An Educational Intervention Model To Improve Hypertension Self-Management In The Elderly: A Systematic Review

ABSTRACT

Aims: This systematic review aimed to evaluate the effectiveness of educational interventions designed to improve hypertension self-management among elderly populations.

Method: The review was conducted in accordance with the PRISMA 2020 guidelines. Eligible studies were selected based on the PICOs framework and included randomized controlled trials, quasi-experimental studies, and pre-post designs published between 2000 and 2024. Six electronic databases—PubMed, Scopus, Web of Science, ScienceDirect, JSTOR, and Cochrane Library—were systematically searched. Study quality was assessed using the Critical Appraisal Skills Program (CASP), and the Risk of Bias (RoB 2) tool was used to assess bias in randomized studies.

Results: This review included 15 studies, primarily RCTs, with sample sizes ranging from 20 to 253 participants. The studies revealed that educational interventions significantly enhanced self-management in elderly individuals with hypertension. Interventions such as mobile application-based support, face-to-face group education, and telephone-based guidance led to improvements in key outcomes, including blood pressure control, medication adherence, and lifestyle modifications. These programs also boosted participants' knowledge and self-efficacy in managing their condition. Notably, interventions targeting adherence to the DASH diet showed significant improvements in both dietary habits and physical activity, contributing to better overall hypertension management.

Conclusion. Educational and self-management interventions, especially those integrating digital tools, effectively improve hypertension management in older adults. These findings support the use of tailored, multifaceted approaches to enhance self-care behaviors and blood pressure control, with implications for future research on long-term and scalable interventions.

Keywords: Educational program, Self-management, Hypertension, Elderly, Systematic review

INTRODUCTION

High blood pressure, often known as hypertension, is a common chronic illness that primarily affects the elderly. It is a significant risk factor for kidney failure, stroke, and cardiovascular illnesses, contributing substantially to global morbidity and mortality rates [1–4]. Among older adults, the prevalence of hypertension is particularly high, largely due to age-related vascular changes and the greater occurrence of comorbid conditions, making it a critical health issue for this population [5,6]. According to the World Health Organization, hypertension control remains suboptimal worldwide, especially among older individuals, who face challenges such as medication non-adherence, poor self-management behaviors, and limited access to tailored health education [7].

Self-management is widely regarded as an essential component of effective hypertension control. This practice includes activities like monitoring blood pressure, maintaining a balanced diet, adhering to prescribed medications, and engaging in regular physical exercise [8,9]. Research has shown that consistent self-management behaviors can substantially reduce the risk of hypertension-related complications [10,11]. However, elderly patients often encounter unique barriers to effective self-management, such as cognitive decline, physical limitations, and limited technological literacy, which can hinder their ability to actively manage their health [12–16].

Educational interventions tailored specifically to the elderly population are essential to addressing these barriers, empowering patients to take control of their hypertension management. Studies indicate that structured educational programs can improve self-efficacy, enhance knowledge about hypertension, and encourage sustainable lifestyle changes, which are vital for effective disease management [17]. Furthermore, educational models grounded in theories such as the Health Belief Model and Social Cognitive Theory provide a structured approach to instill motivation and promote behavioral changes critical to managing chronic conditions in elderly populations [18].

With the rise of digital technology, innovative educational models have emerged, including mobile applications and telehealth programs. By making health information more handy and accessible, telehealth-based educational programs have been demonstrated to increase self-efficacy and encourage healthier lifestyle choices [19]. Digital health tools, such as mobile apps, have been effectively utilized to deliver information on medication adherence, dietary modifications, and lifestyle management for hypertensive patients, demonstrating that technology-assisted interventions can significantly improve health outcomes in elderly patients [20,21]. Additionally, community-based programs and group education models, which provide social support alongside practical education, have proven effective in helping older adults adopt and maintain self-management behaviors [22,23].

Despite these advancements, there is still a need for comprehensive educational models that specifically address the unique needs and limitations of elderly populations. Recent research highlights that multidimensional approaches combining digital tools with in-person support yield the most promising outcomes in terms of adherence, self-efficacy, and sustainable lifestyle changes [24]. However, further studies are needed to develop and refine these models to maximize their effectiveness in managing hypertension among the elderly [25,26].

This systematic review aims to consolidate evidence on educational interventions designed to improve self-management of hypertension in elderly populations. By reviewing studies published from 2000 to 2024, this analysis will evaluate the effectiveness of various educational models, identify key factors influencing self-management behaviors, and provide evidence-based recommendations for enhancing hypertension care in older adults. These insights are intended to guide healthcare practitioners in implementing effective, tailored educational strategies that improve hypertension outcomes in this vulnerable population.

METHOD

Study Design

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 standards were followed in the design and execution of this systematic review [27]. The aim was to synthesize existing evidence on educational interventions that improve hypertension self-management among elderly populations.

Eligibility Criteria

The inclusion and exclusion criteria were developed based on the PICOs framework to maintain alignment with the research question. These criteria are shown below:

Table 1. PICOS statements

PICOS elements	Inclusion Criteria	Exclusion Criteria
Population (P)	Studies focusing on elderly adults aged 60 and older with a clinical diagnosis of hypertension.	Studies including younger adults, or those without a clear diagnosis of hypertension.
Intervention (I)	Educational interventions aimed at self-management of hypertension, including but not limited to digital health tools (e.g., apps, telehealth), in-person education sessions, group programs, and community-based initiatives.	Studies involving pharmacological interventions without an educational component.
Comparison (C)	Studies with a control group receiving usual care, no intervention, or a minimal intervention.	Studies without a control or comparison group, or where comparisons are not relevant to self-management.
Outcomes (O)	Primary outcomes: self-management behaviors, self-efficacy, adherence to hypertension management practices, and blood pressure control. Secondary outcomes: quality of life, knowledge, and dietary improvements.	Studies that do not measure any of the outcomes listed.

