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ORIGINAL RESEARCH

Improvement in Unhealthy Behaviors Among Patients with Chronic Kidney Disease Receiving Integrated Care at Community Hospitals in Thailand

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Purpose: Unhealthy behaviors can accelerate the progression of chronic kidney disease (CKD). This study aimed to evaluate the effectiveness of a community-based integrated care program in modifying key unhealthy behaviors among CKD patients in rural Thailand and to assess the impact of these behaviors on the rate of kidney function decline.

Patients and Methods: This is a post-hoc analysis of the ESCORT-2 trial, which is a 3-year prospective cohort study that enrolled 914 patients with CKD stages 3–4 in rural Thailand. Participants received an integrated care program involving hospital-based multidisciplinary teams and home-based community care networks. Seven unhealthy behaviors were assessed annually: usage of herbal medicines, analgesics, and non-steroidal anti-inflammatory drugs (NSAIDs); being overweight; lack of regular exercise; moderate-to-high salt intake; and high protein intake. Data were collected through patient interviews and standardized questionnaires. Changes in the prevalence of these behaviors were analyzed over three years, and the association between persistent unhealthy behaviors and the rate of eGFR decline was examined.

Results: Over the 3-year study period, the integrated care program led to significant and sustained reductions in the use of herbal medicines (23.3% to 5.0%), analgesics (34.9% to 7.8%), and NSAIDs (4.3% to 1.3%) (all $p<0.0001$). Moderate-to-high salt intake also significantly decreased (22.1% to 14.1%, $p<0.0001$). However, no significant improvement was observed in the prevalence of overweight or high protein intake. While individual persistent unhealthy behaviors did not significantly correlate with the rate of estimated glomerular filtration rate (eGFR) decline, patients with a baseline accumulation of three or more unhealthy behaviors exhibited a significantly faster eGFR decline compared to those with fewer unhealthy behaviors (−2.04 vs −1.02 mL/min/1.73 m², $p<0.001$).

Conclusion: An integrated care model implemented in a primary care setting can effectively reduce medication- and dietary-related unhealthy behaviors in CKD patients. However, fostering sustained improvements in complex lifestyle behaviors such as weight control and regular exercise remains a significant challenge.

Keywords: chronic kidney disease, CKD, integrated care, unhealthy behaviors, lifestyle modification

Introduction

Chronic kidney disease (CKD) is a common communicable disease affecting over 850 million people worldwide.[1] It is a major cause of morbidity and mortality, and its prevalence is increasing globally.[2] The cost of kidney replacement therapy is very high, posing a big threat to economic status in every country, especially in low- and middle-income countries. The expenditure on kidney replacement therapy (KRT) accounts for 0.91 to 7.1% of national healthcare budget.[3] However, most developing countries do not have public funding support for the cost of KRT.[4] Patients with CKD usually have shorter longevity and lower quality of life than controlled population.[5] Thus, providing effective

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means for early recognition and treatment to delay kidney disease progression is of prime importance. Besides specific pharmacologic intervention, lifestyle modification is an indispensable part for delaying kidney disease progression.[6] These include control of body weight, exercise, avoidance of tobacco and analgesic use, and control of dietary protein and salt intake. However, in real world practice, the patient's compliance with this recommendation is still far from perfect. Among patients with diabetes, there were only 53.5% of cases who were able to achieve satisfactory body mass index (BMI).[7] Only 25% to 50% of CKD patients could comply with dietary intake recommendation.[8]

Herbal, alternative, and supplementary therapies are commonly used by CKD patients, despite potential risks and limited evidence of efficacy.[9] This is particularly true among Asian patients due to a common belief that natural products are healing remedies which should be harmless to the body.[10–12] Use of herbal medicines was as high as 42.65% of Thai patients with CKD.[13,14] Since detailed compositions of many medical herbs are unknown or not clearly identified, continuing consumption of herbal medicines poses a continuing risk factor of CKD progression.[15,16]

Non-steroidal anti-inflammatory drugs (NSAIDs) are widely recognized as a risk factor for CKD progression.[17] Despite this adverse effect, use of NSAID or other analgesics for pain relief is not uncommon among CKD patients. About 27% of CKD patients in a Canadian population-based study received at least one NSAID prescription.[18] In Thailand, NSAIDs or analgesic use was found in 39% of CKD patients living in the rural area.[19]

