The effectiveness of patient activation interventions in adults with chronic kidney disease: A systematic review and meta-analysis

Received: 28 May 2022 | Revised: 14 December 2022 | Accepted: 28 December 2022

DOI: 10.1111/wvn.12634

WORLDVIEWS ON EVIDENCE-BASED NURSING

ORIGINAL ARTICLE

The effectiveness of patient activation interventions in adults with chronic kidney disease: A systematic review and meta-analysis

Laura E. Lunardi BM, BN, MCN[1,2] | Kathy Hill PhD[2] | Qunyan Xu PhD[2] | Richard Le Leu PhD[1] | Paul N. Bennett PhD[2]

[1]Central Northern Adelaide Renal & Transplantation Service, Royal Adelaide Hospital, Adelaide, South Australia, Australia

[2]Clinical Health Sciences, Rosemary Byrant AO Research Centre, University of South Australia, Adelaide, South Australia, Australia

Correspondence
Laura E. Lunardi, Central Northern Adelaide Renal & Transplantation Service, Royal Adelaide Hospital, Port Rd, Level 7F 401, Adelaide, SA 5000, Australia.
Email: laura.lunardi@sa.gov.au

Abstract

Background: Chronic kidney disease (CKD) is a complex health condition that profoundly impacts an individual's general health and well-being throughout their entire lifetime. People with CKD require the knowledge, confidence, and skills to actively self-manage their health. This is referred to as patient activation. The efficacy of interventions to increase patient activation in the CKD population is unclear.

Aim: This study aimed to examine the effectiveness of patient activation interventions on behavioral health-related outcomes among people with CKD stages 3–5.

Methods: A systematic review and meta-analysis of randomized controlled trials (RCTs) of patients with CKD stages 3–5 was performed. MEDLINE, EMCARE, EMBASE, and PsychINFO databases were searched between 2005 and February 2021. Risk of bias was assessed using the Joanna Bridge Institute critical appraisal tool.

Results: Nineteen RCTs that enrolled 4414 participants were included for synthesis. Only one RCT reported patient activation using the validated 13-item patient activation measure (PAM–13). Four studies demonstrated strong evidence that the intervention group developed a higher level of self-management compared to the control group (standardized mean differences [SMD] = 1.12, 95% CI [0.36, 1.87], $p = .004$). Eight RCTs led to a significant improvement in self-efficacy (SMD = 0.73, 95% CI [0.39, 1.06], $p < .0001$). There was weak to no evidence on the effect of the strategies shown on the physical component and mental components of health-related quality of life, and medication adherence.

Linking Evidence to Action: This meta-analysis highlights the importance of including tailored interventions using a cluster approach including patient education, goal setting with individualized action plan, and problem-solving to engage patients to be more actively involved in the self-management of their CKD.

KEYWORDS
behavioral change interventions, chronic kidney disease, chronic renal failure, patient activation interventions, self-management, systematic review

INTRODUCTION

Chronic kidney disease (CKD) affects over 500 million people and accounts for approximately 850 million deaths every year worldwide (Silva et al., 2016). Annual direct health cost for CKD is 85% higher than those without CKD, and the costs also increase by CKD stage (Wyld et al., 2014).

When CKD progresses to advanced stages, it is associated with debilitating symptoms, increased morbidity and mortality, and reduced quality of life (Levin et al., 2017; Stenvinkel et al., 2020). When people reach the most advanced stage, end-stage kidney disease, they require renal replacement therapy (RRT), that is, dialysis or transplantation, to reduce symptoms and sustain life.

There is increasing recognition of the potential benefits of empowering people with CKD to self-manage their health to reduce modifiable risk factors and slow disease progression (Welch et al., 2015). This ultimately reduces unnecessary healthcare utilization costs and poor health outcomes, mainly from pateints to effectly self-manage their CKD in response to medical recommendations (Chen et al., 2011).

An important concept in self-management is self-efficacy, which is defined as an individual's belief in their capacity to achieve a goal. Self-efficacy reflects an individual's confidence in their ability to exercise control over events that affect their lives (Bandura, 1997). Self-efficacy is enhanced when patients succeed in solving patient-identified problems and is associated with improved self-management behaviors and medication adherence in people with earlier stages of CKD (Bandura, 1997).

An important antecedent to self-management is patient activation (Hussein et al., 2022). Patient activation refers to the skills, knowledge, and confidence that relate to the willingness and ability of a person to manage their health (Hibbard et al., 2004). In 2004, the 13-item patient activation measure (PAM-13) was developed and psychometrically validated to measures a person's level of activation (Hibbard et al., 2004).

Highly activated patients are more likely to participate in self-management behaviors, have less unmet medical care needs, and greater support from health professionals for self-management of chronic conditions (Hibbard et al., 2004). Conversely, individuals with lower level of activation are more likely to be hospitalized, have poorer adherence to treatment, greater health costs (Johnson et al., 2016), and have worse care experiences compared to those with higher activation level (Zimbudzi et al., 2018).

Patient activation interventions focus specifically on an approach to improve patients' knowledge, confidence, and skills to manage or change their health behavior (Hibbard et al., 2004). For example, health coaching is an intervention tailored to the individual to promote the behaviors that underpin activation or engagement in their health care (Lunardi et al., 2021). In CKD, interventions targeting behavioral change addressing education, skill development, problem-solving, and peer support empowerment are believed to help patients make behavior changes, increasing their activation level and self-efficacy to effectively self-manage their health (Kearns et al., 2020). Hibbard et al. (2015) highlighted that the benefits of greater activation likely operate through behaviors.

This systematic review aimed to measure the effectiveness of patient activation interventions compared with usual care on health-related behavior in people with CKD stages 3–5 not receiving RRT. The primary outcome was patient activation. Secondary outcomes were health-related behavioral outcomes: self-efficacy, self-management, dietary and medication adherence, hospitalization and emergency visit rates, health-related quality of life, and symptoms burden.

METHODS

Study reporting and registration

The review protocol was registered with the International Prospective Register of Systematic Reviews with registration number CRD42020205084 and published prospectively online in JBI Evidence & Synthesis (Lunardi et al., 2021). This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines (Page et al., 2021).

Eligibility criteria and outcomes

The population included adults (above 18 years of age) diagnosed with advanced CKD (CKD stages 3–5), defined as a sustained decrease in eGFR to levels below 60 mL/min/1.73 m^2 (Kidney Health Australia, 2020). Studies with CKD patients receiving RRT, pregnant, or cognitively impaired with a functioning kidney transplant were excluded. People with CKD stages 3–5 not receiving dialysis were selected for this study because they have very different health management (e.g., slowing disease progression to delay dialysis) and intervention profiles to those with kidney failure receiving dialysis.

This review considered studies that measured the effect of health-related behavioral change strategies on self-management. Behavioral change strategies are defined as interventions aiming to modify health-related behaviors to engage patients to be actively involved in their health care (Kearns et al., 2020). These interventions include motivational interviewing, health coaching, goal setting, development of action plans and education. Interventions delivered by health professionals, face-to-face or via telephone, the web, group or individual, in outpatient renal clinic, primary care or in the community, or a combination of these, were included. Studies that used the standard or usual care as the comparator were included.

The primary outcome was patient activation as measured by PAM-13. The secondary outcomes included health-related behaviors: self-care (CKD Self-Care Scale [CKD-SC]); self-management (CKD Self-Management Instrument [CKD-SM]); self-efficacy

(CKD Self-Efficacy Scale [CKD-SE]); dietary adherence and other lifestyle behaviors (smoking cessation, exercise) measured by self-reported questionaries; medication adherence (Morisky Medication Adherence Scale [MMAS]); healthcare utilization (hospital admission rates and emergency department visits); Health Related Quality of Life (HRQoL; European QoL-5 Dimensions [EQ5D] and the Kidney Disease Quality of Life Instrument [KDQOL]); and symptom burden (Palliative Care Outcome Scale-Renal Version [IPOS-Renal], Edmonton Symptom Assessment System [ESAS]).

Literature search

A search strategy was carried out in two steps. First, all identified MeSH headings and key words were searched in MEDLINE, EMBASE, EMCARE, and PsycINFO searching randomized controlled trials (RCTs) published in English from 2004 to February 2021. The rationale to choose peer review articles from 2005 was because the patient activation construct measured by the PAM-13 was first published in 2004. The second step was the screening for title and abstract followed by full-text eligibility of the included articles; this step finalized with the citation search of the eligible articles.

Study selection

All identified citations were collated and uploaded into EndNote X9 (Hupe, 2019) and then exported to COVIDENCE™, a web-based software platform that streamlines the production of systematic reviews, where duplicates were removed. Titles and abstracts were screened against the inclusion criteria for the review by three reviewers (LL, PB, and RL) independently. Studies that did not meet the eligibility criteria were excluded. Full text of the included articles was read and compared against the eligibility criteria by three reviewers (LL, PB, and KH) independently. Full-text studies that did not meet the inclusion criteria were excluded, and reasons for exclusion were recorded (Appendix S1). Any disagreements between reviewers were resolved through discussion between the three reviewers.

Data extraction

The principal investigator extracted data from all eligible studies. The other three reviewers were allocated a subset of eligible studies and extracted data from the allocated studies using a standardized data extraction tool. A predefined dataset was collected for each study consisting of study characteristics, patient's baseline characteristics, intervention format, and delivery (Table 1). Outcomes of significance to the review question and specific objectives are shown in Appendix S1. Authors of articles were contacted for additional data and clarification of discrepancies.

Assessment of risk of bias and certainty of evidence

Eligible studies were critically appraised by four authors (LL, PB, KH, and AX) independently to assess the methodological quality and risk of bias, using a Joanne Briggs Institute (JBI) critical appraisal tool for RCTs (Tufanaru et al., 2017). Critical appraisal results are presented below and in narrative form. Three grades of study quality were used: (1) low risk of bias was judged if the percentage of YES responses were ≥67%; (2) moderate risk of bias was when the YES responses were between 34%–and 66%; and (3) high risk of bias (indicating low quality assessment) was achieved when percentage of YES responses were <33% (Nick et al., 2021; Table 2).

