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Effects of a Nurse-Led Protein Intake Self-Management Support Program on Serum Albumin among Hemodialysis Patients in Southern Thailand

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Abstract

Hypoalbuminemia is a common nutritional complication among patients undergoing maintenance hemodialysis and is associated with increased morbidity and mortality. Improving dietary protein intake through nursing interventions may help optimize serum albumin levels. This study aimed to evaluate the effects of a nurse-led protein intake self-management support program on serum albumin levels and daily protein intake among patients undergoing hemodialysis using a quasi-experimental two-group pretest–posttest design. Sixty-four adult hemodialysis patients with baseline serum albumin levels of 3.0 - 3.8 g/dL were recruited from two dialysis units in southern Thailand and allocated to an experimental group (n = 32) or a control group (n = 32) using cluster randomization. Unlike conventional nutritional education programs, the intervention integrated nurse-led self-management strategies with active family caregiver involvement to improve dietary protein intake. The experimental group received a 12-week program based on Kanfer and Gaelick-Buys' self-management framework, incorporating goal setting, self-monitoring, self-evaluation, and self-reinforcement with family caregiver involvement. The control group received routine nursing care. Serum albumin levels were obtained from medical records, and dietary protein intake was assessed using a semi-quantitative protein intake frequency questionnaire. Data were analyzed using non-parametric statistical tests. After the intervention, the experimental group showed a significant increase in mean serum albumin from 3.53 ± 0.17 to 3.78 ± 0.16 g/dL ($p < 0.001$), and mean daily protein intake increased from 36.47 ± 9.69 to 64.34 ± 9.17 g/day ($p < 0.001$). Furthermore, compared with the control group, the experimental group demonstrated significantly higher mean serum albumin (3.78 ± 0.16 vs. 3.57 ± 0.29 g/dL; $p < 0.01$) and daily protein intake (64.34 ± 9.17 vs. 38.66 ± 5.67 g/day; $p < 0.001$). These findings indicate that a structured, nurse-led, protein-intake self-

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management support program with family involvement effectively improved dietary protein intake and serum albumin levels among hemodialysis patients.

Keywords: Family involvement, Hemodialysis, Protein intake, Renal nursing, Self-management, Serum albumin

Introduction

Chronic kidney disease (CKD) represents a major global public health challenge, affecting approximately 10% of the adult population worldwide and contributing substantially to morbidity, mortality, and healthcare expenditure (Kovesdy, 2022). In Thailand, the burden of CKD is particularly pronounced, with an estimated 11.6 million people (17.5% of the population) affected by CKD (Kanjanabuch & Takkavatakarn, 2020). As CKD progresses to end-stage renal disease (ESRD), renal replacement therapy becomes necessary, including hemodialysis, peritoneal dialysis, and kidney transplantation. Among these treatment modalities, hemodialysis remains the most commonly utilized in Thailand, accounting for approximately 76% of patients receiving renal replacement therapy (Thai Society of Nephrology, 2020). Although hemodialysis is effective in correcting metabolic and electrolyte imbalances, it is associated with multiple long-term complications, among which nutritional deterioration is particularly prevalent and clinically significant.

Hypoalbuminemia is one of the most common nutritional complications observed in patients undergoing maintenance hemodialysis. International studies have reported prevalence rates ranging from 45% to over 90% (Azzeh, 2022; Badrasawi et al., 2021; Gurung, 2024). Although prevalence estimates vary according to the serum albumin cut-off used, hypoalbuminemia remains a significant concern in Thailand. Recent national registry data indicated that 30.6% of incident dialysis patients had serum albumin levels below 3.5 g/dL (Satirapoj et al., 2025). Serum albumin is widely recognized as a key indicator of nutritional status and a strong predictor of clinical outcomes in hemodialysis populations. Low serum albumin levels are associated with increased risks of infection, hospitalization, impaired immune function, reduced quality of life, and increased all-cause mortality (Ikizler et al., 2020). Evidence from recent studies indicates that lower serum albumin levels are consistently associated with increased risks of hospitalization, cardiovascular complications, infection, and all-cause mortality among patients undergoing maintenance hemodialysis. Serum albumin levels below 3.5 g/dL are commonly considered indicative of increased clinical risk and poorer prognosis (Öneç et al., 2026). Although serum albumin may also be influenced by inflammation, infection, hydration status, and other clinical conditions, it remains one of the most widely used prognostic and nutritional indicators in hemodialysis care. Because inadequate dietary protein intake is a major modifiable contributor to hypoalbuminemia, serum albumin was considered a clinically relevant primary outcome for evaluating the effectiveness of the present intervention. The etiology of hypoalbuminemia in hemodialysis patients is multifactorial. Inadequate dietary protein intake is a primary contributor (Gurung, 2024). In addition, hemodialysis itself results in amino acid losses, with approximately 4 - 13 g of amino acids lost per session, representing nearly 6% - 7% of

