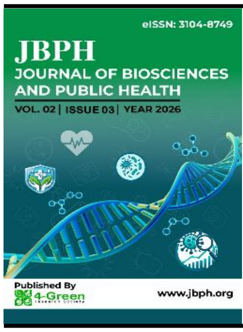

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Review Article

Comparative Effectiveness of Self-Management, Telemonitoring, and Multicomponent Interventions on Blood Pressure Control in Hypertension: A Systematic Review

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ABSTRACT

Background: Hypertension remains a major global risk factor for cardiovascular disease, yet blood pressure (BP) control rates are suboptimal. Self-management, telemonitoring, and combined multicomponent interventions have emerged as promising strategies, but their relative effectiveness and mechanisms require synthesis. Objective: This systematic review compared the effectiveness of self-management, telemonitoring, and multicomponent interventions on BP control in adults with hypertension and explored their behavioral and clinical mechanisms. Methods: Following PRISMA 2020 guidelines, PubMed, Scopus, CINAHL, ScienceDirect, and ProQuest were searched from inception to December 2025. Eligible studies were randomized controlled trials and quasi-experimental studies evaluating self-management, telemonitoring, or combined interventions in hypertensive adults. Primary outcome was systolic blood pressure (SBP). Methodological quality and risk of bias were assessed using JBI tools, RoB 2, and ROBINS-I. Narrative synthesis with visual summaries was conducted due to heterogeneity. Results: Nineteen studies (16 RCTs, 3 quasi-experimental; total participants ≈5,000) were included. Self-management interventions (n=11) consistently improved behavioral outcomes (adherence, self-efficacy, self-care) with variable SBP reductions. Telemonitoring interventions (n=4) showed more consistent and clinically meaningful SBP reductions through enhanced clinical feedback. Combined multicomponent interventions (n=4), integrating self-monitoring, behavioral support, and treatment adjustment, produced the largest and most sustained BP improvements (typically 5–9 mmHg SBP reduction) and highest control rates. Visual syntheses confirmed superior consistency and magnitude of effects in combined and telemonitoring approaches. Conclusion: Multicomponent interventions integrating self-management with telemonitoring and clinical support yield the greatest BP control benefits. Future programs should prioritize integrated, patient-centered strategies.

1. INTRODUCTION

Hypertension remains one of the leading global risk factors for cardiovascular morbidity and mortality, contributing substantially to the burden of stroke, coronary artery disease, heart failure, and chronic kidney disease [1,2]. Despite the availability of effective pharmacological treatments, global rates of blood pressure (BP) control remain suboptimal, particularly in low- and middle-income countries, where healthcare access, adherence, and continuity of care are often limited [3–7]. Recent global estimates indicate that fewer than half of individuals with hypertension achieve adequate BP control, highlighting a persistent gap between treatment availability and real-world effectiveness [8].

In response to this challenge, non-pharmacological and supportive strategies have gained increasing attention, particularly those targeting patient behavior and long-term disease management [9]. Self-management interventions, including patient education, lifestyle modification, medication adherence support, and home blood pressure monitoring, have been widely promoted as essential components of hypertension care [10–13]. Previous systematic reviews have shown that self-management can improve adherence and lifestyle behaviors and may lead to modest reductions in BP, particularly when combined with structured support [14–16]. However, the effectiveness of self-management interventions remains heterogeneous, with considerable variability in intervention intensity, patient engagement, and clinical outcomes.

Parallel to the development of self-management strategies, advances in digital health have led to the increasing use of telemonitoring interventions [17,18]. These approaches enable patients to measure BP at home and transmit data to healthcare providers or automated systems, facilitating timely feedback and treatment adjustment. Prior evidence suggests that telemonitoring can improve BP control, especially when combined with professional support or clinical decision-making pathways [19]. Nevertheless, the effectiveness of telemonitoring appears to depend on the degree of integration with healthcare systems, and questions remain regarding its scalability, resource requirements, and long-term sustainability.