The Grading of Recommendations, Assessment, Development, and Evaluation (GRADE; GRADEpro Guideline Development Tool) approach for determining the certainty of evidence was followed and the Summary of Findings (SoF) was created using the GRADEpro software. The SoF provides a ranking of the quality of evidence based on absolute risks for the intervention and control groups, estimates the relative risks, the limitations of the study, the directness, consistency, heterogenicity, precision, and risk of publication bias in the studies included (Table 3). Any disagreement was resolved by consensus or by the decision of a third reviewer.

Data analysis

The primary outcome measure was patient activation level. There were four secondary outcome measures: (1) self-management; (2) self-efficacy; (3) health behaviors (medication adherence and dietary compliance); and (4) HRQoL. Meta-analysis was carried out when there were more than two studies examining the same outcome measure, using The Cochrane Collaboration Review Manager (RevMan) 5.4.1.

For continuous outcomes (i.e., self-management), each outcome measure was calculated by subtracting the baseline value from the post-intervention value for each treatment group in each study.

The standard deviation (SD) for the change score of each treatment group was imputed using SD of the baseline data, SD of the posttreatment data, and assuming a correlation coefficient of 0.8. Where median and interquartile range were reported for the baseline and posttreatment data, they were converted into means and SDs, considering the sample size as suggested by Wan et al. (2014). Where standard error (SE) of the change score was reported for each treatment group, SD was obtained by multiplying the square root of the corresponding sample size with the SE.

In this review, often outcomes were measured using different scales, which made direct comparison difficult. Standardized mean difference (SMD) standardizes the treatment effect by between-subject variation for each study, hence allowing comparison of treatment effect on the same scale (Higgins et al., 2019), therefore was chosen to be the effect measure.

Heterogeneity among the identified studies was assessed for each meta-analysis in terms of the degree of heterogeneity,

quantified by I^2 and Chi-square test. When substantial heterogeneity was suggested ($I^2 \geq 50\%$ & p-value <.05 from the Chi-square test), random effects model was used to estimate the average effects of studies on each outcome. In addition to this, causes for heterogeneity were explored by conducting subgroup analysis by prespecified variables based on clinical knowledge. They were age (≤50 years & >50 years), gender (male/female <50% & >50%), education level of the participants (50% of the participants have education level > or ≤8 grade), duration of intervention (<3 months & 3–6 months & 6–12 months), and provider of CKD patient activation interventions (single provider vs. multiple provider).

Assessment of risk of publication bias was informed by the Cochrane's Handbook for Systematic Reviews on Interventional studies (Higgins et al., 2019). Publication bias arising from missing results from identified studies was assessed by reporting the studies with missing results and the nature of missing results when possible. Publication bias arising from unidentified studies was assessed with respect to the search plan and funnel plots. Statistical tests for publication bias were not performed due to the lack of power in the present review.

RESULTS

Search results

From an initial 8210 articles identified, 19 RCTs were deemed relevant to answer the research question, based on the inclusion and exclusion criteria. Full search details are shown in Figure 1. These articles were selected for retrieval, and further evaluation and methodological assessment.

Trial and patient characteristics

A total of 19 articles were accepted for review. First authors were from Australia ($n = 4$), China ($n = 4$), United States of America ($n = 3$), Japan ($n = 3$), Netherland ($n = 2$), United Kingdom ($n = 1$), Canada ($n = 1$), and Vietnam ($n = 1$).

The 19 studies considered in this review included data from 4414 participants. Sample sizes ranged from 12 to 2379 participants. Two studies had less than 50 participants (Flesher et al., 2011; Montoya et al., 2016); nine studies had between 50 and 100 (Campbell et al., 2008; Chen et al., 2011; Humalda et al., 2020; Joboshi & Oka, 2017; Li et al., 2020; Tang et al., 2017; Williams, Manias, Liew, et al., 2012; Williams, Manias, Walker, & Gorelik, 2012); and eight had greater than 100 (Blakeman et al., 2014; Chan et al., 2009; Meuleman et al., 2017; Nelson et al., 2018; Nguyen et al., 2019; Tuot et al., 2019; Wu et al., 2018; Yamagata et al., 2016). The average age of study participants was 65 years and 63% were male. Three studies were conducted in populations with low socioeconomic disadvantage or people living in deprived areas (Blakeman et al., 2014; Nelson et al., 2018; Tuot et al., 2019) and one was conducted with culturally and linguistically diverse groups (Williams, Manias, Liew, et al., 2012) A summary of the participants, population sample, variables, measures and outcomes of each study, and a summary of the methodology, methods, intervention, setting, participants, and data analysis of the included articles can be found in Table 1 and Appendix S1.

Risk-of-Bias assessment for included trials

Table 2 presents the quality assessment for the 19 included studies based on the JBI critical appraisal tool. Sixteen studies implemented true randomization scheme, such as computer-generated random number tables (Flesher et al., 2011; Li et al., 2020; Montoya et al., 2016). Group allocation was concealed in 11 studies while the implementation of allocation did not conceal or was unclear in eight studies (Chen et al., 2011; Flesher et al., 2011; Humalda et al., 2020; Li et al., 2020; Montoya et al., 2016; Nelson et al., 2018; Tang et al., 2017; Yamagata et al., 2016). Only two studies did not demonstrate equivalency between groups at baseline (Li et al., 2020; Meuleman et al., 2017). Assessors were blinded to treatment allocation in eight studies; they were aware of the assignment status of participants in six (Campbell et al., 2008; Flesher et al., 2011; Humalda et al., 2020; Li et al., 2020; Nguyen et al., 2019; Tang et al., 2017) while blinding of assessors was not mentioned in five studies (Chan et al., 2009; Chen et al., 2011; Montoya et al., 2016; Tang et al., 2017; Yamagata et al., 2016). In all studies, intervention and control group received the same care and treatment other than the intervention. Intention-to-treat analysis was reported in nine studies (Chan et al., 2009; Humalda et al., 2020; Joboshi & Oka, 2017; Kelly et al., 2020; Nguyen et al., 2019; Tuot et al., 2019; Williams, Manias, Liew, et al., 2012; Williams, Manias, Walker, & Gorelik, 2012; Yamagata et al., 2016). It was unclear or not reported in the other 10 studies. In all the included studies, participants were analyzed in the groups to which they were randomized, and outcomes measured in the same way between groups. Outcomes were measured in a reliable way in 13 studies, while in six, the reliability of the measures used was unclear or insufficiently described (Kelly et al., 2020; Li et al., 2020; Nelson et al., 2018; Nguyen et al., 2019; Tang et al., 2017; Tuot et al., 2019), inducing possible detection bias. Question 13, "Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis?" was not applicable as all studies in this systematic review were parallel and individually randomized RCTs. Thirteen of 19 studies achieved high quality (low risk of bias; ≥67%) on critical appraisal, three achieved between 34% and 66% indicating moderate quality assessment (moderate risk of bias), and three achieved low-quality assessment (<33%; high risk of bias).

TABLE 1 Characteristics of the 19 Included RCTs.

Study author/s and country	Intervention duration and follow-up (months)	Sample size randomized	Participant characteristics			Intervention format and delivery
				IG	CG	Provider
Blakeman et al. (2014) UK	1/6	440	SS analyzed	180	194	LHA
			Mean Age < 75	54.9	59.7	
			Male < 75	54.9	59.7	
			Education > 8th grade	41.9	52	
			White	98.1	99.1	
			Stage of CKD	3	3	
Campbell et al. (2008) Australia	3/3	60	SS analyzed	24	23	D
			Mean age, year	71	68.5	
			Male	60.9	65.5	
			Stage of CKD	4–5	4–5	
Chan et al. (2009) China	3/24	205	SS analyzed	84	83	MDT- led by diabetes team
			Mean age, year	64.4	65.4	
			Male	66	67	
Chen et al. (2011) Taiwan	12/12	54	SS analyzed	27	27	MDT
			Mean age, years	68	69	
			Male	55.6	55.6	
			Education > 8th grade	29.6	29.6	
			Stage of CKD	3–5	3–5	
Flesher et al. (2011) Canada	3/12	40	SS analyzed	23	17	MDT + physiologic and cook educator
			Mean age, year	63.4	63.4	
			Men	61	41	
			Asian	>50%		
			CKD Stages	3–4	3–4	
Humalda et al. (2020) Dutch	3/9	99	SS analyzed	45	44	Research nurses, lifestyle coaches, and dietician
			Mean age, year	56.6	58.2	
			Male	86	81.8	
			Education > 8th grade	41	43	
			White	98	91	
			Stage of CKD	1–4	1–4	
Joboshi & Oka (2017) JPN	3/3	65	SS analyzed	32	29	N
			Mean age, year	67	70	
			Male	31.1	32.8	
			African American	26.2	19.7	
			Hispanic	26.2	27.9	
			Stage of CKD	1–5	1–5	

Intervention format	Setting-context	Strategies included	Comparator	Limitations
• Telephone support • PLANS booklet: provides community resources • Reading materials: kidney information guidebook	Primary care, where participant chosen (telephone interview)	• Individualized care plan • Motivational interview • Goal setting • Action plan • Tailoring support (coaching)	Usual care	Short follow-up, unblinded trial, BP based on the routine data collection
• Nutritional intervention • Telephone support (fortnight for the first month, then monthly) • Cooking class	Outpatient renal clinic first meeting, then over the phone	• Motivational interview • Individualized action plan • Goal settings • Tailoring support	Usual care	Small sample size, limited outcomes assessed
• Structured care protocol with five defined targets (BP, A1C, LDL, TG, and treatment with ACE inh and/or ARB • FTF and telephone support • Book with predefined scheduled visits, assessment items and treatment targets	Outpatient renal clinic	• Tailored support	Usual care	Some patients in CG had the same standard of care
• Self-management programs • Health information, education (individualized lectures about renal health, nutrition, lifestyle, and nephrotoxin avoidance +medication) • Monthly FTF meetings, bimonthly support group (5–10 participants) and weekly telephone support	Outpatient renal clinic	• Tailored education depending on CKD stage • Motivational interview • Tailored support	Usual care	Small sample size limited 1 year follow-up, potential information contamination and the lack of association of SMS with secondary end points
• Cooking and exercise program: • Four times weekly, cooking classes: 2 h, 1 h shopping tour • Reading materials • 12 weeks triweekly exercise class (1 h) • FTF	Outpatient renal clinic	• Tailored support • Goal setting • Building confidence in the management of their disease • Action plan	Usual care	Small size
• Web-based self-management e-coaching + modules • Home BP monitoring device • Group meetings • Telephone	Outpatient renal clinic	• Tailored support • Motivational interviewGoal setting • Social supportProblem solving • Self-efficacy	Usual care	Limited power, post-randomization loss to follow-up, Hawthorne effect, lack of dietary data, and short-term follow-up
• Encourage Autonomous Self-Enrichment Program: participants' behavioral targets including BP, medication, and nutritional management • Phone/email alternating with FTF interviews	clinics or general hospitals that specialized in internal medicine and urology	• Goal setting to foster self-efficacy • Action plan • Tailored support • Motivational interview	Usual care	Short intervention period, small sample

