria were informed about the study objectives before signing the consent form. The educational program was planned for the two groups. The educational classes were provided by the same trainer and the same material using the same method - the face-to-face technique - in the patients' education room located in the endocrinology clinic. The patient identification form and the DCP (pre-test) were administered to patients in the experimental and control groups. After collecting the pre-test data, experimental group were informed about the physiological mode, which constituted the first section of the education. A booklet called "Adaptation to diabetes", structured with RAM, was distributed among the patients in the experimental group. Besides the booklet, the education included various educational methods such as verbal presentation through PowerPoint slides, a question-answer section, demonstration, and implementation. Each educational session lasted 40 - 45 minutes. While the first 15 minutes were devoted to a review of the previous session, new subjects were covered in the remaining 30 minutes. Educational sessions were completed in eight weeks; two sessions per week. After educational sessions on each mode, patients were called to make the controls and to answer patients' questions. Hence, the 12-week education and follow-up periods were completed. The DCP was administered among the experimental group three months after the education in order to trace behavioral changes and this marked the completion of the data collection process for the experimental group (post-test). The DCP was administered among the patients in the control group six months after the initial meeting, and this

marked the completion of the data collection process for the control group (post-test). The educational program, based on RAM, is given below (Table 1).

### 3.4. Data Collections Tools

#### 3.4.1. Patient Identification Form

The form was used to identify the descriptive characteristics of the patients. Patient identification form was prepared by searching the related literature (12, 19, 25, 28-30).

#### 3.4.2. Diabetes Care Profile Scale

The diabetes care profile is a form developed on the basis of the health belief model to analyze the self-care practices of patients with diabetes, the social and psychological dimensions of diabetes treatment. The first version of the scale was devised as the "diabetes educational profile" by Devis et al., to determine the social, psychological, and educational needs of patients with diabetes. It was re-organized as the "diabetes care profile" by Fitzgerald et al. (27). The validity and reliability of the Turkish version of this scale were tested by Ozcan (28). The scale includes a total of 14 sub-scales, six of which include aggravating factors for diabetes control and the other eight, the alleviating factors for diabetes control. The scale has 104 items.

### 3.5. Ethical Considerations

The study was approved by the Ethics Committee of Faculty of Health Sciences (Code: 10.03.2015/14). All the participants provided informed consent. Participants' information was kept confidential.

### 3.6. Data Analysis

The collected data were analyzed statistically with Statistics for Windows, version 18.0 (SPSS Inc., Chicago, Ill., USA). The percentile, distribution, mean  $\pm$  standard deviation, Chi-square, and the t-tests for independent and paired groups were employed to evaluate the data.  $P < 0.05$  was the level of significance.

## 4. Results

Thirty-five of the patients in the control group (53.8%) and 32 of the patients in the experimental group (52.4%) were in the age range of 38 - 57 years; 29 subjects of the control group (44.6%) and 32 subjects of the experimental group (52.5%) were male; 49 subjects of the control group (75.4%) and 49 subjects of the experimental group (80.3%) were married; 36 subjects of the control group (55.4%) and 34 subjects of the experimental group (55.8%) were secondary school graduates; and 45 subjects of the control group (69.2%) and 42 subjects of the experimental group

(68.9%) were living in the families with unknown medical history (Table 2). Control problems, social and personal factors, medical, exercise, and monitoring barriers, as well as negative attitude, are the aggravating factors for diabetes control. There was no significant decrease in the mean sub-scale scores of the control group comparing before and after the education, measures ( $P > 0.05$ ). However, after the education there was a significant decrease in the experimental group's mean scores on the sub-scales involving aggravating factors to control diabetes ( $P < 0.05$ ) (Table 3). Supportive attitude, diet adherence, long-term care benefits, knowledge on diabetes, positive attitude, self-care ability, the importance of care, and self-care adherence are the sub-scales related to alleviating factors to control diabetes. There was no significant increase in the mean scores of alleviating diabetes control after the education compared with before education in the control group ( $P > 0.05$ ). In contrast, a significant increase was observed in the mean scores of alleviating factors for diabetes control after the education compared with before education in the experimental group ( $P < 0.05$ ) (Table 4).

