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The effectiveness of a health literacy enhancement program on knowledge, self-management behaviors, and clinical outcomes in people with chronic kidney disease: A quasi-experimental study in Thailand

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Abstract

Background: Chronic kidney disease (CKD) is a leading cause of death, with a rising incidence worldwide. Effective disease management requires health literacy (HL) interventions to optimize patients' self-management. However, difficulties in communication between patients and healthcare providers often impede improvements in HL. While HL interventions should prioritize enhancing communication quality, current evidence supporting this approach remains limited.

Objective: This study aimed to investigate the effectiveness of a Health Literacy Enhancement (HLE) program on CKD knowledge, self-management behaviors, and clinical outcomes in people with CKD.

Methods: A quasi-experimental study using a two-group pretest-posttest design was conducted from December 2022 to March 2023. Fifty-two participants with stage 3 to 4 CKD, recruited from outpatient CKD clinics in two district hospitals in Central Thailand, were divided into two groups. Participants in the experimental group (n = 25) received the HLE Program based on Baker's HL concept, while the control group (n = 27) received usual care for 12 weeks. Data were collected twice before and after the 12-week program using a demographic form, CKD knowledge, CKD self-management behaviors (SMBs), and clinical outcomes, including blood pressure (BP), hemoglobin A1c (HbA1c), estimated glomerular rate (eGFR), body mass index (BMI), and waist circumference (WC). Data were analyzed using descriptive statistics, Chi-square, Paired t-test, and Independent t-test.

Results: Following the HLE Program, the experimental group had a significantly higher score in CKD knowledge (t = 8.79, p <0.001) and self-management behaviors (SMBs) (t = 7.70, p <0.001). They also achieved a better average estimated glomerular filtration rate (eGFR) (t = 3.14, p <0.01) and had lower systolic blood pressure (SBP) (t = -2.54, p <0.05) and diastolic blood pressure (DBP) (t = -2.05, p <0.05) compared to the control group and their baseline measures. The effect sizes (Cohen's d) were substantial, indicating large effects for CKD knowledge (2.44), self-management behaviors (2.14), and eGFR (0.87), while SBP (-0.71) and DBP (-0.55) indicated medium effects. However, no significant differences were observed in HbA1c, BMI, and WC.

Conclusion: The HLE program can enhance effective patient-provider communication using plain language, leading to significant improvements in CKD knowledge and SMBs, as well as clinical outcomes, including eGFR and BP. Nurses should implement this program to enhance HL in people with CKD, leading to effective self-management and helping slow the progression of the disease.

Trial Registry Number: Thai Clinical Trials Registry (TCTR20240920001)

Keywords

Thailand; health literacy enhancement program; plain language; knowledge; self-management behaviors; clinical outcomes; chronic kidney disease; nursing

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Background

Globally, chronic kidney disease (CKD) was the eleventh-leading cause of death and caused 1.4 million deaths in 2019 (Feng et al., 2023). The prevalence of CKD is 10 % of the world's population (Sundström et al., 2022), and there were over 10 million incident cases of CKD increasing from 1990 to 2019 (Ying et al., 2024). The frightening consequence of CKD is an end-stage renal disease (ESRD), which requires renal replacement treatment to prolong life and imposes substantial economic and social burdens on people with CKD as well as healthcare systems (Chadban et al., 2024). In Thailand, the number of people with renal replacement treatment increased from 100,970 cases in 2016 to 170,774 cases in 2020, which was mainly caused by hypertension (42.30%) and diabetes (41.50%) (Chuasuwan & Lumpaopong, 2022). Moreover, Thailand was ranked fourth for the highest prevalence of treated ESRD across regions in 2020 (National Institutes of Health, 2022). Therefore, effective CKD management is crucial in addressing this significant health issue.