Study Design (S)	Randomized controlled trials (RCTs), quasi-experimental studies, and controlled clinical trials published in peer-reviewed journals from 2020 to 2024.	Non-peer-reviewed studies, qualitative studies, reviews, editorials, or case reports.

Information Sources

To identify relevant studies, we systematically searched six electronic databases including PubMed, Scopus, Web of Science, ScienceDirect, JSTOR and Cochrane Library. These databases were chosen for their comprehensive coverage of health, clinical, and psychological research. The search covered publications from 2000 to 2024 to focus on recent twenty years evidence. Additionally, we conducted hand searches of reference lists in eligible studies and performed citation tracking to identify potentially relevant studies. Experts in hypertension self-management were consulted for insights into unpublished or ongoing studies.

Search Strategy

To guarantee sensitivity and specificity, a medical librarian helped build the search technique. The search terms were formulated using both Medical Subject Headings (MeSH) and free-text keywords. The strategy combined terms related to Population: "elderly," "older adults," "geriatric patients"; Intervention: "hypertension education," "self-management," "educational models," "telehealth," "digital health," "community-based programs"; Outcomes: "self-efficacy," "medication adherence," "dietary adherence," "blood pressure control". Following is the search string for each database.

Table 2. Search string in databases

Databases	Keywords
Pubmed	("Hypertension"[Mesh] OR "high blood pressure") AND ("elderly"[Mesh] OR "older adults" OR "geriatric patients") AND ("self-management"[Mesh] OR "patient education" OR "health education" OR "telehealth" OR "digital health" OR "community-based programs") AND ("self-efficacy" OR "adherence" OR "dietary diversity" OR "blood pressure control")
Scopus	TITLE-ABS-KEY ("hypertension" OR "high blood pressure") AND TITLE-ABS-KEY ("elderly" OR "older adults" OR "geriatric patients") AND TITLE-ABS-KEY ("self-management" OR "patient education" OR "health education" OR "telehealth" OR "digital health" OR "community-based programs") AND TITLE-ABS-KEY ("self-efficacy" OR "adherence" OR "dietary diversity" OR "blood pressure control")
Web of Science	TS=("hypertension" OR "high blood pressure") AND TS=("elderly" OR "older adults" OR "geriatric patients") AND TS=("self-management" OR "patient education" OR "health education" OR "telehealth" OR "digital health" OR "community-based programs") AND TS=("self-efficacy" OR "adherence" OR "dietary diversity" OR "blood pressure control")
Sciencedirect	("hypertension" OR "high blood pressure") AND ("elderly" OR "older adults" OR "geriatric patients") AND ("self-management" OR "patient education" OR "health education" OR "telehealth" OR "digital health" OR "community-based programs") AND ("self-efficacy" OR "adherence" OR "dietary diversity" OR "blood pressure control")
JSTOR	("hypertension" OR "high blood pressure") AND ("elderly" OR "older adults" OR "geriatric patients") AND ("self-management" OR "patient education" OR "health education" OR "telehealth" OR "digital health" OR "community-based programs") AND ("self-efficacy" OR "adherence" OR "dietary diversity" OR "blood pressure control")

Cochrane Library	("Hypertension" OR "high blood pressure") AND ("elderly" OR "older adults" OR "geriatric patients") AND ("self-management" OR "patient education" OR "health education" OR "telehealth" OR "digital health" OR "community-based programs") AND ("self-efficacy" OR "adherence" OR "dietary diversity" OR "blood pressure control")

Study Quality

The reviewers independently evaluated the literature to determine quality for inclusion. Although this step is not mandatory in systematic review protocols, the reviewers considered it beneficial for identifying the strengths and limitations of the chosen studies. Due to the diverse nature of the articles, the Critical Appraisal Skills Program (CASP) for randomized studies was chosen for its ability to systematically evaluate study quality. CASP offers a structured set of questions specifically designed for different study designs, particularly randomized studies. Each CASP checklist includes 11 questions with response options of "yes," "no," or "can't tell," facilitating a standardized appraisal process. Study quality is classified into three categories: Strong, Moderate, and Weak. A study is classified as Weak if there are three non-affirmative responses, Moderate if there are two non-affirmative responses ("Can't tell" or "No"), and Strong if all of the responses are affirmative.

Risk of bias

The assessment of bias in each study was performed using the Risk of Bias in Randomized Studies (RoB 2 tool). This tool was chosen for its structured, validated framework tailored to detecting bias specifically within randomized controlled trials (RCTs), addressing essential areas such as randomization, deviations from the planned interventions, missing outcome data, outcome measurement, and selective reporting. The RoB 2 tool provides a comprehensive and consistent approach to quality assessment, which strengthens the reliability of the review's conclusions. It includes five domains that assess both internal and external validity, with results classified into four levels: Low, Some Concerns, High, and Very High. All authors reviewed and approved the RoB assessment results, incorporating feedback from external reviewers.

