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Effect of Tele-Nursing Follow-up on Quality of Life and Biochemical Parameters in Hemodialysis Patients

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Abstract

Background: Patients undergoing hemodialysis require continuous care and monitoring to manage their chronic condition effectively. Telephone-based follow-up interventions have increasingly been used to support continuity of care. This study investigated the association of nurse-led telephone follow-up with biochemical indicators and quality of life (QOL) in hemodialysis patients.

Methods: This quasi-experimental single-group pretest-posttest study included 31 hemodialysis patients referred to the dialysis ward of Imam Jafar Sadeq Hospital. Participants were recruited using convenience sampling between 2022 and 2024. All eligible patients meeting the inclusion criteria during the study period were included. The 8-week intervention consisted of structured nurse-led telephone follow-up and text message support. QOL was assessed using the WHOQOL-BREF questionnaire before and two months after the intervention. Interdialytic weight gain and biochemical parameters

were measured before, during, and after the intervention. Data were analyzed using repeated-measures ANOVA and paired t-tests.

Results: Tele-nursing follow-up was associated with changes in interdialytic weight gain, QOL scores, and most biochemical parameters ($P < 0.001$). Changes in BUN and sodium levels were observed only between baseline and post-intervention measurements.

Conclusions: Nurse-led telephone follow-up may serve as a complementary supportive strategy for continuity of care in patients undergoing hemodialysis. The findings indicate potential improvements in QOL, biochemical parameters, and weight control; however, the results should be interpreted with caution, given the quasi-experimental single-group design and relatively small sample size. Further controlled studies are recommended.

Clinical trial number: not applicable

Keywords: Hemodialysis, Compliance, Tele-Nursing, Chronic Kidney Disease, Tele-Health

Introduction

Chronic kidney disease (CKD), particularly end-stage kidney disease (ESKD), is a major global public health concern (1). The number of patients requiring renal replacement therapy continues to increase worldwide (2). In Iran, CKD also represents a considerable healthcare burden, with prevalence rates reported between 5% and 15%, and even higher in some regions (3, 4).

ESKD requires long-term treatment, extensive care, and continuous adaptation to complex therapeutic regimens (5). Non-adherence to treatment may lead to missed or shortened dialysis sessions, improper fluid and dietary restrictions, increased hospitalization and mortality risk, and poorer quality of life (QOL) (6). QOL is an important multidimensional indicator in hemodialysis patients and reflects physical, psychological, social, and environmental well-being (7, 8). Therefore, continuous assessment, patient education, and professional support are essential components of CKD management (9).

Telephone-based care (telehealth) has increasingly been used to support communication between healthcare providers and patients. According to the Nursing Interventions Classification, telephone follow-up includes remote assessment, monitoring, and identification of patient problems after treatment (10). Previous evidence suggests that telehealth may improve access to healthcare services and quality of care while reducing healthcare costs and rehospitalization (11).

However, a systematic review of eHealth interventions in CKD patients reported insufficient evidence regarding the superiority of electronic interventions over conventional care in improving clinical and patient-centered outcomes (12). In addition, most telephone-based care studies have focused on chronic obstructive pulmonary disease, heart failure, and diabetes, whereas evidence among patients with ESKD remains limited (13, 14).

Given the geographic conditions of the present study area, many hemodialysis patients live in remote and underserved regions where access to healthcare services and regular follow-up can be challenging, particularly during cold seasons and adverse weather conditions. Because patients undergoing hemodialysis require regular attendance at dialysis centers, ongoing support between treatment sessions may help address treatment-related concerns and improve adherence to therapeutic recommendations. Despite the increasing use of telehealth, evidence regarding nurse-led telephone follow-up and its association with biochemical outcomes and QOL among hemodialysis patients remains limited, particularly in underserved settings. In addition, to the best of our knowledge, few studies have evaluated this approach in the study region and population. Therefore, this study aimed to investigate the association of nurse-led telephone follow-up with biochemical values and QOL among patients undergoing hemodialysis

Materials and Methods

Study Design and Sample Size

The present study employed a quasi-experimental single-group pretest-posttest design and was conducted between 2022 and 2024 during the winter season (December to February). The study population comprised hemodialysis patients referred to the dialysis ward of Imam Jafar Sadeq Hospital. All patients who met the predefined inclusion criteria during the study period were consecutively recruited using convenience sampling, resulting in a final sample of 31 participants. Because a single-group pretest-posttest design without a control group was used, definitive causal inferences regarding the observed outcomes cannot be established. In addition, no formal sample size calculation was performed; therefore, all eligible and accessible patients during the study period were included.