CKD management before reaching the end stage is essential to slow the progression of CKD and prevent CKD-related complications, which consist principally of medication and lifestyle modifications according to the clinical practice guideline of the Kidney Disease Improving Global Outcomes (KDIGO) (de Boer et al., 2020). More importantly, people with CKD must be able to understand and utilize health information to optimize self-management. These skills are called health literacy (HL) (Campbell et al., 2022). Unfortunately, the evidence shows that nearly one-third of people with CKD had limited HL in a primary care setting (Ho et al., 2024), and the majority were found to have low education levels and income or living in rural areas (Dinh et al., 2022). In Thailand, individuals with CKD have demonstrated limited HL, particularly in understanding (Kooariyakul et al., 2024) and sharing health information (Kerdin et al., 2023). It indicates a poor capacity to process and manage health-related information (Gurgel do Amaral et al., 2022), which has contributed to a lack of self-management skills (Boonstra et al., 2022; Gurgel do Amaral et al., 2022; Mackey et al., 2016; Taylor et al., 2016), ultimately accelerating the progression of CKD (Devraj et al., 2015).

To improve disease management, interventions to enhance HL are necessary for people with CKD. These interventions aim to enhance the patient's ability to understand and implement health information and, finally, to improve self-management skills. Such interventions can be found in education programs, self-management programs, or a combination of both (Campbell et al., 2022). HL enhancement interventions have been shown to have positive outcomes in people with CKD, including increased CKD knowledge (Chosivasakul et al., 2017; Khwanchum et al., 2024), improved self-management behaviors (Khwanchum et al., 2024; Li et al., 2020; Maneesri et al., 2023; Nguyen et al., 2019; Pragodpol et al., 2022), and improved clinical outcomes such as increased estimated glomerular filtration rate (eGFR) (Chosivasakul et al., 2017; Huang et al., 2024; Li et al., 2020; Pragodpol et al., 2022), decreased blood pressure (BP) (Chosivasakul et al., 2017; Hinkhaw et al., 2019; Maneesri et al., 2023; Pragodpol et al., 2022; Suwanwaha et al., 2016), decreased hemoglobin A1c (HbA1c) (Chosivasakul et al., 2017; Pragodpol et al., 2022; Suwanwaha et al., 2016), reduced body mass index (BMI) (Pragodpol et al., 2022), and decreased waist circumference (WC) (Pragodpol et al., 2022).

The HL enhancement (HLE) interventions primarily included activities such as education and provision of materials, group discussion, self-management training, telephone follow-up, and communication through the Line application, a popular social media platform in Thailand (Phithak et al., 2023). The programs' duration significantly improved eGFR from 12 weeks (Chosivasakul et al., 2017; Hinkhaw et al., 2019; Li et al., 2020) to 7 months (Pragodpol et al., 2022). However, some studies reported non-significant improvement in self-management behaviors (Nguyen et al., 2019), serum creatinine (Suwanwaha et al., 2016), eGFR (Maneesri et al., 2023), and BMI (Chosivasakul et al., 2017; Li et al., 2020). Therefore, these outcomes require further investigation.

Moreover, studies have shown that healthcare providers (HCPs) often overestimate patients' HL (Dickens et al., 2013; Ishikawa et al., 2009; Narva et al., 2016) and frequently provide unclear or excessive information (Boonstra et al., 2022; Van Dipten et al., 2018), as well as complex written materials (Morony et al., 2017). Additionally, information about kidney disease itself is naturally complex (Narva et al., 2016). These communication barriers make it difficult for people with CKD to understand their disease and self-management, which in turn obstructs their HL development (Boonstra et al., 2021b; Boonstra et al., 2022; Van Dipten et al., 2018). Thus, an effective HLE program would help alleviate these difficulties in patient-provider communication.

The US Agency for Healthcare Quality and Research (AHRQ) Health Literacy Universal Precautions Toolkit (Brach, 2024) and the Health Literacy Toolkit of Thailand (Ministry of Public Health, 2019) recommend tools to enhance the quality of patient-provider communication. These tools emphasize the use of plain language and easy-to-understand materials in both spoken and written communication to help HCPs improve patients' HL. However, few studies have focused on improving communication quality in CKD care using plain language, including plain written messages (Boonstra et al., 2021a; Huang et al., 2024; Pragodpol et al., 2022). Furthermore, the development of simple health materials incorporating visual strategies to enhance HL and improve health outcomes remains underexplored (Boonstra et al., 2021b).