Data Extraction and synthesis

In order to enhance understanding of the content within the eligible studies, key information has been condensed into a table format. Two authors worked together during this process of gathering data. Any discrepancies in extracted data were resolved through mutual agreement. The primary author, year of publication, country, study design, sample size, mean age, outcome, intervention, model, duration, evaluation technique, and key findings were among the details that were included in the extraction criteria.

RESULTS

The initial database query yielded 598 articles. Following the removal of 405 duplicates and irrelevant articles unrelated to the review's focus, 193 articles were available for screening. In the eligibility evaluation, 34 studies underwent assessment, resulting in the exclusion of 80 articles for diverse reasons. Ultimately, only 15 studies fulfilled the criteria and will advance to the subsequent stage for data extraction and analysis.

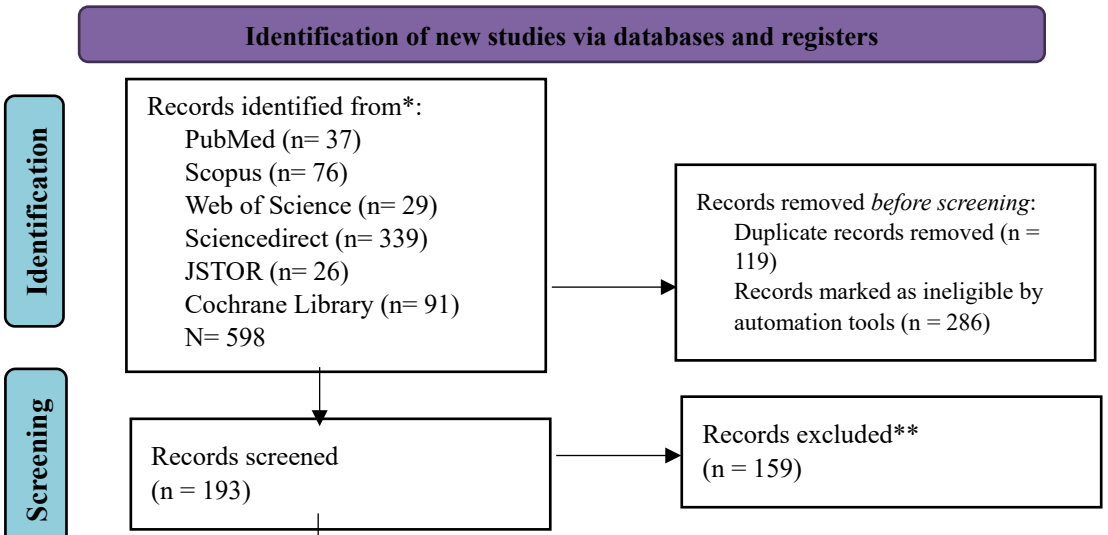

Figure 1. PRISMA flowchart for study selection

Tabel 3. Characteristics of eligible studies

Author, Year, Country	Study Design	Sample Size	Age (Mean Age)	Outcome assessed	Intervention	Model	Duration	Evaluation Method	Main Findings
Baghianimoghadam et al., 2009, Iran [28]	RCT	I = 75 C= 75	57.9	- Attitude - Subjective norms - Intention - Enabling factor - Self-monitoring	Educational	BASNEF	2 months	Self-structured questionnaire	Attitude (0.001) Subjective norms (0.001) Intention (0.001) Enabling factor (0.001) Self-monitoring (0.001)
Beigi et al., 2014, Iran [29]	Quasi-experimental	100	NR	- Life style modification - BP control	Short-term educational program	No	3 months	Self-structured questionnaire	Physical inactivity (<0.001) Inadequate use of vegetables and fruit (<0.001)
Bozorgi et al., 2021, Iran [30]	RCT	120	IG= 52 CG= 51.6	- Adherence to the DASH - BP Control - Physical Activity - Adherence to treatment	mobile application-based educational-supportive	PRECEDE	6 months	the Hill-Bone Scale the researcher-made questionnaire WHO-STEPS GPAQ	IC: Adherence to medication was 65.1 (improvement 5.9 point) IC: Adherence to DASH increased 1.7 point MAP: decreased average 3.4 mmHg IC: Mean PA 247.3 (increase 100 min) IC: Increased in knowledge : 2.9 points; Attitude: 2.3 points; self-efficacy: 1.7 points
Daniali et al., 2016, Iran [31]	RCT	146	IG: 54.14	- Self-Efficacy - BP control	- Self-management,	No	6 months	The scale of self-efficacy DASH diet questionnaire	Improved Self-efficacy (<0.001)

