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RESEARCH ARTICLE

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# The effect of education given to hemodialysis patients based on the Roy Adaptation Model on fluid management, symptom control, and quality of life

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## Abstract

This study aimed to determine the effect of fluid management, symptom control, and quality of life on education based on the Roy Adaptation Model. This randomized controlled study was conducted with the participation of 107 patients (53 intervention, 54 control). Data were collected using the "Patient Data Collection Form," "Fluid Control in Hemodialysis Patients Scale," "Dialysis Symptom Index," and "Nottingham Health Profile." The forms were filled out through face-to-face interviews with the patients in the intervention and control groups at the 0th (onset), 1st, and 3rd months. The patients in the intervention group were trained with an education booklet based on the Roy Adaptation Model. The results revealed that the education given according to the Roy Adaptation Model improved the compliance with fluid control, quality of life, and symptom control of hemodialysis patients. It is recommended that education based on the Roy Adaptation Model be systematically used by hemodialysis nurses. The results are limited to the population included in the study, and further research on hemodialysis populations is needed.

KEYWORDS
fluid management, hemodialysis, quality of life, Roy Adaptation Model, symptom control

## Key points

- Roy Adaptation Model-based education improves patients' fluid compliance.
- Roy Adaptation Model-based education improves patients' quality of life.
- Roy Adaptation Model-based education positively impacts patients' symptom control.

## 1 | INTRODUCTION

There is a global increase in the incidence and prevalence of chronic kidney disease (CKD) (Hill et al., 2016; Süleymanlar et al., 2011). In a meta-analysis study, the prevalence of stage 3–5 CKD was reported as 11.8% in Europe and 14.44% in the United States and Canada (Hill et al., 2016). In the CREDIT (Chronic Renal Disease in Türkiye) study conducted to determine the prevalence of CKD in Türkiye, the rate of CKD in adults was found to be 15.7% (Süleymanlar et al., 2011). In patients with CKD, end-stage renal disease (ESRD) develops over time, and these patients need renal replacement therapy (Süleymanlar et al., 2011, 2021). According to the Turkish Society of Nephrology data for 2020, the number of patients undergoing hemodialysis as renal replacement therapy in Türkiye is 60 558, constituting 72.66% of patients receiving renal replacement therapy (Süleymanlar et al., 2021). In addition to being a common public health problem with high mortality and morbidity rates in patients, CKD reduces the quality of life and increases the cost of health care (Hill et al., 2016; Işik & Erci, 2020).

The adherence of hemodialysis patients to treatment has an important role in improving their quality of life. Fluid-salt restriction is

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the practice in which hemodialysis patients have the most difficulty complying with treatment and experience stress (Beerappa & Chandrababu, 2019; Efe & Kocaöz, 2015; Fernandes et al., 2014). In studies conducted with hemodialysis patients, it was reported that 70%–95% of patients do not comply with fluid-salt restriction (Beerappa & Chandrababu, 2019; Efe & Kocaöz, 2015). An increase in interdialytic weight gain is observed in patients with insufficient fluid compliance. Excessive fluid withdrawal during the hemodialysis procedure causes interdialytic hypotension in patients, and patients experience symptoms such as cramps, nausea-vomiting, and dizziness (Dasgupta et al., 2019). In the literature, hemodialysis patients have limited compliance with fluid control (Beerappa & Chandrababu, 2019; Efe & Kocaöz, 2015), experience physical and psychosocial symptoms (Bossola et al., 2019; Cox et al., 2017; Davison & Jhangri, 2010; Siagian & Habeahan, 2019; Siriwardana et al., 2020), and a reduced quality of life (Mansouri et al., 2020; Thenmozhi, 2018).

Nursing management that is framed around a theoretical model for hemodialysis patient adaptation may assist patients to cope better with the stringent adherence needs for optimal dialysis and quality of life (Frazão et al., 2013). Hemodialysis affects individuals' physiological needs, moods, social relations, self-concept, roles, and working lives. The four adaptative modes defined in the Roy Adaptation Model are physiological, role function, self-concept, and interdependence modes (Roy, 2009; Vicdan & Karabacak, 2016). Roy determined basic physiological requirements such as oxygenation, fluid-electrolyte and acid-base balance, nutrition, elimination, activity, and rest in the physiological modes (Hanna & Roy, 2001; Roy, 2009). Physiological mode is compromised in patients receiving hemodialysis treatment. These patients experience many problems, such as dyspnea, fatigue, bone and joint pain, and insomnia associated with fluid overload, which negatively affects their physiological state. Training based on the Roy Adaptation Model can reduce or eliminate these symptoms (Nobahar et al., 2020; Vicdan & Karabacak, 2016). In this context, the Roy Adaptation Model guides the nursing care of patients undergoing hemodialysis (Frazão et al., 2013). With the nursing interventions to be applied for the Roy Adaptation Model, internal and external stimuli are changed or manipulated to contribute to improving and maintaining the patient's compliance (Afrasiabifar et al., 2013; Roy, 2009). In this model, it is important to ensure and maintain the fluid-electrolyte balance in the physiological mode and to control symptoms for the preservation of physiological integrity (Hanna & Roy, 2001; Roy, 2009; Vicdan & Karabacak, 2016). In a recent study, it was reported that education based on the Roy Adaptation Model increased physical, psychological, and social adaptation in hemodialysis patients (Vicdan & Karabacak, 2016). The Roy Adaptation Model, when applied to the education of hemodialysis patients, offer the potential for effective adaptation in the areas of physiological, role function, self-concept, and interdependence by using the cognitive-emotional coping methods of the patient against environmental stimuli (Vicdan & Karabacak, 2016).

In the literature, it has been emphasized that there is a need for regular training and practices that can change the dimension of knowledge, attitude, and behavior to increase patient-specific compliance and the level of awareness about fluid control. Although it is emphasized that symptom control programs should be developed (Efe & Kocaöz, 2015; Işik & Erci, 2020), it is seen that the physical and psychological outcomes of the education of hemodialysis patients are limited (Afrasiabifar et al., 2013; Vicdan & Karabacak, 2016). Although symptom control in hemodialysis treatment has an important place in disease management, there are very limited studies in the literature evaluating the education of patients for symptom control (Işik & Erci, 2020; Salwa, 2014). We believe that this study will fill this gap in the literature and will be a contribution to the literature. The Roy Adaptation Model was used in this study because it considers the patient with a holistic approach. The use of this model in the study constitutes its strength. This study was planned to evaluate the effect of education based on the Roy Adaptation Model on fluid management, symptom control, and quality of life in hemodialysis patients.

## 2 | MATERIALS AND METHODS

### 2.1 | Study design

The study was conducted as randomized controlled in the northwest of Türkiye with patients who were treated in the dialysis unit of a university hospital in Edirne in two public and two private dialysis centers in Kirklareli between December 9, 2019, and October 12, 2020. It was reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) guidelines. It was registered at ClinicalTrial.gov (number: NCT05187234).