More recently, attention has shifted toward multicomponent or combined interventions that integrate self-management, home BP monitoring, telemonitoring, and treatment adjustment [20,21]. These approaches reflect a more comprehensive model of hypertension care, recognizing that BP control is influenced by multiple interacting factors, including patient adherence, behavioral change, monitoring practices, and therapeutic inertia. Emerging evidence suggests that such integrated strategies may produce greater and more sustained BP reductions than single-component interventions [22]. However, previous reviews have often examined these intervention types separately, limiting understanding of their relative effectiveness and the mechanisms through which they operate [23,24].

An important limitation in the existing literature is the tendency to treat self-management, telemonitoring, and digital health interventions as relatively homogeneous categories, without adequately accounting for differences in intervention components, intensity, and context. In addition, many studies have focused primarily on BP outcomes while giving less attention to behavioral pathways, such as adherence, self-efficacy, and self-care, which may mediate long-term clinical effects [25,26]. Furthermore, there is limited comparative synthesis examining how these intervention approaches perform relative to one another across different populations and healthcare settings.

Despite the growing body of evidence on self-management and telemonitoring interventions, important gaps remain in the literature. First, prior systematic reviews have typically examined these interventions in isolation, limiting direct comparison of their relative effectiveness. Second, existing studies often treat intervention categories as homogeneous, without adequately accounting for variations in intensity, integration, and contextual delivery. Third, while behavioral outcomes such as adherence and self-efficacy are frequently reported, their role as potential mechanisms underlying blood pressure reduction remains insufficiently synthesized. Finally, limited attention has been given to how multicomponent interventions integrate behavioral and clinical pathways to produce sustained outcomes, particularly in diverse and resource-constrained settings.

Therefore, this review provides a comparative and mechanism-oriented synthesis of self-management, telemonitoring, and combined interventions, aiming to bridge these gaps and offer a more integrated understanding of hypertension management strategies. Specifically, this review seeks to (i) evaluate the effects of different intervention types on BP outcomes, (ii) examine their influence on behavioral and self-care outcomes, and (iii) identify patterns of effectiveness and underlying mechanisms across intervention categories.

2. METHODOLOGY

2.1. Study design

This study was conducted as a systematic review to synthesize evidence on the effectiveness of self-management, telemonitoring, and combined interventions for blood pressure control in patients with hypertension. The review was designed and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines [27].

2.2. Eligibility criteria

Eligibility criteria were defined using the Population, Intervention, Comparator, Outcome, and Study design (PICOS) framework. The population of interest included adult patients diagnosed with hypertension, encompassing both community-dwelling individuals and patients receiving care in primary or secondary healthcare settings, including those with comorbid conditions such as diabetes or coronary artery disease. The interventions of interest consisted of self-management strategies, telemonitoring approaches, and combined interventions integrating behavioral and monitoring components.

For clarity, self-management was operationally defined as patient-centered interventions aimed at improving self-care behaviors, including medication adherence, lifestyle modification, and home blood pressure monitoring, with or without digital support. Telemonitoring was defined as remote transmission of patient-generated blood pressure data to healthcare providers or automated systems with feedback mechanisms. Combined interventions were defined as multicomponent strategies integrating behavioral support with monitoring and/or clinical management, including treatment adjustment or telehealth-based feedback.

Comparators included usual care, standard care, or alternative intervention groups. The primary outcome of interest was systolic blood pressure, while secondary outcomes included diastolic blood pressure, blood pressure control rates, medication adherence, self-efficacy, lifestyle behaviors, and other self-care outcomes. Eligible study designs included randomized controlled trials as well as quasi-experimental or nonrandomized comparative studies. Studies were excluded if they did not involve hypertensive populations, did not evaluate relevant interventions, did not report blood pressure-related outcomes, or were published as reviews, editorials, protocols, or conference abstracts without full data.