## 5. Discussion

Patients with type 2 diabetes should follow certain rules and change their habits. Therefore, they need an education that addresses their disease and needs (3). Kartal et al., conducted a study to determine the attitudes of patients with type 2 diabetes on care and treatment, and the factors influencing the attitudes. They found that the patients' adaptation to the disease was at a moderate level (29). It is thought that a systematic educational program for patients with type 2 diabetes can positively influence the factors that aggravate patients' adaptation to the disease. Comparison of the experimental and control groups' pre-test scores on the subscales associated with control problems including hypoglycemia and hyperglycemia showed insignificant differences between the groups (28).

This finding showed that the experimental and control groups were similar in terms of the frequency of complications related to diabetes. The difference between the mean scores of pre-test and post-test in the control group was statistically insignificant ( $P > 0.05$ ) (Table 3), whereas the same difference was statistically significant in the experimental group.

There are studies reporting that patients with diabetes and high mean scores on diabetes control problems had lower scores in self-managing diabetes, and their adaptation to treatment was influenced by the fear of diabetic complications (30). Symptoms related to diabetes influence the life of patients with diabetes (31). The subscale

**Table 1.** Educational Program Based on the Ray Adaptation Model

	Educational Subject	Education Method	Material
<b>Physiological mode indicator</b>			
Endocrine function, oxygenation, elimination, protection, senses, liquid, electrolyte and acid-base balance, neurological function, nutrition, movement and rest	Definition, description and types of diabetes, blood sugar measurement, tests used to diagnose diabetes, use of insulin and attention to be taken, definition, causes, indications and measures of hyperglycemia, definition of hypoglycemia, its causes, signs, and measures, exercise for diabetic individuals, nutrition for diabetic individuals	Expression, question answer, demonstration, discussion	Education booklet, writing board, projection, insulin application, introduction of model and insulin pen, blood glucose meter and its application
<b>Self-concept mode indicator</b>			
Effective coping methods, positive body image, functional self-esteem, physical changes, spiritual integrity in physical growth	Stress definition, streaks, control, foot problems, skin problems, dental problems, eye problems, kidney problems	Expression, question answer, demonstration, discussion	Education booklet, writing board, projection
<b>Role function mode indicator</b>			
Evolution of roles, effective coping process in role change, responsibility to fulfill roles, combine effective roles, balanced role competence	Sexual life, experienced problems, problems in social life, birth control method, experienced problems	Expression, question answer, demonstration, discussion	Education booklet, writing board, projection
<b>Interdependence mode indicator</b>			
Qualification of important persons and support systems, effective coping methods in loneliness, adequate development for learning and maturation in relationships	Diabetes and interpersonal relationships, the impact of undertaking health care for diabetes management and its importance	Expression, question answer, demonstration, discussion	Education booklet, writing board, projection

of social and personal factors investigates the kinds and the extent to which diabetes influences social and personal characteristics (28). There was no statistically significant difference between the pre-test and post-test mean scores of the control group in the social and personal factors subscale. In contrast, there was a significant decrease in the experimental group's pre-test and post-test mean scores ( $P < 0.05$ ) (Table 3). Type 2 diabetes is a chronic disease, affecting the patient psychologically, emotionally, socially, and psychosexually. The study by Fukunaga et al., showed that practices to manage diabetes such as diet planning and tracking and controlling blood sugar limited the freedom of patients with type 2 diabetes (32). One of the factors negatively influencing diabetes management, and adaptation of diabetes is a negative attitude towards diabetes (28). The difference between pre-test and post-test mean scores of the control group was statistically insignificant ( $P > 0.05$ ), whereas the difference between pre-test and post-test mean scores were significant in the experimental group ( $P < 0.05$ ) (Table 3). A study found that patients with negative attitude towards diabetes were more influenced by diabetes. These patients found themselves more insufficient and had poorer diabetes management. There was no statistically significant difference between the control group's pre-test and post-test mean scores in the sub-

scale of exercise barriers ( $P > 0.05$ ), whereas this difference was significant in the experimental group ( $P < 0.05$ ) (Table 3). Exercise is a part of the adaptation to type 2 diabetes treatment. It lowers blood sugar and decreases insulin need and sensitivity (33). The study by Erol determined that patients with diabetes and greater barriers to exercising tried to prevent hypoglycemia more frequently. These patients had higher levels of anxiety and fear of hypoglycemia (34). The difference between pre-test and post-test mean scores of the control group in the monitoring barriers subscale was statistically insignificant ( $P > 0.05$ ), whereas this difference was statistically significant in the experimental group ( $P < 0.05$ ) (Table 3). Postponing blood sugar follow-ups is an inhibiting factor in diabetes management and adaptation to the disease (35). In the study by Ong et al., high levels of glucose in the blood, lack of knowledge, experiencing stigmatization, fear and pain of needles were determined as inhibiting factors for self-monitoring glucose level in the blood. These factors had a negative impact on diabetes management and adaptation (35). In the current study, there was no statistically significant difference between the control group's pre-test and post-test mean scores on the alleviating diabetes control subscales ( $P > 0.05$ ). In contrast, the difference between pre-test and post-test mean scores of the experimen-