### 2.2 | Participants and recruitment

A total of 264 patients were receiving regular hemodialysis treatment in the dialysis centers where the study was conducted. Bicarbonate dialysis was performed in all dialysis centers. All hemodialysis patients were treated with a polysulfone-type dialyzer. The same dialysate solution was used for each session.

Patients with end-stage chronic kidney disease, older than 18 years of age, receiving routine hemodialysis treatment for at least 3 months, having three hemodialysis sessions per week, being literate, and volunteering to participate in the study were included in the study. Patients with acute renal failure, previously diagnosed with liver failure and/or malignancy, patients with New York Heart Association class III-IV heart failure, and a history of kidney transplantation were not included in the study.

### 2.3 | Sample size

The G*Power (v3.1.7) program was used to determine the number of samples and power analysis was performed. The power of the study is expressed as 1-β ($\beta$ = probability of type II error). In the study of

Başer and Mollaoğlu (2019), the effect size (d) was found to be 0.765 in the calculation made to obtain 90% power at the level of $\alpha = 0.01$, based on the differences in the measurement of the fluid control scale in post-hemodialysis patients. Accordingly, it was calculated that there should be a total of at least 106 patients, with 53 patients in each group. Considering that losses may occur during the study, it was decided to include at least 60 patients in each group. In the study, the number of patients to be included from each dialysis center was determined by a proportional calculation based on the categories.

## 2.4 | Randomization and allocation

Patients who did not meet the study criteria were evaluated and determined by the researcher. In the patient lists obtained from the dialysis centers, each patient who met the criteria for inclusion in the study and volunteered to participate in the study was given a number by a nurse who was not involved in the study. A total of 144 patients out of 264 were excluded from the study because they did not meet the study criteria and/or did not volunteer to participate in the study (Figure 1). The remaining 120 patients were divided into intervention ($n = 60$) and control ($n = 60$) groups using the simple random numbers table created by the statistician.

Patients in the intervention group knew that they had received health education, and control group knew that they did not receive any intervention. Due to nature of the intervention, it is not possible to blind the participants. To prevent contamination of patients treated in the same center, the data of the control group were collected first. Then, the intervention group was trained, and their data were collected. Due to the design of the study, the researcher who provided training and collected the data was not blinded. The same researcher provided training to prevent training disparities.

## 2.5 | Data collection

The "Patient Data Collection Form," "Fluid Control in Hemodialysis Patients Scale," "Dialysis Symptom Index," and "Nottingham Health Profile" were used to collect data.

### 2.5.1 | Patient data collection form

It was created based on the Roy Adaptation Model by scanning the literature (Albayrak et al., 2016; Başer & Mollaoğlu, 2019; Vicdan & Karabacak, 2016). The form consisted of two parts. The sociodemographic characteristics of the patient (age, gender, educational status, etc.) and the characteristics of the patient regarding the disease and hemodialysis (primary diagnosis of the patient, duration of dialysis, etc.) were questioned in the first part of the form. The second part questioned the clinical parameters of the patient (interdialytic weight gain, pre- and post-dialysis blood pressure, ultrafiltration amount, edema, etc.). The pre- and post-dialysis weights of the patients were measured with a calibrated-fixed scale. Interdialytic weight gain was accepted as the difference between the predialysis weight for the current session and the previous post-dialysis weight. Blood pressure was measured manually by the dialysis nurse. The presence of peripheral edema was evaluated by the researcher. The amount of ultrafiltration was calculated by the dialysis physician by subtracting the dry weight from the patient's weight for each dialysis session. The patient's clinical parameters (interdialytic weight gain, pre- and post-dialysis blood pressure, and ultrafiltration) were obtained from the patient file.

### 2.5.2 | Fluid control in hemodialysis patients scale (FCHPS)

It is a scale developed to evaluate the knowledge, behavior, and attitudes of hemodialysis patients about fluid restriction. The scale consists of three subscales and a total of 24 items. In the evaluation of the scale, "agree" is scored as 3 points, "undecided" as 2 points, and "disagree" as 1 point. The lowest score that can be obtained from the scale is 24, and the highest score is 72. The higher the score, the higher the patients' compliance with fluid control. The validity and reliability study of the scale was made by Albayrak Cosar and Cinar Pakyuz in 2016. The Cronbach's alpha internal consistency coefficients were 0.92. The Cronbach's alpha values for the total FCHPS scale in this study were found to be 0.622, 0.737, and 0.712, respectively.

### 2.5.3 | Dialysis symptom index (DSI)

It is a scale developed by Weisbord et al. to assess the symptoms experienced by hemodialysis patients and the severity of these symptoms (Weisbord et al., 2004). The scale is a 5-point Likert type and includes 30 items. Patients were asked to describe the presence of each symptom as "yes" or "no" during the previous 7 days. If the answer is "yes," it evaluates the extent to which the symptom was bothersome for the patient. The evaluation is as follows: "1 = not at all," "2 = a little bit," "3 = somewhat," "4 = quite a bit," and "5 = very much." The lowest score to be taken from the scale is 0, and the highest score is 150. The higher the score obtained from the scale, the higher the severity of the symptom. The validity and reliability study of the scale in Turkish was made by Önsöz and Yesilbalkan in 2013. The Cronbach's alpha internal consistency coefficient of the study was found to be 0.84. The Cronbach's alpha values for the total DSI in this study were found to be 0.802, 0.827, and 0.828, respectively.

### 2.5.4 | Nottingham health profile (NHP)

It is a general quality of life scale that evaluates the health problems perceived by patients and the extent to which these problems affect