(Continues)

TABLE 1 (Continued)

Study author/s and country	Intervention duration and follow-up (months)	Sample size randomized	Participant characteristics			Intervention format and delivery
				IG	CG	Provider
Kelly et al. (2020) Australia	6/6	80	SS analyzed	38	38	D
			Mean age, year	63	61	
			Male	63	61	
			White	35	29	
			Asian	2	2	
			European	2	0	
			Indigenous	1	6	
			Stage of CKD	3–4	3–4	
Li et al. (2020) Japan	4/24	60	SS analyzed	25	24	Researcher
			Mean age, year	50.60	51.87	
			Male	68	79	
			Education > 8th grade	100	93	
			Stage of CKD	1–5	1–5	
Meuleman et al. (2017) Netherlands	3/6	138	SS analyzed	67	71	Case manager
			Mean age, year	55.6	54.7	
			Male	79	85	
			Education > 8th grade	40	32	
			Dutch	88%	93%	
			Stage of CKD	4	4	
Montoya et al. (2016) USA	9/9	30	SS analyzed	13	13	MDT + NP
			Mean age, year	68.3	67.9	
			Male	43.7	50	
			Education >8th grade	87.6	85.6	
			African American	21.4	21.4	
			Hispanic	6.3	14.3	
			Caucasian	56.3	64.3	
			Stage of CKD	4	4	
Nelson et al. (2018) USA	12/12	125	SS analyzed	48	50	N
			Mean age, year	48	46	
			Male	58	51	
			Stage of CKD	1–3	1–3	
Nguyen et al. (2019) Vietnam	4/4	135	SS analyzed	68	67	N
			Mean age, year	48.8	48.9	
			Male	42.6	58.2	
			Education >8th grade	60	56	
			Stage of CKD	3–5	3–5	

Intervention format	Setting-context	Strategies included	Comparator	Limitations
• FTF assessment and then all participants receive the ENTICE-CKD workbook designed by a dietician. • Phase 1: individualized, telephone-based coaching every 2 weeks for 3 months and weekly tailored text messages. • Phase 2: no further telephone coaching; only text messages as phase 1 at different frequency	Telehealth coaching across three tertiary hospitals in Australia	• Tailored support by phone • Motivational interview • Goals settings • Action plan using a workbook	Usual care	Study designed to test feasibility. As such, dietary outcomes were secondary outcomes. Most participants reported healthy diet at baseline – this reduced the potential benefit from dietary intervention
• Wearable device + health management platform + social media support. • Education about self-management, diet, and exercise	Where patient chosen	• Tailored support • Action plan	Usual care	Small sample and difference in educational level between groups at baseline
• Self-management of sodium and BP • Lifestyle modifications • FTF (1 h) • Exercise education • Monitor BP and sodium once a week for the first 6 weeks and then every 2–3 weeks	Outpatient renal clinic	• Motivational interviewing techniques • Setting goals • Strengthening intrinsic motivation and self-efficacy • Problem solving	Usual care	Nonblinding, relatively low response rate, and missing data
• Exercise education • 6 months visits- each visit lasted 1.5–2 h. Group visits (eightparticipants) PowerPoint presentation. • First half of IG sessions are physiological examination + second half CKD education. • Booklet provided to each patient with personal medical data and each group visit topic.	Outpatient renal clinic	• Tailored support using a notebook	Usual care	Small size - lack of power
• Home-based kidney care • FTF • Educational materials: pamphlets about how to check BSL, BP, nutrition, smoking cessation, exercise, alcohol consumption, and coping with stress. • Discussion about weight loss • Community resources	Home base	• Motivational interviews • Goal settings • Action plan • Problem solving • Cultural social activities	Usual care	Small sample size, short follow-up period, and lack of tailored PA score interventions. A total of 22% of those enrolled and randomized did not complete the 1 year intervention
• Self-management intervention • CKD booklet "living with reduced kidney function from KHA and living well with CKD by American Kidney Fund." • One FTF session (1 h) to increase self-efficacy in CKD • -two follow-up sessions (20–30 min) by phone aiming to success in goal attainment and support them with strategies (week 4 and 12)	Outpatient renal clinic	• Tailored support • Motivational interview • Goal setting: • Action plan	Usual care	Blind outcome not always possible, KIKS Vietnamese version has low reliability, short duration, and small size

(Continues)

TABLE 1 (Continued)

Study author/s and country	Intervention duration and follow-up (months)	Sample size randomized	Participant characteristics					Intervention format and delivery
				IG		CG		Provider
Tang et al. (2017) China	3/3	90	SS analyzed	42		42		NR
			Mean age, year	46.26		43.90		
			Male	66.67		54.76		
			Education >8th grade	34		28		
			Stage of CKD	1–3		1–3		
Tuot et al. (2019) US	12/12	137	Reg-Registry	CKD Reg.	SMS	SMS + CKD Reg	CG	Health coaches
			SS analyzed	25	37	37	38	
			Mean age, year	60	57	56	56	
			Male	44	56.8	5.8	52.6	
			Limited Health literacy	32	13.5	29.7	21.1	
			Black or African American	32	46	32.4	42.3	
			Hispanic	44	35	35.1	36.5	
			Caucasian/white	4	8	13.5	6.6	
			Asian/Pacific Islander	20	10.8	35.1	10.5	
			Stage of CKD	1–4	1–4	1–4	1–4	
Williams, Manias, Liew, et al. (2012) Australia	3/12	78	SS analyzed	8		21		N
			Male	65.5		65.5		
			Stage of CKD	2–4		2–4		
(Williams, Manias, Walker, & Gorelik, 2012) Australia	3/12	87	SS analyzed	36		39		N
			Stage of CKD	2–5		2–5		
Wu et al. (2018) Taiwan	1/3	112	SS analyzed	36		54		???
			Mean age, year	67.82		71.73		
			Male	68.9		56.7		
			Education >8th grade	51.1		62.8		
			Stage of CKD	3–5		3–5		

Intervention format	Setting-context	Strategies included	Comparator	Limitations
• 3X one-to-one exercise education (20–30 min) and guidance while patients were in hospital • 12 weeks home-based exercise • Telephone follow-up • Reading materials (log booklet about advantages of exercise and goals)	Primary clinic care (general practice)	• Tailored support • Motivational interview • Goals settings • Action plan	Usual care	No direct supervision for the home-based exercise, unknown long-term results, frequent communication between researcher/ participants may exerted a psychologically positive impact and representative population
• Access to CKD Registry • CKD SMS Program-reading materials, education about CKD (26 modules), and phone-based training	Outpatient renal clinic	• Motivational interview • Action plan	Usual care	Single health system
• Multifactorial intervention to improve medication self-efficacy and adherence. • FTF and telehealth • Medication review • Education per person	Outpatient renal clinic	• Motivational interviewing • Tailored support	Usual care	High attrition rate, dropout rate dissimilar characteristics between groups, no CG for Greek cohort, and unpowered sample. Instruments used may not be sensitive to CALD
• Multifactorial intervention to improve medication self-efficacy and adherence. • FTF and telehealth. Medicine review • Digital versatile Disk motivating • Fortnightly motivational interview (phone) then at 12 weeks	Outpatient renal clinic	• Motivational interview • Tailored support • Goal settings • Action plan	Usual care	Small sample size
• Video (10 min last) • Group training about self-efficacy+ CKD management • FTF group support (10–15 held, once/ month) • Efficacy-enhancing program • Telephone support	Outpatient renal clinic	• Tailored support • Motivational interview	Usual care	Ninety participants from a regional hospital, so that the results cannot be generalized. Short follow-up

(Continues)

TABLE 1 (Continued)

Study author/s and country	Intervention duration and follow-up (months)	Sample size randomized	Participant characteristics					Intervention format and delivery
				IG		CG		Provider
Yamagata et al. (2016) Japan	42/42	2379		IGC	IGP	CGC	CGP	MDT
			SS analyzed	23	1195	26	1184	
			Mean age, year		63		62	
			Male		71		72.8	
			Stage of CKD	1–4				

Abbreviations: A/F, audit/feedback; CGC, control group cluster; CGP, control group patient; D, Dietician; DE, Diabetes Educator; FTF, face-to-face; HC, healthy coping; HE, healthy eating; ICP, individualized care plans; IGC, Intervention group cluster; IGP, Intervention group patient; LHA, lay health advisor; MD, Physician; MDT, multidisciplinary team; Meds, medications; N, Nurse; NR, not reported; PE, physical exercise; PS, problem solving; PT, Physiotherapist; RCTs, randomized controlled trials; RR, reducing risks; SB, skill building; SM, self-monitoring; TBC, theory-based counseling; year, in years.

TABLE 2 Critical appraisal results of eligible 19 RCTs studies.

