Development and Effectiveness of Dietary Self-Care Promotion Program using Online Community for Hemodialysis Patients: A Randomized Controlled Trial

Hana Kim and Mi-Kyoung Cho *

Posted Date: 19 February 2024

doi: 10.20944/preprints202402.1045.v1

Keywords: renal dialysis; self care; dietary management; self efficacy; internet-based intervention

Article

Development and Effectiveness of Dietary Self-Care Promotion Program using Online Community for Hemodialysis Patients: A Randomized Controlled Trial

Hana Kim [1] and Mi-Kyoung Cho [2,*]

[1] Department of Nursing Science, College of Life & Health Sciences, Hoseo University, Asan, Republic of Korea; smnhn1004@gmail.com
[2] Department of Nursing Science, School of Medicine, Chungbuk National University, Cheongju, Republic of Korea; ciamkcho@gmail.com
* Correspondence: ciamkcho@gmail.com; Tel.: 82-43-249-1797

Abstract: Background: This study aimed to develop and evaluate a dietary self-care promotion program for hemodialysis patients based on Hurley's self-efficacy model. Methods: The needs of hemodialysis patients were identified, and an online community-based dietary self-care promotion program was developed with expert evaluations. 44 hemodialysis patients were randomly assigned to an experimental group (n=22) and a control group (n=22). The program was applied to the experimental group for four weeks. Before and after the intervention, as well as four weeks after the intervention, dietary self-efficacy, dietary self-care behavior, interdialytic weight gain, serum phosphorus, and serum potassium were assessed in both groups. Results: Significant differences over time and between groups were observed in dietary self-efficacy, interdialytic weight gain, serum phosphorus, and serum potassium. The interaction between time and group was also significant. While no significant differences were found over time in dietary self-care behavior, significant group differences and interaction effects between time and group were identified. Conclusions: The results indicate that the dietary self-care promotion program using an online community for hemodialysis patients is more effective in enhancing dietary self-efficacy and dietary self-care behavior compared to conventional treatment. This suggests the clinical applicability of the proposed dietary self-care promotion program.

Keywords: renal dialysis; self care; dietary management; self efficacy; internet-based intervention

1. Introduction

Among end-stage renal disease patients undergoing hemodialysis (HD), 81% opt for HD, and the duration of HD is gradually increasing due to the extended average lifespan [1]. The self-care practices of HD patients, such as medication adherence, adherence to HD schedules, and arteriovenous fistula management, are generally high. However, practices related to social activities, blood pressure and weight management, exercise and rest, dietary management, and fluid intake restriction show lower adherence rates [2–4].

The degree of dietary self-care behavior among HD patients can be assessed through indicators such as interdialytic weight gain (IDWG), serum phosphorus, and serum potassium levels [5–8]. Increased IDWG due to unrestricted fluid intake can lead to complications such as hypertension, dyspnea, muscle cramps, pulmonary edema, and congestive heart failure [9]. Cardiovascular diseases, which have the highest proportion among the causes of death in HD patients, are closely related to hyperphosphatemia and hyperkalemia [10–13]. Phosphorus and potassium are electrolytes that can be easily consumed in large amounts through food, and although medication can regulate them, maintaining normal levels is challenging without dietary management [14]. Therefore, adherence to dietary self-care behavior is crucial in the care of HD patients[8,9,15,16].

 doi:10.20944/preprints202402.1045.v1

While HD patients possess a high level of knowledge about their condition, their adherence to self-care practices is generally low, and expecting behavioral change through knowledge improvement has limitations [17]. Self-efficacy, identified as an important variable for sustaining specific health behaviors [18], has been confirmed to significantly impact self-care practices in HD patients [19,20]. Building on the self-efficacy theory, studies attempting dietary self-care promotion interventions for HD patients, such as Park & Chang [4], Yun & Choi [21], and Tsay [22], demonstrated improvements in self-efficacy, dietary knowledge, eating habits, nutritional intake, physiological indicators, dietary status, quality of life, and interdialytic weight gain. This suggests that a dietary self-efficacy promotion program is effective for enhancing dietary self-care behavior in HD patients, with lasting effects.

However, existing programs mostly involve face-to-face interventions, which require considerable resources and time, limiting their applicability [23]. In light of this, the potential of mobile health has been considered. While mobile apps are a common method in mobile health services, they come with high initial development costs and ongoing maintenance expenses [24]. In contrast, utilizing the internet for mobile health services allows for unrestricted access without the constraints of time and space, is economically viable without additional fees, ensures operational stability by leveraging existing infrastructure, and is easy to operate and manage without the need for app installation, thereby enhancing accessibility and expanding the scope and audience for education [23].

Therefore, in this study, we implemented an intervention based on Hurley's model to enhance dietary self-efficacy and improve the dietary self-care behavior of HD patients. Additionally, we explored the feasibility and effectiveness of using an online community (NAVER BAND) as a non-face-to-face intervention delivery method.

2. Materials and Methods

2.1. Development of a Dietary Self-Care Promotion Program Using an Online Community

The dietary self-care promotion program in this study, utilizing an online community, was developed through a literature review, needs assessment, program development, and expert evaluation.

2.1.1. Literature Review and Needs Assessment

A needs assessment for the dietary self-care promotion program using an online community was conducted through literature reviews and individual interviews with six HD patients.

2.1.2. Dietary Self-Care Promotion Program Using an Online Community

- Constructing a program

The content of the weekly program was structured based on a literature review of HD patients' dietary self-care and the results of the needs assessment. The program spanned four weeks with a total of 12 sessions, incorporating Bandura's self-efficacy resources—performance accomplishment, vicarious experience, verbal persuasion, and emotional arousal—appropriately throughout the program

- Establishment of an online community

The researcher created an online community named 'Together in Hemodialysis Life' on NAVER BAND for the implementation of the dietary self-care promotion program for HD patients.

