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## Original Article

# Effect of the Continuous Care Model on Self-Management and Its Dimensions in Patients Undergoing Hemodialysis: A Quasi-Experimental Study

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## Abstract

**Background:** Patients undergoing hemodialysis require lifelong adherence to self-management behaviors to prevent complications and improve quality of life. However, sustaining these behaviors presents substantial physical and psychosocial challenges.
**Objectives:** This study aimed to evaluate the effectiveness of the Continuous Care Model (CCM) on self-management competencies and their dimensions in patients undergoing hemodialysis.
**Methods:** This quasi-experimental pretest-posttest control group study was conducted at two hemodialysis centers affiliated with Khoy University of Medical Sciences (Madani and Matin) from September 2025 to June 2026. Seventy-four eligible patients were recruited through convenience sampling and allocated to intervention and control groups (n = 37 each) using non-random block allocation. The intervention group received the four-stage CCM (orientation, sensitization, control, and evaluation) over eight weeks, while the control group received routine care. Self-management was assessed using the Hemodialysis Self-Management Instrument (HD-SMI) before and after the intervention. Data were analyzed using paired and independent t-tests and analysis of covariance (ANCOVA) in SPSS version 26.
**Results:** Although the crude post-test difference was not significant, ANCOVA adjusted for baseline scores showed significantly higher total self-management scores in the intervention group (27.32 vs. 20.11; adjusted mean difference = 7.21, 95% CI [4.24, 10.19], $p < 0.001$, $\eta^2 = 0.247$). Significant improvements were also observed in partnership, self-care, and emotional management, but not problem-solving.
**Conclusion:** CCM was associated with higher adjusted scores for overall self-management, partnership, self-care, and emotional management at eight weeks, but not problem-solving. These findings warrant cautious interpretation, and further research is needed to assess the durability of these associations.

### Implications for Nursing and Midwifery Preventive Care

- The Continuous Care Model was associated with higher self-management scores in hemodialysis patients.
- Nurses may consider structured continuous care protocols to support self-management in dialysis centers.

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## Introduction

Chronic kidney disease (CKD), which progressively leads to end-stage renal disease (ESRD), represents one of the major public health challenges globally [1]. In Iran, the prevalence of chronic kidney disease is higher than the global average [2], and according to national registry data, more than 30,000 patients in Iran are undergoing hemodialysis, with the total number of end-stage renal disease (ESRD) and renal replacement therapy patients exceeding 58,000 [3]. Although lifesaving, hemodialysis requires strict adherence to a multifaceted and demanding regimen, including regular attendance at dialysis sessions, fluid and sodium restrictions, dietary modifications, accurate medication administration, vascular access care, and timely identification of warning signs and complications [4-6]. The relentless nature of these requirements often leads to treatment fatigue, physical and psychological exhaustion, and sustained dependence on dialysis equipment and healthcare providers, confronting patients with substantial barriers to achieving effective self-management and therapeutic adherence [7].

Self-management in hemodialysis patients refers to a structured set of goal-directed behaviors that patients engage in to manage their illness, prevent complications, and maintain their physical functioning and quality of life [8]. This concept extends beyond passive compliance with therapeutic regimens, encompassing dynamic processes such as problem-solving, emotional regulation, self-care practices, active participation in clinical decision-making, and effective communication with healthcare professionals [9]. Optimal self-management can contribute to better control of interdialytic weight gain (IDWG) and fluid control, improved dietary and pharmacological adherence, appropriate vascular access (fistula or catheter) maintenance, and earlier seeking of medical care upon the onset of adverse symptoms. Conversely, inadequate self-management is closely linked to poor fluid and dietary compliance, metabolic disturbances, frequent hospital readmissions, and diminished health-related quality of life [10].