Moreover, current studies lack evidence supporting CKD interventions based on specific HL concepts (Boonstra et al., 2021a). Baker's HL concept (Baker, 2006) provides an appropriate framework for this study, as it addresses the challenges in patient-provider communication in CKD management. This concept emphasizes that HL is influenced by a patient's abilities and the difficulty and complexity of the printed and spoken messages from HCPs within the health environment that individuals encounter. Effective HL leads to new knowledge, behavior changes, and improved health outcomes (Baker, 2006).

Despite previous intervention studies in CKD, several knowledge gaps remain, particularly regarding the limited evidence on the promotion of HL through the improvement of provider communication using plain language, interventions based on HL concepts, and inconsistent clinical outcomes, especially eGFR. To address these gaps, this study

investigated the effectiveness of the HLE program based on Baker's concept, utilizing plain language, together with easy-to-understand materials, among people with CKD living in rural communities in Thailand. We hypothesized that the program would significantly affect CKD knowledge, self-management behaviors, and clinical outcomes, including eGFR, SBP, DBP, HbA1c, BMI, and WC.

Methods

Study Design

A 12-week quasi-experimental trial with a two-group pretest-posttest design was conducted to investigate the effectiveness of the health literacy enhancement (HLE) program plus usual care in the experimental group and usual care only in the control group. This study was registered at the Thai Clinical Trials Registry (TCTR20240920001).

Samples/Participants

The target population was people with stage 3 to 4 CKD. Potential participants in Lopburi City, central Thailand, were recruited from the two outpatient CKD clinics in two district hospitals in rural settings. The potential participants with stage 3 to 4 CKD were selected through purposive sampling following the inclusion criteria: 1) aged 35-85 years and if aged ≥60 years, required to get a score ≥8 out of 10 on the Short Portable Mental Status Questionnaire (SPMSQ) (Intarasombat et al., 1996; Pfeiffer, 1975); 2) a diagnosis of stage 3-4 CKD for at least three months; 3) owns a smartphone for using the Line application; 4) able to communicate in Thai; and 5) willing to participate in this study. Participants were excluded if they had severe associated complications with underlying diseases affecting their participation in the program and hospitalization, such as heart failure or renal failure.

The sample size was calculated using power analysis with G*Power software (Faul et al., 2009) for a *t*-test, with an effect size of 0.74 (Hinkhaw et al., 2019; Li et al., 2020), a power of 0.80, and a significant level of 0.05. This yielded a required sample size of 24 participants per group. The 20% of the sample size was added to prevent attrition and ensure adequate significance in this study. Thus, there were 29 participants per group, with a total of two groups of 58 participants.

Instruments

This study used two types of instruments: the research intervention and the data collection instruments. All instruments, whether employed or adapted, received permission from their respective developers.

The research intervention instrument was the HLE program, based on Baker's HL concept (Baker, 2006). This program incorporated intervention activities adapted from previous studies (Chosivasakul et al., 2017; Hinkhaw et al., 2019; Li et al., 2020), which included providing knowledge through easy-to-read materials, group discussions, practicing self-management skills, using the Line application, and conducting follow-ups. The HL strategies employed, such as the use of plain language and easy-to-read materials, along with techniques like Teach-back, aimed to improve the communication skills of HCPs in both written and oral communication during the program. Baker's HL concept (Baker, 2006) includes health-related printed literacy (the ability to read and understand written health information) and health-related oral literacy (the ability to effectively communicate health information orally). The content validity of the HLE program was assessed by three experts: a nursing instructor with expertise in CKD, a nurse instructor with expertise in HL and the development of educational materials, and an advanced practice nurse. The average index of item-objective congruence (IOC) values for the HLE program was 0.88. The IOC values for the health materials, including PowerPoint slides, an infographic, videos, and Line stickers, were 0.85, 0.91, 0.84, and 0.88, respectively.