2.1.3. Evaluation of the Dietary Self-Care Promotion Program Using an Online Community

For program evaluation, a group of five experts (one nephrologist, two adult nursing professors, one artificial kidney unit nurse, and one nurse with over 10 years of experience in the artificial kidney unit) was formed. The experts assessed the program's self-care contribution, applicability, and Item-level Content Validity Index (I-CVI) for educational materials. Ratings for self-care contribution and

 doi:10.20944/preprints202402.1045.v1

applicability ranged from 1 (not at all) to 3 (very much), with all five experts giving a score of 3, indicating an appropriate level. The content validity of educational materials was rated at 0.95, indicating high validity. Subsequently, based on feedback, revisions were made. The revised materials underwent a second content validity evaluation by three experts (one adult nursing professor, one artificial kidney unit nurse, and one nurse with over 10 years of experience in the artificial kidney unit), resulting in perfect ratings of 1.0 for all eight items.

2.2. Application of the Dietary Self-Care Promotion Program Using an Online Community

2.2.1. Study Design

This study is a randomized control group pretest-posttest design according to the CONSORT (Consolidated Standards of Reporting Trials) guideline 2010 [25]. The purpose is to investigate the impact of the dietary self-care promotion program using an online community on the dietary self-efficacy, dietary self-care behavior, and physiological indicators (IDWG, serum phosphorus, serum potassium) of HD patients. The study is registered with the Clinical Research Information Service (CRIS) under the registration number KCT0007920, conducted following the guidelines of the Helsinki Declaration, and approved by the Chungbuk National University institutional review board (202208-HR-0197).

2.2.2. Participants

Study participants were recruited through online communities of HD patients. The inclusion criteria were adults aged 20 or older who had been diagnosed with end-stage renal disease and underwent HD for at least three months. Participants were required to attend outpatient visits for HD at least twice a week, be able to use the Korean language, and be capable of responding to online surveys. Exclusion criteria included inpatients, individuals participating in other studies related to dietary self-care behavior, and those who did not complete both pre- and post-surveys. A total of 40 participants, excluding four participants, were included in the final analysis from the initial forty-four participants (Figure 1). The intervention period lasted for four weeks.

 doi:10.20944/preprints202402.1045.v1

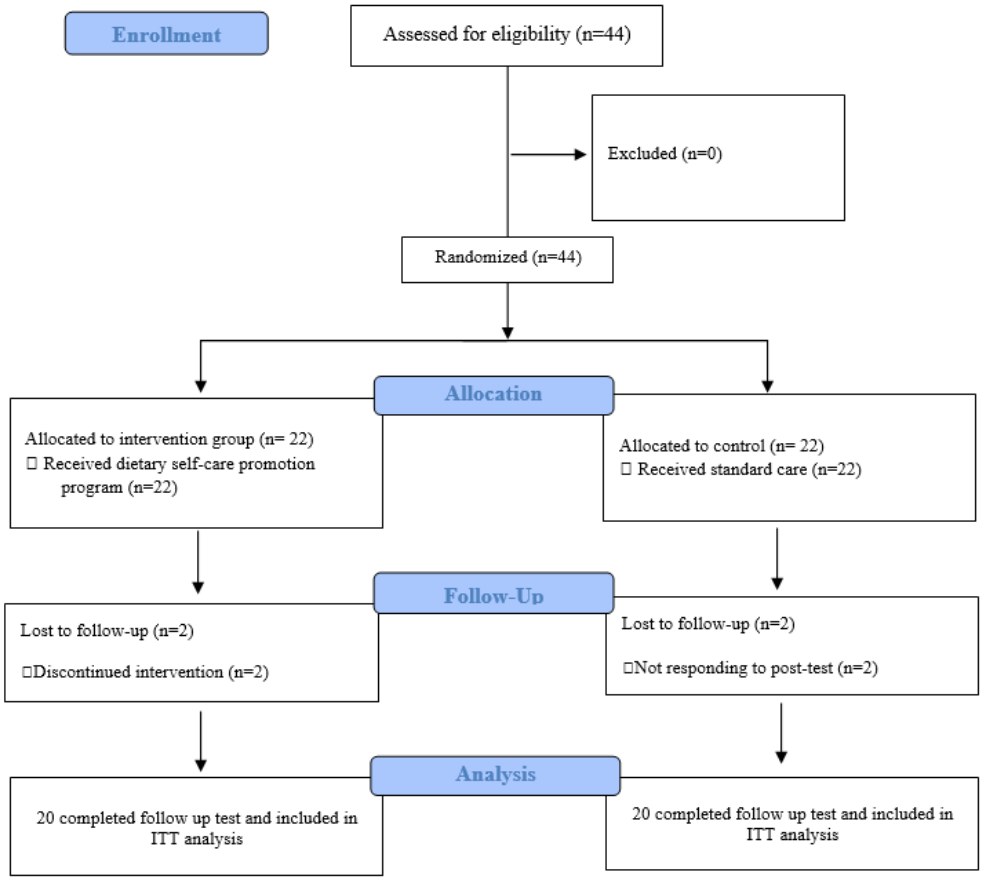

Figure 1. CONSORT flow diagram of participants' enrollment. ITT: Intend-to-treat

2.2.3. Procedures and Intervention

To minimize bias, participants were randomly assigned to the experimental group (n=22) and the control group (n=22) using Google's random number generation program (https://g.co/kgs/4L7p6t). To facilitate the intervention, an online community named 'Dialysis life together' was created for the experimental group, while the control group was given access to a separate online community, 'Dialysis life together 2.' Invitation links were sent via short message service (SMS) for participants to join their respective groups. Data collection was conducted for both groups simultaneously before the start of the program, immediately after the four-week program, and four weeks post-program. The experimental group participated in the dietary self-care promotion program through NAVER BAND ('Dialysis life together') for four weeks. The control group received to conventional treatment during this period, and after data collection completion, those interested were offered the same dietary self-care promotion program on NAVER BAND ('Dialysis life together 2') as the experimental group.