daily protein intake (Post et al., 2022). Chronic low-grade inflammation induced by blood–dialyzer membrane interactions further suppress albumin synthesis and accelerates protein catabolism (Marini et al., 2020). Hypoalbuminemia also contributes to adverse hemodynamic consequences, including interstitial fluid shifts, edema, and intradialytic hypotension, which may be life-threatening in severe cases (Post et al., 2022).

Clinical practice guidelines consistently emphasize adequate dietary protein intake as a cornerstone of nutritional management in patients undergoing maintenance hemodialysis. Current evidence-based nutrition guidelines recommend a daily protein intake of approximately 1.1 - 1.4 g/kg of ideal (dry) body weight for patients undergoing maintenance hemodialysis to prevent protein–energy wasting and maintain nutritional status (Ikizler et al., 2020). In addition to quantity, protein quality is increasingly recognised as critical. High-quality protein sources that provide all indispensable amino acids and demonstrate high digestibility, as assessed by contemporary protein quality indicators such as the Protein Digestibility–Corrected Amino Acid Score (PDCAAS) and the Digestible Indispensable Amino Acid Score (DIAAS), are recommended for patients undergoing hemodialysis (Gaudichon, 2024). International nutrition guidelines emphasize the importance of continuous, individualized dietary counseling delivered by multidisciplinary care teams rather than single-session education (Ikizler et al., 2020). Despite these clear recommendations, many patients on maintenance hemodialysis fail to achieve adequate protein intake, both in quantity and quality. Barriers include limited nutritional knowledge, difficulty estimating portion sizes, concerns regarding phosphorus and potassium content, reduced appetite, altered taste perception, repetitive meal patterns, and dietary fatigue (Gurung, 2024). Moreover, the majority of hemodialysis patients are older adults with multiple comorbidities, leading to declining physical function and increased reliance on family members for food preparation and daily care (Sirijavin & Wichaita, 2022). These interrelated factors pose substantial challenges to sustained dietary adherence and underscore the need for more comprehensive and supportive nutritional interventions.

Renal nurses play a pivotal role in addressing nutritional challenges among patients undergoing maintenance hemodialysis. Beyond technical dialysis procedures, renal nursing practice encompasses nutritional assessment, patient education, behavioral support, and long-term monitoring of self-care behaviors that directly influence clinical outcomes. Self-management frameworks conceptualize patients as active participants in their care, emphasizing goal setting, self-monitoring, self-evaluation, and self-reinforcement as key processes for sustaining health-related behavior change (Kanfer & Gaelick-Buys, 1991). From a behavioral science perspective, dietary adherence in long-term hemodialysis is influenced not only by knowledge but also by self-regulatory capacity, motivation, and social support. Self-management theory posits that individuals regulate their behaviors through continuous monitoring, evaluation, and adjustment to achieve desired health outcomes (Kanfer & Gaelick-Buys, 1991). In chronic illness contexts, interventions incorporating structured goal setting, feedback, and reinforcement have demonstrated superior outcomes compared with information-based education alone (Lorig & Holman, 2003). Previous studies have demonstrated that self-management–based interventions can improve dietary behaviors and nutritional outcomes among hemodialysis

patients. However, existing interventions have several limitations. Many focus primarily on patient-directed education, provide general nutritional information rather than targeting protein intake specifically, and offer limited ongoing behavioural support (Pianprasith et al., 2022; Srisarn & Duangmatphon, 2023).