For usual care, participants received regular follow-up visits at the CKD clinics, including health assessment (history taking and clinical results), brief health advice on controlling blood pressure and blood glucose, avoiding toxic substances on kidneys, diet control, physical activity, and medication adherence at each visit.

Researchers developed the demographic questionnaire, including age, gender, monthly household income, education level, occupation, CKD stage, duration of CKD, and comorbidities.

The CKD knowledge questionnaire, adapted from Chosivasakul et al. (2017), comprised 15 items with three choices: yes, no, and unsure. Each correct response scored 1 point, while incorrect or unsure responses scored 0, yielding total scores between 0 and 15. Higher scores indicated greater CKD knowledge. The questionnaire had an average IOC value of 0.83 and a Kuder Richardson 20 reliability of 0.84.

The CKD self-management behaviors questionnaire, adapted from Chosivasakul et al. (2017), consisted of five domains with a total of 35 items. It utilized a 5-point Likert scale, where "1" indicated "never" and "5" indicated "regular." Positive items scored from 5 to 1, while negative items scored 1 for regular and 5 for never. Higher scores reflected better self-management behaviors. The instrument had an average IOC value of 0.86 and a Cronbach's alpha of 0.81.

The clinical outcomes were assessed as follows. The eGFR was used to evaluate the participants' kidney function, estimated using the CKD-EPI equation and standardized serum creatinine. HbA1c levels were used to assess the participants' glycemic control. These two variables were analyzed at the Bangkok R.I.A Group laboratory throughout the program. BP was measured using the blood pressure measurement method (Thai Hypertension Society, 2019) with a digital blood pressure device (OMRON HEM-7600T). This digital blood pressure device was calibrated and used continuously throughout the program.

BMI was used to screen health problems such as body fat based on weight and height (Centers for Disease Control and Prevention (CDC), 2024). Weight in this study was measured by a digital mobile weighing scale (CAMRY EB9322) that was newly bought, calibrated and used continuously throughout the research procedure. WC was measured by placing a measuring tape around the waist, at an umbilical level parallel to the floor, and assessing in centimeters while exhaling (World Health Organization, 2008).

Interventions

For the HLE program, the researchers communicated to the patients throughout the program with plain language to enhance health-related oral literacy. Easy-to-read health materials were developed to enhance health-related print literacy before beginning the program, following the toolkits (Brach, 2024; Ministry of Public Health, 2019). All health materials were designed to be more concise and attractive with simple words, large sizes of text with easy-to-read fonts, relevant pictures instead of written messages, and organizing content logically from the reader's point of view as follows:

- **PowerPoint slides** covered three topics: general kidney information, CKD information, including renal replacement therapy, and five lifestyle modifications for slowing CKD progression. The five lifestyle modifications were presented using words that all begin with the same Thai alphabet, making them easier to say, remember, and apply. The content included guidelines on CKD diet and medication, regular exercise, maintaining a positive mindset, avoiding smoking and chemical pollutants, and weight management.
- **An infographic** of the CKD diet was printed on A3 coated paper for durability and provided to the participants for use at home, serving as a visual guide to help them maintain a kidney-friendly diet. It was designed to be attractive and practical for the lifestyles of older adults living in rural areas.
- **Two short videos** featuring real-life stories from two patients were shown. One was a patient with end-stage renal disease who shared the experience with hemodialysis, while the other was a role model who had successfully delayed the progression of CKD.
- **Line stickers**, used as teaching aids and communication tools via the Line chat application, were designed as cute cartoon characters. With 96 designs across five categories—greetings, encouragement, reminders for five lifestyle modifications, health goals, and simple responses like 'yes' and 'okay'—these Line stickers facilitated engagement and reinforced key health messages easily and appealingly.

The HLE program consisted of three sessions (**Table 1**): Session 1 focused on enhancing health-related oral and print literacy through face-to-face communication (5-8 participants per subgroup). Session 2 aimed to strengthen these skills in online communication using the Line application and stickers. Session 3 provided follow-ups via private Line voice or video calls.