2.3. Outcome Measurements

2.3.1. General and Disease-Related Characteristics

Through the survey, general characteristics such as gender, age, marital status, educational, presence of occupation, monthly income, and residence were collected. Disease-related characteristics included subjective health status, primary causes of end-stage renal disease, duration of HD, frequency of HD, length of time spent on HD, presence of dietary self-care education experience, and meal preparation.

 doi:10.20944/preprints202402.1045.v1

2.3.2. Dietary Self-Efficacy

Dietary self-efficacy was assessed using a tool developed for HD patients [18], consisting of 14 items rated on a five-point Likert scale. The total scores were calculated by summing individual item scores, reflects dietary self-efficacy levels, with higher scores indicating higher dietary self-efficacy. The tool's Cronbach's α during development was 0.94, and it was confirmed to be 0.94 in this study as well.

2.3.3. Dietary Self-Care Behavior

The tool used to measure dietary self-care behavior was developed by Song [8] for HD patients and modified by Cho [26] into a 35-item self-care tool, with six items related to dietary management being used in this study. Item scores were summed on a Likert five-point scale to calculate the total score, with higher scores indicating a higher level of dietary self-care behavior. The reliability of this tool was reported as Cronbach's α 0.88 in Cho's [26] study and it was confirmed to be 0.91 in this study.

2.3.4. Physiological Indicators

IDWG was measured as the average weight increase over a week. Serum phosphorus and serum potassium values were based on the average from monthly laboratory tests.

2.4. Sample Size Estimation

The sample size was calculated using G*power 3.1 software [27] based on the study by Pack & Lee [28]. For sample calculation, a medium effect size (f=0.25) suggested by Cohen [29] for repeated measures analysis of variance (ANOVA), a significance level of 0.05, a power of 0.90, two groups, three measurement times, a correlation among repeated measures of 0.5, and a nonsphericity correction of 1 were set. The required sample size under these conditions was calculated to be a total of 36 participants. Considering a dropout rate of 15%, a total of 44 participants were recruited.

2.5. Statistical Analysis

Data analysis was conducted using SPSS 26.0 (IBM, Armonk, NY, USA). The general and disease-related characteristics of the participants were analyzed using frequencies, percentages, means, and standard deviations. Homogeneity tests between the experimental and control groups were performed using independent t-tests, χ2-tests, and Fisher's exact tests. Repeated measures ANOVA was conducted to test the group differences over time for dependent variables between the experimental and control groups. However, due to the discovery of differences in homogeneity testing for IDWG, repeated measures analysis of covariance (ANCOVA) was conducted with the pre-measurement values as a covariate. The significance level was set at $p < .05$.

3. Results

3.1. Results of the Application of the Dietary Self-Care Promotion Program Using an Online Community

The weekly plan of the dietary self-care promotion program developed through this study utilizing an online community is provided in Table A1.

3.1.1. Homogeneity Testing for Participant Characteristics and Outcome Variables

The homogeneity testing results for general and disease-related characteristics, and outcome variables between the experimental and control groups showed homogeneity, except for IDWG (Table 1).

 doi:10.20944/preprints202402.1045.v1

Table 1. Homogeneity test of general characteristics, disease-related characteristics and outcome variables between the two groups at baseline (N=40).

Characteristics/Outcome Variables	Categories	Exp. (n=20)	Cont. (n=20)	χ^2 or t-test	p
		n (%) or M±SD	n (%) or M±SD		
Sex	Male	13 (65.0)	13 (65.0)	0.00	0.629
	Female	7 (35.0)	7 (35.0)		
Age (year) †		48.10±7.41	49.90±7.88	−0.74	0.461
	≤ 39	1 (5.0)	1 (5.0)	0.28	0.964
	40-49	10 (50.0)	10 (50.0)		
	50-59	7 (35.0)	6 (30.0)		
	≥ 60	2 (10.0)	3 (15.0)		
Marital status†	Single	6 (30.0)	5 (25.0)	0.42	0.812
	Married (have a spouse)	10 (50.0)	12 (60.0)		
	Married (no spouse)	4 (20.0)	3 (15.0)		
Education	High school	5 (25.0)	11 (55.0)	3.75	0.053
	≥ College	15 (75.0)	9 (45.0)		
Presence of occupation	Yes	13 (65.0)	14 (70.0)	0.11	0.500
	No	7 (35.0)	6 (30.0)		
Monthly income (10,000 won) †	None	1 (5.0)	3 (15.0)	2.87	0.413
	< 200	9 (45.0)	6 (30.0)		
	200-400	6 (30.0)	9 (45.0)		
	>400	4 (20.0)	2 (10.0)		
Residence†	Seoul, Gyeonggi, Incheon	3 (15.0)	8 (40.0)	3.35	0.187
	Gangwon, Chungcheong	7 (35.0)	6 (30.0)		
	Gyeongsang, Jeolla, Jeju	10 (50.0)	6 (30.0)		
Subjective health status†		2.90±0.85	2.80±1.06	0.33	0.744
	Very bad	2 (10.0)	1 (5.0)	7.92	0.095
	Bad	2 (10.0)	8 (40.0)		
	Moderate	12 (60.0)	7 (35.0)		
	Good	4 (20.0)	2 (10.0)		
	Very good	0 (0.0)	2 (10.0)		
Primary cause of ESRD†	Diabetes mellitus	2 (10.0)	7 (35.0)	5.88	0.118
	Hypertension	3 (15.0)	5 (25.0)		
	Glomerulonephritis	9 (45.0)	6 (30.0)		
	Others	6 (30.0)	2 (10.0)		
Duration of HD (year)†		8.40±5.65	8.28±5.52	0.06	0.950
	≤3	3 (15.0)	3 (15.0)	0.53	0.912
	3.1-10.0	9 (45.0)	11 (55.0)		