Table 2. Demographic Characteristics of Patients<sup>a</sup>

Characteristics	Control Group (N = 65)	Experimental Group (N = 61)	Total (N = 126)	Test and Significance
<b>Age, y</b>				$\chi^2 = 3.726, P = 0.444$
18 - 37	15 (23.1)	17 (27.9)	32 (25.5)	
38 - 57	35 (53.8)	32 (52.4)	67 (53.1)	
58 and above	15 (23.1)	12 (19.7)	27 (21.4)	
<b>Gender</b>				$\chi^2 = 1.108, P = 0.293$
Male	29 (44.6)	32 (52.5)	61 (48.4)	
Female	36 (55.4)	29 (47.5)	65 (51.6)	
<b>Marital status</b>				$\chi^2 = 0.178, P = 0.674$
Married	49 (75.4)	49 (80.3)	98 (77.8)	
Single	16 (24.6)	12 (19.7)	28 (22.2)	
<b>Education</b>				$\chi^2 = 2.971, P = 0.812$
Primary school	17 (26.2)	16 (26.3)	33 (26.3)	
Secondary school	36 (55.4)	34 (55.8)	70 (55.6)	
High school- University	12 (18.4)	11 (17.9)	23 (18.1)	
<b>Occupation</b>				$\chi^2 = 6.438, P = 0.490$
Housewife	27 (41.5)	29 (47.7)	56 (44.6)	
Retired	23 (35.4)	15 (24.5)	38 (29.9)	
Other (civil servant, worker, etc.)	15 (23.1)	17 (27.8)	32 (25.5)	
<b>Family type</b>				$\chi^2 = 0.684, P = 0.850$
Extended family	20 (30.8)	19 (31.1)	39 (31.0)	
Nuclear family	45 (69.2)	42 (68.9)	87 (69.0)	
<b>Smoking</b>				$\chi^2 = 2.928, P = 0.397$
Yes	13 (20.0)	8 (13.1)	21 (16.6)	
No	52 (80.0)	53 (86.9)	105 (83.4)	
<b>Drinking alcohol</b>				$\chi^2 = 4.993, P = 0.083$
Yes	3 (4.6)	3 (4.9)	6 (4.8)	
No	62 (95.4)	58 (95.1)	120 (95.2)	
<b>Education on type 2 diabetes</b>				$\chi^2 = 0.409, P = 0.522$
Yes	45 (69.2)	42 (68.8)	87 (69.1)	
No	20 (30.8)	19 (31.2)	39 (30.9)	
<b>Support for type 2 diabetes</b>				$\chi^2 = 0.318, P = 0.426$
Yes	45 (69.2)	46 (75.4)	91 (72.3)	
No	20 (30.8)	15 (24.6)	35 (27.7)	
<b>Support person</b>				$\chi^2 = 12.628, P = 0.125$
Doctor	30 (46.2)	29 (47.5)	59 (46.8)	
Nurse	10 (15.3)	11 (18.0)	21 (16.7)	
Other (family, friends, etc.)	5 (7.7)	6 (9.9)	11 (8.7)	
<b>Diabetes story in family</b>				$\chi^2 = .706, P = 0.997$
Yes	p=.99739 (60.0)	37 (60.6)	76 (60.4)	
No	26 (40.0)	24 (39.4)	50 (39.6)	

<sup>a</sup>Values are expressed as No. (%).

tal group was statistically significant ( $P < 0.05$ ) (Table 4). One of the factors that enable successful diabetes education is the integration of education and the treatment process. A study reported that in educational programs integrated with the treatment process, patients' frequency of follow-ups and knowledge on the disease was higher (36).