			CG: 52.11	- Physical activity - Adherence to DASH	- Home self-monitoring, - SMS			PA scale	PA after 6 months (P 0.120) Decreased BP after 6 months (P 0.001)
Delavar et al., 2019, Iran [32]	RCT	IC= 56 CG= 58	IG= 64 CG= 63.9	- Medication adherence - BP monitoring	- SME followed by four fifteen-minute telephone-based educational	No	30–45-minute; twice a week	HELIA Scale MMAS	IC: increased medication adherence (P 0.002 IC: reduced BP (P<0.05)
Dye et al., 2015, US [33]	Pre-post study	145	71.55	- Knowledge - Behavior - BP control - BMI	Health Coaches for Hypertension Control	University–Community–Hospital system model	16 weeks; 1.5 hours each	Knowledge survey based on NHLBI and AHA The Perceived Competence Scale for Hypertension self-management	Physically active (P .001) Good eating habits (P .001) Maintain BMI (P .001) Handling stress (P .001) Healthy lifestyle (P .001)
Figar et al., 2006, Italy [34]	RCT	IG= 30 CG= 30	IG= 67 CG= 70	- BP - Natriuresis	The self-management empowerment education	PRECEDE	3 months; Weekly; 2 hours	ABPM	IC: significant reduction on BP (P 0.02) IC: BP control regularly (P 0.04)
Kordyarkane et al., 2023, Iran [35]	RCT	IG= 33 CG= 35	IG= 55.91 CG= 53.14	- BP - Self-management	Training based on the CSM	CSM	face to face, once every six days, for 30-45 min each	Self-management behaviors of hypertensive patients' questionnaire Sphygmomanometer	IC: decreased SBP, DBP, MAP (P <0.05); increased self-management score (P <0.05)
Li et al., 2019, China [36]	Cluster RCT	IG= 110 CG= 143	IG= 61.7 CG= 61.3	- BP - Knowledge - Self-efficacy - Social support	Health education-promotion via group discussion in We-Chat	the self-efficacy theory	3 months	The Hypertension Self-Efficacy Scale HPSMBRS	IG= Improved BP (P=0.002) IG= improved knowledge and self-efficacy

Moradi et al., 2019, Iran [37]	RCT	IG= 30 CG= 30	IG= 67.55 CG= 68.34	- Self-efficacy	self-management program	the 5 A's behavior change model	12 weeks	the Self-Efficacy for Managing Chronic Disease Scale, the hypertension Self-Efficacy Scale	IG= hypertension self-efficacy (P <0.001); Self-efficacy (P <0.001)
Ongkulna et al., 2022, Thailand [38]	RCT	IG= 50 CG= 50	IG= 67.98 CG= 68.16	- Health literacy, - Self-efficacy, - Self-management behaviors	The Geragogy-Based Self Management Education Program (GBSEP)	Geragogy model	3 weeks; 6 session; 2 hours each session	HLS HSMSES SMBS	IG= improved health literacy, self-efficacy, and self-management behaviors (P<0.05)
Park et al., 2010, South-Korea [39]	RCT	IG= 18 CG = 22	IG= 71 CG= 69	- Self-care behavior - Self-efficacy - Physical Activity	The HAHA program	No	12 weeks	16-item questionnaire for the self-care behavior of hypertensive patients short International Physical Activity Questionnaire	Control systolic BP (P 0.004) Improved self-efficacy (P 0.006)
Park et al., 2012, South korea [40]	Quasi-experimental	IG= 23 CG= 24	IG= 78.2 CG= 76.5	- BP - Self-care behavior - Self-efficacy - Medication adherence	Group education and individual counselling	Self-management for hypertensive patients; Patient-centeredness	8 weeks; 90 minutes each session	the Scale of Self-Care Behaviour of Hypertension the Self-Efficacy for Exercise scale Medication Adherence Questionnaire	Improved self-care behavior (P<0.005) ; exercise self-efficacy (P = 0.003) No improvement medication adherence (p =0.88)
Sutipan et al., 2018, Thailand [41]	RCT	IG= 20 CG= 20	65.5	- Healthy lifestyle behaviors - BP - BMI	Self-management program	No	8 weeks; 2 hours each session; home visit once a week	Questionnaire	Improved BMI (P<0.01); BP (P<0.01); health responsibility (P<0.01); healthy eating (P<0.01); exercising (P<0.01)

Yazdanpanah et al., 2019, Iran [42]	RCT	IG= 30 CG= 30	IG= 69.1 CG= 63.9	- Medication adherence	Educational program	HBM	60 minutes each session	MMAS-8	Improved medication adherence (P<0.001)

General characteristics of the eligible studies

The studies reviewed in this analysis cover a variety of interventions aimed at improving health outcomes through educational and self-management strategies. The studies were conducted in diverse countries, including Iran, the United States, China, Italy, Thailand, and South Korea, highlighting both cultural and regional approaches to non-pharmacological health interventions.

The majority of the studies employed randomized controlled trials (RCTs), with a few using quasi-experimental and pre-post study designs. RCTs were the predominant design, indicating a strong focus on controlled interventions for evaluating the effectiveness of educational and behavioral strategies.

Sample sizes varied significantly across studies, ranging from as few as 20 participants in some RCTs (e.g., Sutipan et al., 2018) to larger groups, such as the 253 participants in Li et al.'s (2019) [36] cluster RCT in China. Participants were primarily adults, with mean ages typically around the 50s to 70s, reflecting a focus on older adults and individuals managing chronic conditions, particularly hypertension.

Intervention durations ranged from as short as three weeks [38] to as long as six months [30,31]. Formats included face-to-face sessions, mobile application-based interventions, telephone-based guidance, and online group discussions, indicating a mix of in-person and technology-assisted education.

