ORIGINAL ARTICLE

The effects of a nutrition care process on protein-energy malnutrition among patients on continuous ambulatory peritoneal dialysis in Chaiyaphum Province, Thailand

Natpapat Nualsithong[1], Thidarat Somdee[1], Sajja Tatiyanupanwong[2], Chadarat Kleebchaiyaphum[2], Suneerat Yangyuen[1]

[1] Faculty of Public Health, Mahasarakham University, Mahasarakham, Thailand.
[2] Chaiyaphum Hospital, Chaiyaphum, Thailand

Corresponding Author: Suneerat Yangyuen **Email:** suneerat.y@msu.ac.th

Received: 29 December 2024 **Revised:** 22 January 2025 **Accepted:** 28 January 2025 **Available online:** September 2025
DOI: 10.55131/jphd/2025/230312

ABSTRACT

Nutritional status plays a critical role in managing end-stage renal disease (ESRD) in patients undergoing continuous ambulatory peritoneal dialysis (CAPD). Protein intake is particularly important, as insufficient protein intake can lead to protein-energy malnutrition (PEM), negatively impacting patients' quality of life (QoL), and impairing patients' ability to tolerate therapy and recover effectively. This randomized controlled trial aimed to assess the effects of a nutrition care process (NCP) on PEM in 66 patients receiving CAPD, who were randomly assigned to the intervention (n = 33) or the control group (n = 33). The intervention group participated in four sessions of NCP, while the control group received standard care. The program lasted 24 weeks, with follow-up conducted via telephone. Data were collected through structured interviews, and statistical analyses were performed using chi-square, Fisher's exact test, Cochran's Q test, repeated measures ANOVA, and independent-samples t-tests. The results indicated a significant reduction in the proportion of patients with PEM in the intervention group at follow-up ($P = 0.004$), as well as significantly higher mean energy intake, improved food consumption behavior scores, and better QoL than the control group ($P < 0.05$). The NCP was effective in reducing PEM, enhancing energy intake, improving food consumption behavior, and increasing QoL. We thus recommend extending the NCP to other healthcare settings to better support CAPD patients at risk of PEM and enhance their overall well-being.

Keywords:
nutrition, quality of life, protein-energy malnutrition, peritoneal dialysis

Citation:
Natpapat Nualsithong, Thidarat Somdee, Sajja Tatiyanupanwong, Chadarat Kleebchaiyaphum, Suneerat Yangyuen. The effects of a nutrition care process on protein-energy malnutrition among patients on continuous ambulatory peritoneal dialysis in Chaiyaphum Province, Thailand. J Public Hlth Dev. 2025;23(3):150-164 (https://doi.org/10.55131/jphd/2025/230312)

INTRODUCTION

Protein and energy malnutrition are common nutritional challenges in patients undergoing continuous ambulatory peritoneal dialysis (CAPD) as kidney replacement therapy, which often result from poor eating habits, while gastrointestinal symptoms like abdominal pain, constipation, diarrhea, and early satiety result from the instillation of peritoneal dialysis fluid. Additionally, the absorption of glucose from dialysis fluid, particularly during episodes of peritonitis, aggravates the inadequate nutrient intake. This combination of factors can significantly decrease patients' protein levels, negatively affecting patients' overall health and quality of life (QoL)[1] via complications like protein breakdown in muscle tissues, causing muscle atrophy,[2,3] and abnormal metabolism due to the body's inability to metabolize nitrogen from protein to maintain nitrogen balance, resulting in uremia and malnutrition and increasing the risk of mortality.[4]

Motivational interviewing (MI) [5] and the stages of change model (SCM)[6] are commonly used to modify dietary behaviors to meet the needs of patients receiving CAPD.[7] Programs to induce behavior change in patients with chronic conditions such as hypertension, diabetes, obesity, and chronic kidney disease have shown promising results, particularly in alleviating protein-energy malnutrition and improving QoL. One study on behavior change programs led by advanced practice nurses in pre-dialysis patients with chronic kidney disease found significant improvements in both knowledge and self-care behaviors. The intervention group demonstrated a better understanding of chronic kidney disease immediately after the program and maintained that knowledge six months later. Furthermore, their self-care behavior scores improved, indicating that the behavior change program effectively enhanced their motivation, improved their dietary habits, and helped delay the progression of kidney deterioration, ultimately supporting better health outcomes and a higher QoL.[8-10] MI effectively promotes changes in dietary habits in patients with chronic kidney disease that help them improve their nutritional intake and avoid protein-energy malnutrition, thereby increasing their overall QoL, improving their energy levels, and enhancing their kidney function. This positive impact on dietary behaviors crucially reduces the risks associated with protein deficiency and improves patients' well-being.[11-12] Furthermore, the use of SCM to modify lifestyle behaviors and reduce disease risk has been shown to mitigate diabetes risk.[13-14]