A randomized controlled trial (RCT), the ESCORT-1 study, was conducted to evaluate the effectiveness of an integrated care approach for CKD patients at the community level.[20] In that study, patients with stage 3 or 4 CKD residing in a rural district of Kamphaengphet Province, approximately 400 kilometers north of Bangkok, Thailand, received multidisciplinary care at the district hospital and home visits conducted by community nurses from sub-district health offices in collaboration with village health volunteers. It was observed that patients assigned to the intervention group exhibited a reduced rate of kidney disease progression compared to those in the control group, who received conventional care. Furthermore, the intervention group consistently adhered to a low-salt, low-protein diet regimen throughout the study period. It could be inferred that such comprehensive care would empower patients in the intervention group to make more significant lifestyle modifications.

The ESCORT-2 Study was subsequently expanded to include five district hospitals. The care program was modified to be less strict and more aligned with the realities of community-level care in Thailand. Nevertheless, core care activities were maintained.[21] Interventions included training healthcare personnel in CKD management, employing multidisciplinary care teams, conducting scheduled patient education during hospital visits, and implementing regular home visits with protocol checklists by sub-district community nurses and village health volunteers. After a 3-year observation period, the ESCORT-2 Study demonstrated a significantly lower rate of kidney disease progression among its participants when compared to the control group of the preceding ESCORT-1 Study.[21] Given that adverse lifestyle factors can accelerate the progression of CKD, it is important to determine if an integrated care approach can improve these unhealthy behaviors. Thereafter, in planning the ESCORT-2 Study, we determined to prospectively and systematically monitor a set of unhealthy behaviors as well as clinical and biochemical parameters throughout the course of the study period. This study is a follow-up part of the ESCORT-2 study, which has already been published, but will focus on the change in unhealthy behaviors along the course of that study.

Materials and Methods

This article presents a post-hoc analysis of the ESCORT-2 Study data to examine the effect of an integrated care model on modifying unhealthy behaviors associated with CKD progression. The protocol of ESCORT-2 Study was approved by the Ethics Committee of Institutional Review Board, Ministry of Public Health, Thailand, and registered with www.clinicaltrials.in.th (TCTR-20160614001). It was conducted in accordance with the ethical principles of the Declaration of Helsinki. All study participants provided informed consent before the initiation of the study. It was a 3-year prospective cohort study.[21] Those who were 18–70 years old and had estimated glomerular filtration rate(eGFR) of 15–59 mL/ min/ 1.73 m^2 body surface area (BSA) was enrolled. eGFR was calculated by using the 2009 CKD-EPI formula. Details of the exclusion criteria and methods of study have been described elsewhere.[21] In brief, the integrated care program consisted of a hospital-based multidisciplinary care team (HMDT) at each district hospital, and a home-based community care network team (CCNT) at each sub-district health office.

HMDT is comprised of 1–2 general practitioners, a CKD nurse practitioner, 1–2 pharmacists, a nutritionist, and a physical therapist. During patients' hospital visit every 3 months, enrolled cases were interviewed about their current unhealthy behaviors. HMDT provides group education and clinical care to patients. The education included basic knowledge on and self-care for CKD; avoidance of high-salt and high-protein diet; avoidance of use of alcohol, tobacco, herbal medicines, and over-the-counter analgesics or NSAIDs; and advice on regular exercise. The cases were interviewed on their history of the use of herbal medicines, analgesics, or NSAIDs. The CCNT, comprised of a community nurse working at each sub-district health center, and village health volunteers (VHVs) who were responsible for caring for the cases residing in that village, conducted the interviews. CCNT gave advice during home visit every 6 months to the cases on how to conduct healthy behavior to delay CKD progression. CNNT also assessed exercise practicing at home, and consumption of salty or high-protein foods. Antihypertensive agents such as angiotensin-converting enzyme inhibitors (ACEI) and angiotensin receptor blockers (ARB) available at the public primary healthcare level were enalapril and losartan, respectively. Antihyperglycemic agents available for use were sulfonylurea, metformin, and insulin.