Data Collection

Data were collected from December 2022 to March 2023. The researchers randomized two similar contexts of district hospitals from ten district hospitals in Lopburi City and randomly assigned them to an experimental and a control group (29 people per group). At the baseline assessment (week 1), participants in both groups were interviewed to complete questionnaires by the researchers and the research assistant, a registered nurse. The participants were assessed for weight and height, WC, and BP by the researchers and were then evaluated for blood samples taken by the researcher assistant. From weeks 1 to 12, the experimental group participated in the HLE program plus usual care, and the control group received only usual care. After finishing the program at week 12, all participants were assessed for the post-test data as the baseline assessment.

Table 1 Intervention protocol

Activities	Time	Materials used
Session 1: Week 1 (Face-to-face communication)		
Part 1: Provision of knowledge with slow and clear speaking • Creating intimacy in relationships with friendliness and listening to them in the first meeting • Informing the stage and percentage of kidney function and convincing health habit changes to slow the progression of CKD • Providing knowledge with Teach-Back of each topic • Watching the two videos of a hemodialysis patient and a role model	40 minutes	PowerPoint Videos Infographic
Part 2: Group discussion related to the issues of frequent misunderstanding	10 minutes	
Part 3: Practicing self-management techniques	10 minutes	
Session 2: Week 2-12 (Online communication)		
Part 1: Motivation for two-way communication via the Line group chat on weekdays		Line stickers
• Line stickers were sent to the Line group to begin the health information exchange	Morning (8 a.m.)	
• The participants could ask the questions via private chat if they needed to protect the privacy and confidentiality of the research participants	Any time	
Part 2: Motivation for self-management in participants' daily lives • The Line sticker (a nurse cartoon image with the text "Did you perform all five lifestyle modifications today") was sent to motivate participants to assess their behaviors via the Line group • The participants could reply with the Line stickers (a personal image with the text "Yes, completed all five changes" or "Not, completed all five changes") • The researcher encouraged participants to continuously plan to achieve all five behavioral changes the next day	Night (7 p.m.)	-
Session 3: Week 3, 5, 7, 9, and 11 (Following up via private Line voice/ video calls)		
• The researcher assessed the problems and obstacles and found the solutions, answered the questions, together with verbal persuasion to continuously perform self-management behaviors, and helped the participants to achieve their health goal	5-10 minutes per time (2 p.m. or convenient time)	-

Data Analysis

Data were analyzed using SPSS 25. Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to describe the characteristic information. All the dependent variables had the normal distribution with testing of the Shapiro-Wilk test (N <50) and normality visual methods with QQ Plot. A Paired t-test was used to examine the different dependent variables within a group, and an Independent t-test was used to compare between groups.

Ethical Consideration

This study obtained ethical approval from the Institutional Review Board (IRB) at the Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand (COA.MURA2022/643). Before participating in this study, the research objectives, data collection procedures, benefits and impact of this study, and rights of participation or withdrawal without any effect on care were explained. All participants then willingly signed the informed consent form. All data were kept confidential and presented in terms of overall outcomes.

Results

Fifty-eight participants were selected for the program. However, six participants dropped out during the program: four participants from the experimental group and two from the control group due to illnesses, moving back to their hometowns and losing contact. The remaining samples who completed this study were 52 participants: 25 in the experimental group and 27 in the control group, being enough for sample size calculation. The mean ages of the experimental and control groups were 68.08 years (SD = 6.9 years) and 67.67 years (SD = 9 years), respectively. Most participants were male (56.0%) in the experimental group and female (55.6%) in the control group.

The average monthly household income in the experimental and control groups was 7,616 baht (SD = 8,461.6) and 7,181.4 baht (SD = 5,995.9), respectively. Most of the participants in both groups had levels of education at elementary school (68.0% and 70.4%) and were agriculturists (44.0% and 40.7%, respectively). Most participants in the experimental group were in stage 3A (48%), while those in the control group were in stage 3B (55.6%). Regarding comorbidities, almost all participants in both experimental and control groups had hypertension (95.8% and 96.3%), dyslipidemia (96.0% and 88.9%), and more than half of both groups had diabetes (56.0% and 70.4%, respectively). The details are shown in **Table 2**.