Despite the established clinical significance of these self-management behaviors, substantial empirical evidence indicates that many hemodialysis patients experience persistent difficulties in managing fluid intake, dietary restrictions, complex medication regimens, disease-related symptoms, and vascular access integrity. Routine educational programs delivered in dialysis centers are often brief, unidirectional, and primarily focused on simple information transfer, failing to induce sustained behavioral modification or integrate effectively into patients' daily routines [11]. Therefore, self-management support must transcend intermittent, episodic education and shift toward continuous, individualized, and patient-centered approaches grounded in patients' actual healthcare needs. This imperative aligns closely with the Kidney Disease: Improving Global Outcomes (KDIGO) clinical practice guidelines, which strongly advocate for person-centered care, shared decision-making, health-literacy-tailored education, and active patient engagement in the management of chronic conditions [10]. Interventional studies have consistently demonstrated that structured self-management programs can enhance self-efficacy, improve treatment adherence, optimize interdialytic weight gain, normalize key biochemical markers, and elevate overall quality of life in hemodialysis patients [12, 13]. A meta-analysis of randomized controlled trials reported that self-management interventions significantly lowered interdialytic weight gain while enhancing self-efficacy and quality of life across patients with CKD [12]. Similarly, findings from the Hemodialysis Self-Management Randomized Trial (HED-SMART) confirmed that a low-intensity, interactive self-management program substantially enhanced fluid and dietary compliance and improved several clinical parameters in this population [13]. Nonetheless, the ultimate success of such interventions depends heavily on structured implementation, sustained follow-up, educational alignment with patient-specific needs, and active, continuous patient participation. In Iran, the Continuous Care Model (CCM) was developed as an indigenous nursing framework predicated on a continuous and interactive therapeutic relationship

between the patient and healthcare providers [14]. The model comprises four sequential stages: orientation, sensitization, control, and evaluation. By establishing therapeutic rapport, conducting individualized needs assessments, delivering tailored education, maintaining systematic follow-up, and periodically evaluating clinical outcomes, the CCM provides an optimal platform for empowering patients and sustaining long-term self-care behaviors across various chronic conditions [15-17]. Prior research specifically in hemodialysis settings has reported favorable effects of this model on sleep quality, blood pressure regulation, health-related quality of life, and treatment-related outcomes [16, 17]. However, most existing studies have focused predominantly on general outcomes such as sleep quality, caregiver burden, or broad quality-of-life indices, leaving a clear gap regarding the direct impact of the Continuous Care Model on multidimensional self-management, particularly when assessed using disease-specific, validated instruments for hemodialysis patients.

Given the intricate nature of self-care among hemodialysis patients, the documented inadequacies of conventional didactic approaches, and the scarcity of empirical data assessing continuous care interventions on multidimensional self-management, the present study was undertaken. The Continuous Care Model (CCM) provides a theoretically grounded behavioral framework capable of addressing these clinical gaps. Conceptually, its four sequential and dynamic phases, orientation, sensitization, control, and evaluation, foster sustained behavioral change: orientation establishes therapeutic rapport and motivation; sensitization enhances illness perception, facilitating emotional regulation and cognitive problem-solving; control reinforces active self-care behaviors through continuous monitoring; and periodic evaluation ensures sustained partnership with healthcare professionals.

## Objectives

Accordingly, this study aimed to determine the effect of the Continuous Care Model on self-management behaviors among patients undergoing hemodialysis. We hypothesized that patients undergoing the CCM intervention would demonstrate statistically significant improvements in total self-management scores as well as its specific dimensions (problem-solving, emotional regulation, self-care practices, and partnership) compared to those receiving standard care.

## Methods

### Study Design

This study utilized a quasi-experimental, two-arm, pretest-posttest design to examine the impact of the Continuous Care Model (CCM) on self-management behaviors among patients receiving maintenance hemodialysis. Eligible participants were selected via convenience sampling and subsequently assigned to either the intervention or control group using a pre-determined, non-random block allocation sequence prepared by the project statistician. Participants were assigned sequentially upon enrollment by the primary researcher without allocation concealment. To minimize detection bias, post-test outcome assessment was conducted by an independent research assistant who was not involved in delivering the intervention. The study was conducted from September 2025 to June 2026 at the hemodialysis centers affiliated with Khoy University of Medical Sciences (Madani and Matin Hemodialysis Centers), Khoy, Iran.

### Participants

The study population comprised all hemodialysis patients and their accompanying family members referring to the medical centers of Khoy University of Medical Sciences. The sample size was calculated using G*Power software (version 3.1.9.7) based on the study by Asheri et al. [18], considering a type I error (α) of 0.05, a statistical power (1-β) of 90%, and an anticipated effect size derived from the aforementioned study, yielding 34 patients per group. Accounting for an estimated 10% attrition rate, the final sample size was determined to be 37 patients per group (total N = 74).

Initially, a total of 89 patients were screened for eligibility. Of these, 15 patients were excluded, including 9 patients who did not meet the inclusion criteria and 6 who declined to participate.