For patients undergoing hemodialysis, family members constitute a critical component of the social environment, influencing food availability, meal preparation, and dietary decision-making. Integrating family caregivers into self-management interventions may therefore enhance self-efficacy and facilitate sustained improvements in dietary behavior. However, despite its recognized importance, family involvement has often been inadequately integrated into intervention design. This issue is particularly relevant within the Thai cultural context, where family members frequently assume responsibility for food selection, meal preparation, and daily caregiving. Evidence indicates that family-supported dietary interventions are more effective than patient-only approaches in promoting sustained behavior change among patients with chronic kidney disease (Tazeem et al., 2024). Nevertheless, research specifically examining structured, protein-focused self-management interventions with active family caregiver involvement remains limited, particularly in Thailand.

Importantly, the present intervention differs from previously reported nutritional programs in several respects. First, the program was led by renal nurses, who maintained continuous contact with patients throughout routine hemodialysis care and were therefore well positioned to provide ongoing behavioural support. Second, the intervention focused specifically on improving dietary protein intake rather than providing general nutritional education. Third, the program was explicitly grounded in self-management theory, incorporating structured goal setting, self-monitoring, self-evaluation, and self-reinforcement strategies. Finally, family caregivers were actively engaged throughout the intervention process to support food selection, meal preparation, and adherence to protein intake goals. By integrating these components, the intervention addresses behavioural, social, and practical barriers that are often insufficiently addressed in conventional nutritional interventions for hemodialysis patients.

Taken together, existing evidence supports the effectiveness of nutritional education and self-management interventions for improving dietary behaviors among patients undergoing hemodialysis. However, several important gaps remain. Many previous interventions have focused on general nutritional counseling, short-term education, or patient-directed approaches, with limited emphasis on dietary protein intake as a specific nutritional target. Furthermore, family caregivers, who play a critical role in food selection, meal preparation, and dietary adherence, have often been inadequately integrated into intervention design. The present study addresses these gaps through a nurse-led protein intake self-management support program that combines theory-based behavioral strategies, including goal setting, self-monitoring, self-evaluation, and self-reinforcement, with active participation by family caregivers. Unlike conventional nutrition education programs, this intervention specifically targets dietary protein intake, a key modifiable determinant of hypoalbuminemia, and uses renal nurses as primary facilitators during routine hemodialysis care. To our knowledge, few studies have simultaneously integrated nurse-led delivery, protein-focused dietary management, structured self-

management strategies, and family support among hemodialysis patients, particularly within the Thai healthcare context. Therefore, this study was conducted to evaluate the effects of a nurse-led protein intake self-management support program on serum albumin levels and daily protein intake among patients undergoing maintenance hemodialysis in Southern Thailand.

Research objectives

To evaluate the effects of a nurse-led protein intake self-management support program on serum albumin levels and daily protein intake among patients undergoing hemodialysis. The specific objectives were as follows:

1) To compare mean serum albumin levels in the experimental group before and after the nurse-led protein intake self-management support program.

2) To compare mean serum albumin levels between the experimental and control groups after the nurse-led protein intake self-management support program.

3) To compare mean daily protein intake in the experimental group before and after the nurse-led protein intake self-management support program.

4) To compare mean daily protein intake between the experimental and control groups after the nurse-led protein intake self-management support program.

Methodology

Research design and setting

A quasi-experimental two-group pretest–posttest design was employed to evaluate the effects of a nurse-led protein intake self-management support program on serum albumin levels and daily protein intake among patients undergoing maintenance hemodialysis. This design was considered appropriate for evaluating nursing interventions in real-world clinical settings where individual-level randomization is not always feasible (Buatong et al., 2021; Achmad et al., 2022).

The study was conducted in two hemodialysis units located in Nakhon Si Thammarat Province, southern Thailand. These units were purposively selected because they served large numbers of patients undergoing maintenance hemodialysis and had comparable clinical routines and organizational structures. Group allocation was performed using cluster randomization via a lottery method, with each hemodialysis unit treated as a cluster. One unit was randomly assigned to the experimental group and the other to the control group to minimize contamination between groups.

Participants

The target population comprised adults with chronic kidney disease receiving maintenance hemodialysis. Participants were eligible for inclusion if they met the following criteria: (1) aged 40-80 years; (2) receiving maintenance hemodialysis for at least three months; (3) having baseline serum albumin levels between 3.0 and 3.8 g/dL, classified as hypoalbuminemia or pre-hypoalbuminemia (Marini et al., 2020); and (4) able to consume food orally. Patients who required enteral tube feeding,

had advanced liver cirrhosis, or were in terminal or end-of-life conditions were excluded. In addition, patients hospitalized for more than 1 week during the intervention period were excluded.