 doi:10.20944/preprints202402.1045.v1

	10.1-20.0	7 (35.0)	5 (25.0)		
	>20	1 (5.0)	1 (5.0)		
Frequency of HD (per week) †		3.00±0.00	3.00±0.32	0.00	1.000
	2	0 (0.0)	1 (5.0)		
	3	20 (100.0)	18 (90.0)	2.11	0.349
	4	0 (0.0)	1 (5.0)		
Length of time spent on HD (hours) †		3.98±0.26	4.03±.030	−0.57	0.570
	< 4	1 (5.0)	1 (5.0)	0.00	1.000
	≥ 4	19 (95.0)	19 (95.0)		
Presence of dietary self-care education experience	Yes	14 (70.0)	15 (75.0)	0.13	0.500
	No	6 (30.0)	5 (25.0)		
Meal preparation†	Self	12 (60.0)	11 (55.0)		
	Spouse	4 (20.0)	7 (35.0)	1.53	0.466
	Others	4 (20.0)	2 (10.0)		
Dietary self-efficacy		47.30±8.42	44.20±13.08	0.89	0.378
Dietary self-care behavior		18.75±3.97	19.65±6.05	−0.56	0.582
IDWG		2.23±0.72	2.84±1.01	−2.19	0.035
Serum phosphorus		5.54±1.36	5.60±1.28	−0.13	0.899
Serum potassium		4.85±0.53	5.50±1.29	−1.74	0.092

Notes. Exp., Experimental group; Cont., Control group; M, Mean; SD, Standard Deviation; ESRD, end-stage renal disease; HD, hemodialysis; IDWG, interdialytic weight gain. † Fisher's exact test.

3.1.2. Effects of the Dietary Self-Care Promotion Program Using an Online Community

Significant differences over time and between groups were observed in dietary self-efficacy, IDWG, serum phosphorus, and serum potassium for both the experimental and control groups. The interaction effects of time and group were also found to be significant. While there were no significant differences over time in dietary self-care behavior, significant interactions were observed between groups and over time (Table 2).

Table 2. Repeated measures ANOVA in outcome variables (N=40).

Variables	**Time**	**Exp. (n=20)**	**Cont. (n=20)**	**Source**	**F***	***p***
		M±SD	**M±SD**			
Dietary self-efficacy	Pre-test	47.30±8.42	44.20±13.08	Group	5.15	0.029
	Post-test 1	51.30±7.23	44.65±14.21	Time	9.16	0.004
	Post-test 2	55.00±5.44	43.70±12.00	G × T	11.88	0.001
Dietary self-care behavior	Pre-test	18.75±3.97	19.65±6.05	Group	6.33	0.013
	Post-test 1	21.70±3.99	19.65±6.46	Time	1.80	0.171
	Post-test 2	24.35±3.31	18.35±6.37	G × T	4.45	0.014
IDWG	Pre-test	2.23±0.72	2.84±1.01	Group	19.75*	<0.001
	Post-test 1	1.92±0.84	2.75±0.91	Time	4.37*	0.016
	Post-test 2	1.62±0.73	3.14±0.97	G × T	16.51*	<0.001
Serum phosphorus	Pre-test	6.28±1.75	5.60±1.28	Group	6.08	0.019
	Post-test 1	4.39±1.34	6.09±1.19	Time	19.78	<0.001

 doi:10.20944/preprints202402.1045.v1

	Post-test 2	4.08±1.17	6.01±0.93	G × T	46.51	<0.001
	Pre-test	5.15±0.64	5.50±1.29	Group	16.02	<0.001
Serum potassium	Post-test 1	4.42±0.57	5.25±0.70	Time	6.71	0.010
	Post-test 2	4.09±0.43	5.44±0.68	G × T	4.52	0.034

Notes. Exp., experimental group; Cont., control group; M, mean; SD, standard deviation; G, group; T, time; IDWG, interdialytic weight gain; post-test 1, measurements immediately after the program; post-test 2, measurements 4 weeks after program completion. *Repeated measures ANCOVA; Covariate, pre-test measured IDWG values.

4. Discussion

This study aimed to develop and evaluate a dietary self-care promotion program for HD patients based on Hurley's self-efficacy model using an online community. The results confirmed the effectiveness of the program in improving dietary self-efficacy, dietary self-care behavior, IDWG, serum phosphorus, and serum potassium.

4.1. Development of the Dietary Self-Care Promotion Program Using an Online Community

Self-efficacy theory-based self-care promotion programs have shown improvements in self-efficacy and self-care behavior among individuals with various health issues [30].

In this study, the self-efficacy theory was applied as a situation-specific theory to enhance dietary self-efficacy through the dietary self-care promotion program. The study observed that increased dietary self-efficacy led to improved dietary self-care behavior, IDWG, serum phosphorus, and serum potassium.

To tailor the program for HD patients, a literature review and needs assessment were conducted during program development. After program construction, two expert evaluations were conducted. The completeness of educational materials used in the program was enhanced through the use of web design software (Mango Board) and collaboration with a web designer. In order to increase the accessibility of the program, we planned a non-face-to-face program, providing a foundation for trying the intervention on more patients. Additionally, to enhance self-efficacy, the program incorporated the four elements of self-efficacy resources appropriately into its structure [31].

Previous studies have indicated the effectiveness of using online communities in the medical field, showing improvements in patients' subjective well-being, psychological well-being, self-care, and control [32]. In a study involving end-stage renal disease patients, the implementation of self-management education, including an online community, resulted in improvements in self-efficacy, self-care, and physiological indicators [33]. Similarly, in this study, the utilization of an online community led to enhanced dietary self-efficacy, subsequent improvements in dietary self-care behavior, and enhancements in IDWG, serum phosphorus, and serum potassium. Therefore, this program can be proposed as one avenue for the continuous health management of patients with chronic conditions like HD patients. It can serve as a new alternative for non-face-to-face interventions, providing a departure from the predominantly unidirectional communication methods of traditional interventions.