Participants were included in the study based on the following criteria: they had been on dialysis for more than six months to ensure adaptation to dialysis-related conditions (15-17), were older than 18 years (6, 18, 19), received hemodialysis at least three times a week for at least three hours per session, resided in Aligoudarz or surrounding villages, had access to a phone (mobile or landline), had no known psychological disorders that could potentially affect biochemical indicators, had no speech or hearing impairments, did not have advanced systemic diseases, and were willing to participate in the study. The exclusion criteria included migration, kidney transplantation, or death.

Patients had no conditions that led to hospitalization, emergency hemodialysis, or complications requiring hospitalization, nor did they start any new medications during the study. Also, all participants received routine, non-structured health education as part of standard hemodialysis care before the initiation of the telephone-based follow-up.

Tele-nursing Follow-up Intervention

At the beginning of the study, all participants attended an introductory session conducted by the research team to familiarize them with the intervention procedures and telephone follow-up process. The nurse-led

telephone follow-up intervention was conducted over 8 weeks (18, 20). The intervention consisted of scheduled telephone calls focused on reinforcement of educational content, symptom monitoring, and individualized feedback. Calls were scheduled between 8 AM and 8 PM on non-holiday weekdays according to participants' preferences and staff availability. Each call lasted an average of 20 minutes. Detailed information regarding the educational content, call structure, frequency, and follow-up procedures is presented in Box 1 and Supplementary Material 1.

Outcome Measures

At baseline, data collection tools included a demographic and disease questionnaire (Vascular Access for Hemodialysis, Family History of Kidney Disease, Family History of Dialysis, Hepatitis, HIV/AIDS, Hypertension and diabetes), and WHOQOL-BREF quality of life questionnaire, and a checklist to record biochemical values (urea, creatinine, sodium, potassium, calcium, and phosphorus) and weight gain. Demographic data and participant disease information were gathered from their medical records. After the 8-week intervention, the WHOQOL-BREF quality of life questionnaire was administered again in face-to-face interviews with all participants, just as before the study began. WHOQOL-BREF is a general questionnaire that assesses QOL in four domains: physical health, psychological health, social relationships, and environmental conditions, along with two global questions on overall health and QOL. The questionnaire contains 24 questions rated on a 5-point Likert scale, with higher scores indicating better QOL (21). The Iranian version of the WHOQOL-BREF was validated by Nejat et al. (2006), reporting Cronbach's alpha coefficients above 0.70 for all domains except social relationships ($\alpha=0.55$) (22). In this study, Cronbach's alpha was calculated for each domain: physical health (0.88), psychological health (0.88), social relationships (0.86), and environmental conditions (0.89). The WHOQOL-BREF quality of life questionnaire was completed through face-to-face interviews two months before and after the nurse-led telephone intervention.

Before the intervention, blood samples were taken from all participants to measure biochemical values (urea, creatinine, sodium, potassium, calcium, and phosphorus). Biochemical parameters were monitored and recorded monthly. Blood samples for biochemical measurements were taken by a consistent nurse before each hemodialysis session and analyzed at the Imam Jafar Sadiq Hospital laboratory in Aligoudarz using a BT-1500 autoanalyzer. Weight gain was measured two weeks before the intervention, before each dialysis session, and recorded as a weekly average. Throughout the 8-week intervention, weight gain before each hemodialysis session was recorded, and the weekly average was calculated for analysis. Weight measurements were conducted using a calibrated scale checked daily by the researcher with a 1 kg weight. This study was reported in accordance with the TREND statement for nonrandomized intervention studies (Figure 1).