The body mass index was defined as actual weight in kg standardized to a square meter of body height. It was measured at baseline and every 12 months thereafter. An herb was defined as any medicinal product with ingredients made from one or more kinds of plants. Herbal or analgesic/NSAIDs use was defined, on a yes/no basis, as a history of using any herb or analgesic/NSAIDs once during each 3-month period. The term "NSAIDs use" was used exclusively only when a specific drug can be identified as an NSAID. In Thailand, the use of NSAIDs is often linked to the use of pre-packaged, over-the-counter painkiller drugs.[22] Therefore, when collecting patient history, a broad term like "analgesic use" was applied to capture all potential NSAID exposure.

CCNT conducted home visits every 6 months, during which each patient was interviewed about their exercise frequency and salty food consumption in the past week. Exercise could be in the form of either cardiovascular, strengthening or stretching type. Due to the difficulty in distinguishing between authentic exercise and daily agricultural work, lack of exercise at home was defined as having one or fewer authentic exercise sessions in the past week.

Consumption of high salt intake was obtained by using a standard food interview form (SFIF). It was designed by Department of Health Service Support, Ministry of Public Health, Thailand [Appendix 1] and had routinely been used by community nurses during their field works. In that form, 10 types of commonly consumed salty foods or food condiments were listed. During the home visit by CCNT, each patient was interviewed to figure out the frequency of salty food items consumed in a week preceding the home visit. The amount of daily protein intake (DPI) was assessed with a short protein food recall questionnaire (S-PFRQ) developed by a renal dietitian for this study [Appendix 2]. It was counted as the number of tablespoons of high-protein food items consumed during the preceding week and was expressed as a daily average. We have previously reported that DPI estimated from S-PFRQ correlated well with the protein-equivalent of total nitrogen appearance, which was calculated from 24-hour urinary urea-nitrogen excretion.[23]

Outcomes

Continuous variables are presented as mean ± SD, while categorical data are presented as percentages. CKD was stratified into stages 3A, 3B, and 4 based on eGFR values. Usage of herbs and analgesic or NSAIDs obtained during each hospital visit were pooled together over a 12-month interval. If a patient reported such usage once or more at 12-month period, it would be scored as "having unhealthy behavior". Prevalences of overweight were assessed at baseline and annually thereafter. Participants with BMI of 23 kg/m^2 or higher were labeled as being overweight. Lack of regular exercise, salt, and protein intake were assessed at baseline and during home visits every six months. Participants were labeled as having unhealthy behaviors if they reported any of these behaviors during any home visit in a given year. Participants whose unhealthy behaviors were observed in over 50% of recorded instances were classified as having persistent unhealthy behaviors. The cumulative prevalence of unhealthy behaviors was determined for each participant at baseline and annually. Each identified unhealthy behavior was assigned a value of 1 point. The impact of this cumulative unhealthy behavior score on the progression of CKD was analyzed. Although changes in blood pressure and proteinuria could affect the rate of progression of kidney disease, the results of these changes had already been reported in the previous study[22] and will not be presented herein. Comparison between baseline and annual prevalence of each unhealthy

behavior was made with McNemar's chi-square test, The influence of the persistent unhealthy behavior on CKD progression was examined by comparing eGFR decline rates between the persistent and non-persistent groups using an independent *t*-test. Statistical analyses were using the SPSS program software version 23. Statistical analysis was regarded as significant when the p-value was < 0.05.

Results

Out of 1211 cases with CKD stages 3–4, aged 18–70 years-old who were screened for enrollment in the ESCORT-2 Study, fifty-two cases declined the study, 297 cases were excluded, leaving 914 cases for enrollment.[22] The mean age was 62 + 6 years, and 67% were female (Table 1). About 80% of the case received primary education (up to grade 6 from the grade 1–12 scale). Hypertension, hyperlipidemia and diabetes were found in 92%, 68% and 53%, respectively. About 60% of the cases had overweight, defined as BMI equal to or more than 23.0 Kg/m^2 which is the cut-off limit of overweight for Asian population.[24] At enrollment, the histories of herbal medicine usage, analgesic usage and smoking were 23%, 35% and 36%, respectively.