Outcomes were assessed using a variety of self-reported and validated scales. For example, dietary adherence was evaluated using the DASH diet questionnaire, while self-efficacy was commonly measured using the Self-Efficacy for Managing Chronic Disease Scale and other similar scales. Blood pressure control and physical activity were also frequently monitored, often using standard clinical instruments or validated questionnaires (e.g., ABPM for blood pressure in Figar et al., 2006). The primary outcomes varied but were generally centered on improving self-efficacy, adherence to dietary and health recommendations, and managing hypertension. Several studies targeted lifestyle modifications, including improvements in physical activity, dietary diversity, and stress management. Many of the studies reported significant improvements in key outcomes, such as increased knowledge, improved dietary adherence, and better self-management behaviors. Notable findings included reductions in blood pressure (e.g., Kordvarkane et al., 2023), increased adherence to the DASH diet [30], and enhanced self-efficacy for managing chronic conditions [37].

Study Quality Assessment

The following is a summary of the study quality assessment using the CASP tool. Based on the assessment results, in general the eligible studies are in the Strong category, while only three studies are in the Medium category.

Table 3. Summary of Quality Assessment

Studies	Questions											Overall
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	
Baghianimoghadam et al., 2009, Iran	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Beigi et al., 2014, Iran	Y	Y	CT	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Bozorgi et al., 2021, Iran	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Daniali et al., 2016, Iran	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Delavar et al., 2019, Iran	Y	Y	Y	Y	CT	Y	Y	Y	Y	Y	Y	Strong
Dye et al., 2015, US	Y	Y	Y	Y	Y	CT	Y	Y	Y	Y	Y	Strong
Figar et al., 2006, Italy	Y	Y	CT	Y	Y	N	Y	Y	Y	Y	Y	Medium
Kordvarkane et al., 2023, Iran	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Li et al., 2019, China	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Moradi et al., 2019, Iran	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Ongkulna et al., 2022, Thailand	Y	Y	N	Y	CT	Y	Y	Y	Y	Y	Y	Medium
Park et al., 2010, South-Korea	Y	Y	Y	Y	Y	CT	Y	Y	Y	Y	Y	Strong
Park et al., 2012, South korea	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Medium

Sutipan et al., 2018, Thailand	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong
Yazdanpanah et al., 2019, Iran	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Strong

Risk of Bias Assessment

Based on the assessment in five dimensions of RoB2 tool, it was found that most of the studies were in the Low Risk of Bias category, and there were three studies that were in the Some concerns category.

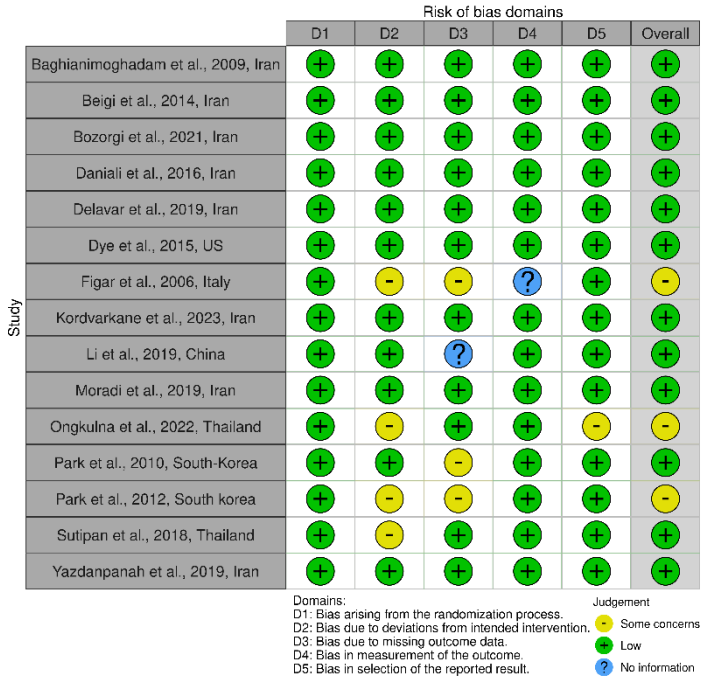

Fig. 2. Traffic light plot for RoB Assessment

Intervention Types and Models

A wide range of intervention models were used across the studies, including educational programs, mobile application-based interventions, face-to-face group education, and self-management programs. Several theoretical models supported these interventions, including the BASNEF, PRECEDE, Geragogy, and the Health Belief Model (HBM). These interventions aimed to improve knowledge, self-efficacy, and adherence to dietary and health practices, targeting sustainable health behaviors.

Outcomes

Knowledge and Self-Efficacy: Several studies reported significant improvements in participants' knowledge and self-efficacy following the interventions. For example, the intervention by Li et al. (2019) [36] in China, using WeChat for health education, improved both blood pressure (BP) control ($p = 0.002$) and knowledge/self-efficacy.

Adherence to Dietary Guidelines: Studies focusing on dietary interventions, such as adherence to the DASH diet [30], demonstrated positive effects on dietary adherence, blood pressure control, and physical activity levels.

Behavioral and Physical Health Indicators: Improvements in health-related behaviors were observed, including healthy lifestyle practices [41] and self-care behaviors related to BP control [39]. Many studies noted significant reductions in BP, such as Figar et al. (2006) in Italy, which showed BP reduction ($p = 0.02$) with regular BP monitoring and empowerment education.