Study	Randomization Q1	Concealment Q2	Similarity at baseline Q3	Participant's blind Q4	Deliver's blind Q5	Assessor's blind Q6
Blakeman et al. (2014)	Yes	Yes	Yes	No	No	Yes
Campbell et al. (2008)	Yes	Yes	Yes	No	No	No
Chan et al. (2009)	Yes	Yes	Yes	No	No	U
Chen et al. (2011)	Yes	No	Yes	No	No	U
Flesher et al. (2011)	U	U	Yes	No	No	No
Humalda et al. (2020)	Yes	No	Yes	No	No	No
Joboshi & Oka (2017)	Yes	Yes	Yes	No	No	No
Kelly et al. (2020)	Yes	Yes	Yes	No	No	Yes
Li et al. (2020)	U	U	No	No	No	No
Meuleman et al. (2017)	Yes	Yes	No	No	No	Yes
Montoya et al. (2016)	U	U	Yes	No	No	U
Nelson et al. (2018)	Yes	U	Yes	No	No	Yes
Nguyen et al. (2019)	Yes	Yes	Yes	No	No	No
Tang et al. (2017)	Yes	U	Yes	No	No	U
Tuot et al. (2019)	Yes	Yes	Yes	No	No	Yes
Williams, Manias, Liew, et al. (2012)	Yes	Yes	Yes	No	No	Yes
Williams, Manias, Walker, & Gorelik (2012)	Yes	Yes	Yes	No	No	Yes
Wu et al. (2018)	Yes	Yes	Yes	No	No	Yes
Yamagata et al. (2016)	Yes	U	Yes	No	No	U

Abbreviations: Q1, Was true randomization used for assignment of participants to treatment groups?; Q2, Was allocation to treatment groups concealed?; Q3, Were treatment groups similar at baseline? Q4, Were participants blind to treatment assignment?; Q5, Were those delivering treatment blind to treatment assignment?; Q6, Were outcome assessors blind to treatment assignment?; Q7, Were treatment groups treated identically other than the intervention of interest?; Q8, Was follow-up complete, and if not, were strategies to address incomplete follow-up utilized?; Q10, Were outcomes measured in the same way for treatment groups?; Q11, Were outcomes measured in a reliable way?; Q9, Were participants analyzed in the groups to which they were randomized?; Q12, Was appropriate statistical analysis used?; U, Unclear.

[a]High quality (> or = 67%).

[b]Medium quality (34%–66%).

[c]Low quality (<33%).

Intervention format	Setting-context	Strategies included	Comparator	Limitations
• Patients—educational session (30 min x 3 months) for lifestyle modification + CKD. Telephone support, reading materials. • GPs received data sheets to facilitate reducing the gap between target and practice	Primary care	• Motivational interview • Goals settings • Action plan	Usual care	No differences in the cumulative incidence of patients starting RRT or suffering CV events between groups

Treated identically	Follow-up	Analyzed in the randomized group	Outcomes measure in the same way	Outcomes measured reliable way	Statistical analysis		
Q7	Q8	Q9	Q10	Q11	Q12	Total	%
Yes	Yes	U	Yes	Yes	Yes	10/12	83[a]
Yes	Yes	U	Yes	Yes	Yes	8/12	67[a]
Yes	Yes	Yes	Yes	Yes	Yes	10/12	83[a]
Yes	Yes	U	Yes	Yes	Yes	8/12	67[a]
Yes	Yes	U	Yes	Yes	U	5/12	42[b]
Yes	Yes	Yes	Yes	Yes	Yes	8/12	67[a]
Yes	Yes	YES	YES	YES	YES	10/12	83[a]
Yes	Yes	Yes	No	U	Yes	8/12	67[a]
Yes	Yes	U	No	U	Yes	4/12	33[c]
Yes	Yes	U	Yes	Yes	Yes	8/12	67[a]
Yes	Yes	U	Yes	U	No	4/12	33[c]
Yes	Yes	U	U	U	Yes	6/12	50[b]
Yes	Yes	YES	NO	U	Yes	7/12	58[b]
U	Yes	U	NO	U	Yes	4/12	33[c]
Yes	Yes	Yes	No	Yes	Yes	9/12	75[a]
Yes	Yes	Yes	Yes	U	Yes	9/12	75[a]
Yes	No	Yes	Yes	Yes	Yes	9/12	75[a]
Yes	Yes	U	Yes	Yes	Yes	9/12	75[a]
Yes	Yes	Yes	Yes	Yes	Yes	8/12	67[a]

TABLE 3 Summary of findings and certainty of evidence for selected outcomes.

Certainty assessment						
Nº of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations
Patient activation (assessed with: PAM-13)						
1	Randomized trials	Not serious	Not serious	Not serious	Not serious	Strong association
Self-management behavior						
4	Randomized trials	Not serious[a]	Very serious[b]	Not serious	Not serious	Strong association dose–response gradient
Self-efficacy behavior						
9	Randomized trials	Not serious[a]	Serious[b]	Not serious	Not serious	None
Medication adherence behavior						
3	Randomized trials	Serious[c]	Serious[d,e]	Not serious	Serious[d]	None
HRQoL mental component						
7	Randomized trials	Serious[a,c,e]	Serious[b,d]	Not serious	Serious[c,d]	All plausible residual confounding would reduce the demonstrated effect
HRQoL physical component						
7	Randomized trials	Not serious	Serious[b]	Serious[d]	Serious[c,d]	All plausible residual confounding would reduce the demonstrated effect

Abbreviations: CI, confidence interval; MD, mean difference; SMD, standardized mean difference.

[a]Studies excluded from meta-analysis due to nonavailability of data.

[b]High heterogeneity.

[c]There was inconsistency with some studies reporting effects in opposite directions. Quality of evidence downgraded by 1.

[d]High variability between studies.

[e]Different outcome measure.

Grading of recommendations

Table 3 provides the GRADE assessment and summary of findings for selected outcomes. The certainty of evidence was high for three of the selected outcomes, moderate for one, and low for one outcome.

Intervention characteristics

The length of the interventions varied from 1 month (Blakeman et al., 2014; Wu et al., 2018) to 3 months (Campbell et al., 2008; Chan et al., 2009; Flesher et al., 2011; Humalda et al., 2020; Joboshi & Oka, 2017; Meuleman et al., 2017; Tang et al., 2017; Williams, Manias, Liew, et al., 2012; Williams, Manias, Walker, & Gorelik, 2012), 4 months (Li et al., 2020; Nguyen et al., 2019), 6 months (Kelly et al., 2020), 9 months, (Montoya et al., 2016), 12 months (Chen et al., 2011; Nelson et al., 2018; Tuot et al., 2019), and 42 months (Yamagata et al., 2016). Three RCTs were conducted in primary care (Blakeman et al., 2014; Tang et al., 2017; Yamagata et al., 2016), 14 in outpatient renal clinic, and two in participant's preferable location (home or outdoor). The most frequent behavioral change strategies used to improve self-management were tailored support (i.e., coaching [74%]), motivational interviewing (74%), individualized care plans (63%), goal setting (63%), problem solving (16%), cultural social activities (11%), and building confidence (5%). Seventeen studies addressed more than one intervention, except two that addressed only one patient activation strategy (i.e., tailored support; Chan et al., 2009; Montoya et al., 2016).

No of patients					
Patient activation intervention	Usual care	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance
Only RCT that aims to examine the efficacy of a home-based kidney care program in Zuni Indians with CKD stage 1–3 assessing patient activation as a primary outcome using PAM-13.				⨁⨁⨁⨁ High	Important
174	194	-	SMD 1.12 higher (0.36 higher to 1.87 higher)	⨁⨁⨁⨁ High	Critical
366	389	-	SMD 0.73 SD higher (0.39 higher to 1.06 higher)	⨁⨁⨁◯ Moderate	Critical
113	120	-	SMD 0.02 SD more (0.23 fewer to 0.28 more)	⨁◯◯◯ Very low	Important
342	337	-	SMD 3.14 SD higher (0.82 higher to 5.46 higher)	⨁⨁◯◯ Low	Important
333	336	-	SMD 0.31 SD higher (0.05 higher to 0.57 higher)	⨁⨁◯◯ Low	Important

The effect of behavioral change strategies on patient activation

The effect of behavioral change strategies on patient activation score was found in one study. This study was conducted in USA in 98 rural adult indigenous Zuni peoples with CKD to measure the efficacy of a home-based kidney care program (Nelson et al., 2018). The intervention was delivered by community health representatives providing education about risk factors to develop CKD and community resources. This was delivered face-to-face and reading materials were provided. Patient activation strategies including motivational interviewing, goals settings, action plan, problem solving, and cultural social activities were implemented. The primary outcome was patient activation using PAM-13. This home-based program showed a significant improvement in patient activation score ($p < .001$).

The effect of behavioral change strategies on self-management

The effect of health-related behavioral change strategies on patients' self-management were evaluated in seven of the 19 studies. Three studies were not pooled for meta-analysis because of absence of data (Flesher et al., 2011; Joboshi & Oka, 2017; Montoya et al., 2016). Flesher et al. (2011) did not report whether results were positive or negative. Joboshi and Oka (2017) had positive results, and the results in Montoya et al. (2016) were not statistically positive (Appendix S1). In the four studies included, the pooled SMD was found to be 1.12 (95% CI [0.36, 1.87], $p = .004$; Figure 2a). Based on those four studies, the intervention groups increased self-management compared to the control groups. The SMD showed a large overall average effect (above 0.8; Bakker et al., 2019) on

patients' self-management. There is a higher degree of heterogeneity ($I^2 = 91\%$, $p < .0001$) within the four studies, and no prespecified variables explained the high level of heterogeneity in the effects of self-management (Appendix S1).