2.3. Information sources and search strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, CINAHL, Scopus, ScienceDirect, and ProQuest (**Table 1**). The search was conducted from database inception to December 2025. No initial date restrictions were applied to maximize study retrieval. Only English-language articles were included due to feasibility constraints, which may introduce language bias. Grey literature sources and trial registries were not systematically searched, and this may increase the risk of publication bias. This review was not registered in PROSPERO. The search strategy combined controlled vocabulary terms and free-text keywords related to hypertension, self-management, telemonitoring, home blood pressure monitoring, mobile health, and blood pressure control. Boolean operators such as "AND" and "OR" were used to refine the search and ensure comprehensive retrieval of relevant studies. The search was limited to articles published in English. In addition, the reference lists of included studies were manually screened to identify any additional relevant publications that may not have been captured through the database search.

Table 1. Detailed search strategy across electronic databases used to identify studies on self-management, telemonitoring, and combined interventions for hypertension.

Database	Search String
PubMed	("Hypertension"[Mesh] OR "high blood pressure" OR hypertension) AND ("self-management" OR "self-care" OR "self-monitoring" OR "self-monitoring") AND ("telemonitoring" OR "telemedicine" OR "telehealth" OR "remote monitoring" OR "mHealth" OR "mobile health") AND ("blood pressure" OR "BP control")
Scopus	TITLE-ABS-KEY (hypertension OR "high blood pressure") AND TITLE-ABS-KEY ("self-management" OR "self-care" OR "self-monitoring") AND TITLE-ABS-KEY ("telemonitoring" OR "telehealth" OR "telemedicine" OR "mHealth" OR "mobile health" OR "remote monitoring") AND TITLE-ABS-KEY ("blood pressure" OR "BP control")
CINAHL (EBSCOhost)	(MH "Hypertension" OR "high blood pressure") AND ("self-management" OR "self-care" OR "self-monitoring") AND ("telemonitoring" OR "telehealth" OR "telemedicine" OR "mobile health" OR "remote monitoring") AND ("blood pressure" OR "BP control")
ScienceDirect	("hypertension" OR "high blood pressure") AND ("self-management" OR "self-care" OR "self-monitoring") AND ("telemonitoring" OR "telehealth" OR "mHealth" OR "mobile health") AND ("blood pressure" OR "BP control")
ProQuest	(hypertension OR "high blood pressure") AND ("self-management" OR "self-care" OR "self-monitoring") AND ("telemonitoring" OR "telehealth" OR "telemedicine" OR "mobile health") AND ("blood pressure" OR "BP control")

2.4. Study selection

All retrieved records were imported into reference management software to facilitate the removal of duplicate entries. Study selection was performed in two stages. In the first stage, titles and abstracts were screened to identify potentially relevant studies. In the second stage, full-text articles were assessed for eligibility based on the predefined inclusion and exclusion criteria. The selection process was conducted systematically to ensure consistency, and any discrepancies in study eligibility were resolved through discussion.

2.5. Data extraction

Data extraction was conducted using a structured and standardized form to ensure consistency across studies. Information extracted from each study included study characteristics such as author and country of origin, as well as methodological features including study design, sample size, and population characteristics. Detailed information on intervention components, comparator conditions, duration of follow-up, and outcomes related to blood pressure and behavioral measures was also collected. The extracted data were subsequently synthesized and presented in a structured table of study characteristics. The characteristics of the included studies are summarized in **Table 2**.

2.6. Quality assessment

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal tools. Randomized controlled trials were evaluated using the JBI checklist for RCTs, while quasi-experimental and nonrandomized studies were assessed using the corresponding JBI appraisal tool. Each study was evaluated across multiple domains, and the overall methodological quality was categorized as high or moderate based on the appraisal results. Particular attention was given to issues such as randomization procedures, baseline comparability, completeness of follow-up, and appropriateness of statistical analysis.

2.7. Risk of bias assessment

Risk of bias was assessed using established tools appropriate to study design. Randomized studies were evaluated using the Cochrane Risk of Bias tool (RoB 2), while nonrandomized studies were assessed using the ROBINS-I framework. The assessment considered key domains including the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selective reporting. Based on these domains, studies were categorized as having low risk of bias, some concerns, or high or serious risk of bias.