In the past five years, Chaiyaphum Province has seen an increase in the rate of new cases of non- communicable chronic diseases, ranking first in the Ninth Health District, which covers the provinces of Nakhon Ratchasima, Chaiyaphum, Buriram, and Surin. Non- communicable diseases are a significant cause of chronic kidney disease,[15] which has become a significant concern for the Nephrology Unit at Chaiyaphum Hospital. This unit provides urgent care for patients with acute kidney injury and chronic kidney disease and serves as a comprehensive referral center for kidney disease management across the 16 districts of Chaiyaphum Province. In 2021, the Kidney Disease Department at Chaiyaphum Hospital reported 674 patients undergoing hemodialysis with artificial kidneys and 565 undergoing peritoneal dialysis.[16] According to statistical data for 2013–2015, patients receiving CAPD have developed problems such as peritonitis, exit site infections, and low blood albumin (ALB) levels of < 2 g/dL in 2.3% of patients and $2.00–3.50$ g/dL in 36% of patients. A pilot study conducted in 2021 found that the

primary cause of patients' low blood ALB levels was inappropriate dietary habits, accounting for 68% of cases, and that in 63% of cases, patients consumed food with less energy content than their body's requirements. Patients in this group should receive advice on increasing their protein intake to improve their nutritional status and QoL. It is important to study this population because it displays several characteristics distinct from those reported by studies conducted in other regions, particularly in the local social and economic conditions, such as lower income levels, limited access to healthcare services, and dietary behaviors distinct from those of urban areas. Studying this population in Chaiyaphum can thus afford us a better understanding of the specific challenges they face and will contribute to the development of healthcare methods or programs tailored to the local context. Furthermore, this study can provide foundational data for developing policies to improve care for CAPD patients in rural areas, who show a heightened risk of protein-energy malnutrition.

In Thailand, the SCM and MI have been used to modify the behaviors of patients with chronic diseases such as diabetes.[13,17] However, few studies have applied these approaches to patients receiving CAPD. Therefore, this study aimed to apply these theories to create a nutrition care program (NCP) for behavior modification to reduce protein- energy malnutrition and improve QoL.

MATERIALS AND METHODS

Study setting, design, and population

This randomized controlled trial was conducted from September 2022 to February 2023. It involved patients with protein- energy malnutrition receiving CAPD in the Nephrology Unit of the Department of Kidney Disease at Chaiyaphum Hospital, Thailand.

The study participants were patients receiving CAPD with protein- energy malnutrition displaying a lack of energy due to deficiencies in all macronutrients and many micronutrients.[34] The nutritional assessment was performed according to the protein- energy malnutrition criteria.[18] Protein malnutrition was assessed based on the following laboratory parameters: blood ALB levels < 3.8 g/dL, blood urea nitrogen (BUN) levels < 50 mg/dL, blood creatinine (Cr) levels < 8 mg/dL, and normalized protein nitrogen appearance (nPNA) ratio < 1.0 g protein/kg body weight/day.[18] Additionally, energy malnutrition was assessed based on the following: energy intake < 25 kcal/kg body weight/day for at least two months; body mass index (BMI) < 18 kg/m^2 with weight loss > 5% within three months or > 10% within six months; and muscle mass decrease > 5% within three months or > 10% within six months.[18]

Sample size

The required sample size was estimated using G* Power (version 3.1.9.4)[19] considering a 95% confidence interval, 95% power, an effect size of 0.25,[20] and a 50% dropout rate. The estimated sample size was 33 participants in each group, totaling 66 in the study cohort. The inclusion criteria were age ≥ 20 years, receiving CAPD for at least six months, a protein crumble rate < 1 g/kg body weight, a blood ALB level < 3.8 g/dL, energy gain < 25 kcal/kg/day, able to read and write in Thai, possessing a phone for communication, and no auditory or vision problems. The exclusion criteria were severe illnesses, abdominal cavity infection, therapy change to hemodialysis or kidney transplant, and inability to cooperate during the duration of the study.

Recruitment and randomization

This study recruited patients with protein-energy malnutrition receiving CAPD at the Department of Kidney Disease. The patients were screened against

the inclusion and exclusion criteria, and the eligible patients were randomly allocated to the control or intervention groups at a 1:1 ratio by block randomization with a block size of four. Initially, 113 patients were assessed to participate in this study. However, 5 had severe illnesses, 3 changed therapy, and 41 were unwilling to participate. Therefore, 66 patients entered this study and were randomly assigned to the intervention and control groups (n = 33/group; Figure 1). The randomization was conducted by an independent statistician not involved in the outcome assessments. All researchers who performed the outcome assessments and analyses were blinded to group allocations.