Statistical Analysis

Data analysis was performed using SPSS version 18 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including frequency distributions, percentages, means, and standard deviations, were used to summarize demographic and clinical characteristics. The Shapiro-Wilk test was used to assess data normality, and the results indicated that biochemical variables, interdialytic weight gain, and QOL dimensions were normally distributed. Changes in weight gain and biochemical variables over time (before, during, and after the intervention) were analyzed using repeated-measures ANOVA. The assumption of sphericity was evaluated using Mauchly's test. When the assumption of sphericity was violated ($p < 0.05$), Greenhouse-Geisser-adjusted degrees of freedom were applied. When Mauchly's test was not significant ($p > 0.05$), standard F-statistics were reported. Following a significant overall time effect, Bonferroni-adjusted pairwise comparisons were conducted to identify differences between measurement time points. Paired t-tests were used to compare QOL scores before and after the intervention, with a significance level set at 0.05. In addition to P-values, effect size measures, including eta squared (η^2) values, were reported where

appropriate to facilitate interpretation of the magnitude of observed changes. No multivariate analysis was performed because of the study design and relatively small sample size.

Results

Participant Characteristics

Of the 42 hemodialysis patients assessed for eligibility, 35 met the inclusion criteria. During the study period, two patients declined participation, one underwent kidney transplantation, and one relocated; therefore, the final analysis included 31 participants. The mean age of the participants was 57.30 ± 17.40 years (minimum 21, maximum 80). Additional demographic and clinical characteristics are presented in Table 1.

Differences in Biochemical Parameters

Significant changes over time were observed in most biochemical parameters during the intervention period (Table 2). Bonferroni-adjusted pairwise comparisons showed that, except for blood urea nitrogen (BUN) and sodium (Na), all biochemical variables demonstrated significant changes during both the intervention and post-intervention assessments compared with baseline values. For BUN and Na, significant differences were observed only between baseline and post-intervention measurements.

Differences in Weight Gain

Interdialytic weight gain demonstrated significant changes over time during the study period (Table 3). Bonferroni-adjusted pairwise comparisons indicated that significant reductions in weight gain became evident during the second month of the intervention compared with baseline measurements.

Differences in QOL

Significant improvements were observed in overall quality of life and all QOL domains following the intervention (Table 4). The largest improvements were identified in the environmental and overall QOL domains.

Discussion

This study aimed to assess the association of tele-nursing follow-up on biochemical parameters and QOL in patients undergoing hemodialysis.

In the present study, tele-nursing follow-up was associated with statistically significant changes in the patients' serum biochemical factors.

Estaji et al. (2016) observed reductions in serum phosphorus and potassium levels following a text message intervention among hemodialysis patients (23). Consistent with these findings, Arad et al. (2021) reported that nurse-led telephone education and follow-up were associated with better treatment adherence and favorable changes in biochemical indicators, including potassium, calcium, creatinine, albumin, iron, and BUN levels (4).

In contrast, Li et al. (2014) and Hayashi et al. (2017) found no significant association between telephone- or smartphone-based interventions and biochemical serum levels in dialysis patients (24, 25). These inconsistent findings may be related to differences in study design, intervention duration, sample size, and patient population. Although the observed biochemical changes were modest, maintaining biochemical balance remains clinically important in patients undergoing hemodialysis because poor control of potassium, phosphorus, and fluid status may increase the risk of complications and hospitalization.

In the current study, tele-nursing follow-up was associated with reduced interdialytic weight gain among participants. Similarly, Hosseini et al. (2016) reported improved control of interdialytic weight gain following telephone consultations in patients undergoing hemodialysis (26), although their study used a different research design. In the present study, significant reductions became evident during the second month of the intervention, whereas Hosseini's intervention lasted only one month. Although interdialytic weight gain decreased, maintaining fluid gain within the recommended range of approximately 2–5% of dry body weight remains clinically important, as both excessive and insufficient fluid accumulation may contribute to adverse clinical outcomes. Improved fluid control may also be clinically relevant

because fluid overload is associated with cardiovascular complications and increased treatment burden in patients undergoing hemodialysis.

The present study suggests that tele-nursing follow-up may be associated with improvements in QOL among patients undergoing hemodialysis. Similar findings were reported by Borzou et al. (2020) in hemodialysis patients (8) and Li et al. (2014) in patients undergoing peritoneal dialysis (24).