The cases were stratified at baseline by stages of CKD and types of unhealthy behavior (Table 2), there was no significant difference among the CKD stages with respect to the proportion of cases with usage of herbal medicine or analgesic, moderate to high salt intake, and high protein intake. However, the prevalence of NSAID use, being overweight, and lack of exercise were significantly less observed in cases with stage 4 CKD than those in the earlier stages of CKD (P =0.001, P = 0.006, and P = 0.006, respectively).

Table 3 illustrated trends of change of unhealthy behaviors along the course of the study. Usage of herbal medicine declined from 23.3% of cases at baseline to 13.4% at the 1st year of follow-up (difference = −9.77, 95% CI [−13 to

Table 1 Demographic and Clinical Characteristics of Study Participants at Baseline

Parameters	Values
Number of patients at enrollment (cases)	914
Age, years (mean ± SD)	62 ± 6
Gender (female/ male)	612/302
Education at primary level (grade 6 or below)	80%
Co-morbid diseases Hypertension Hyperlipidemia Diabetes mellitus	 92% 68% 53%
Overweight	60%
Blood pressure (mean ± SD)	129±15 / 74 ± 9
HbA1c, % (mean ± SD)	7.2 ± 1.8
Number of patients who received ACEI/ARB prescription, case (%)	603 (66%)
History of usage of herbal medicines	23%
History of usage of analgesic	35%
History of usage NSAID	4.3%
History of smoking	36%

Abbreviations: SD, Standard Deviation; NSAID, nonsteroidal anti-inflammatory drug.

Table 2 The Prevalence of Unhealthy Behaviors Among Study Participants Stratified by Stage of CKD at Baseline, No. of Cases (%)

Unhealthy Behaviors	CKD Stage			P value
	3A	3B	4	
Herb use	78 [23.1%]	92 [23.4%]	41 [23.8%]	0.985
Analgesic use	121 [35.7%]	142 [35.6%]	55 [31.6%]	0.60
NSAID use	25 [7.4%]	11 [2.8%]	2 [1.1%]	0.001*
Overweight	223 [65.6%]	240 [60.5%]	88 [50.9%]	0.006*
Lack of regular exercise	60 [18.7%]	51 [13.6%]	13 [8.0%]	0.006*
Moderate to high salt intake	63 [19.6%]	95 [25.5%]	31 [19.1%]	0.106
High protein intake	83 [26.2%]	107 [29.5%]	38 [24.1%]	0.385

Notes: *significance P value of less than 0.05.
Abbreviation: NSAID, nonsteroidal anti-inflammatory drug.

Table 3 Percentage of Unhealthy Behaviors at Baseline and From the First year to Third year of Follow up

Unhealthy Behaviors	Comparison between Baseline and 1st to 3rd Year Follow up						
	Prevalence at Baseline	Prevalence at 1st Year	Difference (95% CI), P value	Prevalence at 2nd Year	Difference (95% CI), P value	Prevalence at 3rd Year	Difference (95% CI), P value
Herb use	23.3%	13.4%	−9.77 (−13 to −6.5), <0.0001	7.0%	−15 (−18 to −12), < 0.0001	5.0%	17 (−21 to −14), <0.0001
Analgesic use	34.9%	18.6%	−16.3 (−20 to −12), <0.0001	16%	−18.8 (−22 to −14), < 0.0001	7.8%	− 27.3 (−30.9 to −23.6), < 0.0001
NSAIDs use	4.3%	2.6%	−1.7 (−3.34 to −0.2), 0.036	2%	−2.3 (−3.85 to −0.78), 0.005	1.3%	−2.9 (−4.43 to −1.38), <0.0001
Overweight	60.5%	62.9%	2.43 (0.16 to 4.69), 0.046	64.0%	3.54 (1.05 to 6.02), 0.007	62.1%	1.15 (−1.65 to 3.95), 0.47
Lack of regular exercise	14.1%	9.9%	−4.1 (−6.7 to −1.6), 0.002	7.8%	−6.2 (−8.9 to −3.5), < 0.0001	12.5%	−1.7 (−3.34 to −0.21), 0.105
Moderate to high salt intake	22.1%	18.0%	−3.92 (−7.15 to −0.69), 0.021	12.9%	−8.53 (−11.9 to −5.13), <0.0001	14.1%	−7.97 (−11.54 to −4.40), <0.0001
High protein intake	27.2%	28.2%	1.13 (−2.63 to 4.89), 0.60	29.7%	2.52 (−1.30 to 6.36), 0.22	24.6%	−2.91 (−6.98 to 1.15), 0.18

Abbreviation: NSAIDs, nonsteroidal anti-inflammatory drugs.