Subsequently, 74 eligible patients were enrolled and allocated into either the intervention group (n = 37) or the control group (n = 37) using a non-random block allocation method with block sizes of four (comprising 18 blocks of four and a final block of two to accommodate the exact sample size). The allocation process was managed sequentially by the primary researcher, who assigned participants as they met the criteria using numbered lists based on the pre-determined sequence prepared by the project statistician, without allocation concealment. All 74 enrolled participants successfully completed the entire 8-week study without attrition [Figure 1]. Participant retention was achieved by scheduling all educational and follow-up sessions directly at the bedside during patients' regular hemodialysis shifts, eliminating extra transportation or scheduling burdens. Additionally, whenever a participant missed a scheduled session due to transient acute illness or fatigue, an individual make-up session was provided during their very next dialysis visit to ensure full protocol adherence. Inclusion criteria were age ≥18 years, undergoing maintenance hemodialysis for at least three consecutive months, attending regular dialysis schedules (2–3 sessions per week), full orientation and cognitive/communicative capacity to complete questionnaires, absence of documented active psychiatric disorders, and willingness to participate in the research. Exclusion criteria included receiving a kidney transplant during the study course, permanent transfer to other dialysis centers, missing more than one intervention/follow-up session, or voluntary withdrawal from the protocol.

## Intervention and Procedure

Participants in the control group received standard routine care and routine nursing education provided by the hemodialysis centers during the 8 weeks. The intervention group received the Continuous Care Model in addition to routine clinical care. To mitigate the risk of cross-contamination and information leakage between groups, participants from both arms were scheduled, to the extent feasible, during alternating shifts or on alternate dialysis days. Furthermore, participants in the intervention group were requested not to share educational materials or discuss the intervention details with other patients during the study period. To monitor potential contamination, research assistants conducted brief, informal inquiries with participants in the control group upon completion of the post-test, specifically asking whether they had received any educational materials or discussed the intervention details with participants from the intervention group. No instances of contamination or information leakage were reported. On ethical grounds, after the completion of post-test data collection, all educational self-care materials were shared with the control group. The intervention was conducted based on the four-stage framework of the Continuous Care Model over eight consecutive weeks, delivered by the primary researcher (a trained master's student in nursing under the direct supervision of nephrology nursing faculty members). All educational content was developed based on established clinical nephrology guidelines and educational booklets approved by the Iranian Ministry of Health, and its content validity was confirmed by an expert panel of nephrologists and nursing specialists. The four stages were scheduled and implemented as follows:

1. **Orientation (Week 1)**

In this stage, the nurse investigator established therapeutic rapport, explained the project's aims, highlighted the vital role of active patient and family engagement, and systematically assessed individual physical complaints and tailored learning needs during one face-to-face individual session (lasting 30–45 minutes) per patient.

2. **Sensitization (Weeks 2–3)**

Four educational sessions (two sessions per week, each lasting 40–50 minutes) were conducted individually (or in small groups of 2–3 patients, along with their primary family caregivers, depending on dialysis shift conditions). The sessions were held either bedside before the initiation of dialysis or in a private consultation room in the hemodialysis unit. The topics covered disease knowledge, regular dialysis compliance, fluid and sodium/potassium restrictions, proper medication adherence, vascular access (arteriovenous fistula/catheter) preservation,

warning-sign recognition, problem-solving skills, emotional/stress regulation, and shared decision-making, supported by illustrated educational booklets.

3. **Control (Weeks 4–7)**

Participants' self-management behaviors were monitored regularly during routine dialysis shifts and through structured weekly telephone follow-up calls (one call per week per patient, lasting approximately 10–15 minutes, conducted on non-dialysis days). During these calls, patients' adherence was reviewed, and individualized problem-solving strategies were collaboratively formulated to overcome daily compliance barriers.

4. **Evaluation (Week 8)**

Progress toward predetermined health goals was systematically reviewed, corrective feedback was provided, and self-management behaviors were reinforced through one final face-to-face individual session (lasting 30 minutes) through the end of week eight.

Patient adherence to the intervention protocol was high, with an overall attendance and completion rate exceeding 90% (average session attendance: 92.5%).