Zhianfar et al. (2020) also showed that telephone follow-up combined with peer group sessions was associated with improvements in QOL and better control of interdialytic weight gain among study participants (18). In contrast, Dey et al. (2016) reported no significant association between computer- and phone-based interventions and QOL in patients undergoing peritoneal dialysis (27). These inconsistent findings may partly be explained by differences in intervention design and delivery methods. In Dey's study, telephone follow-up was based on information entered by patients into a tablet-based application, whereas the present study used structured telephone follow-up combined with supportive text messaging.

Structured tele-nursing follow-up may help support patient engagement and self-care behaviors through regular reminders, individualized feedback, and continuous professional support between dialysis sessions

Improvements in QOL may also be clinically meaningful in patients undergoing long-term hemodialysis, as reduced physical and psychosocial burden may support better treatment adherence and patient engagement. However, these findings should be interpreted cautiously because psychological and social variables affecting QOL were not controlled in the present study.

Given the diversity of telehealth approaches and the inconsistent findings across previous studies, the effectiveness of telehealth interventions in patients undergoing hemodialysis remains uncertain. Lunney et al. (2018) highlighted important limitations in telehealth studies for dialysis patients, particularly related to heterogeneous intervention designs and small sample sizes (28).

More recently, Zhou et al. (2025), in a systematic review and meta-analysis of 17 clinical trials, evaluated the effects of telehealth interventions in patients undergoing hemodialysis. The authors reported that most studies used similar eHealth approaches, while several studies employed combined interventions involving two or more telehealth technologies. Intervention duration ranged from 4 weeks to 12 months, with 3 months being the most common follow-up period. Overall, their findings suggested that telehealth interventions may be associated with improvements in QOL and treatment adherence among hemodialysis patients (14).

In the present study, tele-nursing follow-up was implemented as a complementary supportive strategy alongside routine in-person hemodialysis care. Routine face-to-face interactions remain important because they provide opportunities for direct feedback, observation of patients' clinical conditions, and effective patient-provider communication. Considering the geographic challenges and limited access to healthcare services in the study setting, ongoing telephone-based follow-up may provide an additional opportunity for patient education, symptom monitoring, and reinforcement of self-care behaviors between dialysis sessions.

Strengths and Limitations

This study has several limitations that should be considered when interpreting the findings. First, the study used a single-group quasi-experimental pretest-posttest design without a control group, which limits internal validity and precludes definitive causal inferences. Second, the sample size was relatively small, participants were recruited using convenience sampling from a single center, and no formal power analysis was performed, which may limit the generalizability of the findings.

In addition, QOL was assessed using self-reported measures, which may be influenced by response bias and individual perceptions. Psychological, social, and environmental variables that could affect QOL and adherence behaviors were not controlled in the present study. Furthermore, the absence of blinded

assessors and the lack of formal assessment of participants' cognitive or mental status may have affected the reliability of the findings.

Another limitation was the relatively short intervention and follow-up period. Although the 8-week duration was selected based on previous studies demonstrating short-term effects of telehealth interventions, it may not fully capture the long-term impact of nurse-led telephone follow-up on clinical outcomes and quality of life. In addition, multivariate analyses were not performed because of the limited sample size.

Despite these limitations, this study has several strengths. Continuous monitoring of biochemical parameters and interdialytic weight gain enabled individualized and structured telephone follow-up based on patients' ongoing needs. In addition, the study was conducted in a geographically underserved mountainous region where access to healthcare services and continuous follow-up may be challenging for patients undergoing hemodialysis.

The findings suggest that structured tele-nursing follow-up may serve as a complementary supportive strategy alongside routine face-to-face hemodialysis care by facilitating continuity of care, reinforcement of self-care behaviors, and ongoing patient support between dialysis sessions. Future controlled studies with larger sample sizes, longer follow-up periods, and more advanced telehealth approaches are recommended.

Conclusion

The findings of this study suggest that nurse-led tele-nursing follow-up may support continuity of care, patient education, and ongoing monitoring among individuals undergoing hemodialysis, particularly in geographically underserved settings with limited access to healthcare services.

Telephone-based follow-up may provide an additional supportive approach alongside routine face-to-face care and may help improve communication and continuity of support between dialysis sessions

However, because of the quasi-experimental single-group design, convenience sampling method, and relatively small sample size, the findings should be interpreted cautiously and may not be generalized to all

hemodialysis populations. Further controlled studies with larger sample sizes and longer follow-up periods are recommended to confirm these findings.