Sample size was calculated using G*Power software version 3.1.9.4. Based on an effect size of 0.70 derived from previous dietary and self-management intervention studies among hemodialysis patients (Achmad et al., 2022), a power of 0.80, and a significance level of 0.05, a minimum of 26 participants per group was required. To account for potential attrition, the sample size was increased by 20%, resulting in 32 participants per group and a total of 64 participants.

To enhance comparability between groups, a matched-pairs technique was applied based on age, number of comorbidities, and baseline serum albumin levels, consistent with prior hemodialysis research (Buatong et al., 2021). The two hemodialysis units were then assigned to either the experimental or the control group using a simple randomization lottery.

Instrumentation

Dietary protein intake assessment

Dietary protein intake was assessed using a semi-quantitative protein intake frequency questionnaire adapted from the Oxford WebQ dietary assessment tool (Greenwood et al., 2019) and modified to reflect protein-rich foods commonly consumed by Thai hemodialysis patients. The questionnaire included 10 protein-containing food categories, including eggs, poultry, fish, seafood, red meat, dairy products, soy products, and protein supplements. Participants reported both the amount consumed, using standardized household measures, and the frequency of consumption during the previous week (never = 0; 1 - 2 days = 1; 3 - 4 days = 2; 5 - 6 days = 3; daily = 4).

To improve accuracy and reduce reporting variability, data were collected through interviewer-administered interviews conducted by a trained dialysis nurse, who used standardized visual aids and household measurement references. Weekly intake frequencies were converted into average daily consumption, and protein intake was calculated using standardized Thai food composition tables and protein exchange values. The total protein intake from all reported food sources was summed and expressed as grams per day. Content validity was evaluated by five experts, yielding a content validity index of 0.99. Reliability testing among 30 hemodialysis patients demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.77.

Serum albumin measurement

Serum albumin levels were obtained from routine laboratory records maintained by the dialysis units. Although serum albumin may be influenced by inflammation, infection, hydration status, and other clinical conditions, it remains one of the most widely used biochemical and prognostic indicators in hemodialysis populations (Ikizler et al., 2020). To reduce potential confounding, patients with advanced liver cirrhosis, terminal illness, or hospitalization for more than one week during the intervention period were excluded.

Educational materials

A patient-family educational manual was developed to support home-based dietary self-management. The manual addressed: (1) fundamentals of hemodialysis care; (2) the physiological role and clinical benefits of protein intake in hemodialysis patients, including recommended intake levels; and (3) practical guidance on high-quality protein sources, portion size estimation, and the selection, preparation, and distribution of protein-rich foods. It also included daily protein intake recording sheets. Patients and their caregivers used the manual for review and to record protein intake at home. The content validity of the educational manual was evaluated by five experts, yielding a CVI of 0.98.

Protein intake self-management support program

A structured protein intake self-management support program delivered by renal nurses over a 12-week period. The intervention was grounded in the self-management framework proposed by Kanfer and Gaelick-Buys (1991), which conceptualizes behavior change as a process involving four core components: Goal setting, self-monitoring, self-evaluation, and self-reinforcement. The program consisted of six structured sessions conducted during routine hemodialysis visits to maximize feasibility and minimize participant burden. Both patients and their primary family caregivers were invited to participate. Each session focused on progressively building knowledge, skills, and self-regulatory capacity related to dietary protein intake. Core intervention content included: (1) basic knowledge of chronic kidney disease and hemodialysis, with emphasis on nutrition-related complications; (2) recommended dietary protein intake for patients undergoing maintenance hemodialysis, based on national and international clinical practice guidelines (Ikizler et al., 2020); and (3) practical application of self-management strategies, including setting individual protein intake goals, monitoring daily protein consumption, evaluating progress, and applying reinforcement strategies to maintain adherence. The content validity of the intervention protocol was evaluated by five experts, yielding a CVI of 0.96.

Ethical consideration

This study was approved by the Human Research Ethics Committee of Walailak University (Approval No. WUEC-25-159-01). All participants provided written informed consent prior to participation. The study adhered to internationally accepted ethical principles for research involving human participants, including respect for autonomy, confidentiality, and beneficence.

Data collection

Following approval from the Human Research Ethics Committee of Walailak University and authorization from the participating hospitals, eligible participants were identified from dialysis unit records. A trained research assistant, who was a registered dialysis nurse, received one day of training from the researcher on interview procedures and standardized documentation using the study questionnaires.