## Instruments and Measures (Validity and Reliability)

Data collection tools consisted of two sections: 1- Demographic and Clinical Form: Recorded age, gender, marital status, education level, occupation, residence, duration on dialysis, and underlying comorbidities. 2- Hemodialysis Self-Management Instrument (HD-SMI): Originally developed by Song and Lin [19]. We utilized the 20-item version of the HD-SMI, which encompasses four dimensions: problem-solving (5 items), emotional management (4 items), self-care (7 items), and partnership (4 items). While a revised 18-item version (HDSMI-18) was later psychometrically evaluated by Chen et al. [20], the present study adopted the original 20-item version due to its comprehensive coverage of all initial self-management subdomains. The instrument was translated into Persian by the researchers, and its content validity (yielding a Content Validity Index [CVI] of 0.96 and Content Validity Ratio [CVR] of 0.82) along with its reliability (internal consistency via Cronbach's alpha of 0.84) were calculated and confirmed by the research team. Formal permission to utilize and administer the HD-SMI in this study was directly obtained from the original developer via personal email correspondence, and the original publication [19] has been duly cited. Each of the 20 items was scored from 0 ("Never") to 3 ("Always"). Subscale scores were calculated by summing the item scores within each dimension: partnership (0–12), problem-solving (0–15), self-care (0–21), and emotional management (0–12). The total self-management score was calculated by summing all 20 items (possible range: 0–60). Higher scores indicate better self-management competence.

## Outcome Measures and Data Collection

The primary outcome was self-management competence, measured across its four specific subscales and as an overall composite score. Data were gathered at two distinct time points: baseline (prior to intervention) and post-test (at the end of the eighth week) using self-administered questionnaires. To minimize measurement bias, the post-test questionnaires were administered by a trained research assistant who had no role in group allocation or intervention delivery and was kept unaware of group allocation to the extent possible, although strict blinding could not be fully ensured in the routine dialysis setting (see Limitations). For patients with visual or literacy limitations, items were read aloud verbatim using a standardized, pre-written script and a uniform reading protocol applied identically to all patients without investigator bias, and responses were recorded objectively

## Statistical Analysis

Data was analyzed using IBM SPSS Statistics for Windows, version 26.0. Descriptive statistics, including means and standard deviations for continuous variables and frequencies and percentages n (%) for categorical variables, were calculated. The normality of data distribution was tested using the Shapiro-Wilk test. Baseline comparability between groups was evaluated using independent samples t-tests, Chi-square tests, or Fisher's exact tests as appropriate. Within-group comparisons from baseline to post-test were assessed using paired t-tests. Between-group differences in

post-test self-management scores were analyzed using one-way Analysis of Covariance (ANCOVA), adjusting for baseline pre-test scores as the covariate. The underlying assumptions of ANCOVA were thoroughly evaluated: Levene's test indicated unequal variances for total score (F = 14.57, $p$ = 0.0003), problem-solving (F = 23.51, $p < 0.0001$), and self-care (F = 10.70, $p$ = 0.0016), while partnership ($p$ = 0.335) and emotional management ($p$ = 0.106) met the homogeneity assumption. Furthermore, tests of homogeneity of regression slopes (group-by-pretest interactions) and residual normality (Shapiro-Wilk tests on residuals, $p < 0.01$) showed deviations Given these violations, the ANCOVA results should be interpreted with caution, as sensitivity analyses to further assess the robustness of the findings under these conditions were not conducted. A two-tailed $p < 0.05$ was considered statistically significant.

## Result

A total of 74 hemodialysis patients participated in this study, equally allocated to either the intervention group (n = 37) or the control group (n = 37). The distributional properties and underlying assumptions of ANCOVA were evaluated, though some deviations were noted, and results are interpreted with appropriate statistical caution. While baseline clinical and demographic characteristics were generally comparable [Table 1], a statistically significant difference was observed at baseline in the self-care subdimension ($p$ = 0.012), whereas the baseline difference in total self-management score (17.41 versus 21.97) was numerically large but not statistically significant ($p$ = 0.140). We explicitly acknowledge this baseline inequality. Baseline score differences were adjusted using ANCOVA, recognizing that statistical adjustment does not eliminate the inherent selection bias of non-random allocation.

Within-group analysis of self-management scores demonstrated a statistically significant improvement in the overall self-management score and all its subdimensions (except for problem-solving) in the intervention group following the implementation of the Continuous Care Model ($p < 0.05$). Specifically, the mean total self-management score in the intervention group increased significantly from 17.41 (10.45) at baseline to 25.30 (9.90) post-intervention ($p < 0.001$). Conversely, the control group exhibited no statistically significant changes in either the total self-management score or any of its subdimensions ($p > 0.05$); their mean total score was 21.97 (15.43) at baseline and 22.08 (15.48) at the post-test evaluation ($p$ = 0.324).