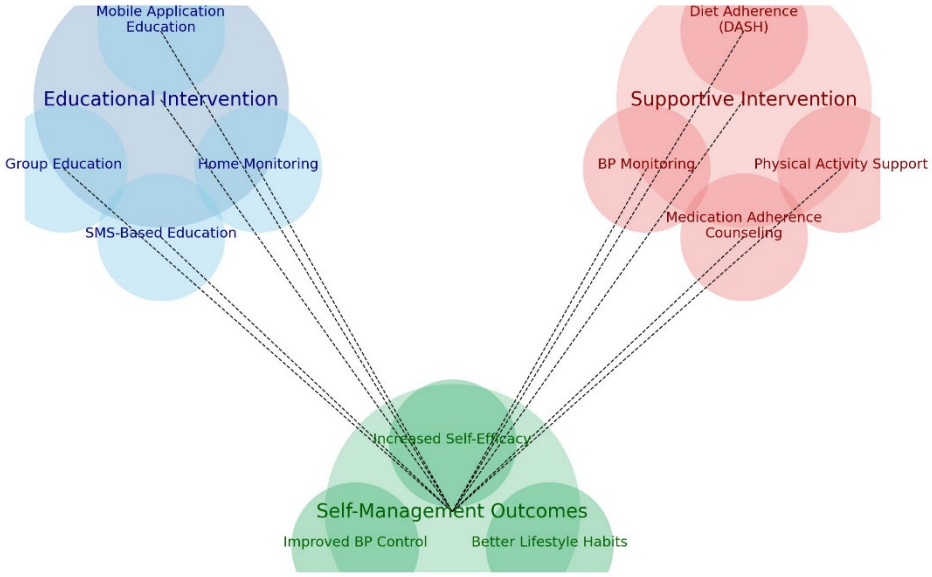

Fig. 3. Summary of the intervention and outcomes

DISCUSSION

Overview of Study Characteristics and Interventions

The studies reviewed in this analysis span a wide range of characteristics and approaches, emphasizing non-pharmacological interventions aimed at improving health outcomes through educational and self-management strategies. Conducted across several countries, including Iran, the United States, China, Italy, Thailand, and South Korea, the studies bring to light cultural and regional variations in health interventions, particularly for managing chronic conditions such as hypertension. This geographic diversity in study settings underscores the universal challenge of chronic disease management and the varying methodologies researchers have adopted in different sociocultural contexts. For instance, while studies from countries such as Iran and Thailand tended to incorporate traditional face-to-face group educational sessions, other regions, like China, leveraged popular local digital platforms such as WeChat to deliver health education in more accessible formats [36]. This adaptation to digital platforms is indicative of a global shift towards technology-driven healthcare solutions, especially in environments where face-to-face interaction may be limited by logistical constraints or during times of increased public health concerns.

Another notable characteristic among these studies is the variation in sample sizes, which ranged from as few as 20 participants to as many as 253. Smaller studies, such as Sutipan et al. (2018) [41] with 20 participants, often provide a more detailed examination of individual-level responses to interventions but may lack the power to detect smaller effects reliably. In contrast, larger studies, such as Li et al. (2019) [36], with a sample size of 253, enhance statistical power, offering more robust insights into intervention effectiveness on a population level. The wide age range, typically focusing on adults in their 50s to 70s, is another distinguishing factor. This age demographic reflects a focus on older adults who are generally more susceptible to chronic conditions and thus may particularly benefit from lifestyle interventions aimed at promoting self-management and improving overall quality of life [43]. The attention to this age group also reflects a public health priority, given the rising prevalence of hypertension and other chronic diseases in aging populations worldwide [44].

Intervention durations varied significantly, from a brief three-week program [38] to extended interventions lasting up to six months [30,31]. Shorter interventions can provide immediate insights into the feasibility and short-term effects of an intervention but may not capture long-term adherence or sustainability. On the other hand, longer interventions are advantageous for observing sustained behavior change and determining whether health improvements persist over time. Such extended interventions might offer a better model for real-world applications, where long-term adherence is critical for managing chronic conditions effectively.

In terms of delivery format, the studies employed a mix of traditional and modern methods, ranging from face-to-face sessions to mobile app-based interventions, telephone guidance, and online group discussions. This variety reflects the growing recognition of the need for flexible, accessible

healthcare delivery, especially in a post-pandemic world where remote options are increasingly valuable. Mobile health applications and other technology-assisted education methods allow participants to engage with intervention materials at their convenience, which can be particularly beneficial for individuals with limited mobility or those in rural areas with reduced access to healthcare facilities [45,46]. At the same time, face-to-face interactions remain valuable for personalized guidance, offering opportunities for real-time feedback, social support, and engagement that digital platforms may lack [47–49].

Improvements in knowledge and self-efficacy

Improvements in knowledge and self-efficacy are crucial components of chronic disease management, particularly in conditions requiring significant lifestyle changes, such as hypertension. Across the reviewed studies, multiple interventions demonstrated statistically significant increases in knowledge and self-efficacy, suggesting that structured educational programs can positively influence individuals' ability to manage their health. For instance, Li et al. (2019) utilized a WeChat-based group discussion for health education in China, which resulted in notable improvements in both blood pressure control ($p = 0.002$) and self-efficacy scores among participants. The use of this popular social media platform allowed for frequent interaction and support, which likely contributed to the effectiveness of the intervention. This finding aligns with Bozorgi et al. (2021), who found that a mobile application-based intervention in Iran improved adherence to the DASH diet, physical activity, and self-efficacy levels. Such digital platforms may enhance accessibility and engagement, providing participants with convenient and continuous support that fosters knowledge retention and self-confidence in managing health behaviors [50,51].