Eligible participants in both groups were approached on their scheduled hemodialysis days. The researcher provided detailed explanations regarding the study procedures, ethical considerations, and participant rights, and written informed consent was obtained prior to data collection. Baseline demographic and clinical data, as well as serum albumin levels, were extracted from medical records by the researcher. Dietary protein intake was assessed by the research assistant through individual face-to-face interviews using a semi-quantitative protein intake frequency questionnaire.

During the implementation phase, participants in the experimental group received a structured self-management program for protein intake, delivered by renal nurses in six sessions over 12 weeks. Each session lasted approximately 30–45 minutes and was delivered face-to-face during routine hemodialysis visits. Family caregivers attended educational and goal-setting sessions and participated in home-based monitoring activities. Participants in the control group received routine nursing care in accordance with standard dialysis unit protocols, including routine clinical assessment and monitoring, as well as general dietary advice provided before, during, and after hemodialysis sessions. No structured self-management strategies or family-based components were included in the control condition.

Post-intervention data collection was conducted at week 12. Serum albumin levels were retrieved from laboratory records, and dietary protein intake was reassessed using the same questionnaire and interview procedures.

Data analysis

Data were analyzed using SPSS software. Descriptive statistics were used to summarize participant characteristics. Baseline equivalence between the experimental and control groups was examined using Chi-square or Fisher's exact tests for categorical variables, and Mann–Whitney U tests for continuous variables.

Given the non-normally distributed data and quasi-experimental design, within-group comparisons were conducted using the Wilcoxon signed-rank test, while between-group comparisons were analyzed using the Mann–Whitney U test. Statistical significance was set at $p < 0.05$.

Results and discussion

Results

Demographic and characteristics

A total of 64 patients undergoing maintenance hemodialysis participated in the study, with 32 participants allocated to the experimental group and 32 to the control group. Overall, 60.9% of participants were female, and the mean age was 65.53 years (SD = 10.99; range 40 - 80 years). Most participants were older adults aged 60 - 80 years (71.9%). The mean dry body weight was 59.8 kg (SD = 12.67), and the mean duration of hemodialysis was 5.4 years (SD = 3.6) (**Table 1**).

Comorbidities and baseline clinical status

Most participants had three to four comorbid conditions (78.1%). Hypertension was present in all participants (100%), followed by diabetes mellitus (87.5%) and dyslipidemia (76.7%). The mean baseline serum albumin level was 3.54 g/dL (SD = 0.17), and the mean daily protein intake was 37.84 g/day (SD = 10.26) (**Table 1**).

Baseline comparability between groups

Baseline comparisons demonstrated no statistically significant differences between the experimental and control groups in demographic characteristics, clinical variables, serum albumin levels, or daily protein intake, indicating baseline equivalence between groups (**Table 1**).

Table 1 Demographic and clinical characteristics of participants (n = 64).

Characteristic	Experimental (n = 32)	Control (n = 32)	*p*-value
Age (years), mean ± SD	65.88 ± 11.32	65.19 ± 10.81	0.752[b]
Female, n (%)	20 (62.5)	19 (59.4)	0.798[a]
Dry weight (kg), mean ± SD	60.3 ± 10.5	59.2 ± 14.7	0.740[b]
Duration of hemodialysis (years), mean ± SD	5.4 ± 3.6	5.3 ± 3.7	0.953[b]
≥ 3 comorbidities, n (%)	25 (78.1)	25 (78.1)	1.000[a]
Serum albumin (g/dL), mean ± SD	3.53 ± 0.17	3.55 ± 0.17	0.437[b]
Daily protein intake (g/day), mean ± SD	36.47 ± 9.69	39.21 ± 10.79	0.204[b]

[a] Chi-square test, [b] Mann–Whitney U test

Effects of the intervention on protein intake

Within the experimental group, mean daily protein intake increased significantly from 36.47 ± 9.69 g/day at baseline to 64.34 ± 9.17 g/day after the intervention ($p < 0.001$). No significant change in daily protein intake was observed in the control group ($p = 0.183$). Post-intervention comparisons showed that the experimental group had significantly higher daily protein intake than the control group (64.34 ± 9.17 g/day vs. 38.66 ± 5.67 g/day, $p < 0.001$) (**Table 2**).