In the unadjusted between-group post-test comparisons, no statistically significant differences were observed between the intervention and control groups in total self-management ($p$ = 0.282), partnership ($p$ = 0.085), self-care ($p$ = 0.948), or problem-solving ($p$ = 0.359); only emotional management demonstrated a significant difference."

In contrast, one-way analysis of covariance (ANCOVA) adjusting for baseline pre-test scores as the covariate revealed significant between-group differences in post-intervention total self-management and its subdimensions, except for problem-solving. The adjusted mean total self-management score was significantly higher in the intervention group (adjusted M = 27.32, SE = 1.05, 95% CI [25.23, 29.41]) compared to the control group (adjusted M = 20.11, SE = 1.05, 95% CI [18.02, 22.20]; $p < 0.001$; adjusted mean difference = 7.21, 95% CI [4.24, 10.19]; $\eta^2 = 0.247$).

Furthermore, statistically significant between-groups were observed in the adjusted mean scores of partnerships, self-care, and emotional management. The most pronounced intervention effects were detected in the self-care and emotional management domains. In contrast, the difference between the two groups in the problem-solving dimension did not reach statistical significance ($p$ = 0.965). Detailed ANCOVA findings, including adjusted group means, standard errors, 95% confidence intervals (formatted from lower to upper bounds), test statistics (F), and effect sizes ($\eta^2$), are summarized in [Table 2].

**Table 1.** Baseline Demographic and Clinical Characteristics of Hemodialysis Patients in the Intervention and Control Groups

| Variable | Subcategory | Intervention, n (%) | Control, n (%) | Test | *p* |
|---|---|---|---|---|---|
| Age, M (SD) | — | 51.95 (12.03) | 52.11 (17.82) | t = −0.05 | 0.964¥ |
| Age groups | < 40 y | 7 (18.9) | 8 (21.6) | $\chi^2 = 3.26$ | 0.196¶ |
| | 41–65 y | 24 (64.9) | 17 (45.9) | | |
| | > 65 y | 6 (16.2) | 12 (32.4) | | |
| Gender | Female | 20 (54.1) | 22 (59.5) | $\chi^2 = 0.22$ | 0.639¶ |
| | Male | 17 (45.9) | 15 (40.5) | | |
| Marital status | Married | 30 (81.1) | 23 (62.2) | $\chi^2 = 4.19$ | 0.113¶ |
| | Single | 4 (10.8) | 11 (29.7) | | |
| | Other | 3 (8.1) | 3 (8.1) | | |
| Employment | Employed | 11 (29.7) | 5 (13.5) | $\chi^2 = 3.49$ | 0.322¶ |
| | Retired | 7 (18.9) | 9 (24.3) | | |
| | Unemployed | 8 (21.6) | 7 (18.9) | | |
| | Homemaker | 11 (29.7) | 16 (43.2) | | |
| Education | Primary | 11 (29.7) | 20 (54.1) | $\chi^2 = 4.75$ | 0.093¶ |
| | Diploma | 18 (48.6) | 13 (35.1) | | |
| | Academic | 8 (21.6) | 4 (10.8) | | |
| Dialysis duration | < 12 mo | 4 (10.8) | 6 (16.2) | $\chi^2 = 4.72$ | 0.094¶ |
| | 13–60 mo | 15 (40.5) | 22 (59.5) | | |
| | > 60 mo | 18 (48.6) | 9 (24.3) | | |
| Comorbidities | Yes | 18 (48.6) | 16 (43.2) | $\chi^2 = 0.22$ | 0.641¶ |
| | No | 19 (51.4) | 21 (56.8) | | |
| Renal failure cause | Hypertension | 20 (54.1) | 13 (35.1) | $\chi^2 = 6.68$ | 0.086¶ |
| | Diabetes | 12 (32.4) | 11 (29.7) | | |
| | Congenital | 0 (0.0) | 4 (10.8) | | |
| | Other | 5 (13.5) | 9 (24.3) | | |
| Income | Low | 15 (40.5) | 18 (48.6) | $\chi^2 = 0.58$ | 0.764¶ |
| | Moderate | 19 (51.4) | 17 (45.9) | | |
| | High | 3 (8.1) | 2 (5.4) | | |

Note: M = mean; SD = standard deviation. Continuous variables are presented as M (SD), and categorical variables as n (%).
¥ Determined by independent samples t-test.
¶ Determined by Chi-square test, except for renal failure cause, income, and marital status, which were analyzed using Fisher's exact test / Fisher-Freeman-Halton exact test due to expected cell counts below 5.