Previous research has also demonstrated the efficiency of educational interventions in enhancing knowledge and self-efficacy. For example, a study by Bandura (1997) [52] demonstrated that interventions aimed at increasing self-efficacy can lead to sustained behavior change, as higher self-efficacy is directly associated with greater resilience in overcoming obstacles. Similarly, Clark and Dodge (1999) [53] emphasized the role of self-efficacy in promoting adherence to dietary and exercise regimens, particularly in hypertensive populations. By empowering patients with the knowledge and confidence needed to make informed health choices, these interventions can yield substantial long-term benefits.

In addition to mobile-based interventions, face-to-face educational sessions have also shown substantial efficacy in improving knowledge and self-efficacy. For example, Park et al. (2010) implemented the HAHA program in South Korea, which included face-to-face counseling and physical activity sessions. The program led to significant improvements in both self-efficacy and systolic blood pressure control ($p = 0.004$). This result aligns with findings from Yazdanpanah et al. (2019) in Iran, where an educational intervention based on the Health Belief Model (HBM) led to significant increases in medication adherence and self-efficacy ($p < 0.001$). These findings suggest that in-person interactions allow for personalized feedback, real-time social support, and direct reinforcement of health knowledge, all of which can enhance participants' self-efficacy and commitment to behavioral change.

The variation in delivery formats—ranging from digital platforms to face-to-face programs—suggests that the effectiveness of these interventions may depend on factors such as accessibility, frequency of interaction, and participants' preferences. Ongkulna et al. (2022) demonstrated the success of the Geragogy-Based Self-Management Education Program (GBSEP), which combines in-person sessions with geragogy principles tailored to older adults. This program improved participants' health literacy, self-efficacy, and self-management behaviors ($p < 0.05$). These findings are comparable to a similar intervention by Dye et al. (2015) in the United States, which used health coaches to foster self-management skills in older adults with hypertension. By adapting interventions to participants' age-related learning needs, such programs enhance understanding and self-efficacy, facilitating better health behaviors over time.

These findings are consistent with the Social Cognitive Theory (Bandura, 1986), which posits that knowledge and self-efficacy are critical in driving behavior change. The reviewed studies align with this theory, indicating that well-designed educational interventions can significantly impact self-efficacy and, consequently, adherence to health-promoting behaviors. Taken together, this body of research demonstrates that both knowledge and self-efficacy improvements are achievable across diverse formats and settings, underscoring the versatility and potential of educational interventions to support chronic disease management across different populations and health systems.

Role of Theoretical Models in Intervention Design

Theoretical models play a critical role in designing health interventions, particularly those aimed at improving self-management behaviors and health outcomes in chronic conditions such as hypertension. These models provide a structured framework for understanding how individuals adopt and sustain health-promoting behaviors, which is essential for the effectiveness of interventions. In the studies reviewed, several theoretical models were employed to guide intervention development and ensure their success. These include the Health Belief Model (HBM), Social Cognitive Theory (SCT), the PRECEDE-PROCEED Model, the BASNEF Model, and Geragogy.

Each model contributed unique perspectives and mechanisms for understanding and influencing behavior, thereby supporting tailored and effective interventions. For example, interventions based on HBM focus on modifying individuals' perceptions about the severity of their condition, their susceptibility to complications, and the benefits of adopting preventive behaviors. Yazdanpanah et al. (2019) used the HBM in their intervention with elderly patients in Iran, demonstrating that when patients perceived their hypertension as serious and recognized the benefits of medication adherence, their adherence significantly improved ($p < 0.001$). This finding aligns with earlier studies showing that the HBM can effectively predict and enhance adherence to health recommendations by emphasizing individual belief systems [54,55].

The BASNEF model, which combines elements of both the Health Belief Model and social influences, was also employed in several interventions to increase adherence to lifestyle modifications. The model considers the impact of social norms and enabling factors, such as family support and access to resources, which are crucial in environments where family dynamics and social support play a significant role in health management. Daniali et al. (2016) in Iran used the BASNEF model to improve dietary adherence among hypertensive patients, with participants showing substantial improvement in blood pressure and diet adherence scores. This success reflects the model's strength in emphasizing social and environmental influences, suggesting that interventions in family-oriented cultures may benefit from leveraging social support and norms to drive behavior change [56,57].

PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) is another theoretical framework, served as the foundation for several educational interventions. PRECEDE focuses on diagnosing specific factors that predispose, reinforce, or enable behavior change. In the intervention by Baghianimoghadam et al. (2009) in Iran, the model was instrumental in structuring an educational program that addressed specific barriers and reinforcing factors for hypertension management. This framework enabled the design of targeted educational content and provided reinforcement through follow-ups and community support, resulting in measurable improvements in participants' knowledge and blood pressure control (Baghianimoghadam et al., 2009). By making sure that programs are customized to the particular requirements and obstacles faced by particular groups, prior research has also confirmed the efficacy of the PRECEDE approach, particularly in community-based interventions [58,59].

Geragogy, a model specifically focused on educating older adults, was another theoretical foundation applied in interventions targeting elderly populations with chronic illnesses like hypertension. Geragogy emphasizes age-specific learning techniques that accommodate cognitive and sensory changes associated with aging. Ongkulna et al. (2022) employed this model in a self-management education program for older adults in Thailand, finding that tailoring the intervention to meet age-related needs, such as by providing simplified instructions and visual aids, led to significant improvements in health literacy and self-efficacy ($p < 0.05$). Geragogy's approach acknowledges that older adults may require different educational strategies than younger populations, as shown in previous studies, which found that geragogical methods improve health knowledge and self-care practices in older adults more effectively than standard educational approaches [60,61].