List of abbreviations

Chronic kidney disease (CKD)

End-stage kidney disease (ESKD)

Quality of life (QOL)

World Health Organization Quality of Life Brief (WHOQOL-BREF)

Blood Urea Nitrogen (BUN)

Sodium (Na)

Declarations

□ Ethics approval and consent to participate

This study was approved by Shahid Beheshti University of Medical Sciences, Tehran, Iran, under the ethical approval code IR.SBMU.PHARMACY.REC.1398.359 (approved on March 2, 2020). Ethical approval was obtained before the initiation of the study in accordance with institutional requirements. Participant recruitment and data collection were conducted between 2022 and 2024. The interval between ethical approval and data collection was primarily due to administrative procedures and inter-institutional coordination required to conduct the study in Lorestan Province, where the research setting was located. These procedures included obtaining official permissions and coordinating with the relevant institutions and authorities before participant recruitment could begin. The study protocol remained unchanged throughout this period, and no changes were made to the study objectives, methodology, participant eligibility criteria, data collection procedures, research setting, implementation conditions, or research team.

All procedures were performed in accordance with the ethical standards of the responsible ethics committee and the Declaration of Helsinki (1975, revised in 2000). Participants were informed about the study objectives

and procedures and provided written informed consent before participation. They were assured that participation was voluntary, that they could withdraw from the study at any time, and that all collected information would remain confidential and used solely for research purposes. Clinical trial registration was not applicable.

□ **Consent for publication**

Not Applicable. Any information that could reveal the identities of the study participants has been omitted or changed.

□ **Availability of data and materials**

The data underlying this article is available upon contacting the corresponding author.

□ **Competing interests**

The authors declare that they have no conflict of interest.

□ **Funding**

The authors did not receive support from any organization for the submitted work.

□ **Authors' contributions**

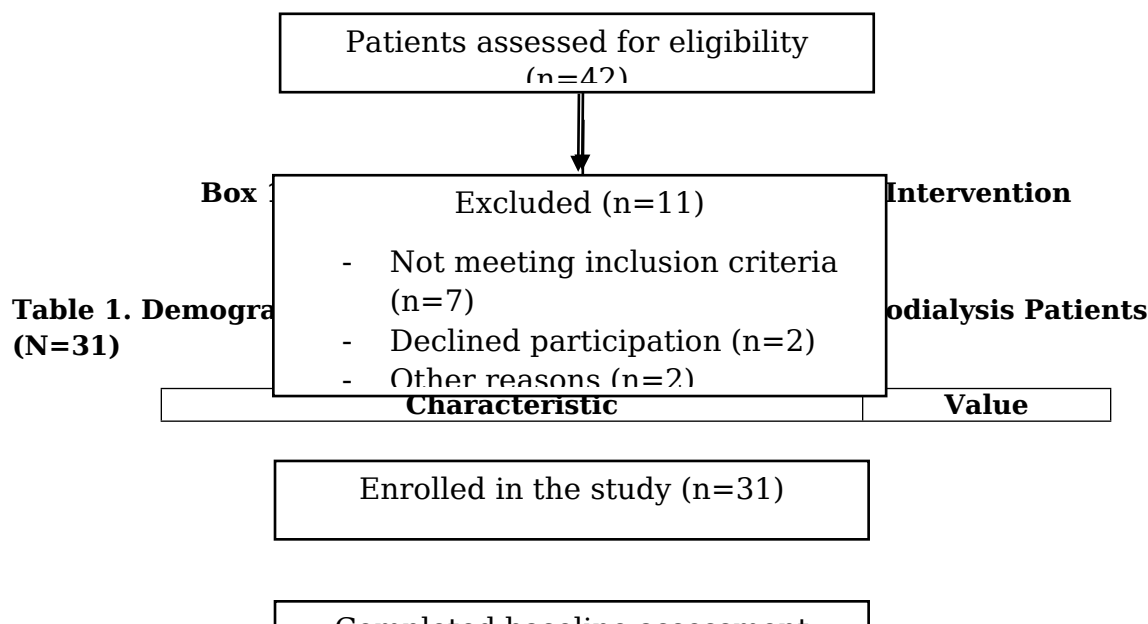
All authors contributed to the study's conception and design. Material preparation was performed by [Fatemeh Estebarsari], data collection was performed by [Arezoo shahsavari], [Sima Hejazi], and analysis was performed by [Arezoo Shahsavari]. The first draft of the manuscript was written by [Fatemeh Estebarsari], and all authors commented on previous versions. All authors read and approved of the final manuscript.