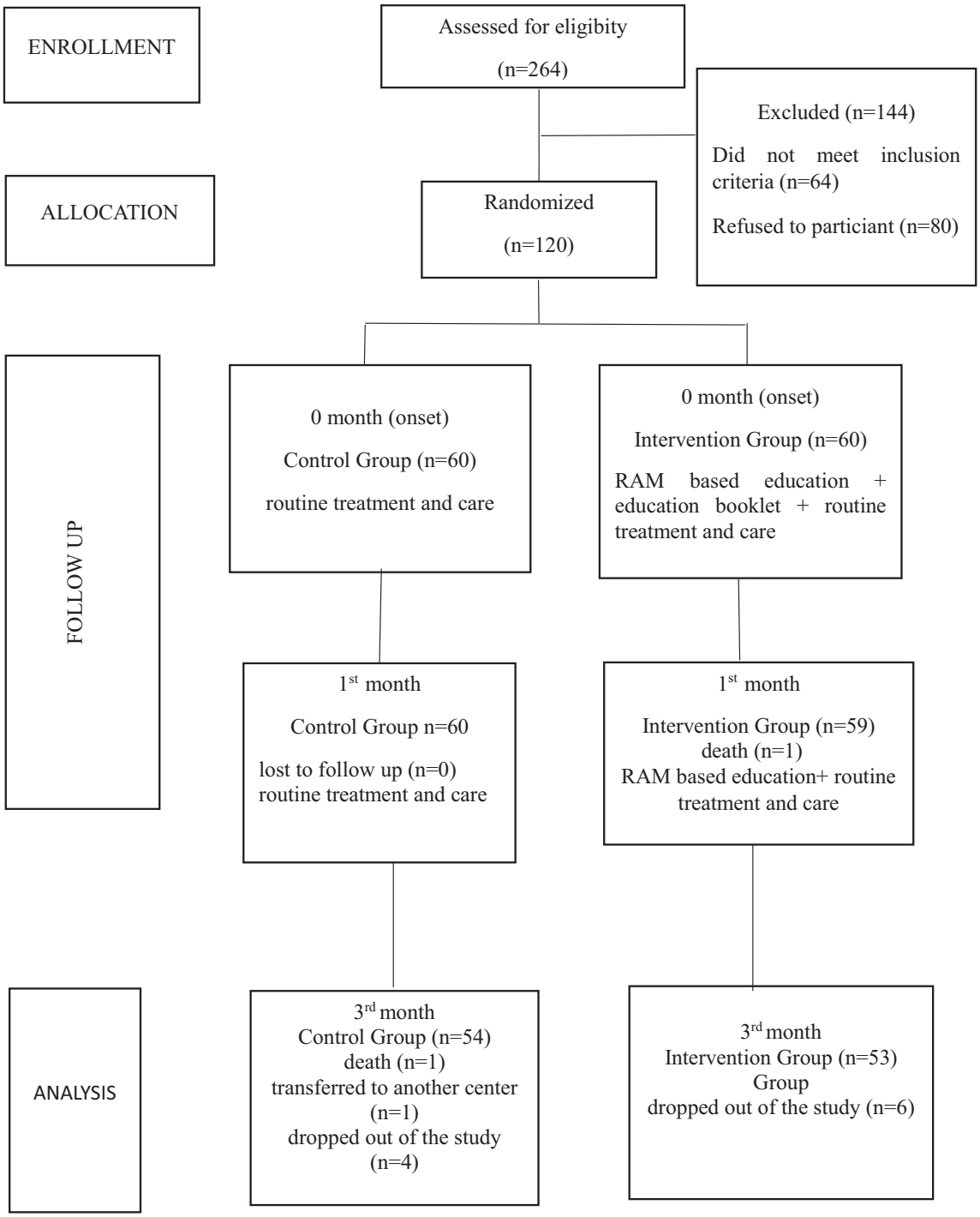


**FIGURE 1** CONSORT flow diagram of the study.

normal daily living activities. The Turkish validity and reliability study of the scale was performed by Kücükdeveci et al., 2000. The scale consists of six subscales and 38 items. The subscales are energy level, pain, emotional reactions, social isolation, sleep, and physical mobility. The lowest score that can be obtained from each subscale is 0, and the highest score is 100. A high score obtained from the scale indicates a poor health status. The Cronbach's alpha internal consistency coefficient of the scale was reported as 0.56 to 0.83. It is recommended to use this scale to evaluate the quality of life of hemodialysis patients (Kutlay et al., 2003). In this study, the KR-20 values related to the total NHP were found to be 0.839, 0.864, and 0.870, respectively.

## 2.6 | Intervention and control protocols

### 2.6.1 | Intervention group

Their routine treatment and usual care continued. Additionally, the intervention group received two episodes of education and a

handbook for personal reading. The training was given by a specialist nurse researcher with clinical experience and training in dialysis nursing.

The first training was given at the first encounter (0 months), and the second training was given 1 month after the first training. The contents of the two sessions of training were the same.

Training was provided for each hemodialysis patient in the intervention group during the first 2 h of the dialysis session.

The training was given face-to-face and individually at the bedside. The duration of each training was about 30–45 min.

The direct instruction method and question and answer were used as training methods. The training was supported by a booklet.

*Intervention process*

1. Meeting the patient, introducing oneself
2. Determining maladaptive behaviors related to the patient's four adaptation modes using data collection forms in the interview before starting the training and identifying internal and external stimuli that affect the patient's behavior (focal, contextual, and residual stimuli)
3. Providing training programs for the patient's adaptation modes (physiological, role function, self-concept, and interdependence)
4. Answering the patient's questions
5. Giving the education booklet to the patient (at the first meeting)
6. Making an appointment for the next meeting

The education booklet was based on the Roy Adaptation Model and developed by the researchers. The education booklet was evaluated with the DISCERN (Quality Criteria for Consumer Health Information) measurement tool. The content of the education booklet consisted of main topics covering the functions of the kidney, kidney failure, problems and suggestions related to the physiological mode that hemodialysis patients may encounter, problems and suggestions related to the self-concept mode that hemodialysis patients may encounter, problems and suggestions regarding role function mode that hemodialysis patients may encounter, and interdependence mode that hemodialysis patients may encounter.

The clinical parameters of the patients in the intervention group were recorded at the first encounter (0th month), at the 1st month, and at the 3rd month, and the scales were applied at each visit.

### 2.6.2 | Control group

No intervention was made for the patients in the control group. Their routine treatment and usual care continued. The clinical parameters of the patients were recorded at the first meeting (0th month), at the 1st