Table 2 Demographic data of study sample (N = 52)

Variables	Experimental group (n = 25)	Control group (n = 27)	Statistical value	p-value
Age (years), M ± SD	68.08 ± 6.9	67.67 ± 9	-	0.85[a]
Gender, *n (%)*			0.69	0.41[c]
Male	14 (56.0)	12 (44.4)		
Female	11 (44.0)	15 (55.6)		
Household income (THB), M ± SD	7,616.0 ± 8,461.6	7,181.4 ± 5,995.9	-	0.83[a]
Education level, *n (%)*			6.30	0.07[b]
No formal education	1 (4.0)	6 (22.2)		
Elementary school	17 (68.0)	19 (70.4)		
Secondary school	5 (20.0)	2 (7.4)		
Bachelor's degree	2 (8.0)	0 (0.0)		
Occupation, *n (%)*			-	1.00[b]
Agriculturist	11 (44.0)	11 (40.7)		
Butler/housewife	8 (32.0)	8 (29.6)		
Employee	3 (12.0)	4 (14.8)		
Merchant	2 (8.0)	3 (11.1)		
Government/ State enterprise	1 (4.0)	1 (3.7)		
CKD stage, *n (%)*			1.42	0.50[b]
Stage 3A	12 (48.0)	9 (33.3)		
Stage 3B	10 (40.0)	15 (55.6)		
Stage 4	3 (12.0)	3 (11.1)		
Duration of CKD (year)	7.72 (3.02)	8.52 (3.82)	-	0.41[a]
Comorbidities, *n (%)*				
Hypertension	24 (95.8)	26 (96.3)	-	0.96[c]
Dyslipidaemia	24 (96.0)	24 (88.9)	0.92	0.34[c]
Diabetes mellitus	14 (56.0)	19 (70.4)	1.17	0.28[c]

Note: a = Independent t-test; b = Fisher's exact test; c = Chi-Square test

The comparison of means within the experimental group before and after receiving the HLE program using Paired t-tests is shown in **Table 3**. The participants with CKD in the experimental group had a significantly higher mean of CKD knowledge (p <0.001), higher mean of self-management behaviors (p <0.001), better mean of eGFR (p <0.01), lower mean of SBP (p <0.01), and lower mean of DBP (p <0.001) than before receiving the program. As measured by Cohen's d, the effect sizes for CKD knowledge, self-management behaviors, SBP, DBP, and eGFR indicated large effects. However, after finishing the program, there were no significant differences in HbA1c, BMI, and WC.

Table 3 Comparison of means before and after receiving the HLE program in the experimental group using Paired *t*-test (*n* = 25)

Variables	Experimental group *(n = 25)*		*t*	*p*-value	Effect size (Cohen's *d*)
	Before	After			
	Mean (SD)	Mean (SD)			
CKD knowledge	6.16 (3.05)	10.44 (1.73)	10.23	<0.0001	2.09
Self-management behaviors	111.64 (5.71)	142.52 (13.43)	10.05	<0.0001	15.36
SBP	140.72 (12.70)	133.16 (9.23)	-3.27	<0.01	-11.56
DBP	77.92 (6.58)	72.44 (4.62)	-4.71	<0.0001	-5.82
HbA1c	6.58 (1.25)	6.40 (0.94)	-1.43	0.166	-0.63
eGFR	45.04 (9.24)	48.62 (10.84)	4.00	<0.01	4.47
BMI	26.33 (3.30)	25.93 (3.11)	-1.60	0.12	-1.25
WC	96.12 (7.95)	95.84 (7.80)	-1.66	0.11	-0.84

Note: SBP = Systolic blood pressure; DBP = Diastolic blood pressure; HbA1c = Hemoglobin A1c; eGFR = Estimated glomerular filtration rate; BMI = Body mass index; WC = Waist circumference