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Intervention Phase	Objectives	Educational Content	Follow-up Activities	Tele-nursing Schedule
First month	Healthy nutrition and weight control	Education regarding renal nutrition, dietary recommendations, interpretation of food labels, meal planning, and selection of affordable and appropriate foods	Assessment of barriers to nutritional self-care, individualized counseling, reinforcement of adherence behaviors, problem-solving support, and answering patient questions	Two telephone follow-up sessions and two text messages per week
Second month	Physical activity, medication adherence, and fistula care	Education regarding walking and simple home-based exercises, medication adherence, and arteriovenous fistula care	Monitoring treatment adherence, identifying medication-related problems and barriers to adherence, individualized recommendations, symptom monitoring, and answering patient questions	One telephone follow-up session and one text message per week

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Figure 1: Flow diagram of participant recruitment and follow-up



Age (years), mean $\pm$ SD	57.30 $\pm$ 17.40
Gender, n (%)	
Male	19 (61.3)
Female	12 (38.7)
Marital status, n (%)	
Single	6 (19.4)
Married	25 (80.6)
Education level, n (%)	
Illiterate	9 (29.0)
Middle school	8 (25.8)
High school diploma	14 (45.2)
Living location, n (%)	
Urban	23 (74.2)
Rural	8 (25.8)
Income status, n (%)	
Sufficient	4 (12.9)
Partially sufficient	23 (74.2)
Insufficient	4 (12.9)
Occupation, n (%)	
Homemaker	10 (32.3)
Self-employed	14 (45.2)
Employee	2 (6.5)
Retired	5 (16.1)
Housing type, n (%)	
Owned	26 (83.9)
Rented	5 (16.1)
Body mass index (kg/m²), mean $\pm$ SD	22.14 $\pm$ 3.94
Duration of hemodialysis (years), mean $\pm$ SD	6.45 $\pm$ 3.23
Vascular access for hemodialysis, n (%)	
Arteriovenous fistula	20 (64.5)
Permacath	11 (35.5)
Family history of kidney disease, n (%)	
Yes	11 (35.5)
No	20 (64.5)
Hypertension, n (%)	
Yes	21 (67.7)
No	10 (32.3)
Diabetes mellitus, n (%)	
Yes	20 (64.5)
No	11 (35.5)

Table 2. Changes in Biochemical Parameters During Telephone Follow-up (N=31)

Variable	Baseline Mean $\pm$ SD	During Intervention Mean $\pm$ SD	Post- Intervention Mean $\pm$ SD	P- value	η^2
BUN	122.29 $\pm$ 30.00	122.13 $\pm$ 30.21	120.39 $\pm$ 29.49	<0.05	0.302
Creatinine	6.99 $\pm$ 2.43	6.85 $\pm$ 2.34	6.54 $\pm$ 2.15	<0.001	0.314
Sodium	138.06 $\pm$ 3.02	137.87 $\pm$ 2.73	137.58 $\pm$ 2.80	0.006	0.178
Potassium	5.41 $\pm$ 0.97	5.17 $\pm$ 0.93	4.99 $\pm$ 0.86	<0.001	0.526
Calcium	9.30 $\pm$ 0.91	9.22 $\pm$ 0.80	9.16 $\pm$ 0.79	<0.001	0.264

Phosphorus	4.14 ± 0.71	4.01 ± 0.72	3.69 ± 0.78	<0.001	0.600
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Footnote: P-values were obtained using repeated-measures ANOVA. Bonferroni-adjusted pairwise comparisons were performed where appropriate.