2.8. Data synthesis

Due to heterogeneity in study designs, intervention characteristics, and outcome reporting, a narrative synthesis approach was employed. The included studies were grouped into three main categories, namely self-management interventions, telemonitoring interventions, and combined interventions. Comparative analysis across these categories was conducted to identify patterns of effectiveness and differences in intervention mechanisms.

In addition to narrative synthesis, visual synthesis techniques were applied to enhance interpretability. These included a harvest plot to illustrate the direction and consistency of intervention effects, a bar chart summarizing the proportion of studies demonstrating significant blood pressure reductions across intervention categories, and an effect size plot based on studies with available quantitative data. These visualizations were used to support the comparative interpretation of findings and to highlight differences in effectiveness across intervention types.

3. RESULTS

3.1. Selection of studies

A total of 1,247 records were identified across databases. After removal of duplicates and ineligible studies by automation tool (n = 312), 935 records remained for screening. During title and abstract screening, 812 records were excluded. A total of 123 reports were sought for retrieval, all of which were successfully retrieved and assessed for eligibility. Of these, 104 reports were excluded due to irrelevant interventions (n = 38), absence of BP-related outcomes (n = 27), ineligible study design (n = 21), insufficient data (n = 10), and overlapping data (n = 8). Finally, 19 studies (from 19 reports) were included in the review. The study selection process is illustrated in **Figure 1**.