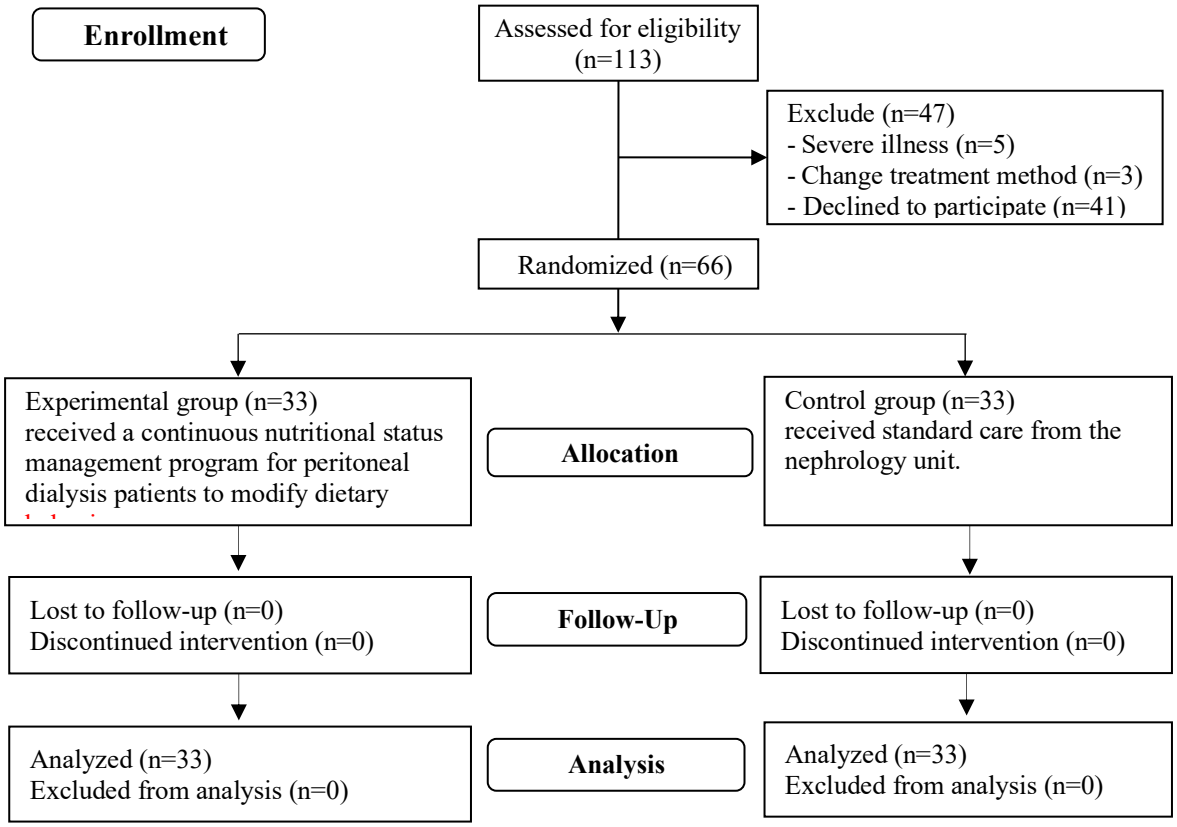

Figure 1. Overview of recruitment and group assignment

Data collection instrument and data collection procedure

The primary outcome was the change in the proportion of participants with protein- energy malnutrition from baseline to post- intervention and at the 12-week follow- up. The secondary outcomes were changes in food consumption behavior scores and QoL. The data were collected through interviews conducted in a private room by trained interviewers using a four-part structured interview questionnaire:

Part 1: Baseline characteristics, including sex, age, education, occupation, monthly income, advice they had received on protein food consumption, regular medicine types used, peritoneal dialysis treatment duration, peritoneum infection history, dialysis solution type, peritoneal dialysis method, dialysis frequency per day, food types used, whether food preparation

was done separate from family members, and number of meals consumed daily. All variables were cat dichotomous.

Part 2: Food consumption behaviors were assessed using a scale developed by Jukkrit Wungrath et al..[21] This 21-item scale is scored on a four-point Likert scale ranging from 1 (*regular practice*) to 4 (*did not practice at all*), such that higher scores indicate better dietary behaviors. It has a Cronbach's α of 0.81, indicating good internal consistency.

Part 3: QoL was measured using the self-reported Kidney Disease Quality of Life: Short Form,[22] which comprises 24 items and 80 sub- items. It includes a generic health survey and multi-item scales targeted at kidney disease and dialysis, including the burden, symptoms or problems, and effects of kidney disease. Higher scores indicate better QoL.

Part 4: A 24- hour dietary recall questionnaire to assess dietary behavior regarding food intake and quality[18] and to elicit detailed information about all foods and beverages consumed in the preceding 24 hours in order to calculate their energy intake.

Intervention

After conducting a literature review and discussions with specialists in health education, health behavior, and nutrition, we developed an NCP based on SCM theory[6] and MI,[5] consisting of four sessions lasting 30– 45 minutes each delivered in weeks 1, 4, 8, and 12. Participants in the intervention group attended the four- week NCP and were followed up for 12 weeks post- intervention. The researcher performed all sessions in the Nephrology Unit in the Department of Kidney Disease (Table 1). The details of each session are as follows:

Session 1 (week 1) : The engagement activity involves building rapport with the group, asking questions, and conducting interviews about the challenges of peritoneal dialysis that affect health and QoL. It is intended to motivate participants to consume high-protein foods, explain the advantages and disadvantages of dietary behavior changes, and provide information on self- care and suitable dietary practices for patients with chronic kidney disease.

Session 2 (week 4) : The preparation activity involves lectures about the benefits of consuming high- protein foods to encourage participants to choose suitable food menus and practices for themselves. It also includes setting goals for daily high- protein food intake and fostering self-motivation for adherence.

Session 3 (week 8) : The action activity showcases a high- protein food model and demonstrates a complete seven- day high- protein food menu, a backward step, and the use of a high- protein food manual with manual practice. Participants are asked to write down a seven- day high- protein food menu plan, of whom four are randomly selected to present their own plans and inspire others to follow theirs.

Session 4 (week 12) : The maintenance activity involves reviewing the high- protein food model and the consequences of not adhering to the prescribed plan. Participants are divided into four groups to brainstorm and write down the causes, problems, obstacles to adhering to the plan, and ways to overcome these issues. They then present their findings for additional guidance and restate their commitment to the goals.