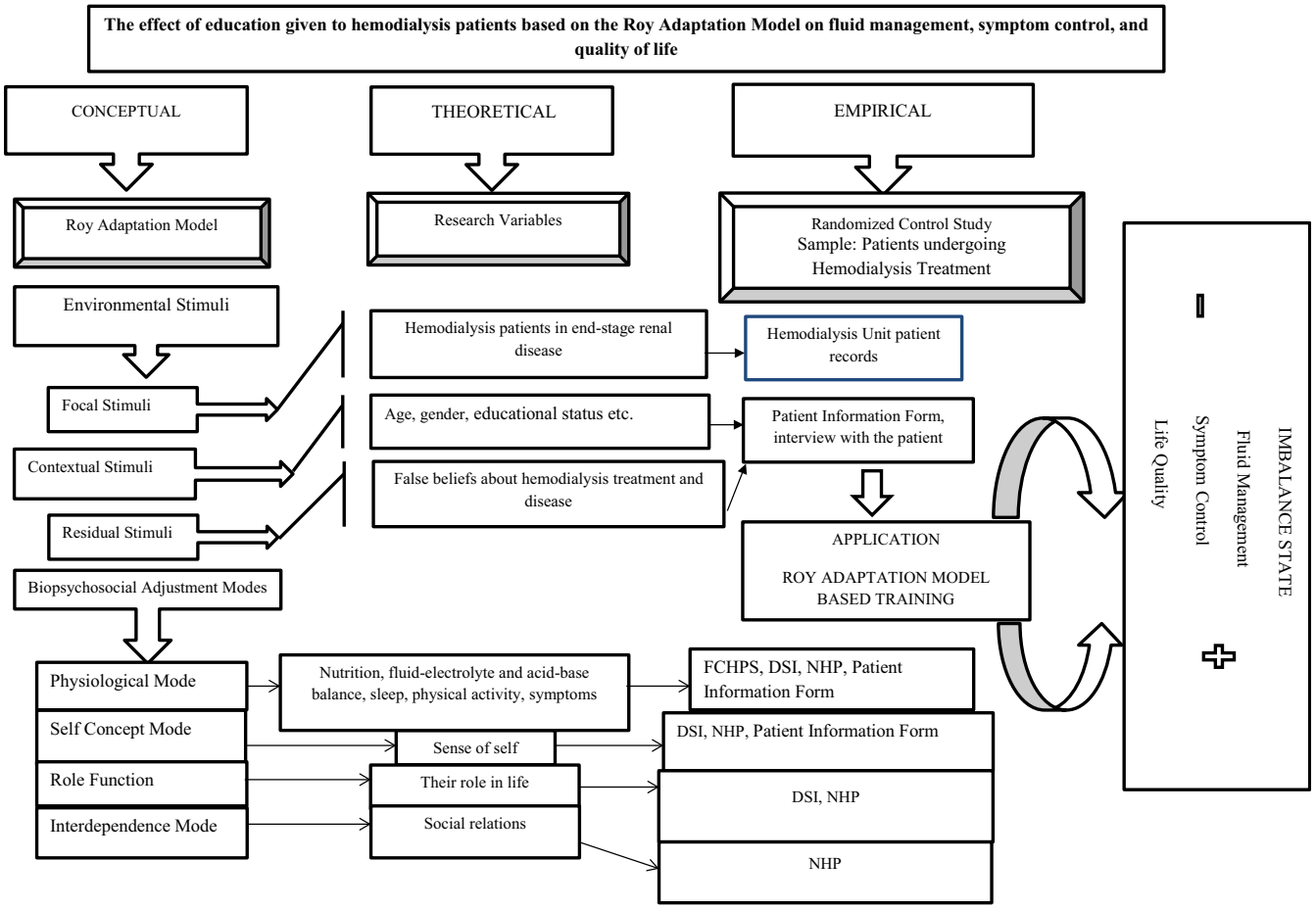


**FIGURE 2** The conceptual, theoretical, and experimental design of the study.

**TABLE 1** Comparison of sociodemographic and clinical characteristics according to groups.

| Variables | | Intervention group ($n = 53$) *n* (%) | Control group ($n = 54$) *n* (%) | *p* value |
|---|---|---|---|---|
| Age (year) | Min-Max. (Median) | 31–85 (64) | 30–83 (61.5) | [a] 0.866 |
| | Mean ± SD | 61.96 ± 11.42 | 62.39 ± 14.48 | |
| Duration of dialysis treatment (month) | Min-Max (Median) | 6–204 (48) | 8–204 (41) | [e] 0.920 |
| | Mean ± SD | 63.6 ± 50.79 | 64.57 ± 51.06 | |
| Gender | Female | 23 (43.4) | 21 (38.9) | [b] 0.636 |
| | Male | 30 (56.6) | 33 (61.1) | |
| Educational status (about dialysis) | Yes | 51 (96.2) | 53 (98.1) | [d] 0.618 |
| | No | 2 (3.8) | 1 (1.9) | |
| Educational degree | Primary school and below (<8 years) | 43 (81.1) | 44 (81.5) | [b] 0.556 |
| | Above primary school (>8 years and over) | 10 (18.9) | 10 (18.5) | |
| Primary CKD cause | Unknown | 8 (14.8) | 7 (13.2) | [c] 0.979 |
| | Diabetes | 18 (33.3) | 17 (32.1) | |
| | Hypertension | 21 (38.9) | 21 (39.6) | |
| | Glomerulonephritis | 1 (1.9) | 1 (1.9) | |
| | Pyelonephritis | 1 (1.9) | 1 (1.9) | |
| | The other (polycystic kidney disease, prostate etc.) | 5 (9.3) | 6 (11.4) | |
| Presence of comorbidity | Yes | 24 (45.3) | 18 (33.3) | [b] 0.206 |
| | No | 29 (54.7) | 36 (66.7) | |
| Hemodialysis access route | Fistula | 44 (83.0) | 44 (81.5) | [c] 1.000 |
| | Graft | 1 (1.9) | 1 (1.9) | |
| | Catheter | 8 (15.1) | 9 (16.7) | |

Abbreviations: CKD, chronic kidney disease; Mean ± SD, Mean ± Standard Deviation.
[a]Student's *t*-test.
[b]Pearson's Chi-Square Test.
[c]Fisher–Freeman–Halton Exact test.
[d]Fisher's Exact test.
[e]Mann–Whitney *U* test.

month, and at the 3rd month, and all scales were applied at each visit. The data were collected using self-reported.

When comparing the intervention and control groups, 0th month, 1st month, and 3rd month measurements were taken into consideration. An education booklet was given to the patients in the control group at the end of the study, considering ethical principles.

The conceptual, theoretical, and experimental design of the study is presented in Figure 2.

At baseline, data were collected by interviewing 60 patients from the intervention group and 60 patients from the control group who were trained at the first meeting (onset). In the first month, face-to-face interviews were conducted with 59 patients from the intervention group since one patient from the group died and 60 patients from the control group, and data were collected. In the third-month interview, six patients from the intervention group left the study, one patient from the control group died, one patient was transferred to a different center, and four patients from the control group left the study. Therefore, data were collected through face-to-face interviews with 53 patients from the intervention group and 54 patients from the control group.

## 2.7 | Data analysis

Statistical analysis of the study data was done with the NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program. Descriptive statistical methods (mean, ratio, minimum, maximum, median, standard deviation, frequency) were used in the evaluation of study data. The conformity of the quantitative data to the normal distribution was tested with the Shapiro–Wilk test, the Kolmogorov–Smirnov test, and graphical evaluations. The Student's *t*-test was used for two-group comparisons of normally distributed quantitative data, and the Mann–Whitney *U* test was used for two-group comparisons of quantitative data that did not show normal distribution. The Fisher–Freeman–Halton Exact Test, Pearson's Chi-Square Test, and Fisher's Exact Test were used to compare