−6.5]), to 7% at the 2nd year of follow-up (−15, 95% CI [−18 to −12]), and to 5% at the 3rd year of follow-up (−17, 95% CI [−21 to −14]), P < 0.0001 for all comparisons.

The prevalence of analgesic or NSAID usage decreased remarkably from 34.9% and 4.3%, respectively, at baseline to 18.6% and 2.6%, respectively, at the 1st year (P < 0.0001 and P < 0.036, respectively), to 16.0% and 2.0%, respectively, at the 2nd year (P < 0.0001 and P < 0.005, respectively), and to 7.8% and 1.3%, respectively, at the 3rd year (P < 0.0001 for both).

The percentage of overweight participants exceeded 60% throughout the study period and did not decrease with integrated care management (Table 3). Using the standard food interview form (SFIF), the baseline prevalence of moderate to high salt intake was 22.1%, which significantly decreased to 18% at the one-year follow-up (P=0.0021). Further reductions were observed at the two-year (12.9%) and three-year (14.1%) follow-ups (P<0.0001). In

Table 4 Relationship Between Persistent Unhealthy Behaviors and Rate of eGFR Decline

Unhealthy Behaviors	Reference Group	Number of Cases	Rate of eGFR Decline (mL/min/1.73m2/year) mean	Difference (95% CI)	P[a] value
Herb use	No	788	−0.99	0.28 (−0.44, 1.01)	0.439
	Yes	93	−1.28		
Analgesic use	No	724	−1.11	−0.51 (−1.09, 0.08)	0.088
	Yes	157	−0.60		
NSAIDs use	No	872	−1.01	1.01 (−1.21, 3.24)	0.372
	Yes	9	−2.02		
Lack of regular exercise	No	795	−1.00	0.16 (−0.59, 0.91)	0.67
	Yes	86	−1.16		
Overweight	BMI < 23 kg/m^2	310	−1.18	−0.26 (−0.72, 0.21)	0.283
	BMI > 23 kg/m^2	571	−0.93		
Moderate to high salt intake	No	737	−1.06	−0.26 (−0.86, 0.34)	0.40
	Yes	144	−0.80		
High protein intake	No	627	−0.95	0.22 (−0.27, 0.71)	0.381
	Yes	254	−1.18		

Abbreviations: BMI, Body mass index; NSAIDs, nonsteroidal anti-inflammatory drugs.

contrast, the prevalence of high protein intake, as estimated by the S-PFRQ, did not change significantly during the study.

The potential for unhealthy behaviors to exacerbate the progression of CKD has been suggested.[25] This study aimed to determine if the sustained accumulation of unhealthy behaviors over time correlated with a greater rate of decline in eGFR. We conducted a comparative analysis of eGFR decline between participants exhibiting persistent unhealthy behaviors and those without [Table 4]. However, the results did not reveal any statistically significant differences in eGFR decline between the two groups for any of the unhealthy behaviors investigated.

Nevertheless, we observed a progressive decline in the percentage of participants with unhealthy behavior counts of 3 or more, from 26% at baseline to 17%, 14.8%, and 14.4% at years 1, 2, and 3, respectively, during the follow-up period (Figure 1). Furthermore, participants with unhealthy behavior counts of 3 or more at baseline exhibited a significantly faster rate of eGFR decline compared to those with fewer than 3 unhealthy behaviors (−2.04 vs −1.02 mL/min per 1.73 m² per year; mean difference 0.98 [95% confidence interval (CI) 0.48–1.48], P < 0.001) (Figure 2).

Discussion

Previous literature has shown that several unhealthy behaviors can negatively impact the progression of CKD, particularly during its early stages.[25] Clinical practice guidelines for CKD management emphasize the crucial role of lifestyle modifications as a fundamental component of treatment.[6] However, these changes can be difficult for patients to comply with due to various factors including low health literacy, inadequate education programs, and lack of motivation. Therefore, effective CKD management strategies should prioritize patient support and education to facilitate the adoption of healthier behaviors.