Telephone follow-ups were conducted in weeks 2, 6, and 10, during which participants were asked about any challenges or obstacles they encountered in making behavior changes and received counseling and motivational support to facilitate their behavior change process. The post-intervention follow-up period lasted 12 weeks. The intervention group also received 10-minute weekly telephone consultations for 11 weeks to sustain the effects of the intervention, followed by a

visit to the clinic in week 12 for outcome measurements.

Table 1. Summary of a nutrition care program on protein energy malnutrition (NCP).

Session	Topics	Objectives
1	Engagement activity	To motivate participants to desire continuous changes in their dietary behavior, provide information on self-care and suitable dietary practices for patients undergoing continuous ambulatory peritoneal dialysis.
2	Preparation activity	To offer members information about the benefits of consuming high-protein foods, encourage participants to choose suitable food menus, and determine their daily high-protein food intake goals.
3	Action activity	To offer participants information about how to plan a seven-day high-protein food menu and motivate them to follow their plans.
4	Maintenance activity	To review the high-protein food model and motivate participants to adhere consistently and persistently to the dietary guidelines for high-protein intake.
Follow-up	support and encouragement	To provide participants with support and encouragement to facilitate their behavior change.

Control group

The participants in the control group did not receive any of the NCP components but continued with their usual care process provided by a nurse, without a focus on protein and energy intake.

Study procedures

During the NCP, the participants continued with their usual medical treatment. Before starting the NCP intervention, the participants also received information about the research and its voluntary nature and a declaration of anonymity and confidentiality. All participants provided written informed consent, and their baseline characteristics and outcome measurements were then recorded. Next, the NCP was delivered to participants in the intervention group over four weekly sessions, who were then followed up for 12 weeks. In contrast, participants in the control group only received their usual care. The outcome measurements were taken for both groups after the intervention and at the follow-up visits. The data collection procedure was the same for the intervention and control groups. The trained outcome assessors were blinded to participants' group allocations.

Statistical analysis

Descriptive statistics were used to examine participants' characteristics and outcomes. The categorical baseline characteristics of the two groups were compared using chi-square and Fisher's exact tests, while the outcome measurements were compared between baseline (pre-intervention), immediate post-intervention, and post-intervention follow-up visits. Within-group comparisons used repeated-measures analysis of variance (ANOVA) for normally distributed continuous variables and Cochran's Q test for categorical variables. Comparisons between the intervention and control groups used independent-samples *t*-tests for normally distributed continuous variables and

Fisher's exact test for categorical variables. All statistical analyses were conducted using SPSS (version 18; IBM Corp. , Armonk, NY, USA), and a *P*- value < 0.05 was considered statistically significant.

RESULTS

Regarding the general characteristics of the study cohort, most participants in the intervention group were male (55.5%), aged ≥ 60 years (69.7%), cooked their own meals (72.7%), had an education level of primary school or lower (97.0%), were employed (60.6%), and had been undergoing CAPD for at least two years (69.7%). Most participants in the control group were male (60.6%), aged ≥ 60 years (57.6%), cooked their own meals (72.7%), had an education level of primary school or lower (78.8%), were employed (90.9%), and had been undergoing CAPD for at least two years (66.7%). The baseline characteristics of the two groups did not differ significantly (Table 2).

The outcomes were next compared within each group between pre-intervention, post- intervention, and the 12-week follow- up visit. The proportion of participants in the intervention group with protein- energy malnutrition decreased significantly ($P < 0.05$). In addition, their mean energy intake, food consumption behavior score, and QoL score increased significantly ($P < 0.05$). In contrast, no significant changes were observed in the control group (Table 3).

Notably, the proportions of participants with protein- energy malnutrition and the mean energy intake, food consumption behavior scores, and QoL pre- and post- intervention did not differ significantly between groups. However, the proportions of participants with protein- energy malnutrition at the 12-week follow- up visit differed significantly between the groups, and the mean energy intake, food consumption behavior scores, and QoL were significantly higher in the intervention group than in the control group ($P < 0.05$; Table 4).

Table 2. Baseline characteristics of participants

Characteristics	Intervention	Control	*P*-value
	n (%)	n (%)	
Socio-demographic factors			
Sex			0.172¶
Male	18 (55.5)	20 (60.6)	
Female	15 (45.5)	13 (39.4)	
Age (y)			0.341¶
< 60	10 (30.3)	14 (42.4)	
≥60	23 (69.7)	19 (57.6)	
Education			1.000‡
Elementary school	32 (97.0)	26 (78.8)	
Secondary school and above	1 (3.0)	7 (21.2)	
Occupation			1.000‡
Unemployed	13 (39.4)	3 (9.1)	
Employed	20 (60.6)	30 (90.9)	
Monthly income (THB)			0.119¶
< 3,000	17 (51.5)	19 (57.6)	
≥ 3,000	16 (48.5)	14 (42.4)	
Advice received on protein food consumption			1.000‡
No	1 (3.0)	1 (3.0)	
Yes	32 (97.0)	32 (97.0)	
Regular medicine types used			0.100‡
Hypertension medications	16 (48.5)	19 (57.6)	
Diabetes medications	9 (27.3)	9 (27.3)	