**TABLE 2** Evaluation of fluid control scale mean scores (FCHPS) in hemodialysis patients according to groups.

| FCHPS | | | Intervention group ($n = 53$) | Control group ($n = 54$) | $p$ value |
|---|---|---|---|---|---|
| Knowledge subscale | Onset | Min-Max (Median) | 13–21 (18) | 12–21 (17) | [a] **0.036*** |
| | | Mean ± SD | 17.66 ± 2.06 | 16.80 ± 2.16 | |
| | 1st month | Min-Max (Median) | 9–21 (19) | 11–21 (17) | [a] **0.001**** |
| | | Mean ± SD | 19.25 ± 2.07 | 16.61 ± 2.29 | |
| | 3rd month | Min-Max (Median) | 14–21 (19) | 13–21 (17) | [a] **0.001**** |
| | | Mean ± SD | 19.21 ± 1.77 | 16.56 ± 2.30 | |
| | | [b] p | **0.001**** | 0.338 | |
| | Within-group difference;[c] p | Onset – 1st month | **0.001**** | 0.951 | |
| | | Onset – 3rd month | **0.001**** | 0.568 | |
| | | 1st month-3rd month | 1.000 | 1.000 | |
| Behavior subscale | Onset | Min-Max (Median) | 13–26 (19) | 13–33 (19) | [a] 0.358 |
| | | Mean ± SD | 19.23 ± 4.02 | 19.94 ± 4.02 | |
| | 1st month | Min-Max (Median) | 13–29 (23) | 11–26 (18.5) | [a] **0.001**** |
| | | Mean ± SD | 22.60 ± 4.08 | 18.69 ± 3.34 | |
| | 3rd month | Min-Max (Median) | 13–30 (22) | 11–30 (19) | [a] **0.001**** |
| | | Mean ± SD | 21.92 ± 4.12 | 19.09 ± 3.63 | |
| | | [b] p | **0.001**** | **0.040*** | |
| | Within-group difference;[c] p | Onset – 1st month | **0.001**** | **0.041*** | |
| | | Onset – 3rd month | **0.001**** | 0.463 | |
| | | 1st month-3rd month | **0.024*** | 0.928 | |
| Attitude subscale | Onset | Min-Max (Median) | 6–16 (9) | 6–14 (9) | [a] 0.333 |
| | | Mean ± SD | 9.26 ± 2.68 | 8.81 ± 2.06 | |
| | 1st month | Min-Max (Median) | 6–17 (10) | 6–14 (8) | [a] **0.001**** |
| | | Mean ± SD | 10.21 ± 2.71 | 8.63 ± 2.15 | |
| | 3rd month | Min-Max (Median) | 6–17 (10) | 6–15 (8) | [a] **0.001**** |
| | | Mean ± SD | 10.19 ± 2.87 | 8.52 ± 2.14 | |
| | | [b] p | **0.002**** | 0.325 | |
| | Within-group difference;[c] p | Onset – 1st month | **0.002**** | 1.000 | |
| | | Onset – 3rd month | **0.017*** | 0.427 | |
| | | 1st month-3rd month | 1.000 | 1.000 | |
| Total FCHPS | Onset | Min-Max (Median) | 34–58 (46) | 34–62 (45.5) | [a] 0.616 |
| | | Mean ± SD | 46.15 ± 6.27 | 45.56 ± 5.98 | |
| | 1st month | Min-Max (Median) | 38–66 (52) | 30–54 (44) | [a] **0.001**** |
| | | Mean ± SD | 52.06 ± 6.51 | 43.93 ± 5.18 | |
| | 3rd month | Min-Max (Median) | 35–63 (52) | 32–55 (44) | [a] **0.001**** |
| | | Mean ± SD | 51.32 ± 6.67 | 44.17 ± 5.10 | |
| | | [b] p | **0.001**** | **0.017*** | |
| | Within-group difference;[c] p | Onset – 1st month | **0.001**** | **0045*** | |
| | | Onset – 3rd month | **0.001**** | 0.095 | |
| | | 1st month-3rd month | 0.246 | 1.000 | |

*Note*: Bold indicates best values.

Abbreviations: FCHPS, fluid control in hemodialysis patients scale; Mean ± SD, Mean ± Standard Deviation.

[a]Student's *t* test.

[b]Repeated Measures test.

[c]Bonferroni test.

**$p < 0.01$; *$p < 0.05$.

**TABLE 3** Evaluation of Dialysis Symptom Index (DSI) scale mean scores according to groups.

| | | | Intervention group ($n = 53$) | Control group ($n = 54$) | $p$ value |
|---|---|---|---|---|---|
| Total DSI | Onset | Min-Max (Median) | 0–45 (15) | 2–54 (17) | [a] 0.589 |
| | | Mean ± SD | 16.60 ± 9.51 | 18.19 ± 11.13 | |
| | 1st month | Min-Max (Median) | 0–27 (7) | 3–49 (17.5) | [a] **0.001**** |
| | | Mean ± SD | 8.06 ± 4.89 | 18.04 ± 9.71 | |
| | 3rd month | Min-Max (Median) | 0–26 (7) | 2–43 (19) | [a] **0.001**** |
| | | Mean ± SD | 7.34 ± 4.38 | 18.87 ± 9.50 | |
| | | [b]$p$ | **0.001**** | 0.265 | |
| | Within-group difference;[c] p | Onset-1st month | **0.001**** | 0.805 | |
| | | Onset-3rd month | **0.001**** | 0.408 | |
| | | 1st month-3rd month | 0.731 | 1.000 | |

*Note*: Bold indicates best values.
Abbreviations: DSI, dialysis symptom index; Mean ± SD: Mean ± Standard Deviation.
[a]Mann–Whitney *U* test.
[b]Friedman test.
[c]Bonferroni Dunn test.
**$p < 0.01$.

qualitative data. Analysis of Variance for Repeated Measures was used to evaluate the follow-up of normally distributed variables, and pairwise comparisons were evaluated using the Bonferroni test. The Friedman Test was used to evaluate the follow-up of variables that did not show a normal distribution, and the Bonferroni Dunn Test and Wilcoxon Signed-Rank Test were used to evaluate pairwise comparisons. Significance was evaluated as at least $p < 0.05$.

### 2.8 | Ethical considerations

Ethics committee approval was obtained from the Trakya University Ethics Committee for Scientific Research (TÜTF-BAEK 2019/336) for this study. In addition, institutional permission was obtained from the dialysis centers where the study was conducted. The patients participating in the study were informed about the study and their written and verbal consent were obtained. This study was completed in accordance with the Declaration of Helsinki.

## 3 | RESULTS

### 3.1 | Sample description

The patients in the intervention and control groups were homogeneous in terms of sociodemographic and clinical characteristics ($p > 0.05$) (Table 1).

### 3.2 | Effects of the training

The Fluid Control in Hemodialysis Patients Scale knowledge subscale (0th month, 1st month, and 3rd month) ($p < 0.05$; $p < 0.01$; $p < 0.01$, respectively), behavior subscale (1st month, 3rd month) ($p < 0.01$), attitude subscale (1st month, 3rd month) ($p < 0.01$), and mean total scale score (1st month, 3rd month) ($p < 0.01$) of the intervention group trained were significantly increased compared to the control group (Table 2). It was found that the patients' fluid control increased after the training.

It was found that the Dialysis Symptom Index total mean score of the intervention group who were trained (1st month, 3rd month) ($p < 0.01$) was found to be statistically significantly decreased compared to the control group. (Table 3). The symptom severity of the patients decreased after the training.