The previous ESCORT-1 and ESCORT-2 studies utilized an integrated care approach that combined lifestyle modification into the clinical management of CKD patients.[21,22] This concerted approach involved a HMDT during hospital consultations and a CCNT during home visits. Each team member had a specific set of activities to provide for

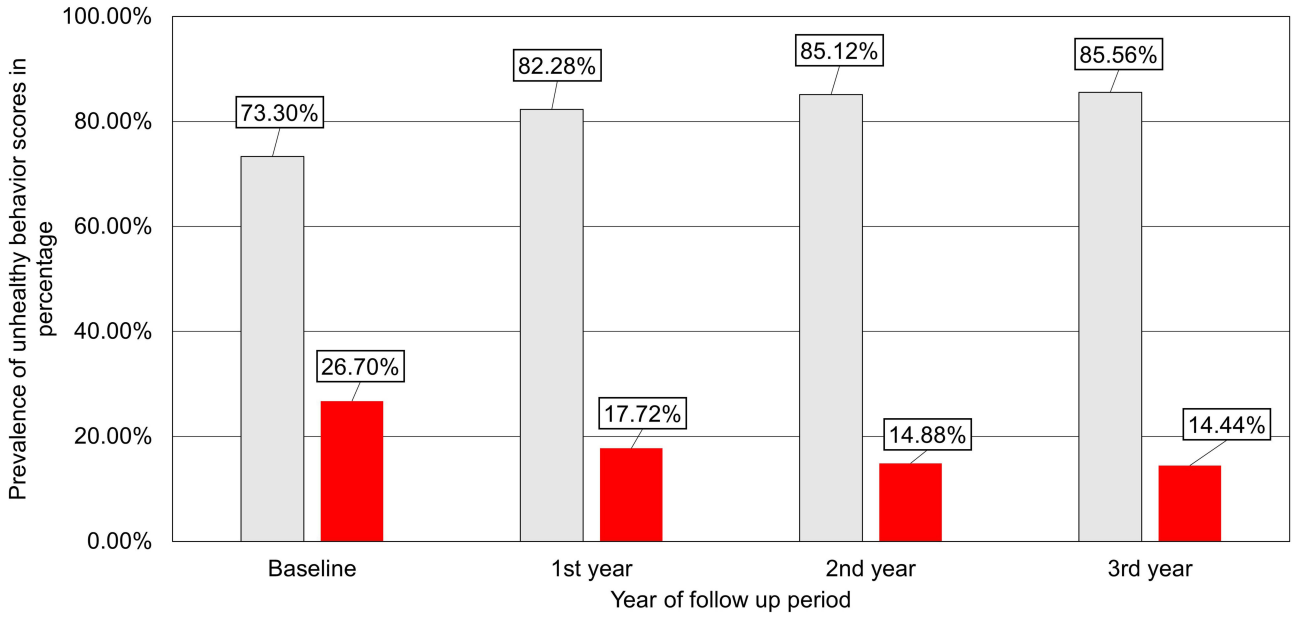

Figure 1 Trend of cumulative unhealthy behavior scores. ☐ UH count less than 3; ■ UH count equal or more than 3.
Abbreviation: UH, Unhealthy behavior.