The effect of behavioral change strategies on self- efficacy

The effect of health-related behavioral change strategies on patients' self-efficacy were evaluated in nine studies. One study was excluded because of absence of data (Williams, Manias, Liew, et al., 2012), and one study had one of the three intervention arms relevant for this study (Tuot et al., 2019). Based on the study not pooled for meta-analysis (sample size of 78; Williams, Manias, Liew, et al., 2012), there were no significant differences in medication self-efficacy between the intervention and control groups at each data collection time point. Pooled results showed that behavioral change strategies led to a significant improvement in self-efficacy on average. The pooled SMD was found to be 0.73 (95% CI [0.39, 1.06], $p < .0001$; Figure 2b). A high level of heterogeneity was detected among the included studies ($\chi^2 = 37.80$ $p < .00001$, $I^2 = 79\%$). The subgroup analysis indicated that duration of intervention (<3 months, 3–6 months, >6 months) explained heterogeneity. Heterogeneity within the studies that implement an intervention of 3–6 months duration was 39%, and 6–12 months was 27%; only one study had a duration <3 months. The effect size pooled from studies with an intervention between 3 and 6 months was SMD of 0.82, (95% CI [0.57, 1.07], $p < .00001$, $I^2 = 39\%$; Appendix S1); and for the studies with an intervention lasting for 6–12 months was SMD of 0.17 (95% CI [−0.19, 1.53], $p = .35$, $I^2 = 27\%$). Age, education, and provider did not explain the heterogeneity.

The effect of behavioral change strategies on medication adherence

Among the 19 RCT, the five studies (Blakeman et al., 2014; Nelson et al., 2018; Tuot et al., 2019; Williams, Manias, Liew, et al., 2012;

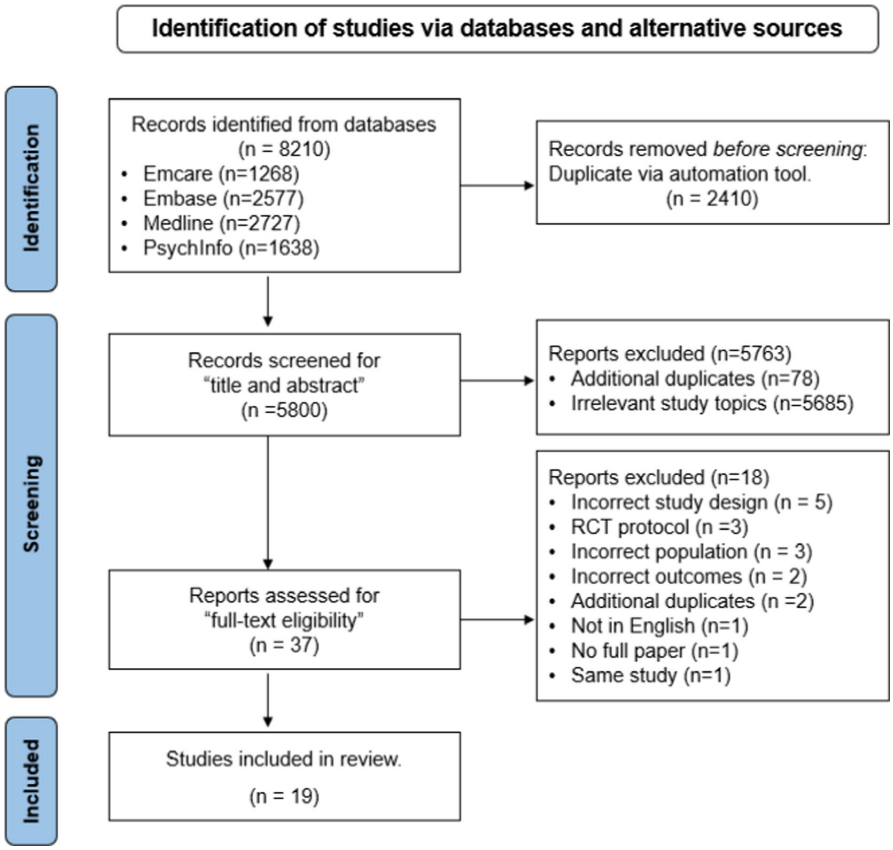
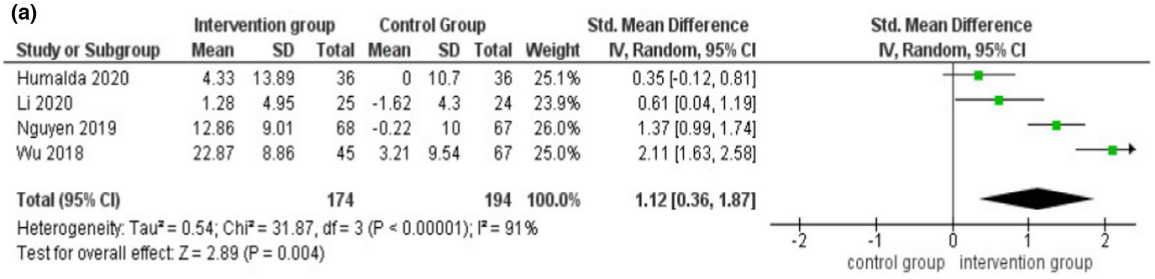


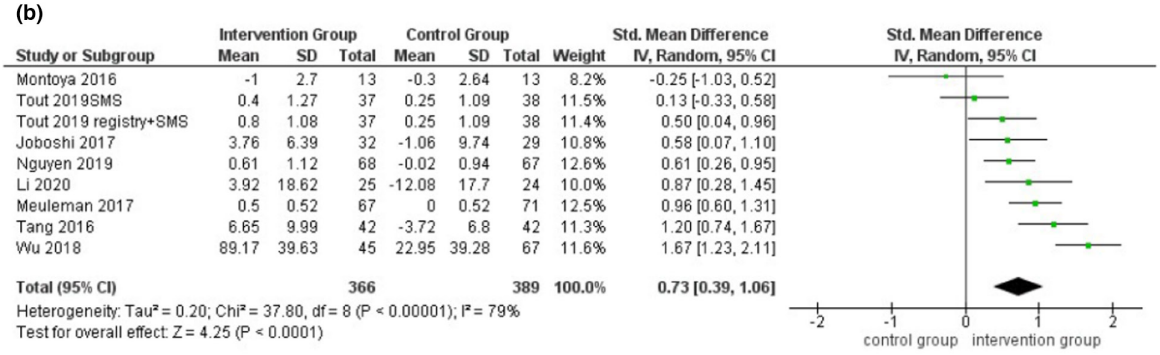
FIGURE 1 Flowchart search results and study selection and inclusions process.

FIGURE 2 Forest plot displaying the effect of behavioral change strategies compared with standard care on self-management, self-efficacy, medication adherence, and health-related quality of life (Mental and physical components). Note. Forest plots displaying the effect of behavioral change strategies compared with standard care in patients with chronic kidney disease stages 3–5 on Panel (a): Self-management; Panel (b): Self-efficacy; Panel (c): Medication adherence; Panel (d): Physical component of health-related quality of life; and Panel (e) Mental component of health-related quality of life. The x-axis represents mean differences or standard mean differences. The 95% CI for individual studies are represented by a horizontal line and by a diamond for pooled effect. IV, inverse variance; SD, standard deviation.

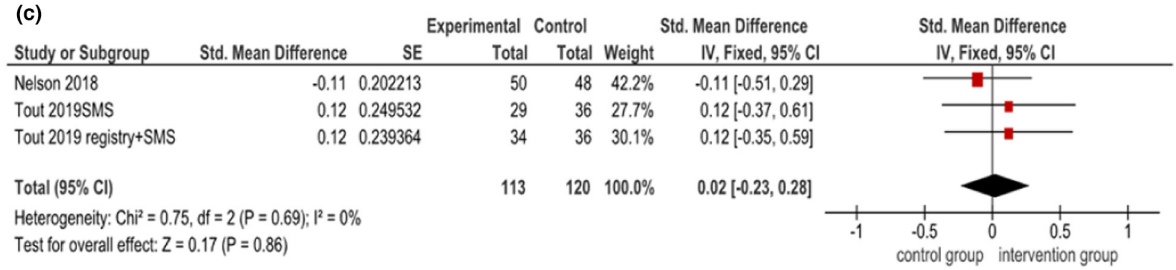
(a)



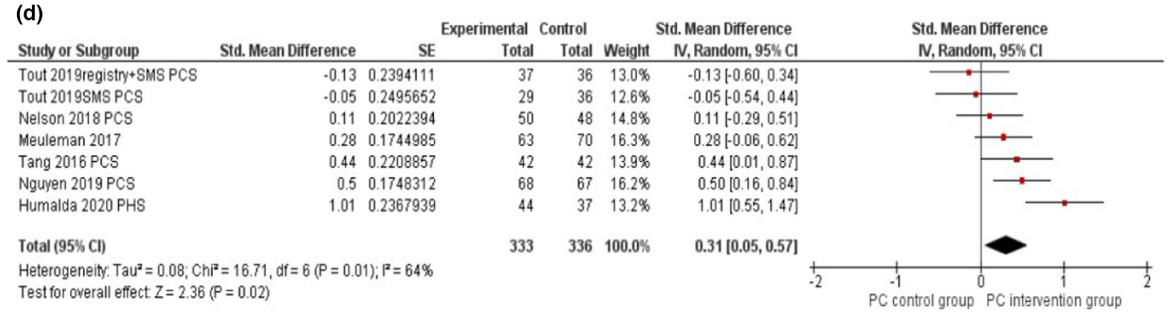
(b)



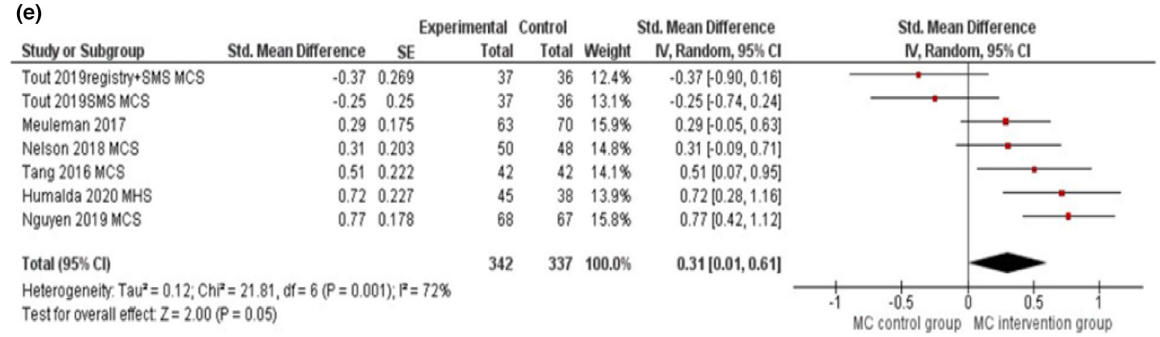
(c)



(d)



(e)



Williams, Manias, Walker, & Gorelik, 2012) assessed medication adherence behavior reported similar results showing that there was no difference post-interventions in medication adherence between groups.