The study by Cihangir using Roy and Orem models concluded that there was an increase in the adaptations of adolescents in the experimental group to medical treatment and disease management (37). Similarly, Alimohammadi et al., in a study aimed at designating the physiological adaptation levels of patients with stroke observed that the care

**Table 3.** Comparison of the Mean Score of Pretest-Posttest Score for Aggravating Factors of Diabetes Control

Subscale	Control Group (N = 65)				Experimental Group (N = 61)			
	Pre-Test	Post-Test	t	P Value	Pre-Test	Post-Test	t	P Value
Control problems	2.71 ± 0.83	2.67 ± 0.67	1.115	0.269	2.65 ± 0.88	1.79 ± 0.44	8.993	0.000
Social and personal factors	3.44 ± 0.21	3.42 ± 0.27	0.356	0.180	3.41 ± 0.14	2.82 ± 0.78	5.804	0.000
Medical barriers	2.43 ± 0.16	2.44 ± 0.15	1.655	0.103	2.45 ± 0.17	2.23 ± 0.37	5.117	0.000
Exercise barriers	3.05 ± 0.29	2.99 ± 0.39	1.321	0.191	3.09 ± 0.31	2.41 ± 0.70	6.376	0.000
Monitoring barriers	2.64 ± 0.84	2.61 ± 0.86	1.013	0.315	2.68 ± 0.79	1.27 ± 0.36	12.727	0.000
Negative attitude	2.62 ± 0.26	2.60 ± 0.33	0.504	0.671	2.64 ± 0.28	2.26 ± 0.48	5.940	0.000

**Table 4.** Comparison of the Mean Scores of Pretest-Post-test for the Subscales Associated with Alleviating Factors for Diabetes Control

Subscales	Control Group (N = 65)				Experimental Group (N = 61)			
	Pre-Test	Post-Test	t	P Value	Pre-Test	Post-Test	t	P Value
Supportive attitude	2.49 ± 0.32	2.55 ± 0.31	1.511	0.136	2.55 ± 0.33	2.89 ± 0.48	5.308	0.000
Diet adherence	2.97 ± 0.35	2.87 ± 0.65	1.271	0.208	2.87 ± 0.39	3.25 ± 0.56	6.705	0.000
Long-term care benefits	2.85 ± 0.23	2.88 ± 0.29	0.920	0.361	2.85 ± 0.32	3.15 ± 0.36	6.081	0.000
Knowledge on diabetes	1.91 ± 0.18	1.94 ± 0.18	1.047	0.299	1.92 ± 0.18	2.28 ± 0.32	8.311	0.000
Positive attitude	2.27 ± 0.32	2.22 ± 0.27	1.173	0.245	2.34 ± 0.37	2.99 ± 0.74	-6.759	0.000
Self-care ability	2.36 ± 0.54	2.40 ± 0.61	0.710	0.481	2.21 ± 0.66	2.70 ± 0.77	6.828	0.000
Importance of care	2.68 ± 0.30	2.70 ± 0.37	0.527	0.600	2.65 ± 0.56	3.11 ± 0.53	9.337	0.000
Self-care adherence	1.79 ± 0.57	1.81 ± 0.56	1.150	0.254	1.89 ± 0.62	2.26 ± 0.80	3.504	0.001

**Table 5.** Features of DCP

Sub-Scale	Alpha Values of the Scale <sup>a</sup>	Alpha Values of the Scale <sup>b</sup>	Alpha Values of the Scale <sup>c</sup>
Control problems	0.86	0.78	0.80
Social and personal factors	0.85	0.87	0.84
Positive attitude	0.80	0.76	0.73
Negative attitude	0.77	0.83	0.80
Self-care ability	0.72	0.54	0.52
Importance of care	0.90	0.97	0.90
Self-care adherence	0.70	0.58	0.55
Diet adherence	0.87	0.80	0.79
Medical barriers	0.75	0.78	0.76
Exercise barriers	0.60	0.69	0.73
Monitoring barriers	0.65	0.86	0.76
Understanding mgt. practice	0.92	0.98	0.95
Long-term care benefits	0.95	0.94	0.88
Support attitude	0.65	0.58	0.69

<sup>a</sup>Fitzgerald et al. (1996).<sup>b</sup>Ozcan (1999).<sup>c</sup>The current study.

given in line with the RAM increased patients' adaptation to the physiological mode (14). The findings of the current

study suggested that a systematic educational program for patients with diabetes positively affected factors alleviat-