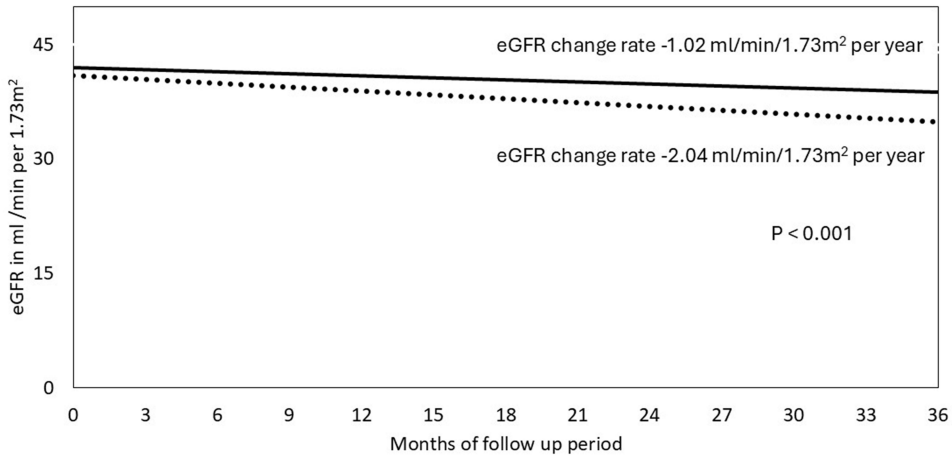

Figure 2 Comparison of extrapolation lines represent eGFR decline rate between participants with UH count less than 3 and UH count equal or more than 3. ▬ UH count less than 3; ■ ■ ■ ■ ■ ■ UH count equal or more than 3.
Abbreviations: UH, Unhealthy behavior; eGFR, estimated Glomerular filtration rate.

the patient during each visit. The activities were rotated throughout the year to maintain patient engagement with the advice. The core educational content, however, remained focused on basic CKD knowledge and lifestyle modifications to slow disease progression. The integrated care model incorporated several behavioral change techniques. Regular interviews and home visits provided opportunities for feedback and monitoring. Group education sessions offered instruction on healthy behaviors. Live demonstrations illustrate these behaviors, while home visits facilitated social support.[26] In the end, there was a reduced rate of CKD progression among participants in the intervention group who received integrated care. Nevertheless, the extent to which this model effectively modified unhealthy behaviors, and the precise nature of these changes requires further investigation.

Participants who were enrolled in the ESCORT-2 Study were living in rural communities of a province in northern Thailand. They could be representative of typical Thai rural population. This communication addresses seven unhealthy behaviors known to contribute to CKD progression. These behaviors fall into three categories: 1. Medication use-related

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unhealthy behaviors (usage of analgesics or NSAIDs, and herbal medicine); 2. Unhealthy dietary behaviors (consumption of food items containing moderate to high salt content, and high protein content); and 3. Lifestyle-related behaviors (lack of exercise, and obesity). The baseline prevalence rates of these unhealthy behaviors were largely consistent with those reported in previous studies.[25] However, it is noteworthy that the prevalence of being overweight and the use of analgesics or NSAIDs were notably high, reaching 60% and 40%, respectively. In our study, the prevalence of NSAIDs use alone appeared to be lower than what has been reported for the general population in previous studies.[27] This is because the inclusion of both analgesic and NSAIDs terminology was utilized to ensure a comprehensive capture of all possible exposures to NSAIDs. In Thai rural areas, people often get NSAIDs from pre-packaged analgesic drugs sold in local pharmacies or grocery stores. If we combine the prevalence of analgesic and NSAIDs use described herein, the overall prevalence becomes higher than what has been previously reported for the general Thai population but is comparable to a previous report of 39% among CKD patients in a rural area of another part of Thailand.[19] This could be attributed to the fact that the population enrolled in this study consisted primarily of agricultural workers engaged in physically demanding jobs. Moreover, the widespread availability of over-the-counter pain-relieving packages containing multiple analgesics and NSAIDs in village-level stores could have facilitated easy access to potentially harmful medications for CKD patients.

The prevalences of these unhealthy behaviors at baseline were analyzed separately for each stage of CKD. A lower prevalence of overweight, NSAID utilization, and physical inactivity was observed among patients with CKD stage 4 when compared to stages 3A and 3B. It is plausible that individuals in this advanced stage of the disease had a heightened understanding of their condition's seriousness, leading to improved compliance with recommended healthy behaviors.

The present study provides compelling evidence of a substantial decrease in several critical unhealthy behaviors throughout the study duration. Although the improvement of unhealthy behaviors demonstrated variability across different categories, the findings of our study indicate a marked and consistent decrease in medication-usage related unhealthy behaviors. Medication use-related unhealthy behaviors are frequently more amenable to change than other categories of unhealthy behaviors. This is due to factors such as the ability to deliver explicit instructions to the patient and the ease of implementing, monitoring and support systems.