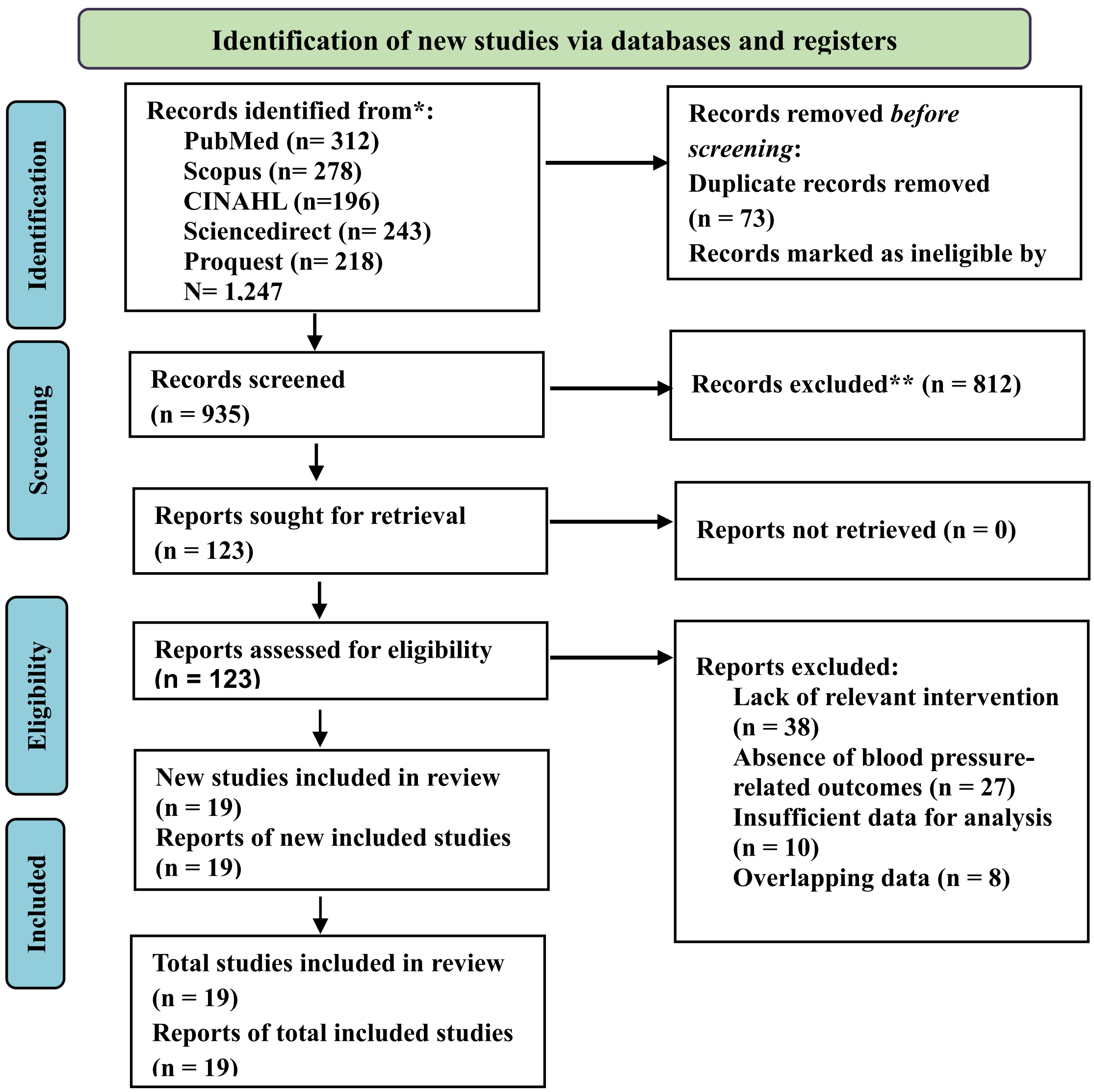

Figure 1. PRISMA 2020 flow diagram illustrating the study selection process for the systematic review, including identification, screening, eligibility, and inclusion stages (total records identified = 1,247; studies included = 19).

3.2. Characteristics of included studies

A total of 19 studies were included in this systematic review, comprising 16 randomized studies and 3 quasi-experimental or nonrandomized comparative studies. The studies were conducted across China, the United States, Iran, Canada, the United Kingdom, Japan, South Korea, Indonesia, Spain, and Vietnam, indicating broad geographic and health-system diversity [28–46]. Eleven studies evaluated self-management interventions, four evaluated telemonitoring interventions, and four evaluated combined (multicomponent) interventions.

In addition, self-management interventions (n = 11) primarily involved digital platforms (e.g., WeChat, smartphone apps), community health worker support, home blood pressure monitoring (HBPM), or nurse-led home visits [28,30–36,39,44,45]. Telemonitoring interventions (n = 4) focused on remote transmission of home BP data linked to clinician feedback or telehealth support [37,38,40,41]. Combined interventions (n = 4) integrated self-management elements with HBPM, telemonitoring, medication self-titration, and/or lifestyle support [29,42,43,46].

Furthermore, sample sizes ranged from 54 to 1,114 participants. Follow-up durations varied from 2 weeks [45] to 24 months [29]. The primary outcome was systolic blood pressure (SBP) in nearly all studies, with secondary outcomes including diastolic blood pressure (DBP), BP control rates, medication adherence, self-efficacy, and lifestyle behaviors. Detailed characteristics are presented in **Table 2**.

Table 2. Characteristics of included studies evaluating self-management, telemonitoring, and combined interventions for blood pressure control in patients with hypertension (n = 19).

Study Ref.	**Country**	**Design**	**Sample**	**Population / setting**	**Intervention**	**Comparator**	**Follow-up**	**Main BP findings**	**Intervention type**
Li et al., 2019 [28]	China	Cluster-randomized controlled trial	464 recruited; 253 analyzed	Community middle-aged and elderly adults with hypertension	WeChat-based self-management: health education, health promotion, group chat, and BP monitoring	Usual care / control community center	6 months	Adjusted mean difference: SBP −6.9 mmHg and DBP −3.1 mmHg vs control; self-management, knowledge, and self-efficacy also improved	Digital self-management
Bosworth et al., 2009 [29]	USA	2×2 randomized trial	636 randomized	Hypertensive patients in 2 university-affiliated primary care clinics	Behavioral telephone self-management, home BP monitoring, or both	Usual care	24 months	Greatest benefit in the combined arm; BP control improved by 11.0% relative to usual care, with SBP difference of 3.9 mmHg	Behavioral self-management + HBPM
Boulware et al., 2020 [30]	USA	Randomized comparative effectiveness trial	159	Socially disadvantaged African American adults with uncontrolled hypertension in an urban primary care clinic	CHW-based hypertension self-management, with added shared decision-making or problem-solving components	CHW arm as reference comparator across 3 groups	12 months	BP control improved in all groups from 36% to 52%; no clear between-group BP superiority, but problem-solving improved self-care and self-efficacy	Context-adapted self-management