Effects of the intervention on serum albumin levels

Within the experimental group, mean serum albumin levels increased significantly from 3.53 ± 0.17 g/dL at baseline to 3.78 ± 0.16 g/dL after the 12-week intervention ($p < 0.001$). In contrast, no significant change in serum albumin levels was observed in the control group over the same period ($p = 0.214$). Post-intervention comparisons showed that serum albumin levels were significantly higher in the experimental group than in the control group (3.78 ± 0.16 vs. 3.57 ± 0.29 g/dL, $p < 0.01$) (**Table 2**).

Table 2 Effects of the nurse-led protein intake self-management support program on serum albumin levels and daily protein intake.

Outcome variable	Group	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Within-group *p*-value†	Between-group *p*-value‡
Serum albumin (g/dL)	Experimental (n = 32)	3.53 ± 0.17	3.78 ± 0.16	< 0.001	< 0.01
	Control (n = 32)	3.55 ± 0.17	3.57 ± 0.29	.214	
Daily protein intake (g/day)	Experimental (n = 32)	36.47 ± 9.69	64.34 ± 9.17	< 0.001	< 0.001
	Control (n = 32)	39.21 ± 10.79	38.66 ± 5.67	0.183	

† Wilcoxon signed-rank test (within-group comparison)

‡ Mann–Whitney U test (post-intervention comparison between groups)

Overall, participants who received the nurse-led protein intake self-management support program demonstrated statistically significant improvements in both serum albumin levels and daily protein intake after the intervention, whereas participants receiving routine nursing care showed no significant changes.

Discussion

This study demonstrated that a nurse-led protein intake self-management support program with active family caregiver involvement significantly improved both dietary protein intake and serum albumin levels among patients undergoing maintenance hemodialysis. Participants receiving the intervention achieved protein intake levels closer to current nutritional recommendations and demonstrated clinically meaningful improvements in serum albumin compared with those receiving routine nursing care. These findings suggest that integrating structured self-management strategies with ongoing nurse support and family participation may be an effective approach for addressing nutritional challenges in hemodialysis populations. Importantly, the present study extends existing evidence by evaluating a protein-focused intervention that combines behavioral self-management principles with active family engagement, an approach that has received limited attention in previous hemodialysis nutrition research, particularly in Thailand.

Demographic and clinical characteristics

The demographic and clinical characteristics of the participants are consistent with profiles reported in national and international hemodialysis studies. Most participants were older adults with multiple comorbidities, particularly hypertension and diabetes mellitus, which are the leading causes of chronic kidney disease in Thailand (Thai Society of Nephrology, 2020). The prolonged duration of hemodialysis observed among participants reflects long-term exposure to treatment-related nutritional challenges. Baseline serum albumin levels were within the hypoalbuminemic or pre-hypoalbuminemic range, reinforcing evidence that nutritional risk remains highly prevalent among

patients receiving maintenance hemodialysis (Akhlaghi et al., 2020; Azzeh, 2022; Badrasawi et al., 2021).

Protein intake

At baseline, mean daily protein intake was substantially below recommended levels for patients undergoing maintenance hemodialysis. Current clinical guidelines recommend a daily protein intake of 1.1 - 1.4 g/kg of ideal (dry) body weight to prevent protein–energy wasting and maintain nutritional status (Ikizler et al., 2020). The inadequate baseline intake observed in this study aligns with previous reports of persistent protein insufficiency despite routine dietary counseling (Gurung, 2024). Contributing factors include limited nutritional knowledge, dietary restrictions related to phosphorus control, reduced appetite, altered taste perception, and reliance on family members for food preparation and daily care (Sirijavin & Wichaita, 2022).

Following the intervention, participants in the experimental group demonstrated substantial improvements in daily protein intake, reaching levels aligned with guideline recommendations. Importantly, the improvement reflected not only an increase in total protein intake but also an enhanced selection of high-quality protein sources appropriate for hemodialysis patients. The integration of self-management strategies—goal setting, self-monitoring, self-evaluation, and self-reinforcement—appears to have facilitated the translation of nutritional knowledge into sustained dietary behavior change. These findings are consistent with previous studies demonstrating the effectiveness of self-management–based interventions in improving dietary adherence among patients with chronic kidney disease (Pianprasith et al., 2022; Srisarn & Duangmatphon, 2023).