4.2. Effects of an Online Community-Based Dietary Self-Care Promotion Program

After implementing the dietary self-care promotion program, the experimental group's dietary self-efficacy significantly increased over time, similar to the findings of Kim & Choi [34]. Kim & Choi [34] provided tailored dietary education to HD patients for four weeks, confirming a significant effect on self-efficacy, which persisted for up to eight weeks. This provides evidence that the intervention period in this study was sufficient for enhancing dietary self-efficacy, and the effect could potentially last up to eight weeks. Moreover, the study by Kim & Choi [34], which offered face-to-face counseling, yielded results similar to our study, suggesting that there may not be a significant difference in the effects between face-to-face and non-face-to-face programs. Park & Kim [35] provided a non-face-to-face self-care behavior promotion program, confirming significant differences in self-efficacy,

 doi:10.20944/preprints202402.1045.v1

treatment adherence, IDWG, serum potassium, and serum phosphorus levels. This reaffirms that non-face-to-face interventions can be an effective means for enhancing self-efficacy in HD patients.

Pack & Lee [28] conducted a self-care behavior promotion program for HD patients using an app, confirming results similar to those of our study. In their study, they measured dietary self-efficacy using the same tools as our study, and immediately after the intervention, observed an increase of 11.54 points compared to before the intervention. This effect was larger than the 7.7 points increase observed in our study. It can be speculated that Pack & Lee [28] implemented active interventions through app counseling or phone calls. In our study, attempts were made to provide personalized dietary practices and behavioral corrections through comments on participants' posts; however, this was mainly provided to participants with high engagement, limiting its effectiveness. Therefore, in future research, it may be worth considering interventions that identify participants requiring active intervention and provide counseling, addressing the limitations of non-face-to-face intervention methods.

In this study, significant differences between groups over time and significant interactions between groups and time were observed in dietary self-care behavior after providing the dietary self-care promotion program. In the domain of self-care among HD patients, dietary management was identified as an area with low adherence [2,3,36,37]. Some previous studies have reported that even after implementing a dietary self-care promotion program, no significant effects were observed in dietary self-care behavior [38–41]. However, in this study, some significant effects were identified in dietary self-care behavior, and these results are consistent with the findings of Kim & Choi [34] and Hashemi et al. [42]. Kim & Choi [34] conducted individual counseling and education, while Hashemi et al. [42] provided individual counseling and education with follow-up measures via phone and in-person. In our study, significant effects were observed by tailoring dietary practices and behavior modification suggestions based on individuals' mission performance and Q&A. Therefore, it is suggested that when constructing non-face-to-face intervention programs, tailored intervention components based on participants' individual situations are essential to enhance the effectiveness of the program. Additionally, considering that end-stage renal disease patients may have good awareness of food (low phosphorus, low sodium, low fluid intake) but may lack understanding of the direct impact of food [43], explanations were provided using examples of common food menus, home-cooked meals, and supplemental foods. Furthermore, to address the potential difficulty of execution due to the burden of dietary self-care behavior, explanations were focused on permissible foods rather than restricted ones, and encouragement for practice yielded positive results.

Research attempting to enhance self-care through online communities among HD patients is challenging to compare directly due to the scarcity of cases. Li et al. [33] utilized an app, including an online community, to provide dietary, exercise, and self-care education to end-stage renal disease patients, resulting in improvements in self-efficacy, self-care, and physiological indicators (eGFR). Yang et al. [44] also applied interventions with online community features to delay the initiation of dialysis in end-stage renal disease patients. Considering the nature of patients with chronic illnesses who must continue their daily lives in a diseased state, the advantage of interventions that patients can access anytime, anywhere may have played a role. Moreover, the poor adherence to dietary self-care behavior in HD patients can act as a cause of various complications and mortality [9,45–47]. Therefore, the improvement in dietary self-care behavior is considered a positive effect of the program. Additionally, Kim et al. [39] applied a video program, An [48] conducted a study comparing three non-face-to-face intervention methods (phone calls, text messages, emails) and confirmed significant effects in self-care behaviors. Cho & Park [49] utilized a tablet personal computer (PC), and Park & Kim [35] used an app for non-face-to-face interventions, both confirming significant effects in self-care behaviors. Baraz et al. [50] compared the effects of face-to-face and non-face-to-face interventions (video) and found no significant differences in dietary self-care behavior between the two groups. This supports the applicability of the non-face-to-face intervention through online communities attempted in this study and provides evidence for the potential use of this program as an efficient alternative to reduce the burden on healthcare providers and healthcare costs associated with the increasing number of HD patients.

 doi:10.20944/preprints202402.1045.v1

The results of applying the dietary self-care promotion program in this study showed significant differences in IDWG in terms of within-group changes over time, between-group differences at the same time points, and interactions between time and groups. These findings are consistent with the results of Tsay [22], Yun & Choi [21], and Park & Kim [35]. Tsay [22] and Yun & Choi [21] implemented face-to-face interventions, while Park & Kim [35] predominantly used applications and SMS for interventions. This suggests that the effects of not only face-to-face programs but also non-face-to-face interventions, such as applications and SMS, can be confirmed. However, studies that implemented face-to-face intervention [9], non-face-to-face interventions (video) [39], and Cho & Park [49] did not find significant results. IDWG, which is utilized as an objective indicator of dietary management among HD patients, can be influenced by seasons or temperature [51], and in cases where the average weight gain of the study participants is within the normal range, significant differences may not be observed [39]. Additionally, younger age has been associated with greater IDWG [52], and being unmarried has been identified as a predictive factor for treatment non-adherence [53]. Despite these limitations, including IDWG as an objective indicator is considered desirable since evaluating program effects based solely on subjective indicators can introduce errors due to self-reporting.