Three studies were not pooled in meta-analysis because of absence of data (Williams, Manias, Liew, et al., 2012) or using different outcome measure (Williams, Manias, Walker, & Gorelik, 2012). Two studies were

pooled for meta-analysis (Tuot et al., 2019; Nelson et al., 2018); one of the studies had two arms and interventions that were pooled for meta-analysis. The studies pooled for meta-analysis measured medication adherence using Morisky Medicine Adherence Scale. The pooled SMD was found to be 0.02 (95% CI [−0.23, 0.28], $p = .86$; Figure 2c), which provided little evidence that behavioral change strategies improved medication adherence in studies that were meta-analyzed.

The effect of behavioral change strategies on HRQoL

The effect of health-related behavioral change strategies on patients' HRQoL were evaluated in 10 of the 19 RCTs included (Blakeman et al., 2014; Campbell et al., 2008; Humalda et al., 2020; Kelly et al., 2020; Meuleman et al., 2017; Nelson et al., 2018; Nguyen et al., 2019; Tang et al., 2017; Tuot et al., 2019; Williams, Manias, Liew, et al., 2012). Studies using scales measuring the mental and physical components of HRQoL separately were included for meta-analysis (Humalda et al., 2020; Meuleman et al., 2017; Nelson et al., 2018; Nguyen et al., 2019; Tang et al., 2017; Tuot et al., 2019). Four studies were not included for meta-analysis due to two reasons: (1) two studies included the mental and physical components of HRQoL separately but data were absent (Campbell et al., 2008; Williams, Manias, Liew, et al., 2012); and (2) two studies did not measure mental and physical components of HRQoL separately (Blakeman et al., 2014; Kelly et al., 2020). Based on the studies not pooled for meta-analysis, two showed no difference post-intervention between groups (Kelly et al., 2020; Williams, Manias, Liew, et al., 2012), one showed modest improvement in the intervention group, and one showed clinical improvement on HRQoL in the intervention group post-intervention (Campbell et al., 2008). Six studies, including one with two arms and intervention, examining the mental and physical components of HRQoL were pooled for meta-analysis (Humalda et al., 2020; Meuleman et al., 2017; Nelson et al., 2018; Nguyen et al., 2019; Tang et al., 2017; Tuot et al., 2019).

Behavioral change strategies on physical component on HRQoL

The SMD of the physical component of HRQoL (SMD of 0.31, 95% CI [0.05, 0.57], $p = .02$; Figure 2d), indicated a small overall average effect (below 0.8; Bakker et al., 2019). The studies showed a moderate degree of heterogeneity ($I^2 = 64\%$, $p \leq .01$). Age, education, and provider did not explain the heterogeneity.

Behavioral change strategies on mental component on HRQoL

The overall average effect size on mental component of HRQoL was 0.3 with a (95% CI [−0.01, 0.61], $p = .06$), showing weak evidence for the effect of intervention on the mental component of the HRQoL (Figure 2e). The studies showed a moderate degree of heterogeneity ($I^2 = 75\%$, $p = .0006$). Age, education, and provider did not explain the heterogeneity.

Other secondary outcomes

The following outcome measures were not meta-analyzed due to the small number of articles examining different outcome measures or missing summary data. Self-care behavior was measured in one study (Blakeman et al. 2014), indicating that using a local community resource with telephone guidance significantly increase patient's levels of self-care activity in the intervention group compared to the control group with an adjusted MD found to be 0.23 (95% CI [0.04, 0.41, $p = .019$]). Dietary adherence behavior was assessed in two studies using different outcome measures (Campbell et al., 2008; Kelly et al., 2020) showing opposite results. Other lifestyle behaviors (smoking cessation, exercise) were not examined in the 19 studies included. Symptom burden was assessed in one study (Wu et al., 2018), showing a 50% reduction of the level of depression in the intervention group compared with the control group. Healthcare utilization was measured in five RCTs; all five studies lack data for analysis (Blakeman et al., 2014; Flesher et al., 2011; Chan et al., 2009; Chen et al., 2011; Yamagata et al., 2016).

DISCUSSION

In this systematic review and meta-analysis, we examined the effect of patient activation interventions on behavioral health-related outcomes among people with CKD stages 3–5 who are not on dialysis. Strong evidence for these interventions' ability to increase self-management and self-efficacy was found, weak evidence was found for improved HRQoL, and little evidence was found for improving medication adherence. Research examining the effects of patient activation interventions on health service utilization, self-care behavior, smoking, and dietary behaviors have been scarce.

A significant improvement in self-management behavior was identified in our review. The studies included showed a multimodal approach to improve this outcome; it was delivered face-to-face (Flesher et al., 2011; Humalda et al., 2020; Joboshi & Oka, 2017; Montoya et al., 2016; Nguyen et al., 2019; Wu et al., 2018); with higher benefits when it was delivered in an interactive small group training, in printed materials (Flesher et al., 2011; Li et al., 2020; Montoya et al., 2016; Nguyen et al., 2019), via telephone or email (Flesher et al., 2011; Humalda et al., 2020; Joboshi & Oka, 2017; Li et al., 2020; Montoya et al., 2016; Nguyen et al., 2019; Wu et al., 2018), in digital (DVD and PowerPoint; Montoya et al., 2016; Wu et al., 2018), and in web-based mechanisms (mobile application, wearable device; Humalda et al., 2020; Li et al., 2020). All interventions included patient education, goal setting with individualized

action plan, and problem-solving with topics related not only to general CKD knowledge (Humalda et al., 2020; Joboshi & Oka, 2017; Li et al., 2020; Montoya et al., 2016; Nguyen et al., 2019), but also nutrition (Flesher et al., 2011; Humalda et al., 2020; Joboshi & Oka, 2017; Li et al., 2020), physical activity (Flesher et al., 2011; Li et al., 2020; Montoya et al., 2016), symptom management (Nguyen et al., 2019), and lifestyle changes (Flesher et al., 2011; Nguyen et al., 2019). This demonstrates that a cluster approach should be considered when developing new self-management interventions in this cohort.

We identified significant improvement in self-efficacy with strategies associated with (1) small interactive weekly group (10–15 participants) or individualized coaching using motivational interviews to encourage participants to set personal goals followed with phone calls; and (2) the higher overall effect on interventions delivered between 3 and 6 months (to be more specific ≤ 4 months). The intervention delivery mode varied between face-to-face coaching plus telephone support (Joboshi & Oka, 2017; Nguyen et al., 2019; Tang et al., 2017; Wu et al., 2018), telephone coaching only (Tuot et al., 2019), face-to-face only (Montoya et al., 2016), or using wearable device with health management platform and social medical support (Li et al., 2020). All studies used patient activating strategies including tailored support, goals setting, action plans, and problem-solving to enhance self-management, except one that did not include participant's goal setting (Montoya et al., 2016). These delivery modes and strategies can assist in the design of future self-management interventions.

This review highlights the inherent difficulties in implementing behavioral change strategies within disadvantaged populations with low sociodemographic and economic circumstances (Blakeman et al., 2014; Nelson et al., 2018; Tuot et al., 2019), health literacy issues (Nelson et al., 2018), and language barriers (Williams, Manias, Liew, et al., 2012). These individual variables can influence the effectiveness of self-management behavioral interventions. Therefore, some interventions may not have the same applicability between different contexts or countries.

We found weak evidence that behavioral change strategies improved the HRQOL compared to usual care in CKD non-dialysis population, while Ahmadzadeh et al. (2017) demonstrated no evidence of HRQoL with the implementation of a self-management program in CKD populations undergoing dialysis. In contrast, a meta-analysis published by Lee et al. (2016) demonstrated an effective improvement in the mental component but no improvement in the physical component of patients' HRQoL with the implementation of self-management programs in the CKD population.

The estimated average effects on self-management, self-efficacy, the mental and physical components of HRQoL, and medication adherence obtained from the meta-analysis were considered with risk of publication bias. To start with, it was noted that the one study excluded from the meta-analysis for self-efficacy did not obtain a positive result. Had this study been included, the estimated average effect for self-efficacy would have shifted to

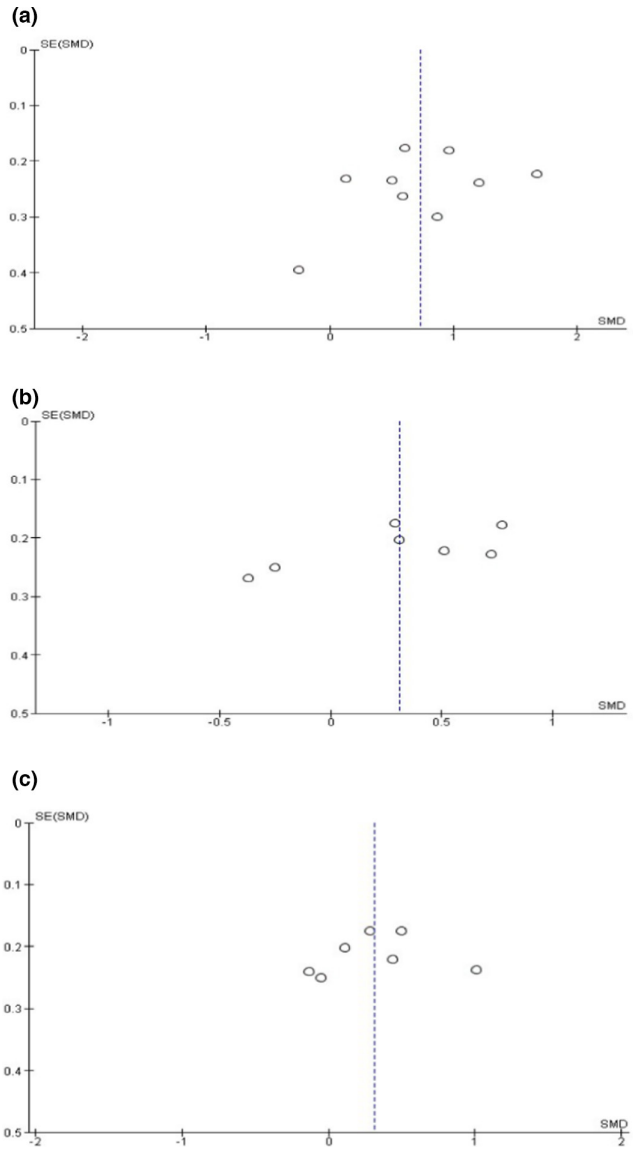


FIGURE 3 Funnel plot displaying the effect of behavioral change strategies compared with standard care on self-efficacy, mental and physical components of health-related quality of life. Note. Funnel plots displaying the effect of behavioral change strategies compared with standard care on Panel (a): Self-efficacy; Panel (b): Mental component of health-related quality of Life; Panel (c): Mental and physical component of health-related quality of life.

null. However, given the large effect size on self-efficacy and that only one identified study was excluded, it is unlikely that the average effect would be explained away completely. The funnel plot for self-efficacy (Figure 3) suggested that studies not identified by the review appeared to be small studies with large effect, which is an uncommon reason for not publishing (Higgins et al., 2019). In short, it is concluded that average effect of behavior change strategies on self-efficacy is robust.