The total mean score of the Nottingham Health Profile scale (1st month, 3rd month) ($p < 0.01$) and the energy (1st month) ($p < 0.05$), pain (1st month, 3rd month) ($p < 0.05$; $p < 0.01$, respectively), emotional reactions ($p < 0.05$), sleep (3rd month) ($p < 0.01$), social isolation (1st month) ($p < 0.01$), and physical mobility (3rd month) ($p < 0.05$) of the trained intervention group were significantly decreased compared to the control group (Table 4). It was determined that the quality of life of the patients improved after the training.

It was found that interdialytic weight gain (1st month) ($p < 0.01$), ultrafiltration (UF) amount (1st month) ($p < 0.05$), edema (1st month, 3rd month) ($p < 0.01$), and pre-dialysis diastolic blood pressure (3rd month) ($p < 0.05$) of the trained intervention group were significantly decreased compared to the control group (Table 5).

## 4 | DISCUSSION

One of the most common problems encountered in patients undergoing hemodialysis is compliance with fluid-salt restriction (Beerappa & Chandrababu, 2019; Fernandes et al., 2014). Fluid restriction is an important lifestyle change for patients undergoing hemodialysis (Parker, 2019). Hemodialysis patients experience many symptoms that

**TABLE 4** Comparison of Nottingham Health Profile (NHP) scale mean scores by groups.

| NHP | | | Intervention group ($n = 53$) | Control group ($n = 54$) | $p$ value |
|---|---|---|---|---|---|
| Energy subscale | Onset | Min-Max (Median) | 0–100 (60.8) | 0–100 (42.4) | [a] 0.900 |
| | | Mean ± SD | 44.39 ± 30.24 | 46.59 ± 37.31 | |
| | 1st month | Min-Max (Median) | 0–100 (24) | 0–100 (60.8) | [a] **0.008**** |
| | | Mean ± SD | 31.08 ± 29.90 | 48.95 ± 34.99 | |
| | 3rd month | Min-Max (Median) | 0–100 (24) | 0–100 (60.8) | [a] 0.067 |
| | | Mean ± SD | 33.74 ± 32.93 | 46.70 ± 36.11 | |
| | | [b] p | **0.001**** | 0.910 | |
| | Within-group difference;[c] p | Onset-1st month | **0.012*** | 1.000 | |
| | | Onset-3rd month | **0.022*** | 1.000 | |
| | | 1st month-3rd month | 0.808 | 1.000 | |
| Pain subscale | Onset | Min-Max (Median) | 0–100 (0) | 0–90 (5.8) | [a] 0.132 |
| | | Mean ± SD | 13.74 ± 25.84 | 12.41 ± 16.99 | |
| | 1st month | Min-Max (Median) | 0–59.4 (0) | 0–100 (5.8) | [a] **0.031*** |
| | | Mean ± SD | 7.46 ± 14.47 | 15.95 ± 24.79 | |
| | 3rd month | Min-Max (Median) | 0–59.4 (0) | 0–100 (9.7) | [a] **0.002**** |
| | | Mean ± SD | 7.24 ± 14.14 | 17.08 ± 23.67 | |
| | | [b] p | **0.028*** | **0.040*** | |
| | Within-group difference;[c] p | Onset-1st month | **0.010*** | 0.136 | |
| | | Onset-3rd month | **0.004**** | **0.043*** | |
| | | 1st month-3rd month | 0.919 | 0.406 | |
| Emotional reactions subscale | Onset | Min-Max (Median) | 0–29 (7.2) | 0–76.7 (0) | [a] 0.336 |
| | | Mean ± SD | 9.60 ± 8.87 | 10.36 ± 16.40 | |
| | 1st month | Min-Max (Median) | 0–28.9 (7.1) | 0–76.7 (7.2) | [a] **0.040*** |
| | | Mean ± SD | 6.66 ± 7.86 | 12.82 ± 16.51 | |
| | 3rd month | Min-Max (Median) | 0–36.1 (7.1) | 0–80.2 (7.2) | [a] 0.102 |
| | | Mean ± SD | 7.46 ± 8.82 | 13.77 ± 17.80 | |
| | | [b] p | **0.001**** | **0.021*** | |
| | Within-group difference;[c] p | Onset-1st month | **0.041*** | 0.149 | |
| | | Onset-3rd month | 0.058 | **0.045*** | |
| | | 1st month-3rd month | 0.884 | 0.665 | |
| Sleep subscale | Onset | Min-Max (Median) | 0–100 (28.7) | 0–100 (22.4) | [a] 0.481 |
| | | Mean ± SD | 36.44 ± 34.98 | 30.79 ± 31.07 | |
| | 1st month | Min-Max (Median) | 0–100 (12.6) | 0–100 (12.6) | [a] 0.053 |
| | | Mean ± SD | 20.34 ± 23.64 | 31.43 ± 30.33 | |
| | 3rd month | Min-Max (Median) | 0–87.4 (12.6) | 0–100 (28.7) | [a] **0.001**** |
| | | Mean ± SD | 18.69 ± 20.53 | 38.37 ± 30.53 | |
| | | [b] p | **0.001**** | **0.002**** | |
| | Within-group difference;[c] p | Onset-1st month | **0.001**** | 1.000 | |
| | | Onset-3rd month | **0.001**** | **0.037*** | |
| | | 1st month-3rd month | 1.000 | 0.071 | |
| Social isolation sub-dimension | Onset | Min-Max (Median) | 0–44.5 (0) | 0–57.3 (0) | [a] 0.557 |
| | | Mean ± SD | 3.83 ± 9.50 | 5.20 ± 11.55 | |
| | 1st month | Min-Max (Median) | 0–58.1 (0) | 0–78 (0) | [a] **0.029*** |
| | | Mean ± SD | 2.06 ± 8.81 | 6.05 ± 13.85 | |
| | 3rd month | Min-Max (Median) | 0–100 (0) | 0–57.3 (0) | [a] 0.124 |
| | | Mean ± SD | 3.89 ± 16.02 | 5.03 ± 11.62 | |
| | | [b] p | 0.140 | 0.867 | |

(Continues)