The results of applying the dietary self-care promotion program showed significant differences in serum phosphorus and serum potassium in terms of within-group changes over time, between-group differences at the same time points, and interactions between time and groups. This aligns with the findings of Milazi et al. [54] and Reese et al. [55], however, caution is needed when comparing effects as their study participants were hyperphosphatemia patients. Nevertheless, Milazi et al. [54] reported not only a decrease in serum phosphorus but also a significant increase in self-efficacy for chronic disease management, aligning with the context of our study. Baraz et al.'s [50] study confirmed a decrease in phosphorus levels in both face-to-face and non-face-to-face interventions (video education), and a similar effect was observed in the study by Park & Kim [35], where non-face-to-face intervention played a predominant role. In contrast, serum potassium, which did not show a significant decrease in many studies attempting dietary intervention [21,39,50], demonstrated a significant decrease in Kim & Choi [9]. Kim & Choi [9] conducted needs assessments and provided a program tailored to participants' demands, including individual counseling, suggesting that the observed significant effect in their study could be attributed to meeting the participants' requirements, supporting the context similarity with our study.

The main causes of an increase in serum phosphorus and serum potassium levels are primarily excessive intake [6], and managing these levels is challenging with medication alone, necessitating dietary management [14,56]. However, HD patients, often elderly, face physical changes such as altered taste perception due to aging, making it more difficult to change lifelong dietary habits [57,58]. Moreover, Korean seniors tend to prefer vegetarianism over meat consumption, making potassium regulation more challenging [59]. Therefore, the significant decrease in serum phosphorus and potassium in this study can be interpreted as a positive effect of program participation, reflecting a reduction in dietary intake.

Limitations of this study include the inability to directly observe and correct the process of actual dietary self-care behavior execution, as the study utilized online communities for non-face-to-face intervention. Secondly, the study employed a pre-post experimental design for the randomized control group, aiming to elevate the level of evidence. However, the lack of blinding for intervention providers may have introduced researcher bias. Thirdly, the relatively young average age of study participants (experimental group: 48.1 years, control group: 49.9 years) and the recruitment of participants active in the HD patient community, who are interested in disease management and proficient in Information and Communication Technologies (ICT), may limit the generalizability of study results to the entire population of HD patients.

5. Conclusions

This study aimed to develop and evaluate a dietary self-care promotion program utilizing an online community based on Hurley's self-efficacy model for improving dietary self-care behavior in

 doi:10.20944/preprints202402.1045.v1

HD patients. The research results confirmed the improvement of dietary self-efficacy and the adherence of dietary self-care behavior. Furthermore, objective indicators reflecting the adherence of dietary self-care behavior, such as IDWG, serum phosphorus, and serum potassium, significantly improved. This affirms the clinical applicability of the dietary self-care promotion program. The significance of this study lies in recognizing the potential for improving dietary self-care behavior in HD patients by considering not only education but also enhancing dietary self-efficacy. Moreover, the use of an online community for program implementation enhances patient accessibility and enables self-directed utilization. Additionally, the effectiveness of the program in HD patients undergoing dialysis in challenging environments underscores its importance as an efficient intervention method.

Author Contributions: Conceptualization, M.-K.C. and H.K.; methodology, M.-K.C. and H.K.; software, H.K.; validation, M.-K.C. and H.K.; formal analysis, H.K.; investigation, H.K.; resources, M.-K.C. and H.K.; data curation, M.-K.C. and H.K.; writing—original draft preparation, H.K.; writing—review and editing, M.-K.C. and H.K.; visualization, H.K.; supervision, M.-K.C.; project administration, M.-K.C. and H.K.; funding acquisition, H.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Health Fellowship Foundation (2021).

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Chungbuk National University (No. CBNU-202208-HR-0197, September 2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data sharing not available.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Weekly plan for dietary self-care promotion program.

Session	Contents	Self-efficacy resources	Strategies	Methods
1	Education materials (Subject change every time)	VP, EE	Education about self-care, didactic persuasion, empathize with performance difficulties	Video PDF
	Weekly mission introduction (Mission changes every week)	PA	Perform the task	Homework Write a post
	Recommended to view posts (weekly mission, Q&A)	VE	Indirect experience	Read the post
	Encouraging the practice of dietary self-care	VP, EE	Didactic persuasion, emotional support for performance difficulties	Write a post
	Comments on mission performance and Q&A	VP, EE	Supportive environment, mentoring, didactic persuasion, emotional support for performance difficulties	Add a comment
	Q & A	VP, EE	Supportive environment, personalized counseling, provide correction for improper performance, emotional support	Add a comment

 doi:10.20944/preprints202402.1045.v1

			for performance difficulties	
	Provide music link	EE	Relaxation	Video
2	Education materials (Subject change every time)	VP, EE	Education about self-care, didactic persuasion, empathize with performance difficulties	Video PDF
	Weekly mission reannouncement	PA	Perform the task	Homework Write a post
	MVP Selection and reward	PA	Positive reinforcement	Write a post Awarding of rewards
	Participate in MVP voting	VE	Indirect experience	Participation in voting
	Implementation of sudden mission (Mission changes every week) and awards	VP	Didactic persuasion	Write a post, Recheck education materials Awarding of rewards
	Recommended to view posts (weekly mission, Q&A)	VE	Indirect experience	Read the post
	Watch a video about success stories of dietary self-care in hemodialysis patients or proposal of expert practice	VE, VP, EE	Indirect experience, modeling, providing vivid information related to dietary performance Confirmation of the process of overcoming the difficulties of performing dietary self-care for other hemodialysis patients	Video
	Encouraging the practice of dietary self-care	VP, EE	Didactic persuasion, emotional support for performance difficulties	Write a post
	Comments on mission performance and Q&A	VP, EE	Supportive environment, mentoring, didactic persuasion, emotional support for performance difficulties	Add a comment
	Q & A	VP, EE	Supportive environment Personalized counseling Provide correction for improper performance Emotional support for performance difficulties	Add a comment
	Provide music link	EE	Relaxation	Video

Notes. VP, verbal persuasion; EE, emotional arousal; PA, performance accomplishment; VE, vicarious experience; MVP, most valuable player.