Table 3. Changes in Interdialytic Weight Gain During Telephone Follow-up in Patients Undergoing Hemodialysis (N=31)

Time Point	Mean ± SD
Baseline	2.59 ± 0.37
Month 1	2.50 ± 0.31
Month 2	2.19 ± 0.33
Post-Intervention	1.96 ± 0.32

Repeated-measures ANOVA demonstrated statistically significant changes in interdialytic weight gain over time ($F = 45.558$, $P < 0.001$, $\eta^2 = 0.603$).

Footnote: Bonferroni-adjusted pairwise comparisons were performed for repeated measurements. Detailed weekly measurements are provided in the Supplementary Material.

Table 4. Quality of Life Scores Before and After Nurse-Led Telephone Follow-up in Hemodialysis Patients (N=31)

QOL Dimension	Baseline Mean ± SD	Post-Intervention Mean ± SD	Mean Difference (Post-Baseline)	P-value*
Physical	15.90 ± 1.35	17.42 ± 1.06	1.516	<0.001
Psychological	13.00 ± 1.41	15.77 ± 1.45	2.774	<0.001
Social Relationships	5.32 ± 0.98	6.06 ± 0.93	0.742	<0.001
Environmental	15.55 ± 1.15	20.00 ± 1.48	4.452	<0.001
General Health	5.58 ± 1.12	5.94 ± 1.06	0.355	<0.05
Overall QOL	55.35 ± 2.42	65.19 ± 2.79	9.839	<0.001

Footnote: *P-values were obtained using paired t-tests

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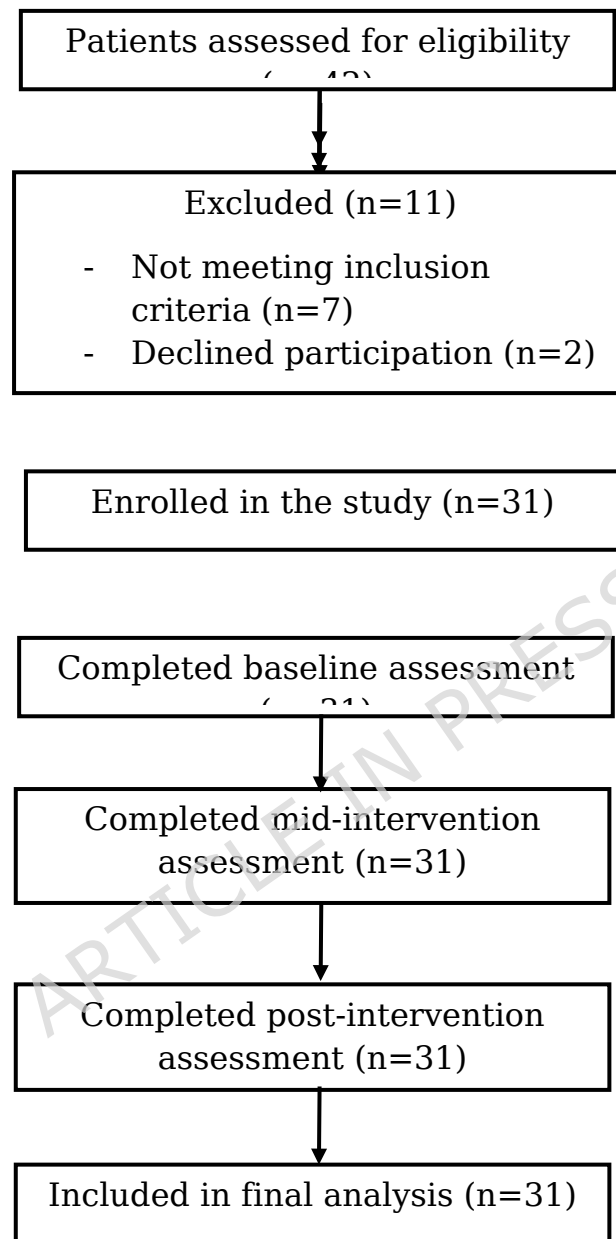
Figure 1: Flow diagram of participant recruitment and follow-up

Table 1. Demographic and Clinical Characteristics of Hemodialysis Patients (N=31)