**Table 2.** Comparison of Self-Management Scores and Its Dimensions Between the Intervention and Control Groups

| Dimension | Group | Pre-test M (SD) | Post-test M (SD) | Within-group p¥ | Adjusted M (SE) [95% CI] | ANCOVA F (df), $\eta^2$ |
|---|---|---|---|---|---|---|
| Partnership | Intervention | 3.95 (3.08) | 4.95 (2.46) | 0.033 | 4.94 (0.28) [4.37, 5.50] | 6.98 (1, 71), 0.090 |
| | Control | 3.92 (2.95) | 3.86 (2.85) | 0.534 | 3.87 (0.28) [3.31, 4.44] | |
| | Between-group p¶ | 0.969 | 0.085 | – | 0.010 | |
| Problem Solving | Intervention | 4.19 (2.98) | 4.43 (2.38) | 0.549 | 4.85 (0.27) [4.30, 5.39] | 0.002 (1, 71), < 0.001 |
| | Control | 5.16 (4.79) | 5.24 (4.77) | 0.262 | 4.83 (0.27) [4.28, 5.38] | |
| | Between-group p¶ | 0.298 | 0.359 | – | 0.965 | |
| Self-care | Intervention | 6.57 (3.84) | 9.68 (4.21) | < 0.001 | 11.05 (0.47) [10.10, 11.99] | 16.95 (1, 71), 0.193 |
| | Control | 9.62 (6.12) | 9.59 (6.31) | 0.800 | 8.23 (0.47) [7.28, 9.17] | |
| | Between-group p¶ | 0.012 | 0.948 | – | < 0.001 | |
| Emotional Management | Intervention | 2.70 (2.41) | 6.24 (2.34) | < 0.001 | 6.45 (0.29) [5.88, 7.03] | 64.01 (1, 71), 0.474 |
| | Control | 3.27 (2.94) | 3.38 (2.91) | 0.210 | 3.17 (0.29) [2.59, 3.75] | |
| | Between-group p¶ | 0.367 | < 0.001 | – | < 0.001 | |
| Total Self-management | Intervention | 17.41 (10.45) | 25.30 (9.90) | < 0.001 | 27.32 (1.05) [25.23, 29.41] | 23.35 (1, 71), 0.247 |
| | Control | 21.97 (15.43) | 22.08 (15.48) | 0.324 | 20.11 (1.05) [18.02, 22.20] | |
| | Between-group p¶ | 0.140 | 0.282 | – | < 0.001 | |

**Note:** M = mean; SD = standard deviation; SE = standard error; CI = confidence interval.
¥: Comparison of pre- and post-intervention means within each group (Paired t-test).
¶: Comparison of means between the two groups at each time point (Independent t-test) or p-value for ANCOVA analysis.
**ANCOVA:** Analysis of Covariance to compare post-intervention scores between the two groups, adjusting for the effect of pre-intervention scores as a Covariate.