**TABLE 4** (Continued)

| NHP | | | Intervention group ($n = 53$) | Control group ($n = 54$) | *p* value |
|---|---|---|---|---|---|
| | Within-group difference;[c] p | Onset-1st month | 1.000 | 1.000 | |
| | | Onset-3rd month | 1.000 | 1.000 | |
| | | 1st month-3rd month | 1.000 | 1.000 | |
| Physical mobility sub-dimension | Onset | Min-Max (Median) | 0–66.1 (22) | 0–100 (22) | [a] 0.236 |
| | | Mean ± SD | 22.18 ± 19.16 | 27.99 ± 23.59 | |
| | 1st month | Min-Max (Median) | 0–66.1 (20.1) | 0–100 (22) | [a] 0.125 |
| | | Mean ± SD | 20.01 ± 18.72 | 26.68 ± 22.81 | |
| | 3rd month | Min-Max (Median) | 0–66.1 (21.4) | 0–100 (31.3) | [a] **0.046*** |
| | | Mean ± SD | 20.08 ± 18.56 | 29.59 ± 23.44 | |
| | | [b] p | **0.001**** | 0.531 | |
| | Within-group difference;[c] p | Onset-1st month | **0.046*** | 1.000 | |
| | | Onset-3rd month | 0.072 | 1.000 | |
| | | 1st month-3rd month | 0.846 | 1.000 | |
| Total NHP | Onset | Min-Max (Median) | 0–300.1 (119.5) | 0–401.2 (147.4) | [a] 0.983 |
| | | Mean ± SD | 130.19 ± 72.15 | 133.34 ± 90.37 | |
| | 1st month | Min-Max (Median) | 0–258.6 (79.8) | 7.1–421.9 (129.9) | [a] **0.001**** |
| | | Mean ± SD | 87.61 ± 60.81 | 141.87 ± 94.77 | |
| | 3rd month | Min-Max (Median) | 0–333.8 (75.3) | 0–440.5 (144.4) | [a] **0.001**** |
| | | Mean ± SD | 91.10 ± 68.41 | 150.53 ± 93.20 | |
| | | [b] p | **0.001**** | 0.069 | |
| | Within-group difference;[c] p | Onset-1st month | **0.001**** | 0.687 | |
| | | Onset-3rd month | **0.001**** | 0.071 | |
| | | 1st month-3rd month | 1.000 | 0.870 | |

*Note*: Bold indicates best values.
Abbreviations: Mean ± SD, Mean ± Standard Deviation; NHP, Nottingham Health Profile.
[a]Mann–Whitney *U* test.
[b]Friedman test.
[c]Bonferroni Dunn test.
*$p < 0.05$; **$p < 0.01$.

negatively affect their quality of life (Bossola et al., 2019; Cox et al., 2017; Davison & Jhangri, 2010; Siriwardana et al., 2020). In this section, we discussed the effects of training based on the Roy Adaptation Model on fluid management, symptom relief, and quality of life in hemodialysis patients.

In this study, the fluid control compliance of the intervention group that has been trained was found to be higher than that of the control group. Similarly, in a recent quasi-experimental study, it was reported that the Roy Adaptation Model was effective in pre-dialysis CKD, especially affecting the fluid intake behavior of patients positively and improving fluid compliance (Agustiyowati et al., 2018). In experimental studies, it was determined that education based on the Roy Adaptation Model positively affects the physiological adaptation of hemodialysis patients (Afrasiabifar et al., 2013; Vicdan & Karabacak, 2016). Educating hemodialysis patients about fluid-salt restriction supports patients' self-control of fluid compliance (Parker, 2019). In the study of Başer and Mollaoğlu (2019), it was reported that the FCHPS knowledge, behavior, and attitude subscale scores of the trained group were higher than the control group and that education increased fluid control compliance in hemodialysis patients. Changes in knowledge and attitude toward the restriction of fluid intake support the fluid management of patients by creating behavioral changes in fluid intake (Jia et al., 2016). Maintaining fluid and electrolyte balance is in the physiological mode of the Roy Adaptation Model. In this study, education based on the Roy Adaptation Model in fluid control training for hemodialysis patients increased fluid control compliance.

In the literature, compliance with fluid control in hemodialysis patients is evaluated with clinical parameters such as blood pressure, presence of edema, interdialytic weight gain, etc. (Sarkar et al., 2006; Yılmaz et al., 2014). In this study, interdialytic weight measurements, UF measurements, edema incidence, and pre-dialysis diastolic blood pressure measurements of patients in the trained intervention group were lower than the control group. In a recent study conducted with hemodialysis patients, it was reported that while the interdialytic weight gain and ultrafiltration values of the patients decreased after the training, there was no change in the dry weight of the patients (Başer & Mollaoğlu, 2019). Tsay (2003) reported that the interdialytic

**TABLE 5** The mean scores of of some clinical parameters according to groups.

| | | | Intervention group ($n = 53$) | Control group ($n = 54$) | $p$ value |
|---|---|---|---|---|---|
| Interdialytic weight gain (kg) | Onset | Min-Max (Median) | 2.5–5.5 (3) | 2.5–6.5 (2.8) | [a] 0.911 |
| | | Mean ± SD | 3.25 ± 0.73 | 3.23 ± 0.89 | |
| | 1st month | Min-Max (Median) | 1.5–5.8 (2.7) | 1.7–6.5 (3.1) | [a] **0.007**** |
| | | Mean ± SD | 2.83 ± 0.71 | 3.27 ± 0.92 | |
| | 3rd month | Min-Max (Median) | 1.8–5.9 (3) | 1.5–6.3 (3.2) | [a] 0.231 |
| | | Mean ± SD | 3.11 ± 0.93 | 3.32 ± 0.87 | |
| | | [e] p | **0.001**** | 0.616 | |
| | Within-group difference;[c] p | Onset-1st month | **0.001**** | 1.000 | |
| | | Onset-3rd month | 0.445 | 0.967 | |
| | | 1st month-3rd month | 0.063 | 1.000 | |
| Ultrafiltration volume (L) | Onset | Min-Max (Median) | 2–5.2 (3) | 2–5.2 (2.8) | [a] 0.462 |
| | | Mean ± SD | 3.19 ± 0.69 | 3.09 ± 0.71 | |
| | 1st month | Min-Max (Median) | 1.8–4.8 (2.8) | 1.7–5 (3.2) | [a] **0.017*** |
| | | Mean ± SD | 2.81 ± 0.61 | 3.14 ± 0.76 | |
| | 3rd month | Min-Max (Median) | 1.7–5 (3) | 1.5–4.8 (3.1) | [a] 0.234 |
| | | Mean ± SD | 3.02 ± 0.79 | 3.20 ± 0.70 | |
| | | [e] p | **0.001**** | 0.295 | |
| | Within-group difference;[c] p | Onset-1st month | **0.001**** | 1.000 | |
| | | Onset- 3rd month | 0.053 | 0.393 | |
| | | 1st month-3rd month | **0.045*** | 0.972 | |
| Presence of edema before dialysis | Onset | Yes | 12 (22.6) | 18 (33.3) | [b] 0.218 |
| | | No | 41 (77.4) | 36 (66.7) | |
| | 1st month | Yes | 7 (13.2) | 20 (37.0) | [d] **0.005**** |
| | | No | 46 (86.8) | 34 (63.0) | |
| | 3rd month | Yes | 5 (9.4) | 19 (35.2) | [d] **0.001**** |
| | | No | 48 (90.6) | 35 (64.8) | |
| | | [e] p | **0.020*** | 0.873 | |
| | Within-group difference;[f] p | Onset-1st month | **0.025*** | 0.564 | |
| | | Onset- 3rd month | **0.020*** | 0.782 | |
| | | 1st month-3rd month | 0.414 | 0.819 | |
| Diastolic blood pressure before dialysis (mmHg) | Onset | Min-Max (Median) | 50–100 (75) | 50–100 (75) | [a] 0.510 |
| | | Mean ± SD | 75.06 ± 10.48 | 73.70 ± 10.69 | |
| | 1st month | Min-Max (Median) | 50–100 (75) | 50–95 (77.5) | [a] 0.760 |
| | | Mean ± SD | 74.06 ± 9.46 | 74.63 ± 9.85 | |
| | 3rd month | Min-Max (Median) | 50–100 (70) | 60–100 (80) | [a] **0.013*** |
| | | Mean ± SD | 73.21 ± 9.15 | 77.87 ± 9.89 | |
| | | [e] p | 0.309 | **0.001**** | |
| | Within-group difference;[c] p | Onset-1st month | 1.000 | 1.000 | |
| | | Onset-3rd month | 0.413 | **0.002**** | |
| | | 1st month-3rd month | 1.000 | **0.007**** | |