At baseline, the average values for each dependent variable were not significantly different between the experimental and control groups, as indicated by an Independent *t*-test ($p \geq 0.05$). **Table 4** presents the comparison of means between the experimental group and the control group after the HLE Program. Following the program, participants with CKD in the experimental group demonstrated significantly higher levels of CKD knowledge ($p < 0.001$), improved self-management behaviors ($p < 0.001$), lower SBP ($p < 0.05$), lower DBP ($p < 0.05$), and higher eGFR ($p < 0.01$) compared to the control group, which received usual care. Effect sizes, measured by Cohen's *d*, showed large effects for CKD knowledge, self-management behaviors, and eGFR, while SBP and DBP demonstrated medium effects. However, there were no significant differences in HbA1c, BMI, and WC at the conclusion of the program.

Table 4 Comparison of means after receiving the interventions between the experimental and the control groups using Independent *t*-test (*N* = 52)

Variables	Experimental group (*n* = 25)	Control group (*n* = 27)	*t*	*p*-value	Effect size (Cohen's d)
	Mean (SD)	Mean (SD)			
CKD knowledge	10.44 (1.73)	5.63 (2.17)	8.79	<0.0001	2.44
Self-management behaviors	142.52 (13.43)	115.67 (11.69)	7.70	<0.0001	2.14
SBP	133.16 (9.23)	140.37 (11.06)	-2.54	<0.05	-0.71
DBP	72.44 (4.62)	76.74 (9.79)	-2.05	<0.05	-0.55
HbA1c	6.40 (0.94)	6.90 (1.30)	-1.58	0.121	-0.44
eGFR	48.62 (10.84)	39.55 (9.96)	3.14	<0.01	0.87
BMI	25.93 (3.11)	25.62 (3.61)	0.34	0.738	0.09
WC	95.84 (7.80)	92.70 (8.73)	1.36	0.179	0.38

Note: SBP = Systolic blood pressure; DBP = Diastolic blood pressure; HbA1c = Hemoglobin A1c; eGFR = Estimated glomerular filtration rate; BMI = Body mass index; WC = Waist circumference

Discussion

This study demonstrates the effectiveness of a HLE program for people with CKD in rural Thailand. The program led to improved CKD knowledge, enhanced self-management behaviors, and better clinical outcomes, including improved eGFR and BP. Furthermore, the large effect sizes indicate that participation in the HLE program has a significant impact on enhancing participants' knowledge and self-management behaviors as well as eGFR. In contrast, the effect sizes for systolic BP at 0.71 and diastolic BP at 0.55 indicate medium effects, suggesting that the differences in BP reduction are not as pronounced as the improvements in CKD knowledge, self-management behaviors, and eGFR.

The favorable results align with Baker's HL concept (Baker, 2006), which emphasizes that reducing the difficulty and complexity of health information can improve patient's HL and outcomes. The participants in this study were at high risk for limited HL due to their status as older adults living in rural areas with low educational attainment and low family income (Aljassim & Ostini, 2020; Candemir et al., 2023; Friis et al., 2016), affecting lower ability to understand the disease information (Taylor et al., 2016) resulting in poor self-care knowledge and skills. The HLE program addressed these challenges by utilizing plain language and straightforward health materials through several key activities: enhancing CKD knowledge, facilitating group discussion, practicing self-management skills, promoting two-way communication, and monitoring behavior change via the Line application. This approach helped the participants access and understand health information more easily (Dawson et al., 2020; Warde et al., 2018). Specifically, regarding the CKD diet, participants were encouraged to regularly consume egg whites, as they are an affordable and readily available local food option (The Nephrology Society of Thailand, 2022). Consequently, their HL was enhanced, significantly improving CKD knowledge, self-management behaviors, and clinical outcomes.