Reference

 doi:10.20944/preprints202402.1045.v1

1. Hong, Y.A., et al., *Trends in epidemiologic characteristics of end-stage renal disease from 2019 Korean Renal Data System (KORDS).* Kidney research and clinical practice, 2021. **40**(1): p. 52.
2. Kim, H. and M.-K. Cho, *Factors influencing self-care behavior and treatment adherence in hemodialysis patients.* International Journal of Environmental Research and Public Health, 2021. **18**(24): p. 12934.
3. Kim, H.K., H. , *Self-care performance, depression and family support in hemodialysis patients.* . Journal of the Korea Academia-Industrial cooperation Society, 2022. **23**(8): p. 628-636.
4. Park, H.H.C., H. K. , *Factors influencing self-management adherence in hemodialysis patients.* . Journal of the Korea Academia-Industrial cooperation Society, 2022. **23(7)**: p. 445-456.
5. Choi, E.-Y., K.-S. Park, and H.-S.Z. Lee, *Factors affecting self-care performance in hemodialysis patients: based on the theory of unpleasant symptoms.* Journal of the Korea Convergence Society, 2019. **10**(6): p. 381-391.
6. Lee, J., *The effect of self-efficacy promotion program on hemodialysis patients self-efficacy, self-care practice and physiologic index.* Jinju: Gyeongsang National University, 2003: p. 1-59.23.
7. Min, Y. and M. Park, *Effects of a mobile-app-based self-management support program for elderly hemodialysis patients.* Healthcare Informatics Research, 2020. **26**(2): p. 93-103.
8. Song, M.R., *The development and test of self-efficacy promotion program on self-care of hemodialysis patients.* Journal of Korean Academy of Nursing, 2000. **30**(4): p. 1066-1077.
9. Kim, S.C., Y., *Effects of a repeated hemodialysis diet education program for older adults.* Korean Journal of Adult Nursing, 2020. **32**(5): p. 515-525.
10. Ganesh, S.K., et al., *Association of elevated serum PO4, Ca× PO4 product, and parathyroid hormone with cardiac mortality risk in chronic hemodialysis patients.* Journal of the American Society of Nephrology, 2001. **12**(10): p. 2131-2138.
11. Kovesdy, C.P., et al., *Serum and dialysate potassium concentrations and survival in hemodialysis patients.* Clinical Journal of the American Society of Nephrology, 2007. **2**(5): p. 999-1007.
12. Song, K.-I., et al., *Survival analysis of elderly hemodialysis patients in a single center.* Korean Journal of Nephrology, 2003: p. 228-236.
13. Suh, M.-R., et al., *Survival analysis of hemodialysis patients: a single center study.* Korean Journal of Nephrology, 2002: p. 636-644.
14. Woo, H.J., et al., *Association of food intake with serum levels of phosphorus and potassium in hemodialysis patients.* Journal of Nutrition and Health, 2014. **47**(1): p. 33-44.
15. Daugirdas, J.T., Blake, P. G., & Ing, T. S., *Handbook of dialysis*. 2018, Alphen aan den: Wolters Kluwer.
16. Denhaerynck, K., et al., *Prevalence and consequences of nonadherence to hemodialysis regimens.* American journal of critical care, 2007. **16**(3): p. 222-235.
17. Park, J.-S., et al., *Relationship between knowledge and adherence to self-management guidelines, and influencing factors of adherence for hemodialysis patients.* The Korean Journal of Rehabilitation Nursing, 2011. **14**(1): p. 39-46.
18. Seo, A.-R., et al., *A validation of dietary self-efficacy questionnaire in hemodialysis patients.* Korean Journal of Health Promotion, 2012: p. 22-30.
19. Lee, J. and D. Noh, *Factors associated with self-care among patients receiving hemodialysis: A cross-sectional observational study.* Research and Theory for Nursing Practice, 2021.
20. Sim, E.-K., & Seo, N.-S. , *A structural equation model on treatment adherence in hemodialysis patients.* Journal of the Korea Academia-Industrial cooperation Society. , 2022. **23(1)**: p. 812-822.
21. Yun, K.S. and J.Y. Choi, *Effects of dietary program based on self-efficacy theory on dietary adherence, physical indices and quality of life for hemodialysis patients.* Journal of Korean Academy of Nursing, 2016. **46**(4): p. 598-609.
22. Tsay, S.L., *Self-efficacy training for patients with end-stage renal disease.* Journal of advanced nursing, 2003. **43**(4): p. 370-375.
23. Kim, J.-S. and H.-S. Shin, *Effects of a discharge education program using on-line community for parents of premature infants.* Child Health Nursing Research, 2010. **16**(4): p. 344-351.
24. Jung Y-J, S.S.-W., Seo J-H, Kim Y-J, Jung D-I, *Mobile Hybrid Application Development Platform.* . Proceedings of the Korea Information Processing Society Conference [Internet], 2020.
25. Moher, D., et al., *CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials.* International journal of surgery, 2012. **10**(1): p. 28-55.
26. Cho, M.K., *Effect of health contract intervention on renal dialysis patients in K orea.* Nursing & health sciences, 2013. **15**(1): p. 86-93.
27. Faul, F., et al., *Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses.* Behavior research methods, 2009. **41**(4): p. 1149-1160.
28. Pack, S. and J. Lee, *Randomised controlled trial of a smartphone application-based dietary self-management program on haemodialysis patients.* Journal of clinical nursing, 2021. **30**(5-6): p. 840-848.
29. Cohen, J., *Statistical power analysis for the behavioral sciences*. 2013: Academic press.
30. Peterson, S. and T.S. Bredow, *Middle range theories: Application to nursing research and practice*. 2019: Lippincott Williams & Wilkins.