Recent international studies have similarly demonstrated the effectiveness of behavioral nutrition interventions among hemodialysis patients. For example, interventions incorporating individualized dietary counseling, self-monitoring tools, and continuous follow-up have been associated with significant improvements in dietary adherence, nutritional knowledge, and biochemical indicators of nutritional status (Achmad et al., 2022; Peng et al., 2025; Zhang & Xia, 2024; Ma et al., 2025). Systematic reviews have further shown that nutrition education combined with behavioral support strategies is more effective than conventional education alone in improving dietary outcomes among patients receiving maintenance hemodialysis (Tazeem et al., 2024; Sarmadi et al., 2026; Ma et al., 2025). Consistent with these findings, the present intervention emphasized continuous behavioral reinforcement rather than one-time dietary education. However, the incorporation of structured family caregiver involvement and theory-based self-management components may explain the magnitude of improvement observed in both protein intake and serum albumin levels (Escudero-Lopez et al., 2024; Pal et al., 2024; Yasin et al., 2024).

Serum albumin levels

The significant increase in serum albumin levels observed in the experimental group further highlights the clinical relevance of the intervention. Serum albumin is a well-established indicator of nutritional status and a strong predictor of morbidity and mortality in hemodialysis populations

(Ikizler et al., 2020; Öneç et al., 2026). Even modest improvements in serum albumin have been associated with reduced risks of hospitalization and mortality. The findings of this study support existing evidence that nutritional interventions targeting dietary protein intake can improve serum albumin levels among patients undergoing maintenance hemodialysis.

Furthermore, this result is consistent with recent international evidence synthesized in a systematic review and meta-analysis by Tazeem et al. (2024), which reported that nutritional education and dietary support interventions were associated with improved nutritional indicators among hemodialysis patients. The present study extends this evidence by demonstrating that a nurse-led, self-management–based intervention with active family caregiver involvement can achieve similar improvements within routine clinical practice.

Although serum albumin is widely recognized as a nutritional marker, it is also influenced by inflammation, infection, hydration status, and other clinical factors. Therefore, improvements in serum albumin should be interpreted cautiously and considered within the broader clinical context. Nevertheless, serum albumin remains one of the most widely accepted prognostic indicators in hemodialysis populations and is strongly associated with hospitalization, morbidity, and mortality. The increase in serum albumin from 3.53 to 3.78 g/dL may be clinically meaningful, as serum albumin concentrations below 3.5 g/dL have consistently been associated with increased risks of hospitalization and mortality among hemodialysis patients. Therefore, the observed improvement suggests not only enhanced nutritional status but also potential improvements in long-term clinical outcomes.

Role of family involvement and nurse-led self-management support

A key strength of the intervention lies in its emphasis on family involvement. Nearly all participants lived with family members, reflecting Thailand's sociocultural context of care. Family caregivers played an essential role in selecting food, preparing meals, and reinforcing dietary goals, thereby addressing practical barriers to adequate protein intake. This collaborative approach aligns with evidence indicating that family-supported dietary interventions are more effective at sustaining behavior change among patients with chronic kidney disease than patient-only approaches (Pianprasith et al., 2022; Tazeem et al., 2024). Unlike many previous nutritional interventions that focused primarily on education alone, the present program combined behavioral self-management strategies with active family participation, which may explain the magnitude of improvement observed in both protein intake and serum albumin levels. From a renal nursing perspective, these findings underscore the importance of engaging family members as partners in nutritional care.

The intervention's effectiveness may be explained by its grounding in self-management and social cognitive theories. By enabling patients to set achievable dietary goals, monitor protein intake, and receive feedback with family support, the intervention likely enhanced self-efficacy and behavioral regulation—key determinants of sustained behavior change (Bandura, 1997; Lorig & Holman, 2003). These findings support theoretical and empirical evidence suggesting that

interventions that address both individual self-regulation and social support mechanisms are more effective for chronic disease management than information-based or patient-only approaches.

The observed improvements in dietary protein intake and serum albumin levels are also consistent with international guidelines that emphasize proactive, continuous nutritional management as a core component of hemodialysis care (Ikizler et al., 2020). Rather than relying solely on dietitian-led counseling, this study demonstrates that renal nurses can operationalize guideline recommendations by delivering structured self-management support during routine dialysis sessions. This approach may enhance the feasibility and sustainability of guideline implementation, particularly in settings with limited access to specialized nutritional resources.