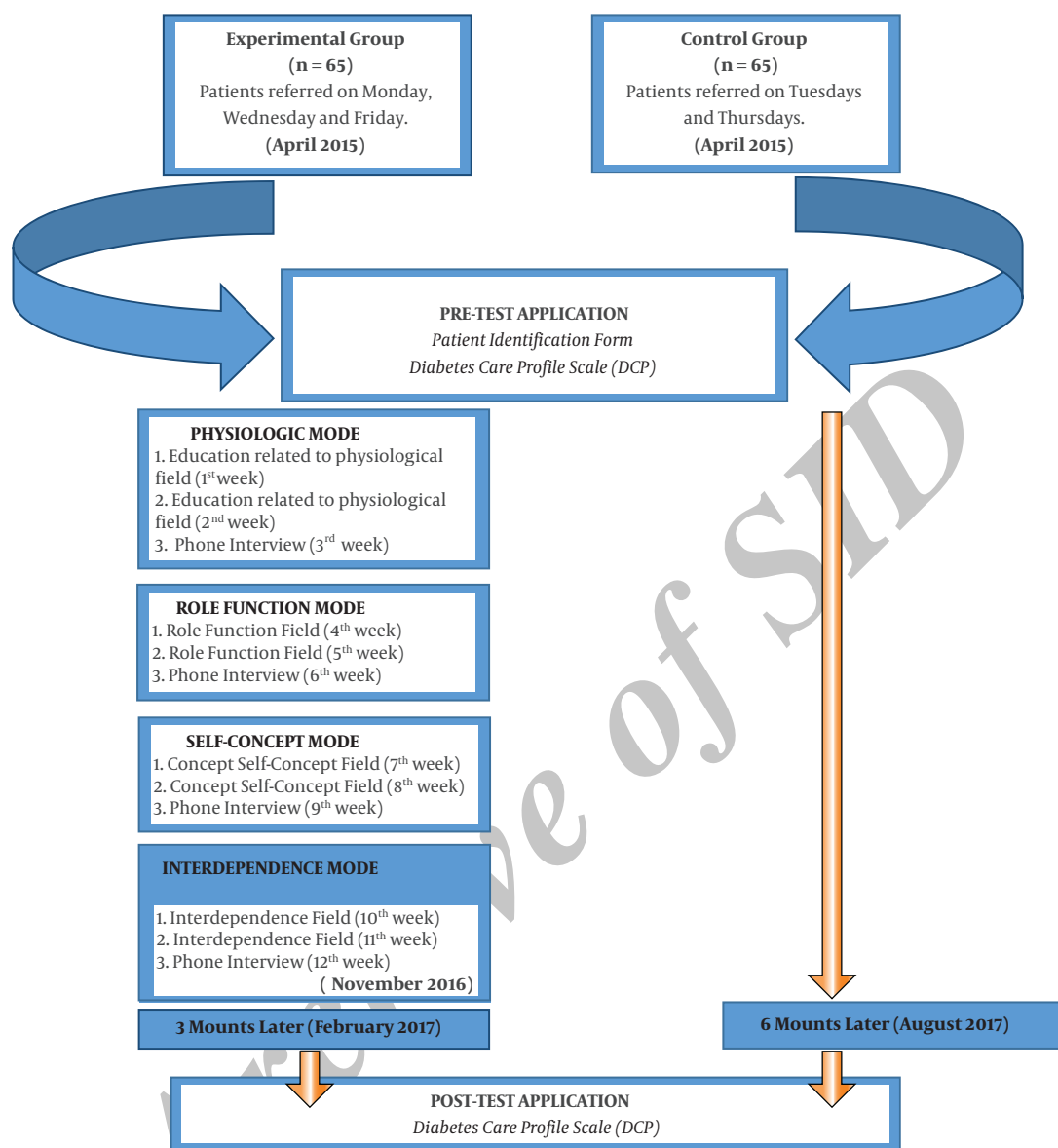


Figure 1. Flowchart of the study

ing diabetes control. Comparison of the means of the pre-test and post-test scores for the sub-scale of self-care ability indicated that the difference was statistically insignificant in the control group ( $P > 0.05$ ), but significant in the experimental group ( $P < 0.05$ ) (Table 4). The active participation of patients with type 2 diabetes in their own care leads to positive outcomes in diabetes management (28). The study by Nam et al., aimed at examining the factors inhibiting diabetes management found that a positive perception of the disease positively affected glycemic control and adaptation to the disease (38). Similarly, in the study by