Characteristics	Intervention	Control	*P*-value
	n (%)	n (%)	
Hyperlipidemia medications	8 (24.2)	5 (15.2)	
Treatment condition factors			
Peritoneal dialysis treatment duration (y)			0.430 ¶
< 2	10 (30.3)	11 (33.6)	
≥ 2	23 (69.7)	22 (66.7)	
Peritoneum infection history			1.000‡
Yes	5 (15.2)	4 (12.1)	
No	28 (84.8)	29 (87.9)	
Dialysis solution type			1.000‡
1.5 %	32 (97.0)	32 (97.0)	
2.5 %	1 (0.0)	1 (0.0)	
Peritoneal dialysis method			1.000‡
Change the dialysis solution every 4-6 hours	32 (97.0)	32 (97.0)	
Change dialysis solution throughout the night 9-10 hours/day	1 (0.0)	1 (0.0)	
Dialysis frequency per day			1.000‡
≤ 3	1 (3.0)	1 (3.0)	
> 3	32 (97.0)	32 (97.0)	
Food consumption behavior factors			
food types			
Cooked their own meals	24 (72.7)	24 (72.7)	0.384 ¶
Bought food from outside	9 (27.3)	9 (27.3)	
food preparation separate from family members			
Yes	17 (51.5)	28 (84.8)	1.000‡
No	16 (48.5)	5 (15.2)	
number of meals consumed daily			1.000‡
> 3	30 (90.9)	31 (93.9)	
≤3	3 (9.1)	2 (6.1)	

Note. ‡ Fisher exact test, ¶ Chi square test

Table 3: Comparison of the outcome measurements within the intervention and control groups at pre-intervention, post-intervention, and follow-up.

Outcomes	Intervention group			*P*-value	Control group			*P*-value
	Pre-intervention	Post-intervention	Follow-up		Pre-intervention	Post-intervention	Follow-up	
	n (%)	n (%)	n (%)		n (%)	n (%)	n (%)	
- Protein-energy malnutrition	33 (100.00)	16 (48.48)	6 (18.18)	<0.001†	33 (100.00)	31 (93.94)	30 (90.91)	0.174†
	Mean ± S.D.	**Mean ± S.D.**	**Mean ± S.D.**		**Mean ± S.D.**	**Mean ± S.D.**	**Mean ± S.D.**	
- Energy intake (Kcal)	1395.91±205.39	1473.21±225.49	1734.85±325.17	<0.001‡	1311.52±220.63	1376.21±252.44	1358.18±324.64	0.574‡
- Food consumption behaviors	67.06±7.28	67.33±7.17	74.94±4.24	<0.001‡	66.42±6.75	66.42±6.75	66.42±6.75	0.847‡
- Quality of Life	54.78±5.03	55.32±4.97	67.64±10.06	<0.001‡	53.73±5.41	53.73±5.41	53.73±5.41	0.114‡

Note. †Cochran's Q test; ‡Repeated measure ANOVA; S.D., Standard deviation

Table 4: Comparison of the outcome measurements between the intervention and control groups at pre-intervention, post-intervention, and follow-up.

Outcomes	Pre-intervention		*P*-value	Post-intervention		*P*-value	Follow-up		*P*-value
	Intervention	Control		Intervention	Control		Intervention	Control	
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
- Protein-energy malnutrition	33 (100.00)	33 (100.00)	N/A	16 (48.48)	31 (93.94)	0.227‡	6 (18.18)	30 (90.91)	0.004‡
	Mean ± S.D.	**Mean ± S.D.**		**Mean ± S.D.**	**Mean ± S.D.**		**Mean ± S.D.**	**Mean ± S.D.**	
- Energy intake (Kcal)	1395.91±205.39	1311.52±220.63	0.113††	1473.21±225.49	1376.21±252.44	0.105††	1734.85±325.17	1358.18±324.64	<0.001††
- Food consumption behaviors	67.06±7.28	66.42±6.75	0.714††	67.33±7.17	66.42±6.75	0.641††	74.94±4.24	66.42±6.75	<0.001††
- Quality of Life	54.78±5.03	53.73±5.41	0.420††	55.32±4.97	53.73±5.41	0.238††	67.64±10.06	53.73±5.41	<0.001††

Note. ‡ Fisher's exact test; †† Independent t test; S.D., Standard deviation

DISCUSSION

Our trial demonstrated that an NCP can effectively treat patients receiving CAPD with protein- energy malnutrition. Our results support our hypothesis that the NCP would significantly reduce protein-energy malnutrition, consistent with previous studies[23-25] that reported that adjustments in behavior should take the patient's readiness into account. Assessing readiness involves selecting appropriate activities and evaluating behavior change outcomes based on decision- making and individual goals at each stage. One possible explanation is that the NCP emphasizes the crucial importance of creating motivation for behavior change through MI and assessing patients' readiness at each stage of change.[26-27] This approach enables patients to better adjust their dietary behaviors, leading to significant improvements in protein- energy malnutrition within the intervention group, consistent with the findings of previous research,[28] thus confirming that nutrition care can significantly improve kidney function. One possible explanation is that the components of the NCP, including demonstrations and follow- up sessions on preparing high- protein meals and regular monitoring, can motivate patients to consistently adopt correct dietary behaviors, which may help improve renal function.[26-27]