Overall, the nurse-led nature of the intervention is highly relevant to renal nursing practice. Renal nurses are well-positioned to conduct nutritional assessments, provide individualized education, support self-management behaviors, and coordinate care with family caregivers. Integrating structured nutritional self-management support into routine hemodialysis care enables nurses to address modifiable nutritional risk factors and contribute meaningfully to improved patient outcomes, reinforcing the expanding role of renal nursing in chronic disease management beyond technical dialysis procedures.

Strengths and Limitations

This study has several notable strengths. First, the intervention was grounded in a well-established self-management framework and delivered by renal nurses, enhancing both theoretical rigor and clinical relevance. Second, the program incorporated active involvement of family caregivers, reflecting real-world care contexts, particularly in cultures where family members play a central role in dietary management and daily support. Third, the use of an objective clinical outcome measure—serum albumin levels obtained from routine laboratory records—strengthens the validity and reliability of the findings. In addition, matched-group allocation and baseline equivalence between the experimental and control groups support the study's internal validity.

Several limitations should be considered when interpreting the findings. First, the quasi-experimental design and cluster allocation limit the ability to establish definitive causal relationships compared with randomized controlled trials. Second, the study was conducted in only two hemodialysis units within a single province, which may limit generalizability to other populations and healthcare settings. Third, dietary protein intake was assessed using a self-reported questionnaire and interviewer-administered recall procedures, which may be subject to recall bias and social desirability bias. Consequently, actual dietary protein intake may have been underreported or overreported. Fourth, although serum albumin was selected as the primary outcome because of its clinical relevance and prognostic value, albumin concentrations may also be influenced by inflammation, infection, hydration status, and other non-nutritional factors. Inflammatory biomarkers such as C-reactive protein were not measured; therefore, the contribution of inflammatory processes to changes in serum albumin could not be fully evaluated. Despite these limitations, the use of

validated instruments, objective laboratory outcomes, matched-group allocation, and standardized data collection procedures strengthens the credibility of the findings.

Future research should examine the long-term sustainability of dietary behavior changes and improvements in serum albumin beyond the intervention period. Incorporating booster sessions or ongoing follow-up support may help maintain adherence over time. Studies with larger, multi-center samples and randomized designs are recommended to strengthen generalizability. Additionally, evaluating the effects of similar nurse-led, family-supported interventions on broader clinical outcomes—such as hospitalization rates, quality of life, and functional status—would further support their integration into routine renal nursing practice.

Implications for Clinical Practice

The findings of this study have important implications for renal nursing practice. First, routine assessment of dietary protein intake and serum albumin levels should be prioritized as part of comprehensive nursing care for patients undergoing maintenance hemodialysis. Early identification of inadequate protein intake and suboptimal albumin levels enables timely, targeted interventions.

Second, nurse-led self-management support programs can be effectively integrated into routine hemodialysis care without requiring additional specialized resources. Renal nurses are well-positioned to provide individualized education, support goal setting, and monitor dietary behaviors during regular dialysis sessions. Incorporating structured self-management strategies into nursing practice may enhance patient engagement and promote sustained dietary behavior change.

Third, active involvement of family caregivers should be encouraged in nutritional care planning. Family members play a critical role in food selection, meal preparation, and reinforcement of dietary recommendations, particularly among older adults and patients with functional limitations. Engaging families as partners in care may improve adherence to dietary recommendations and clinical outcomes.

Finally, the use of practical educational materials, such as patient–family manuals with clear guidance on protein sources and portion sizes, can facilitate understanding and implementation of dietary recommendations. Integrating these materials into standard renal nursing practice may support consistent and patient-centered nutritional management.

Conclusions

This study demonstrates that a nurse-led protein intake self-management support program with active family involvement can significantly improve daily protein intake and serum albumin levels among patients undergoing maintenance hemodialysis. By addressing both behavioral and contextual factors influencing dietary intake, the intervention effectively targeted a modifiable risk factor for hypoalbuminemia.

The findings support the integration of structured, nurse-led, family-supported nutritional self-management interventions into routine renal nursing practice. Such approaches have the potential to enhance nutritional status, reduce the risk of hypoalbuminemia, and improve clinical outcomes for

patients receiving long-term hemodialysis. Future research with longer follow-up periods and broader study settings is recommended to further evaluate the sustainability and generalizability of these interventions.

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