Daly et al., aimed at examining the factors influencing diabetes management, it was determined that the belief in the effectiveness of the treatment had an impact on diabetes management (39). In the significance of care subscale, the difference between pre-test and post-test mean scores were insignificant in the control group ( $P > 0.05$ ), but significant in the experimental group ( $P < 0.05$ ) (Table 4). Many studies show that patients' education on type 2 diabetes had a positive impact on the patients' care practices and their knowledge of the disease and also helped them to be more attentive to the implementations for disease man-

agement (40). The most important factor influencing patients' adaptation to diet treatment was their resistance to the changes they need to make in their dietary habits. In the current study, the difference between pre-test and post-test mean scores of the control group in the subscale of diet adherence was not significant ( $P > 0.999$ ), whereas it was significant in the experimental group ( $P < 0.05$ ) (Table 4). One of the important constituents of type 2 diabetes management is the adaptation to diet (2). The study by Kartal et al., highlighted that metabolic control of diabetes could be ensured more easily by endowing patients with healthy diet habits and diet adherence, which are the basis of diabetes treatment (29). Gazmararian et al., found that patients with diabetes had a better adaptation to the disease when following doctors, nurses, and dieticians' to avoid unhealthy food (41). There is a positive relationship between patients' knowledge levels and their adaptation to the disease (41). It can be argued that being knowledgeable and conscious about diabetes makes diabetes management easier for patients with type 2 diabetes; thus, it is a motivating factor. In the current study, the high post-test mean scores indicated that a systematic educational program positively influenced diabetes management. The difference between the pre-test and post-test mean scores for the subscale of knowledge on diabetes was insignificant in the control group ( $P > 0.05$ ), but significant in the experimental group ( $P < 0.05$ ) (Table 4). Jeragh-Alhaddad et al., emphasized that lack of knowledge had an inhibiting role for patients with diabetes (30). Likewise, studies by Shakibazadeh et al., and Simmons et al., reported that a lack of knowledge of diabetes was an inhibiting factor for diabetic self-care (31, 42). The findings of Fort et al., supported these arguments and showed that a lack of knowledge of symptoms was among the factors that inhibited disease management (43). Awareness of a disease and its related problems contributed to the development of self-care behaviors. On the sub-scale of long-term care benefits the difference between the pre-test and post-test mean scores was insignificant in the control group ( $P > 0.05$ ), but significant in the experimental group ( $P < 0.05$ ) (Table 4). In the study by Erol, patients with type 2 diabetes believing that receiving the best possible care for diabetes postpones or prevents long-term diabetic complications displayed preventive practices more frequently (34). In the current study, after education the experimental group's mean scores on the long-term care subscale were high. This finding indicates that raising awareness about the complications associated with diabetes motivates the patient to fulfill the practices that help diabetes management. Since diabetes is a chronic disease, family support is crucial for the individual's adaptation to the disease. On the subscale of supportive attitudes, the difference between the control group's

mean pre-test and post-test scores were insignificant ( $P > 0.05$ ), whereas it was significant in the experimental group ( $P < 0.05$ ) (Table 4). As the diabetic individual goes through the efforts of pursuing a healthy lifestyle, their partner, family, and friends might be influenced in either a positive or a negative way (44). Nagelkerk et al., carried out a study to determine the perceived restrictions in diabetes management and effective strategies to cope with them. Their results showed that having a supportive person who might help the patient influenced adaptation to diabetes in a positive way (45). Similarly, studies by Shakibazadeh et al., and Ong et al., underlined that giving encouragement to diabetic patients about their self-care and the provision of positive feedback from health-care providers constituted motivating factors for patients who practiced diabetic self-care (31, 35, 46).

The results of this study showed that there was a significant decrease in the mean scores on the sub-scales involving control problems, social and personal factors, medical, exercise, and monitoring barriers, as well as negative attitude, which are the aggravating factors for diabetes control and after the educations in the experimental group, a significant increase was found in the mean scores on the subscales of supportive attitude, diet adherence, long-term care benefits, knowledge on diabetes, positive attitude, self-care ability, importance of care, self-care adherence, which are the factors alleviating diabetes control.

The results of the study are limited to patients with type 2 diabetes at the university hospital where the study was conducted. Furthermore, the study of a limited sample is limited by the fact that the research data was obtained by the same researcher and the research was carried out in a single center. Additionally, the following demographic characteristics were not examined in the study: height, weight, body mass index (BMI), systolic and diastolic pressures, history of serious diseases and their durations.

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