This trial also found that the NCP significantly increased energy intake and good food consumption behaviors. Researchers have reported[29] that the provision of nutritional knowledge significantly affected nutrition care and that reminders significantly facilitated adherence to correct behavioral guidelines. One possible explanation is that reviewing knowledge on high- protein dietary behaviors and discussing the potential impacts of consuming low- protein meals during the NCP can facilitate mutual learning.[30-31] Family encouragement also significantly promotes more appropriate behavioral practices.[31-32] Furthermore, while our comparison of dietary behaviors between groups revealed no significant differences before and after the intervention, there was a statistically significant difference ($P < 0.05$) at follow-up. Upon entering the program, they received a high-protein dietary guide, instructional materials for lectures, and motivational support to encourage behavior changes in food consumption and began adopting a more appropriate high-protein dietary pattern than before the intervention. However, only minor behavioral changes were observed during the 12-week intervention period due to insufficient commitment or readiness to implement the new nutritional practices[33], partly because preparing meals according to the guide required intentional effort, as the menu differed somewhat from their usual lifestyle. Additionally, some participants relied on the availability and ability of meal preparers to accommodate their needs, and financial constraints also impacted their ability to purchase necessary food items. Consequently, no statistically significant difference in food consumption behavior was observed during the first 12 weeks. However, after continuous encouragement and monitoring, adequate financial resources and improved meal preparation routines caused the experimental group's high-protein food consumption behavior to significantly improve. As a result, by the follow-up, a statistically significant difference in dietary behavior was observed ($P < 0.05$).[29]

Additionally, the NCP significantly improved QoL, corroborating previous studies.[34-35] Health-related QoL is a crucial aspect of patient health that should be an integral part of evaluations of patient-centered outcomes, especially because it is

associated with patient morbidity and mortality.[3 0-3 1,36] This trial prioritized patient- centered processes, focusing on activities that addressed both their physical and psychological behaviors, and monitored their behavior change outcomes. However, a comparison of QoL between the experimental and control groups revealed no significant differences before and after the intervention, though a statistically significant difference was observed at the follow-up. Before the intervention, the experimental group reported a lower QoL in daily activities, such as experiencing fatigue during household chores, difficulty walking upstairs, body aches while working, occasional dizziness, and dry, itchy skin, all of which contributed to health-related anxiety.[35] During the 12-week intervention period, there were no significant changes in health due to minimal adjustments in protein consumption, resulting in no noticeable improvements in QoL. However, by follow-up, the experimental group had increased their consumption of high-protein foods, leading to improved health. As a result, they reported decreased fatigue during household chores and walking upstairs and diminished bodily pain or dizziness, which contributed to reduced health-related anxiety and an overall enhancement in the QoL of the experimental group.

The protein and energy malnutrition, dietary behaviors, and QoL before the intervention differed from those observed at follow-up. This change may be attributed to the fact that the experimental group had received continuous encouragement and monitoring, adequate financial resources, and improved meal preparation routines over time, contributing to an increase in the frequency of high-protein food consumption. The more frequent consumption of high-protein foods led to the accumulation of protein and energy in the body, which in turn reduced physical fatigue during daily activities, alleviated bodily pain, and decreased anxiety. These improvements were reflected in an overall enhancement in the QoL of the participants.[35] This is consistent with the Stages of Change Model, specifically the preparation stage, in which individuals decide and commit to changing their behavior within the next month, ensuring that they are prepared in a variety of respects to begin making changes, leading to the action stage, where they actively engage in the behavior change. This is followed by the maintenance stage, where individuals continue to practice the new behavior and integrate it into their daily lives.[36]

Despite the successful outcomes, this study had certain limitations. First, in the telephone follow- ups, some patients living in remote areas faced communication challenges, which required coordination with local health promotion hospitals to contact these patients. Second, the NCP was developed for use in small healthcare units and small groups, which may limit the generalizability of our findings to other patient groups and healthcare units. Despite these limitations, our study demonstrated that the NCP is suitable for patients receiving CAPD since it offers diverse activities tailored to each stage of change and uses MI techniques to foster motivation for behavior change. Therefore, the developed NCP can effectively modify patients' health behaviors.

RECOMMENDATIONS

Our NCP program effectively improved protein-energy malnutrition, energy intake, food consumption behaviors, and QoL among patients receiving CAPD. Therefore, our findings suggest that NCP programs should be implemented to address malnutrition in CAPD patients, a population particularly vulnerable to protein-energy malnutrition, and integrated into healthcare processes or services provided in clinical settings.

AUTHOR CONTRIBUTIONS

S.Y., N.N., T.S., S.T., C.K.: Conceptualization, S.Y., N.N.: Data curation. S.Y., N.N.: Formal analysis. S.Y., N.N., T.S., S.T.: Funding acquisition. S.Y., N.N., T.S., S.T.: Investigation. S.Y., N.N., T.S.: Methodology. S.Y., N.N.: Project administration. S.Y., N.N., T.S., C.K.: Resources. S.Y., N.N.: Software. S.Y., N.N.: Supervision. S.Y., N.N., T.S., C.K.: Validation. S.Y., N.N.: Visualization. S.Y., N.N.: Writing – original draft. S.Y., N.N., T.S.: Writing – review & editing.

ETHICAL CONSIDERATION

This study was approved by the Ethics Committee for Research Involving Human Subjects at Mahasarakham University (Ref. No. 235-449/2022; approved on 24 June 2022) and by the Ethics Committee for Research Involving Human Subjects at Chaiyaphum Hospital (Approval No. 011/2022; approved on 29 August 2022). After getting the approval of the ethics committee for human research, the researcher asked for the samples' permission to explain the objectives and procedures for collecting data. The research did not affect the treatment or services they obtained. The data collection was kept secret in safe places, and the data were presented only in the whole picture with the samples' acceptance of participating in this research and the samples' signatures for acceptance.