Bozorgi et al., 2021 [31]	Iran	Randomized controlled trial	120	Adults with primary hypertension attending a tertiary heart center	Mobile “blood pressure management application” to support self-management	Routine treatment / control	24 weeks	Improved treatment adherence, low-fat and low-salt diet adherence, and physical activity; app supported self-management enhancement	App-based self-management
Chandler et al., 2019 [32]	USA	Two-arm efficacy trial	54	Hispanic adults with uncontrolled hypertension and poor medication adherence	SMASH smartphone-enabled medical regimen self-management with Bluetooth BP monitor and electronic medication tray	Enhanced standard care	9 months	SBP was significantly lower in the SMASH group at 1, 3, 6, and 9 months; BP control rates also higher	Culturally tailored digital self-management
Ghavami et al., 2024 [33]	Iran	Randomized clinical trial	1114 hypertensive CAD patients	CAD patients with hypertension in a tertiary cardiac center	Green Heart smartphone application for BP self-monitoring, education, reminders, and feedback	Paper-based education / conventional group	6 months	Successful BP management was higher in the app group (88.6% vs 78.5%; OR 2.13)	App-based self-management
Gong et al., 2020 [34]	China	Multicenter randomized controlled trial	480	Adults with primary hypertension from 38 hospitals	“Yan Fu” mobile health app for BP management, reminders, and education	No mHealth app; paper recording	6 months	SBP and DBP were reduced more in the intervention group; BP control and medication adherence were also higher	App-based self-management
Gu et al., 2020 [35]	China	2×2 factorial randomized clinical trial	180	Community-dwelling older adults with hypertension and diabetes	Pedometer, HBPM, or pedometer+HBPM plus health education	Health education alone	12 months	Largest benefit in combined pedometer+HBPM arm: SBP −8.1 mmHg and DBP −3.6 mmHg vs control	Self-management / HBPM
Jung & Lee, 2017 [36]	South Korea	Quasi-experimental study	64	Elderly people living alone with hypertension in the community	Community-based eHealth self-management: education, eHealth monitoring, and monthly telephone counseling	Control group	24 weeks	SBP fell from 133.9 to 122.5 mmHg; self-efficacy, self-care behavior, and social support improved	Community eHealth self-management
Lee et al., 2019 [37]	Vietnam / Korea	Comparative telehealth study	234 registered	Overseas Koreans with high blood pressure in a medically underserved setting	Telehealth counseling plus mobile self-monitoring application	Non-monitoring comparison within telehealth program	3 months	Mean SBP change was greater in the monitoring group than in the non-monitoring group (16.0 vs 5.7 mmHg, p=0.008)	Telehealth + mobile self-monitoring
Yatabe et al., 2021 [38]	Japan	Randomized controlled trial	97 randomized (99 screened)	Adults with uncomplicated hypertension	Home BP telemonitoring through a 3G device plus web-based video visits and mailed prescriptions	Usual care using self-recorded BP and office visits	12 months	Final weekly average SBP was lower in telemedicine than usual care (125 vs 131 mmHg, p=0.02); BP control also better	Telemonitoring / telemedicine
Liu et al., 2023 [39]	China	2-arm randomized controlled trial	297	Adults with hypertension in Ningxia	“Blood Pressure Assistant” mHealth app with recording, reminders, education, and provider feedback	Usual care	6 months	BP control rate was higher in the intervention group (90.1% vs 65.2%); SBP and DBP reductions were significantly greater	App-based self-management