Educational Models improved the self-management of patient

In examining the correlation between educational programs and self-management among hypertensive patients, the data from your systematic review underscores the vital role that structured educational interventions play in enhancing self-management behaviors. Educational programs, particularly those tailored to hypertension management, significantly boost patients' knowledge, self-efficacy, and adherence to health recommendations. For example, studies in your dataset, such as Li et al. (2019) and Moradi et al. (2019), demonstrated that education-driven

initiatives led to improved blood pressure control and increased self-management capabilities, including medication adherence and lifestyle adjustments.

Programs integrating personalized coaching, mobile app-based guidance, and self-monitoring tools were particularly effective. These tools encouraged patients to take a more active role in their treatment, which resulted in better management of hypertension-related risks. Studies that utilized self-management frameworks, such as the Health Belief Model (Yazdanpanah et al., 2019), further confirmed that interventions with a strong theoretical foundation resulted in measurable improvements in self-care behaviors and blood pressure outcomes.

Comparing these findings with prior studies reinforces the positive relationship between education and self-management. Previous literature has consistently shown that hypertension patients benefit from education on lifestyle changes, medication adherence, and stress reduction [62,63]. The synergy between education and self-management not only helps reduce hypertension risks but also fosters a sense of personal responsibility in patients, which is pivotal for long-term management of chronic conditions [64–66].

LIMITATIONS

This systematic review provides valuable insights into the effectiveness of educational programs in improving self-management and health outcomes for hypertensive patients. However, there are several limitations that should be considered when interpreting the findings. First, the studies included in the review are from diverse geographic regions, such as Iran, the United States, China, Italy, Thailand, and South Korea, which may introduce regional and cultural biases in the interventions. Cultural differences in health behaviors, attitudes towards self-management, and adherence to medical advice may limit the generalizability of the results across different populations. Second, while randomized controlled trials (RCTs) were the predominant study design, a few studies used quasi-experimental or pre-post designs, which are subject to inherent biases and lack the rigorous control found in RCTs. This variation in study design could affect the reliability of the findings. Additionally, the sample sizes in some studies were relatively small (e.g., Sutipan et al., 2018 with 20 participants), which could limit the statistical power of these studies and make it difficult to draw firm conclusions about the effects of the interventions on larger populations.

Another limitation is the heterogeneity in the interventions used across studies. The intervention formats ranged from face-to-face sessions to mobile applications, telephone-based guidance, and online discussions, making it challenging to determine which specific elements of the interventions were most effective. Additionally, variations in the duration of the interventions, which ranged from three weeks to six months, make it difficult to compare the long-term effectiveness of different programs. Moreover, outcomes were assessed using various scales, which might introduce inconsistencies in measuring the success of the interventions.

Finally, the quality assessment of the included studies using the CASP tool showed that most studies were categorized as "Strong" in quality, but there were a few studies in the "Medium" category. The presence of studies with moderate quality raises concerns about potential bias or incomplete reporting of intervention details, further limiting the strength of the conclusions drawn from this review.

CONCLUSION

In conclusion, the findings from this systematic review suggest that educational interventions can significantly improve the self-management behaviors, knowledge, and self-efficacy of hypertensive patients. The evidence highlights the positive impact of both face-to-face and technology-assisted interventions, including mobile applications and online platforms. Notably, the improvement in blood pressure control, adherence to dietary recommendations (such as the DASH diet), and overall health behaviors indicates the potential of educational programs to support hypertensive patients in managing their condition more effectively.

The use of various theoretical models, including the Health Belief Model, BASNEF, and PRECEDE, provided a robust framework for many of the interventions, suggesting that a well-structured educational program with a strong theoretical foundation is likely to be more effective. However, the variability in intervention formats, study designs, and assessment methods highlights the need for further research to standardize the approaches used in such programs. Future studies should aim to address the limitations of sample size and study quality to strengthen the evidence base for these interventions.

Despite the promising results, the effectiveness of educational programs may depend on the context in which they are implemented. Cultural differences, the accessibility of technology, and the level of support available for patients are important factors that could influence the success of these interventions. More research is needed to explore the optimal combination of intervention strategies, durations, and theoretical models that could lead to sustainable improvements in the self-management of hypertension on a global scale.

In summary, this review supports the growing body of evidence indicating that educational programs play a crucial role in improving the management of hypertension. The findings underscore the importance of integrating educational strategies with self-management tools to empower patients in making informed decisions about their health and lifestyle.

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Ethical permissions

For this systematic literature review, ethical permissions are not required as the research only examines and analyzes data that has been previously published in scientific publications. All sources used in this study are works that have been openly published and do not involve direct interaction with human or animal subjects. As part of the procedure, all data analyzed is ensured to meet ethical standards of publication and the proper use of sources, in accordance with the applicable academic guidelines.

Decralation of Conflicting Interest

None declared

Authors contributions

The contributions of the authors to this research are as follows: ER was responsible for the conceptualization of the study, developing the research questions, and supervising the overall process (40%). MR conducted the systematic literature review, analyzed the data, and drafted the manuscript (20%). GUS contributed to the interpretation of results and provided critical revisions to the manuscript (20%) and MHE contributed to the interpretation of results and provided critical revisions to the manuscript (20%).

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