*Note*: Bold indicates best values.
Abbreviation: Mean ± SD, Mean ± Standard Deviation.
[a]Student's t test.
[b]Repeated measures test.
[c]Bonferroni test.
[d]Pearson's Chi-Square Test.
[e]Friedman test.
[f]Wilcoxon Signed-Rank test.
*$p < 0.05$; **$p < 0.01$.

weight gain of the intervention group patients gradually decreased compared to the control group in their single-blind randomized controlled study. In a randomized controlled study based on the Roy Adaptation Model, it was reported that systolic blood pressure decreased in the second interview after the training, but there was no significant difference between the intervention and control groups in terms of body weight (Afrasiabifar et al., 2013). In the literature, it was reported that there was a statistically significant decrease in interdialytic weight gain (Baraz et al., 2010; Nadri et al., 2020; Oller et al., 2018; Sharaf, 2016) and diastolic blood pressure after starting the training program (Sharaf, 2016). Nursing education, along with follow-up with patients undergoing hemodialysis, increases patients' knowledge (Parvan et al., 2016). In this study, patients' compliance with fluid control was evaluated by FCHPS and the change in interdialytic weight gain, edema, and blood pressure. Since education based on the Roy Adaptation Model increases compliance with fluid management, there is a significant decrease in the interdialytic weight gain, edema, and blood pressure of the patients after the training.

In this study, it was found that hemodialysis patients in the intervention group who were trained had a lower severity of symptoms and better symptom control than the control group. Fazel Asgarpoor et al. (2011) showed that the implementation of a care plan based on the Roy Adaptation Model is a low-cost, effective nursing practice to reduce fatigue in hemodialysis patients. In a recent randomized controlled study in hemodialysis patients, in the 1st-month evaluation following the training given to the patients by creating a care plan based on the Roy Adaptation Model, it was reported that while there was no change in the somatic symptoms of the patients, symptoms such as social isolation, depression, anxiety, and insomnia decreased (Nobahar et al., 2020). In a recent meta-analysis of CKD patients, it was reported that education reduces emotional symptoms such as depression and improves the quality of life (Lee et al., 2016). Similarly, in a randomized controlled study with hemodialysis patients, it was found that education by nurses reduced the symptom of fatigue (Salwa, 2014). It is thought that hemodialysis patients receiving training based on the Roy Adaptation Model reduce the severity of symptoms.

In the literature, it is reported that the quality of life of hemodialysis patients is low (Bossola et al., 2019; Mansouri et al., 2020; Thenmozhi, 2018), but the education given under the leadership of nurses increases their quality of life (Alikari et al., 2019; Atik et al., 2020; Mansouri et al., 2020). In this current study, it was found that the quality of life of the intervention group was better than that of the control group. In experimental studies conducted with hemodialysis patients, it was determined that the education program had a positive effect on quality of life (Bakarman et al., 2019; Ebrahimi et al., 2016). In a quasi-experimental study, it was reported that a group of hemodialysis patients who received patient education focusing on dialysis compliance, diet, and medications showed a 2% improvement in their quality of life in 6 months (Thomas et al., 2009). In a randomized controlled study using a different model, it was reported that the care given using the model reduced the symptoms and improved the quality of life of patients receiving hemodialysis treatment (Işik & Erci, 2020). In a randomized controlled study with hemodialysis patients, Nobahar et al. reported that the general health of the training group was positively affected compared to the control group in the 1st-month evaluation (Nobahar et al., 2020). It has been observed that there is limited study on the effect of education based on the Roy Adaptation Model on the quality of life. It is thought that education based on the Roy Adaptation Model improves the quality of life of hemodialysis patients.

### 4.1 | Limitations and strengths of the study

The strengths of the study are that it is multicenter, uses models in patient education, and is a randomized controlled study. The study had some limitations. One of these is that the results are based on self-reported data and are subjective. Another limitation is that it is impossible to blind the researcher, participants, or trainer due to the design of the intervention, which is a randomized controlled study. Another limitation is the data loss, which includes seven patients from the intervention group (one deceased, six dropped out of the study) and six patients from the control group (one deceased, one transferred to another center, four dropped out of the study). In addition, the fact that the training was given in two sessions with a 1-month interval and the training effectiveness was evaluated after 1 and 3 months is also a limitation. The results are limited to the population included in the study, and further research on hemodialysis populations is needed.

## 5 | CONCLUSIONS

In this study, we determined that the education based on the Roy Adaptation Model improved compliance with fluid control, symptom control, and quality of life in hemodialysis patients. According to the findings, the use of the Roy Adaptation Model in patient education can serve as an example for the design and implementation of training programs for nurses in order to improve symptom management, fluid control, and quality of life in patients receiving hemodialysis treatment. Hemodialysis nurses and patients should be made aware of fluid and symptom control. We recommend that hemodialysis nurses evaluate the patients' fluid control compliance and symptoms at periodic intervals with valid and reliable scales. We also suggest conducting blinded studies with longer follow-up periods to evaluate the effectiveness of training in hemodialysis patients.

## 6 | RELEVANCE FOR CLINICAL PRACTICE

The main concept of the Roy Adaptation Model is adaptation. This study emphasizes the importance of the Roy Adaptation Model, one of the nursing models, for hemodialysis nurses. It is thought that the Roy Adaptation Model can be used as a standard practice to increase fluid management, provide symptom control, and improve the quality of life of hemodialysis patients. It is recommended that education based on the Roy Adaptation Model be systematically used by hemodialysis nurses.

## AUTHOR CONTRIBUTIONS

**Ozlem Ozdemir:** Conceptualization; data curation; formal analysis; visualization; writing – original draft; methodology; investigation; supervision; project administration; writing – review and editing; software; funding acquisition; validation; resources. **Serap Unsar:** Resources; funding acquisition; validation; methodology; investigation; supervision; project administration; writing – review and editing; writing – original draft; visualization; formal analysis; data curation; conceptualization; software.

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## CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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