The reduction in dietary-related unhealthy behaviors, while significant and consistent, was less pronounced than the reduction in medication use-related unhealthy behaviors. These results indicate that the integrated care model, while promising, may not be sufficient to ensure consistent adherence to dietary recommendations. The difficulty of implementing dietary interventions in CKD populations is widely acknowledged.[28] The formulation of effective strategies to enhance dietary counseling is a complex endeavor, influenced by numerous variables.[29] While the integrated care model addresses key factors like group education, live demonstrations, and regular monitoring, incorporating supplementary techniques such as personalized educational sessions, motivational interviewing, and access to affordable healthy food options could significantly enhance the effectiveness of dietary counseling.[29]

Yet, there was no significant improvement in lifestyle-related behaviors, specifically exercise and weight control. Regular exercise levels improved initially, but a notable decline occurred in the last year of follow-up. This pattern aligns with the expected response to lifestyle modification programs, characterized by an initial period of improvement, followed by a plateau and a subsequent decline. Weight control is a complex process influenced by numerous factors, including dietary intake, physical activity, sleep patterns, stress management, and smoking cessation. Consequently, weight control is often the most challenging lifestyle modification for CKD patients, which is consistent with our findings.

Over a 36-month observation period, we aimed to determine if improvements in unhealthy behaviors were associated with a reduced rate of eGFR decline. Unfortunately, we found that individual improvements in specific unhealthy behaviors did not significantly affect the rate of eGFR decline. This lack of impact may be due to the complex and multifaceted mechanisms that contribute to GFR decline in kidney disease. However, we did observe that individuals with a baseline cumulative score of 3 or more unhealthy behaviors experienced a faster rate of eGFR decline compared to those with a score below 3.

To our knowledge, this is the first longitudinal, prospective observational cohort study of patients with CKD in a primary healthcare setting. This article demonstrates that a structured, integrated care program effectively reduces unhealthy behaviors. The program's success in slowing the progression of CKD is attributed to a combination of lifestyle modifications and the close control of key clinical and biochemical parameters, as previously shown in our original ESCOR2 study.[22] The model is likely to be implemented at a nationwide level. Furthermore, since such program utilized in this study is not a costly or technically advanced intervention, it could be generalized to the other rural communities as well.

The findings of this study must be interpreted with certain limitations. Firstly, the majority of unhealthy behaviors examined in this study were obtained via self-report, a methodology recognized for its potential limitations in terms of accuracy and reliability. Additionally, most of the enrolled patients had only a primary education level, which could introduce qualitative error, especially in their ability to accurately recall information.

Secondly, the questionnaires employed for assessment of dietary intake behavior were designed to be both user-friendly for primary health care personnel and suitable for integration into routine clinical practice. Therefore, the list may not be complete. Several food items were omitted from the questionnaire list. Furthermore, some unhealthy behaviors, such as alcohol consumption and illicit drug use, were not included in our study. Accurately measuring these behaviors in Thailand presents significant challenges, and our intervention was not designed to effectively address them.

Thirdly, information collected by healthcare providers may be biased due to the Hawthorne effect. This occurs when participants who are aware of being observed alter their behavior, often by providing overly positive responses. Finally, it is important to note that we did not collect data on direct outcomes associated with each unhealthy behavior. For example, we did not assess the prevalence of acute kidney injury (AKI) in patients with a history of NSAID use or the correlation between muscle mass and regular exercise.

While this study provides valuable insights, further research is needed to explore the optimal strategies for promoting sustained behavioral change and to elucidate the precise mechanisms by which these changes impact CKD progression. Future studies should consider incorporating more rigorous assessment methods, such as objective measures of dietary intake and physical activity, to enhance the accuracy of data collection. Additionally, exploring the impact of targeted interventions for specific unhealthy behaviors, such as personalized dietary counseling and tailored exercise programs, may yield more significant results.

Conclusion

This study demonstrates the feasibility and effectiveness of an integrated care model in addressing multiple unhealthy behaviors among CKD patients in a primary care setting. The intervention led to significant reductions in medication-related and dietary-related unhealthy behaviors, particularly in the early stages of the study. However, maintaining long-term adherence to lifestyle modifications, especially weight control and physical activity, remains a challenge.

Data Sharing Statement

The data supporting the findings of this study are available from the corresponding author (Teerawat Thanachayanont, Tthanachayanont@gmail.com) upon reasonable request.

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Disclosure

The authors declare no conflicts of interest in this work.

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