ACKNOWLEDGMENTS

We thank the Faculty of Public Health at Mahasarakham University for its research funding support, and we sincerely thank all patients for their participation.

CONFLICT OF INTEREST

There are no conflicts of interest.

FUNDING

This study received grant support from the Faculty of Public Health, Mahasarakham University.

REFERENCES

1. Gunalay S, Ozturk YK, Akar H, Mergen H. The relationship between malnutrition and quality of life in haemodialysis and peritoneal dialysis patients. Rev Assoc Med Bras (1992). 2018 Sep;64(9):845-852. doi: 10.1590/1806-9282.64.09.845.
2. Carrero JJ, Chmielewski M, Axelsson J, Snaedal S, Heimbürger O, Bárány P, Suliman ME, Lindholm B, Stenvinkel P, Qureshi AR. Muscle atrophy, inflammation and clinical outcome in incident and prevalent dialysis patients. Clin Nutr. 2008 Aug;27(4):557-64. doi: 10.1016/j.clnu.2008.04.007.
3. Pongskul C, Sirivongs D, Keobounma T, Chanlertrith D, Promajuk P, Limwatananon C. Survival and technical failure in a large cohort of Thai CAPD patients. J Med Assoc Thai. 2006 Aug;89 Suppl 2: S98-105. PMID: 17044460.
4. Therrien M, Byham-Gray L, Beto J. A Review of Dietary Intake Studies in Maintenance Dialysis Patients. J Ren Nutr. 2015 Jul;25(4):329-38. doi: 10.1053/j.jrn.2014.11.001. Epub 2015 Jan 13. PMID: 25592493.
5. Miller WR, Rollnick S. Motivational interviewing: Preparing people to change addictive behavior. Guilford Press; 1991. doi.org/10.1002/casp.2450020410.

6. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. Am J Health Promot. 1997 Sep-Oct;12(1):38-48. doi: 10.4278/0890-1171-12.1.38. PMID: 10170434.
7. Thiensa-ard J. Effects of counseling program and educating as interview principles for motivating on health behaviors and results from clinic of patients with chronic kidney disease before therapy instead of kidney. J Nurs Pract Thai Midwifery. 2018; 5(2):19-38.
8. Singhprasert R, et al. The Effect of Behavioral Modification by Advanced Practice Nurses on Clinical Outcomes in Pre-Dialysis Chronic Kidney Disease Patients. Thai J Nurs Council. 2017;5(1):57-74.
9. Bridle, C., Riemsma, R. P., Pattenden, J., Sowden, A. J., Mather, L., Watt, I. S., & Walker, A. (2005). Systematic review of the effectiveness of health behavior interventions based on the transtheoretical model. Psychology & Health, 20(3), 283–301. https://doi.org/10.1080/08870440512331333997.
10. Korkut Y, Balcıoglu İ, Onbası K. Determination of the Perception Level of Life Style Innovations in Type 2 Diabetes Mellitus. Ethiop J Health Sci. 2019 Jul;29(4):447-452. doi: 10.4314/ejhs. v29i4.5. PMID: 31447517; PMCID: PMC6689712.
11. Sanitchone, A. (2019). Effect of Motivation Interviewing Consulting on Changing Food Consumption Behavior of Chronic Kidney Disease Patients: -. Journal of Nutrition Association of Thailand (Online), 54(1), 55–68. Retrieved from https://he01.tci-thaijo.org/index.php/JNAT/article/view/158026.
12. Morton K, Beauchamp M, Prothero A, Joyce L, Saunders L, Spencer-Bowdage S, Dancy B, Pedlar C. The effectiveness of motivational interviewing for health behaviour change in primary care settings: a systematic review. Health Psychol Rev. 2015;9(2):205-23. doi: 10.1080/17437199.2014.882006.
13. Sriyakun D, Lapbenjakul S, Srithamrongsawat S, et al. Effectiveness of lifestyle modification program on preventing type 2 diabetes among Thai adults with prediabetes. J Health Syst Res. 2024;18(1):72-92.
14. Khajehlandi K, Babaei A, Araban M, et al. Effect of Targeted Educational Program Based on the Transtheoretical Model in Promoting Healthy Nutrition Behaviors in Middle-aged Women in Dehdez, Iran. J Educ Community Health. 2019;6(1):25-31. doi: 10.29252/jech.6.1.25.
15. Chaiyaphum Provincial Public Health Office. Health Data Center (HDC), Conclusion of data in 43 files in the database. 2021 [Internet]. [Cited 2022 Sep 3]. Available from: https://cpm.hdc.moph.go.th/hdc/main/index.php. [Thai].
16. Kidney Disease Department. Medical records Chaiyaphum: Chaiyaphum Hospital; 2021.Thai.
17. Dhupawiroch O, Laplai P, Jirathana K. The Effect of health Behavior Modification Programme on Self-care Behaviors Management Blood Glucose HbA1c Level and Quality of Life among Uncontrolled Diabetic Patients Phra Nakhon Si Ayutthaya Hospital: Randomized Controlled Trial; RCT. JPMAT [internet]. 2023 Jan. 16 [cited 2023 Jan. 21];12(3):552-75. available from: https://he01.tci-thaijo.org/index.php/JPMAT/article/view/258777.
18. The Nephrology Society of Thailand. Recommendations for nutritional therapy for adult kidney disease patients. Bangkok: The Nephrology Society of Thailand; 2018. Thai.