The results were similar to previous studies in CKD, including improvement in CKD knowledge (Chen et al., 2023), self-management behaviors (Phuttimanee et al., 2023; Pragodpol et al., 2022), and clinical outcomes: BP (Pragodpol et al., 2022), and eGFR at six months (Huang et al., 2024) and seven months (Pragodpol et al., 2022). The enhancement of health-related oral literacy using plain language in previous studies on CKD has been reported in only a few instances and has not been a primary focus (Chosivasakul et al., 2017;

Pragodpol et al., 2022). However, prior research has addressed the enhancement of health-related print literacy through materials tailored to limited HL levels with visual strategies, like those used in this study, such as CKD booklets (Nguyen et al., 2019), dietary health education videos (Huang et al., 2024), and kidney models (Chosivasakul et al., 2017).

However, the decrease in HbA1c, BMI, and WC values was not significantly different. The possible reasons might be explained as follows. Almost half of the participants in the present study had no diabetes; therefore, their HbA1c values were normal at the beginning of the program. Hence, there was no significant change. The results were comparable to previous studies that had no significant improvement in BMI (Chosivasakul et al., 2017; Li et al., 2020). Most participants were also older adults with generally lower metabolic rates (Zampino et al., 2020). They may require more time and intensive lifestyle modifications, both dietary and physical activity, to reduce BMI and WC (Conley et al., 2021).

In contrast, the results differed from those of Pragodpol et al. (2022), who studied the effectiveness of an HL promotion model to slow the progression of CKD among patients with CKD. The program included education, using various formats of health materials, self-management training, the Line application, home visits, and telephone follow-up that demonstrated significant changes in HbA1c, BMI, and WC for seven months. A program duration of more than 12 weeks might be needed to show significant changes in variables such as HbA1c, BMI, and WC for people with CKD.

Nurses and healthcare providers are encouraged to implement the HLE program for individuals with CKD to enhance their knowledge and self-management behaviors, leading to better clinical outcomes. Further research should explore the long-term effects of such interventions on self-management behaviors and clinical outcomes beyond 12 weeks.

Implications of the Study

The study's findings have significant implications for nursing practice, particularly in managing CKD among vulnerable populations. Firstly, the effectiveness of the HLE program highlights the importance of tailored education in improving patients' knowledge and self-management behaviors. Nurses can integrate similar HLE approaches in their practice by using plain language, visual aids, and engaging activities that facilitate understanding and retention of health information.

Moreover, the study highlights the necessity of addressing social determinants of health, such as educational attainment and income level, which may affect health literacy in older adults in rural areas. Nurses should assess patients' health literacy levels and adapt their communication strategies accordingly, ensuring that information is accessible and relevant. Additionally, the use of technology, like the Line application for monitoring behavior changes, can enhance patient engagement and follow-up. Nurses can utilize such tools to maintain ongoing patient communication, promoting sustained behavior change.

Lastly, while improvements in knowledge and self-management were significant, the slower changes in metabolic markers suggest the need for longer interventions. Nurses should advocate for extended programs that encompass lifestyle modifications, emphasizing the importance of continuous support in achieving health goals. Overall, these strategies can empower patients with CKD, leading to better health outcomes in similar settings.

Limitations of this Study

There were some biases in the data collection process. The research design did not incorporate double-blinding for the research assistant or the participants. This could have introduced bias in the data collection and analysis. The findings may not be easily generalized to urban settings or other contexts, as the study was conducted in rural areas with specific demographic and socioeconomic characteristics. The program relied on participants using smartphones and the Line application. This dependency limited the applicability of the program to those who have access to and are familiar with these technologies. These limitations should be considered when interpreting the results and applying the findings to different settings or populations.

Conclusion

The findings suggest that the HLE program can increase the quality of patient-provider communication by using plain language communication, which is a valuable intervention strategy for people with CKD. This approach can improve knowledge, self-management, and clinical outcomes. Implementing this program or strategy in practice is worthwhile and benefits both patients and HCPs.

Declaration of Conflicting Interest

The authors declared no conflict of interest.

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Authors' Contributions

All authors equally contributed to all stages of the study, including literature review, conception, research design, data collection, data analysis, and conclusion, including drafting and revising the manuscript. All authors approved the publication of the final version of this article.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declaration of Use of AI in Scientific Writing

The authors did not use generative AI in the writing process of this article.

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