Characteristic	Value
Age (years), mean $\pm$ SD	57.30 $\pm$ 17.40
Gender, n (%)	
Male	19 (61.3)
Female	12 (38.7)
Marital status, n (%)	
Single	6 (19.4)
Married	25 (80.6)
Education level, n (%)	
Illiterate	9 (29.0)
Middle school	8 (25.8)
High school diploma	14 (45.2)
Living location, n (%)	
Urban	23 (74.2)
Rural	8 (25.8)
Income status, n (%)	
Sufficient	4 (12.9)
Partially sufficient	23 (74.2)
Insufficient	4 (12.9)
Occupation, n (%)	
Homemaker	10 (32.3)
Self-employed	14 (45.2)
Employee	2 (6.5)
Retired	5 (16.1)
Housing type, n (%)	
Owned	26 (83.9)
Rented	5 (16.1)
Body mass index (kg/m²), mean $\pm$ SD	22.14 $\pm$ 3.94
Duration of hemodialysis (years), mean $\pm$ SD	6.45 $\pm$ 3.23
Vascular access for hemodialysis, n (%)	
Arteriovenous fistula	20 (64.5)
Permacath	11 (35.5)
Family history of kidney disease, n (%)	
Yes	11 (35.5)
No	20 (64.5)
Hypertension, n (%)	
Yes	21 (67.7)
No	10 (32.3)
Diabetes mellitus, n (%)	
Yes	20 (64.5)
No	11 (35.5)

Table 2. Changes in Biochemical Parameters During Telephone Follow-up (N=31)

Variable	Baseline Mean $\pm$ SD	During Intervention Mean $\pm$ SD	Post- Intervention Mean $\pm$ SD	P- value	η^2
BUN	122.29 $\pm$ 30.00	122.13 $\pm$ 30.21	120.39 $\pm$ 29.49	<0.05	0.302
Creatinine	6.99 $\pm$ 2.43	6.85 $\pm$ 2.34	6.54 $\pm$ 2.15	<0.001	0.314
Sodium	138.06 $\pm$ 3.02	137.87 $\pm$ 2.73	137.58 $\pm$ 2.80	0.006	0.178
Potassium	5.41 $\pm$ 0.97	5.17 $\pm$ 0.93	4.99 $\pm$ 0.86	<0.001	0.526
Calcium	9.30 $\pm$ 0.91	9.22 $\pm$ 0.80	9.16 $\pm$ 0.79	<0.001	0.264
Phosphorus	4.14 $\pm$ 0.71	4.01 $\pm$ 0.72	3.69 $\pm$ 0.78	<0.001	0.600

Footnote: P-values were obtained using repeated-measures ANOVA. Bonferroni-adjusted pairwise comparisons were performed where appropriate.

Table 3. Changes in Interdialytic Weight Gain During Telephone Follow-up in Patients Undergoing Hemodialysis (N=31)

Time Point	Mean $\pm$ SD
Baseline	2.59 $\pm$ 0.37
Month 1	2.50 $\pm$ 0.31
Month 2	2.19 $\pm$ 0.33
Post-Intervention	1.96 $\pm$ 0.32

Repeated-measures ANOVA demonstrated statistically significant changes in interdialytic weight gain over time ($F = 45.558$, $P < 0.001$, $\eta^2 = 0.603$).

Footnote: Bonferroni-adjusted pairwise comparisons were performed for repeated measurements. Detailed weekly measurements are provided in the Supplementary Material.

Table 4. Quality of Life Scores Before and After Nurse-Led Telephone Follow-up in Hemodialysis Patients (N=31)

QOL Dimension	Baseline Mean $\pm$ SD	Post- Intervention Mean $\pm$ SD	Mean Difference (Post-Baseline)	P-value*
Physical	15.90 $\pm$ 1.35	17.42 $\pm$ 1.06	1.516	<0.001
Psychological	13.00 $\pm$ 1.41	15.77 $\pm$ 1.45	2.774	<0.001
Social Relationships	5.32 $\pm$ 0.98	6.06 $\pm$ 0.93	0.742	<0.001
Environmental	15.55 $\pm$ 1.15	20.00 $\pm$ 1.48	4.452	<0.001
General Health	5.58 $\pm$ 1.12	5.94 $\pm$ 1.06	0.355	<0.05
Overall QOL	55.35 $\pm$ 2.42	65.19 $\pm$ 2.79	9.839	<0.001

Footnote: *P-values were obtained using paired t-tests