The meta-analysis provided evidence that behavioral change strategies improve self-management. The three studies excluded from the meta-analysis reported mixed effects on

self-management. For this very reason, including the results from the three studies is unlikely to change the conclusion around self-management. Assessing publication bias arising from unidentified studies is somewhat difficult for self-management. For example, assessing asymmetry of the funnel plot is limited by the small number of studies (Figure 3). However, a comprehensive search plan was conducted in this review, which should have reduced publication bias.

We found weak to no evidence for the effect of behavioral change strategies on HRQoL components and medication adherence from the meta-analysis. And studies excluded from these meta-analyses also reported a lack of evidence. Therefore, publication bias related to missing results from identified studies was unlikely for these outcomes. The funnel plots for HRQoL components were asymmetrical, but like self-efficacy, missing studies are likely to be small studies with large effect sizes (Figure 3). Therefore, it is concluded that behavioral change strategies have little effect on HRQoL and self-management.

Overall, there was moderate to strong evidence to support the effectiveness of behavioral change strategies in improving self-management behavior perception of self-efficacy. There was weak evidence in the physical and mental components of HRQoL; and a lack of evidence to support the effectiveness of medication adherence among the CKD patients in stage 3–5 participants. One isolated individual strategy may not be sufficient to influence health-related behavioral outcomes and the following strategies can be recommended to improve health-related behavioral outcomes to CKD stages 3–5 population: (1) develop an individualized care plan; (2) renal education including discussion scenarios to increase knowledge and showing how to perform the task via health coaching with motivational interviews (personalized or in a group) to improve participant's skills in self-management behavior; (3) goal setting with a systematic follow-up to assist patients to improve the skills to maintain life changes needed and handle health-related complications; and (4) tailored support (coaching) to help patients build confidence in how to do the task and follow healthcare recommendations. However, the common denominator between the behavioral change strategies that showed significant improvement in self-management and perception of self-efficacy to manage CKD were goal setting and tailored support, also known as coaching.

Limitations

The limitations in this study were as follows: (1) only one RCT was found to assess patient activation using PAM-13; given this was a possible outcome, we chose to include the secondary health-related behavioral outcomes of aligned concepts that included self-care, self-management, self-efficacy, medication adherence, healthcare utilization, health-related quality of life, and symptom burden; (2) English only studies were included; hence, some relevant non-English articles may have been missed; (3) due to the nature of the interventions, blinding of participants and assessors was not possible in most of the studies; and (4) it is unknown if this review has failed to include eligible studies despite the comprehensive search plan. It is a limitation of the review that trial registrations were not searched. Despite these limitations, this review provides a reference base for implementing health-related behavioral change interventions in the context of advanced CKD.

This study has several strengths. First, this is the first systematic review of evidence on patient activation interventions on health-related behavioral outcomes in the CKD population. Second, the systematic methodology using validated systematic and meta-analysis tools and methods contributed to the validity, reliability, and replicability of this study. Third, the protocol for this systematic review was registered with the International Prospective Register of Systematic Reviews and published prospectively online in JBI Evidence and Synthesis (Lunardi et al., 2021).

CONCLUSION

In summary, our systematic review suggested that patient activation interventions are effective in improving self-management and self-efficacy when they are tailored and interactive. Effective interventions include small groups using motivational interviews to encourage participants to set personal goals, individualized coaching in-person, and over-the-phone coaching for 6 months. We recommend researching patient activation interventions as an effective strategy for improving health-related behaviors.

Linking evidence to action

- For people living with chronic kidney disease, behavioral change interventions have a beneficial effect on self-management and self-efficacy but not on HRQoL and medication adherence.
- Tailored interventions in small groups or individualized coaching followed by in-person or over the phone for up to 6 months of duration improve self-efficacy.
- A cluster approach including patient education, goal setting with individualized action plan, and problem-solving, should be considered when developing a health-related behavioral change intervention in CKD population.
- CKD patient activation interventions can be tailored to the level of the patient to improve engagement in their health care and monitored regularly to adjust the intervention according to the activation level.

ACKNOWLEDGMENT

Open access publishing facilitated by University of South Australia, as part of the Wiley - University of South Australia agreement via the Council of Australian University Librarians.

FUNDING INFORMATION

None. The author(s) received no financial support for the research, authorship, and/or publication of this article.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

ORCID

Laura E. Lunardi https://orcid.org/0000-0002-0689-3300

REFERENCES

Ahmadzadeh, S., Matlabi, H., Allahverdipour, H., & Khodaei Ashan, S. (2017). The effectiveness of self-management program on quality of life among haemodialysis patients. *Progress in Palliative Care*, *25*(4), 177–184. https://doi.org/10.1080/09699260.2017.1345407

Bakker, A., Cai, J., English, L., Kaiser, G., Mesa, V., & Van Dooren, W. (2019). Beyond small, medium, or large: Points of consideration when interpreting effect sizes. *Educational Studies in Mathematics*, *102*(1), 1–8. https://doi.org/10.1007/s10649-019-09908-4

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman https://find.library.unisa.edu.au/primo-explore/fulldisplay?vid=UNISA&search_scope=All_Resources&docid=UNISA_ALMA2155597650001831

Blakeman, T., Blickem, C., Kennedy, A., Reeves, D., Bower, P., Gaffney, H., Gardner, C., Lee, V., Jariwala, P., Dawson, S., Mossabir, R., Brooks, H., Richardson, G., Spackman, E., Vassilev, I., Chew-Graham, C., & Rogers, A. (2014). Effect of information and telephone-guided access to community support for people with chronic kidney disease: Randomised controlled trial. *PLoS One*, *9*(10), e109135. https://doi.org/10.1371/journal.pone.0109135

Campbell, K. L., Ash, S., & Bauer, J. D. (2008). The impact of nutrition intervention on quality of life in pre-dialysis chronic kidney disease patients. *Clinical Nutrition*, *27*(4), 537–544. https://doi.org/10.1016/j.clnu.2008.05.002

Chan, J. C., So, W.-Y., Leung, W. Y., Tong, P. C., Yeung, C.-Y., Ko, G. T., Lau, I.-T., Tsang, M.-W., Lau, K.-P., Siu, S.-C., Li, J. K., & Yeung, V. T. (2009). Effects of structured versus usual care on renal endpoint in type 2 diabetes: The SURE study: A randomized multicenter translational study. *Diabetes Care*, *32*(6), 977–982. https://doi.org/10.2337/dc08-1908

Chen, S.-H., Tsai, Y.-F., Sun, C.-Y., Wu, I. W., Lee, C.-C., & Wu, M.-S. (2011). The impact of self-management support on the progression of chronic kidney disease—A prospective randomized controlled trial. *Nephrology Dialysis Transplantation*, *26*(11), 3560–3566. https://doi.org/10.1093/ndt/gfr047

Flesher, M., Woo, P., Chiu, A., Charlebois, A., Warburton, D. E., & Leslie, B. (2011). Self-management and biomedical outcomes of a cooking, and exercise program for patients with chronic kidney disease. *Journal of Renal Nutrition*, *21*(2), 188–195. https://doi.org/10.1053/j.jrn.2010.03.009

Hibbard, J. H., Greene, J., Shi, Y., Mittler, J., & Scanlon, D. (2015). Taking the long view: How well do patient activation scores predict outcomes four years later? *Medical Care Research and Review*, *72*(3), 324–337. https://doi.org/10.1177/1077558715573871

Hibbard, J. H., Stockard, J., Mahoney, E. R., & Tusler, M. (2004). Development of the patient activation measure (PAM): Conceptualizing and measuring activation in patients and consumers. *Health Services Research*, *39*(4 Pt 1), 1005–1026. https://doi.org/10.1111/j.1475-6773.2004.00269.x

Higgins, J. P., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. (2019). *Cochrane handbook for systematic reviews of interventions version 6.0*. (updated July 2019). Cochrane. https://www.training.cochrane.org/handbook/archive/v6

Humalda, J. K., Klaassen, G., de Vries, H., Meuleman, Y., Verschuur, L. C., Straathof, E. J. M., Laverman, G. D., Bos, W. J. W., van der Boog, P. J. M., Vermeulen, K. M., Blanson Henkemans, O. A., Otten, W., de Borst, M. H., van Dijk, S., Navis, G. J., & Investigators, S. (2020). A self-management approach for dietary sodium restriction in patients with CKD: A randomized controlled trial [randomized controlled trial]. *American Journal of Kidney Diseases*, *75*(6), 847–856. https://doi.org/10.1053/j.ajkd.2019.10.012

Hupe, M. (2019). EndNote X9. *Journal of Electronic Resources in Medical Libraries*, *16*(3–4), 117–119. https://doi.org/10.1080/15424065.2019.1691963