19. Faul F, Erdfelder E, Buchner A, Lang A-G. Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. Behav Res Methods. 2009; 41:1149-1160.
20. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Erlbaum Associates; 1988.
21. Wungrath J, Rerkkasem K, Saengyo S, et al. Factors predicting food consumption behavior of hemodialysis patients with end-stage renal disease at Maharaj Nakorn Chiang Mai Hospital. J Health Syst Res. 2018;12(4):625-635.
22. Homjean K, Sakthong P. Translation and cognitive testing of the Thai version of the Kidney Disease Quality of Life Short-Form Questionnaires Version 1.3. Thai J Pharm Pract. 2019; 2(1):3-14.
23. Leecharoen P. Application of Transtheoretical Model to Complication Prevention in Patients with Chronic Disease. Nurs J Min Pub Health. 2014;23(3):1-11. [internet]. 2014 Feb. 25 [cited 2022 Dec. 20]; 23(3):1-11. available from: https://he02.tci-thaijo.org/index.php/tnaph/article/view/16527.
24. Hinkhaw C, Loysak B, Nitirat P. Group Motivational Interviewing for Behavior Modification among Uncontrolled Diabetic Patients. JPNC [internet]. 2020 Jun. 23 [cited 2022 Jan. 20];31(1):205-12. available from: https://he01.tci-thaijo.org/index.php/pnc/article/view/242189.
25. Ackard DM, Cronemeyer CL, Richter S, Egan A. Do symptom-specific stages of change predict eating disorder treatment outcome? Eat Weight Disord. 2015 Mar;20(1):49-62. doi: 10.1007/s40519-014-0153-0. Epub 2014 Sep 24. PMID: 25249403.
26. Numpool J. Application of theoretical stages in behavior modification in adult patients with metabolic symptom group. J Thai Red Cross Council. 2020;13(2):15-28.
27. Ganesan MV, Annigeri RA, Shankar B, Rao BS, Prakash KC, Seshadri R, Mani MK. The protein equivalent of nitrogen appearance in critically ill acute renal failure patients undergoing continuous renal replacement therapy. J Ren Nutr. 2009 Mar;19(2):161-6. doi: 10.1053/j.jrn.2008.11.009. PMID: 19218043.
28. Khakpour S, Tavafian S, Niknami S, et al. Effect of Combined Education on Promoting Nutritional Behaviors of Female Students. J Educ Community Health. 2016;3(2):41-46. doi: 10.21859/j ech-03026.
29. Chanwikrai Y, Wungrath J, Taechangam S, et al. Frequent Snacks Improved Energy Intake and Nutritional Status in Community-Dwelling Older Adults at Risk of Malnutrition, Chiang Mai, Thailand. J Educ Community Health. 2022;9(1): 11-17. doi: 10.34172/jech.2022.3
30. Rojsuporn S, Piyabanditkul L, Jaiteng A. Food Management for Persons with Diabetes and Hypertension in the Community. J Health Nurs Educ. 2021;27(2):96-111.
31. Lundahl B, Moleni T, Burke BL, Butters R, Tollefson D, Butler C, Rollnick S. Motivational interviewing in medical care settings: a systematic review and meta-analysis of randomized controlled trials. Patient Educ Couns. 2013 Nov;93(2):157-68. doi: 10.1016/j.pec.2013.07.012. Epub 2013 Aug 1. PMID: 24001658.
32. Kanitta Wisitjaroen et al. The Effects of a Community Empowerment Program on Behavioral Modification among Buddhist Monks' Healthcare Leaders and Buddhist Monks to Prevent Non-Communicable Disease Journal of Health and Nursing

Education.2024;30(2):1-17. DOI: 10.12982/CMUJASR.2016.0008.
33. Kulprasutidilok, A., Kulprasutidilok, P. The effects of the community-based lifestyle intervention program on the prevention of Type 2 Diabetes Mellitus among pre-diabetic elderly people at Khlong Lat Phrao community. J Health & Health Manage [internet]. 2021 Dec. 30 [cited 2024 Jan. 10];7(2):129-42. available from: https://he01.tci-thaijo.org/index.php/slc/article/view/250568.
34. Aguiar R, Pei M, Qureshi AR, Lindholm B. Health-related quality of life in peritoneal dialysis patients: A narrative review. Semin Dial. 2019 Sep;32(5):452-462. doi: 10.1111/sdi.12770.
35. Daniel SC, Azuero A, Gutierrez OM, Heaton K. Examining the relationship between nutrition, quality of life, and depression in hemodialysis patients. Qual Life Res. 2021 Mar;30(3):759-768. doi: 10.1007/s11136-020-02684-2.
36. Madhuri S, Hegde SS, Ravi S, Deepti A, Simpy M. Comparison of chewing ability, oral health related quality of life and nutritional status before and after insertion of complete denture amongst edentulous patients in a Dental College of Pune. Ethiop J Health Sci. 2014 Jul;24(3):253-60. doi: 10.4314/ejhs. v24i3.9.