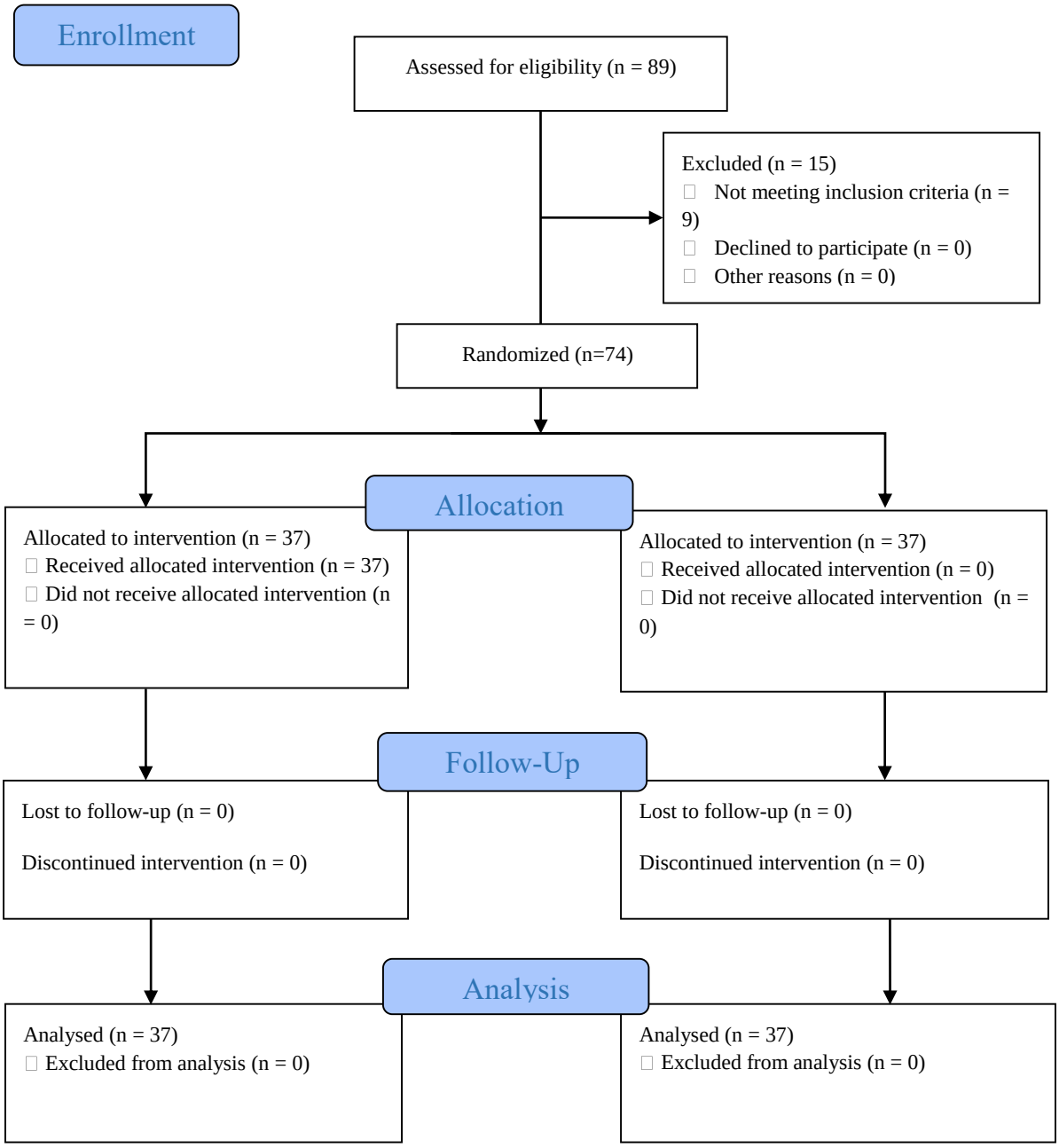



**Figure 1.** Flow Diagram of The Study Participant Progression Through Screening, Allocation, Follow-up, and Analysis.

## Discussion

Following covariate adjustment via ANCOVA, while unadjusted (raw) post-test comparisons between the groups showed no statistically significant differences across most dimensions including total self-management, partnership, self-care, and problem-solving, with only emotional management demonstrating a significant difference this quasi-experimental study indicated that the

implementation of the Continuous Care Model (CCM) was associated with significantly improved overall self-management and its specific domains (partnership, self-care, and emotional management) only after baseline score adjustment. In contrast, the problem-solving dimension remained non-significant even after adjustment. These outcomes suggest an association between structured, theory-based nursing frameworks and better management of the multifaceted challenges of end-stage renal disease (ESRD); however, the quasi-experimental design precludes causal inference.

For overall self-management, the ANCOVA-adjusted post-intervention difference between the groups was statistically significant. Chronic kidney disease is characterized by an unyielding treatment regimen that demands lifelong adherence, dietary restrictions, and constant self-monitoring. Traditional, episodic educational approaches often fail to provide sustained support, whereas continuous models are designed to maintain an active, ongoing dialogue between the nurse, the patient, and the family [20-22].Such ongoing engagement may provide a context in which patients can apply health-related knowledge in their daily routines; however, this process was not directly examined in the present study.

The adjusted between-group differences in the self-care and partnership domains are conceptually consistent with the structured components of the CCM, particularly its emphasis on orientation, sensitization, and patient engagement. Maintenance hemodialysis patients face relentless clinical demands, including strict interdialytic weight gain control, fluid management, and vascular access protection, all of which are vital to prevent life-threatening cardiovascular and fluid-overload complications. The structured stages of the CCM are intended to help patients clarify their roles in disease management. The model therefore frames patients as active partners in their care, although the present findings do not establish that these components caused the observed group differences. This interpretation is broadly consistent with prior interventional studies reporting favorable changes in self-care behaviors following structured supportive programs [23-25].