Hussein, W. F., Bennett, P. N., Abra, G., Watson, E., & Schiller, B. (2022). Integrating patient activation into dialysis care. *American Journal of Kidney Diseases*, *79*(1), 105–112. https://doi.org/10.1053/j.ajkd.2021.07.015

Joboshi, H., & Oka, M. (2017). Effectiveness of an educational intervention (the encourage autonomous self-enrichment program) in patients with chronic kidney disease: A randomized controlled trial. *International Journal of Nursing Studies*, *67*, 51–58. https://doi.org/10.1016/j.ijnurstu.2016.11.008

Johnson, M. L., Zimmerman, L., Welch, J. L., Hertzog, M., Pozehl, B., & Plumb, T. (2016). Patient activation with knowledge, self-management and confidence in chronic kidney disease. *Journal of Renal Care*, *42*(1), 15–22. https://doi.org/10.1111/jorc.12142

Kearns, R., Harris-Roxas, B., McDonald, J., Song, H. J., Dennis, S., & Harris, M. (2020). Implementing the patient activation measure (PAM) in clinical settings for patients with chronic conditions: A scoping review. *Integrated Healthcare Journal*, *2*(1), e000032. https://doi.org/10.1136/ihj-2019-000032

Kelly, J. T., Conley, M., Hoffmann, T., Craig, J. C., Tong, A., Reidlinger, D. P., Reeves, M. M., Howard, K., Krishnasamy, R., Kurtkoti, J., Palmer, S. C., Johnson, D. W., & Campbell, K. L. (2020). A coaching program to improve dietary intake of patients with CKD: ENTICE-CKD. *Clinical Journal of the American Society of Nephrology*, *15*(3), 330–340. https://doi.org/10.2215/CJN.12341019

Kidney Health Australia. (2020). *Chronic kidney disease (CKD) management in primary care* (4th ed.) Kidney Health Australia. https://kidney.org.au/health-professionals/ckd-management-handbook

Lee, M. C., Wu, S. V., Hsieh, N. C., & Tsai, J. M. (2016). Self-management programs on eGFR, depression, and quality of life among patients with chronic kidney disease: A meta-analysis. *Asian Nursing Research*, *10*(4), 255–262. https://doi.org/10.1016/j.anr.2016.04.002

Levin, A., Tonelli, M., Bonventre, J., Coresh, J., Donner, J. A., Fogo, A. B., Fox, C. S., Gansevoort, R. T., Heerspink, H. J. L., Jardine, M., Kasiske, B., Köttgen, A., Kretzler, M., Levey, A. S., Luyckx, V. A., Mehta, R., Moe, O., Obrador, G., Pannu, N., … Eckardt, K. U. (2017). Global kidney health 2017 and beyond: A roadmap for closing gaps in care, research, and policy. *Lancet*, *390*(10105), 1888–1917. https://doi.org/10.1016/s0140-6736(17)30788-2

Li, W.-Y., Chiu, F.-C., Zeng, J.-K., Li, Y.-W., Huang, S.-H., Yeh, H.-C., Cheng, B.-W., & Yang, F.-J. (2020). Mobile health app with social media to support self-management for patients with chronic kidney disease: Prospective randomized controlled study. *Journal of Medical Internet Research*, *22*(12), e19452. https://doi.org/10.2196/19452

Lunardi, L. E., Bennett, P. N., Hill, K., Eckert, M., & Corsini, N. (2021). Effect of patient activation interventions on health-related behavioral outcomes in adults with chronic kidney disease: A systematic review protocol. *JBI Evidence Synthesis*, *19*(12), 3394–3401. https://doi.org/10.11124/jbies-20-00387

Meuleman, Y., Hoekstra, T., Dekker, F. W., Navis, G., Vogt, L., van der Boog, P. J. M., Bos, W. J. W., van Montfrans, G. A., van Dijk, S., & Group, E. S. (2017). Sodium restriction in patients with CKD: A randomized controlled trial of self-management support.

American Journal of Kidney Diseases, *69*(5), 576–586. https://doi.org/10.1053/j.ajkd.2016.08.042

Montoya, V., Sole, M. L., & Norris, A. E. (2016). Improving the care of patients with chronic kidney disease using group visits: A pilot study to reflect an emphasis on the patients rather than the disease. *Nephrology Nursing Journal*, *43*(3), 207–222.

Nelson, R. G., Pankratz, V. S., Ghahate, D. M., Bobelu, J., Faber, T., & Shah, V. O. (2018). Home-based kidney care, patient activation, and risk factors for CKD progression in Zuni Indians: A randomized, controlled clinical trial. *Clinical Journal of the American Society of Nephrology*, *13*(12), 1801–1809. https://doi.org/10.2215/CJN.06910618

Nguyen, N. T., Douglas, C., & Bonner, A. (2019). Effectiveness of self-management programme in people with chronic kidney disease: A pragmatic randomized controlled trial. *Journal of Advanced Nursing*, *75*(3), 652–664. https://doi.org/10.1111/jan.13924

Nick, J. M., Roberts, L. R., & Petersen, A. B. (2021). Effectiveness of telemonitoring on self-care behaviors among community-dwelling adults with heart failure: A quantitative systematic review. *JBI Evidence Synthesis*, *19*(10), 2659–2694. https://doi.org/10.11124/jbies-20-00329

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Silva, R. A., Souza, V. L., Oliveira, G. J., Silva, B. C., Rocha, C. C., & Holanda, J. R. (2016). Coping strategies used by chronic renal failure patients on hemodialysis. *Escola Anna Nery Revista de Enfermagem*, *20*(1), 147–154. https://doi.org/10.5935/1414-8145.20160020

Stenvinkel, P., Fouque, D., & Wanner, C. (2020). Life/2020—The future of kidney disease. *Nephrology Dialysis Transplantation*, *35*(Suppl 2), ii1–ii3. https://doi.org/10.1093/ndt/gfaa028

Tang, Q., Yang, B., Fan, F., Li, P., Yang, L., & Guo, Y. (2017). Effects of individualized exercise program on physical function, psychological dimensions, and health-related quality of life in patients with chronic kidney disease: A randomized controlled trial in China. *International Journal of Nursing Practice*, *23*(2), e12519. https://doi.org/10.1111/ijn.12519

Tufanaru, C., Aromataris, E., Campbell, J., & Hopp, L. (2017). Systematic reviews of effectiveness. In E. Aromataris & Z. Munn (Eds.), *Joanna Briggs institute Reviewer's Manual*. The Joanna Briggs Institute https://reviewersmanual.joannabriggs.org/

Tuot, D. S., Rubinsky, A. D., Velasquez, A., McCulloch, C. E., Schillinger, D., Handley, M. A., Hsu, C. Y., & Powe, N. R. (2019). Interventions to improve blood pressure control among socioeconomically disadvantaged patients with CKD: Kidney awareness registry and education pilot randomized controlled trial. *Kidney Medicine*, *1*(5), 242–252. https://doi.org/10.1016/j.xkme.2019.07.004

Wan, X., Wang, W., Liu, J., & Tong, T. (2014). Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Medical Research Methodology*, *14*(1), 135. https://doi.org/10.1186/1471-2288-14-135

Welch, J. L., Johnson, M., Zimmerman, L., Russell, C. L., Perkins, S. M., & Decker, B. S. (2015). Self-management interventions in stages 1 to 4 chronic kidney disease: An integrative review. *Western Journal of Nursing Research*, *37*(5), 652–678. https://doi.org/10.1177/0193945914551007

Williams, A., Manias, E., Liew, D., Gock, H., & Gorelik, A. (2012). Working with CALD groups: Testing the feasibility of an intervention to improve medication self- management in people with kidney disease, diabetes, and cardiovascular disease. *Renal Society of Australasia Journal*, *8*(2), 62–69. https://www.cochranelibrary.com/central/doi/10.1002/central/CN-02129098/full

Williams, A., Manias, E., Walker, R., & Gorelik, A. (2012). A multifactorial intervention to improve blood pressure control in co-existing diabetes and kidney disease: A feasibility randomized controlled trial. *Journal of Advanced Nursing*, *68*(11), 2515–2525. https://doi.org/10.1111/j.1365-2648.2012.05950.x

Wu, S. F. V., Lee, M. C., Hsieh, N. C., Lu, K. C., Tseng, H. L., & Lin, L. J. (2018). Effectiveness of an innovative self-management intervention on the physiology, psychology, and management of patients with pre-end-stage renal disease in Taiwan: A randomized, controlled trial. *Japan Journal of Nursing Science*, *15*(4), 272–284. https://doi.org/10.1111/jjns.12198

Wyld, M., Lee, C., Chadban, S., Zhuo, X., White, S., Shaw, J., Morton, R., & Coalagiuri, S. (2014). Cost of CKD in Australia. *Nephrology*, *19*, 23. https://doi.org/10.1111/jjns.12198

Yamagata, K., Makino, H., Iseki, K., Ito, S., Kimura, K., Kusano, E., Shibata, T., Tomita, K., Narita, I., Nishino, T., Fujigaki, Y., Mitarai, T., Watanabe, T., Wada, T., Nakamura, T., Matsuo, S., & Study Group for Frontier of Renal Outcome Modifications in Japan (FROM-J). (2016). Effect of behavior modification on outcome in early- to moderate-stage chronic kidney disease: A cluster-randomized trial. *PLoS One*, *11*(3), e0151422. https://doi.org/10.1371/journal.pone.0151422

Zimbudzi, E., Lo, C., Misso, M. L., Ranasinha, S., Kerr, P. G., Teede, H. J., & Zoungas, S. (2018). Effectiveness of self-management support interventions for people with comorbid diabetes and chronic kidney disease: A systematic review and meta-analysis. *Systematic Reviews*, *7*(1), 84. https://doi.org/10.1186/s13643-018-0748-z

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Lunardi, L. E., Hill, K., Xu, Q., Le Leu, R., & Bennett, P. N. (2023). The effectiveness of patient activation interventions in adults with chronic kidney disease: A systematic review and meta-analysis. *Worldviews on Evidence-Based Nursing*, *20*, 238–258. https://doi.org/10.1111/wvn.12634