 doi:10.20944/preprints202402.1045.v1

31. Bandura, A., W.H. Freeman, and R. Lightsey, *Self-efficacy: The exercise of control*. 1999, Springer.
32. Smailhodzic, E., et al., *Social media use in healthcare: A systematic review of effects on patients and on their relationship with healthcare professionals.* BMC health services research, 2016. **16**(1): p. 1-14.
33. Li, W.-Y., et al., *Mobile health app with social media to support self-management for patients with chronic kidney disease: prospective randomized controlled study.* Journal of medical Internet research, 2020. **22**(12): p. e19452.
34. Kim, S.C., Y. , *The effects of tailored dietary education among role failure hemodialysis patients on self-care compliance, Self-efficacy and physiologic indices.* . The Korean Journal of Rehabilitation Nursing, 2021. **24**(1): p. 46-55.
35. Park, O.L. and S.R. Kim, *Integrated self-management program effects on hemodialysis patients: A quasi-experimental study.* Japan Journal of Nursing Science, 2019. **16**(4): p. 396-406.
36. Khalil, A.A. and M.W. Darawad, *Objectively measured and self-reported nonadherence among J ordanian patients receiving hemodialysis.* Hemodialysis International, 2014. **18**(1): p. 95-103.
37. St-Jules, D.E., et al., *Exploring problems in following the hemodialysis diet and their relation to energy and nutrient intakes: the BalanceWise Study.* Journal of Renal Nutrition, 2016. **26**(2): p. 118-124.
38. Başer, E. and M. Mollaoğlu, *The effect of a hemodialysis patient education program on fluid control and dietary compliance.* Hemodialysis International, 2019. **23**(3): p. 392-401.
39. Kim, S.Y., et al., *The effect of a video dietary instruction program for hemodialysis patients.* Journal of Korean Clinical Nursing Research, 2014. **20**(1): p. 134-145.
40. Kim, C.E. and J.Y. Han, *Effects of individualized diet education program on the dietary knowledge and self-care compliance among hemodialysis patients.* Journal of Korean Clinical Nursing Research, 2016. **22**(3): p. 257-264.
41. Wileman, V., et al., *Evidence of improved fluid management in patients receiving haemodialysis following a self-affirmation theory-based intervention: A randomised controlled trial.* Psychology & health, 2016. **31**(1): p. 100-114.
42. Hashemi, S., et al., *An Investigation of the Effect of Continuous Care Model on Compliance with Dietary and Fluid Restrictions in Hemodialysis Patients: A Clinical Trial Study.* Medical-Surgical Nursing Journal, 2018. **7**(3).
43. McCloskey, C., J. Clarke, and H. Rayner, *Dialysis patients' understanding of nutritional advice.* Journal of Renal Nutrition, 1997. **7**(2): p. 90-101.
44. Yang, F.-J., Y.-H. Hou, and R.-E. Chang, *The Impact of a Social Networking Service–Enhanced Smart Care Model on Stage 5 Chronic Kidney Disease: Quasi-Experimental Study.* Journal of Medical Internet Research, 2020. **22**(4): p. e15565.
45. Cozzolino, M., M. Ketteler, and C.A. Wagner, *An expert update on novel therapeutic targets for hyperphosphatemia in chronic kidney disease: preclinical and clinical innovations.* Expert opinion on therapeutic targets, 2020. **24**(5): p. 477-488.
46. Noori, N., et al., *Association of dietary phosphorus intake and phosphorus to protein ratio with mortality in hemodialysis patients.* Clinical journal of the American Society of Nephrology: CJASN, 2010. **5**(4): p. 683.
47. Park, E.S., *Pathology*. 2019, Gyeonggi-do Paju Soomoonsa.
48. An, G.-J., *Effects of self-care program using SMS, e-mail, or telephone call on self-care compliance and nutritional status in hemodialysis patients.* Journal of Korean biological nursing science, 2009. **11**(2): p. 157-166.
49. Cho, H. and S. Park, *The effects of self-performance management video program on patients receiving hemodialysis.* Japan Journal of Nursing Science, 2020. **17**(2): p. e12303.
50. Baraz, S., et al., *Dietary and fluid compliance: an educational intervention for patients having haemodialysis.* Journal of advanced nursing, 2010. **66**(1): p. 60-68.
51. Chung, S., et al., *Seasonal variation of interdialytic weight gain in Korean hemodialysis patients.* Korean Journal of Nephrology, 2003: p. 426-432.
52. Ipema, K.J., et al., *Causes and Consequences of Interdialytic weight gain.* Kidney and Blood Pressure Research, 2016. **41**(5): p. 710-720.
53. Halle, M.P., et al., *Non-adherence to hemodialysis regimens among patients on maintenance hemodialysis in sub-Saharan Africa: an example from Cameroon.* Renal Failure, 2020. **42**(1): p. 1022-1028.
54. Milazi, M., C. Douglas, and A. Bonner, *A bundled phosphate control intervention (4Ds) for adults with end-stage kidney disease receiving haemodialysis: A cluster randomized controlled trial.* Journal of Advanced Nursing, 2021. **77**(3): p. 1345-1356.
55. Reese, P.P., et al., *A pilot randomized trial of financial incentives or coaching to lower serum phosphorus in dialysis patients.* Journal of Renal Nutrition, 2015. **25**(6): p. 510-517.
56. Tonelli, M., N. Pannu, and B. Manns, *Oral phosphate binders in patients with kidney failure.* New England Journal of Medicine, 2010. **362**(14): p. 1312-1324.
57. Lee, J.W., et al., *The effect of aging on taste thresholds in Korean.* Korean J Otorhinolaryngol-Head Neck Surg, 2013. **56**(5): p. 286-90.
58. Song, M., *Effects of empowerment program on the hemodialysis patients.* Unpublished doctoral dissertation, Kosin University, Busan, 2004.
59. Choi, S., *A study of the nutritional status and its related factors in the elderly hemodialysis patients.* Journal of Nutrition and Health, 2006. **39**(2): p. 133-144.

 doi:10.20944/preprints202402.1045.v1