Furthermore, the positive shift observed in the "emotional management" domain addresses a critical yet frequently overlooked aspect of dialysis care. Psychosocial distress, including anxiety, depression, and a profound sense of dependency, is highly prevalent among hemodialysis patients and acts as a major barrier to effective self-management. The continuous follow-up calls and empathetic communication embedded in the CCM may represent a plausible mechanism through which patients' emotional needs are addressed during treatment [26]. However, this interpretation should be considered tentative, as the observed improvement was measured through the emotional management subscale rather than a dedicated psychosocial measure. Conversely, the absence of a statistically significant difference in the "problem-solving" domain warrants careful authorial consideration and reflects the complex nature of behavioral modification. Unlike routine self-care tasks (such as taking medications or restricting fluids), clinical problem-solving requires higher-order cognitive processes, critical thinking, and the ability to dynamically adapt to unexpected symptoms or physiological changes. The lack of significant change in this domain may be attributed to the relatively short intervention duration, which might have been insufficient to cultivate complex cognitive-behavioral adaptation. Additionally, mastering problem-solving in chronic illness typically demands intensive, scenario-based simulation training, longitudinal reinforcement, and active multidisciplinary involvement rather than standard educational follow-ups alone [27-29]. Therefore, while the CCM showed favorable improvements in basic self-care and emotional management dimensions, facilitating patients' ability to independently troubleshoot complex clinical scenarios requires more prolonged and specialized cognitive interventions.

This study was subject to several limitations that should be considered when interpreting the findings. First, the lack of allocation concealment and the sequential non-random assignment method may

have introduced selection bias. Second, due to the nature of this educational and behavioral intervention, participants and the interventionist (the primary researcher) could not be blinded. Although post-test questionnaires were administered by an independent research assistant who did not deliver the intervention, strict blinding of the assessor could not be fully ensured in a routine dialysis setting, which may have led to detection bias. Third, despite efforts to schedule patients in alternating shifts or days, the possibility of information exchange and contamination between the intervention and control groups within the same dialysis centers cannot be entirely ruled out. Fourth, the increased attention received by the intervention group may have contributed to a Hawthorne (attention) effect, influencing their behavioral responses. Fifth, although baseline score differences were adjusted using ANCOVA (recognizing that statistical adjustment does not eliminate selection bias from non-random allocation), the relatively limited sample size from a single region (Khoy) restricts the generalizability of the results. Sixth, reliance on self-report questionnaires introduces potential recall and social desirability biases, which could be strengthened in future studies by incorporating objective clinical markers (such as interdialytic weight gain or laboratory parameters). Finally, the follow-up was restricted to the immediate post-intervention period at 8 weeks, with no intention-to-treat (ITT) analysis required as there was no participant attrition; thus, the long-term sustainability of the observed effects remains to be established in future multi-center, long-term randomized controlled trials.

## Conclusion

In this quasi-experimental study, implementation of the Continuous Care Model (CCM) was associated with significantly higher adjusted scores for overall self-management and the partnership, self-care, and emotional management domains among hemodialysis patients at the end of the eighth week. No statistically significant between-group difference was observed in the problem-solving domain. Given the non-randomized design, these findings should be interpreted as associations rather than evidence that the CCM caused the observed differences.

The findings support further evaluation of the CCM in routine nursing settings; multi-center longitudinal studies, preferably randomized controlled trials, are warranted to assess the durability of these associations and their relationship with objective clinical outcomes, such as treatment adherence, hospitalization rates, and health-related quality of life.

### Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Khoy University of Medical Sciences (Ethics approval code: IR.KHOY.REC.1403.053, granted on March 18, 2025, for the approved master's thesis proposal), with data collection conducted from September 2025 to June 2026. Written informed consent was obtained from all participants prior to their enrollment. This study was not registered in a clinical trial registry.

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### Conflict of Interest

The authors declare that they have no competing interests.

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## Authors' Contributions

Conceptualization: S. Ahmadi
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All authors read and approved of the final manuscript.

## Artificial Intelligence Utilization

During the preparation of this manuscript, the authors utilized ChatGPT (GPT-4o / OpenAI) exclusively for academic language translation, grammar refinement, and improving the scholarly readability and flow of the English text. The tool was not used to generate research concepts, clinical data, statistical calculations, or study conclusions. Following the use of this tool, all authors thoroughly reviewed, verified, and edited the entire manuscript against the original Persian study data and protocols to ensure academic integrity and factual accuracy. The authors take full responsibility for the integrity and validity of the published content.

## Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to patient privacy and institutional confidentiality regulations but are available from the corresponding author upon reasonable academic requests.

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