Logan et al., 2012 [40]	Canada	Randomized controlled trial	110 randomized	Diabetic patients with uncontrolled systolic hypertension	Home BP telemonitoring with automated self-care support via smartphone	Home BP monitoring alone	12 months	Mean daytime ambulatory SBP decreased significantly only in the intervention group; between-group difference 7.1 mmHg; target BP achieved by 51% vs 31%	Telemonitoring + automated self-care support
McKinstry et al., 2013 [41]	UK	Multicentre randomized controlled trial	401	Adults with uncontrolled hypertension in primary care	Telemonitoring with transmission of home BP readings and optional automated patient decision support	Usual care	6 months	Adjusted difference vs usual care: daytime ambulatory SBP 4.3 mmHg and DBP 2.3 mmHg lower in intervention arm	Telemonitoring
McManus et al., 2010 (TASMINH2) [42]	UK	Randomized controlled trial	527 randomized	Treated adults with poorly controlled hypertension in general practice	Self-management: self-monitoring, self-titration of antihypertensives, and telemonitoring	Usual care	12 months	Between-group SBP difference favored intervention at 6 months (3.7 mmHg) and 12 months (5.4 mmHg)	Combined self-management + telemonitoring
McManus et al., 2018 (TASMINH4) [43]	UK	Parallel randomized controlled trial	1182 randomized	Adults with treated but inadequately controlled hypertension in primary care	Self-monitoring alone or self-monitoring with telemonitoring for antihypertensive titration	Usual care	12 months	Both intervention groups had lower systolic BP than usual care; adjusted mean difference −3.5 mmHg for self-monitoring and −4.7 mmHg for telemonitoring	Self-monitoring ± telemonitoring
Muldoon et al., 2021 [44]	USA	Randomized feasibility trial	62	Community-dwelling adults ≥55 years with hypertension	MyBP digital intervention: video education + automated SMS prompts for HBPM	Treatment-as-usual with BP cuff alone	Median 22.9 weeks	Engagement was sustained; overall BP difference between groups was not significant, but those with higher baseline SBP showed greater decline with MyBP	Digital self-management / HBPM
Putri et al., 2021 [45]	Indonesia	Quasi-experimental pre-post study with control group	134	Elderly people with hypertension in community health centers	Four-session self-management home-visit intervention with caregiver involvement	Health center care / control group	2 weeks intervention	Significant positive effects on adherence to self-care and health status (both p<0.001)	Nurse-led self-management
Villafuerte et al., 2024 (MEDICHY) [46]	Spain	Randomized multicenter parallel single-blind controlled trial	153 randomized	Adults 35–75 years with poorly controlled hypertension in primary care	Self-monitoring of BP, self-management of medication, dietary intervention, and physical activity	Usual care	6 months	Intervention group had lower SBP and DBP; adjusted mean SBP difference 8.7 mmHg and DBP difference 5.4 mmHg; BP control 54.4% vs 32.9%	Multicomponent self-management

3.3. Methodological quality and risk of bias

Overall methodological quality was moderate to high (**Tables 3** and **4**). Among randomized trials, six studies were rated high quality [29,30,40,41,43,46], while the remainder were moderate, primarily due to challenges with allocation concealment, blinding (inherent in behavioral/digital interventions), and handling of attrition. For nonrandomized studies, two were rated high quality [36, 45] and one moderate [37].

Table 3. Methodological quality assessment of randomized controlled trials using the Joanna Briggs Institute (JBI) critical appraisal checklist.

No	Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Category
1	Li et al., 2019	Y	U	Y	N	N	U	Y	N	N	Y	Y	Y	Y	Moderate
2	Bosworth et al., 2009	Y	Y	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	High
3	Boulware et al., 2020	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	High
4	Bozorgi et al., 2021	Y	U	Y	N	N	U	Y	Y	U	Y	Y	Y	Y	Moderate
5	Chandler et al., 2019	Y	U	Y	N	N	U	Y	Y	U	Y	Y	Y	Y	Moderate
6	Ghavami et al., 2024	Y	U	Y	N	U	U	Y	Y	U	Y	Y	Y	Y	Moderate
7	Gong et al., 2020	Y	U	Y	N	N	U	Y	Y	U	Y	Y	Y	Y	Moderate
8	Gu et al., 2019	Y	U	Y	N	N	U	Y	Y	U	Y	Y	Y	Y	Moderate
9	Yatabe et al., 2021	Y	N	Y	N	N	N	Y	Y	U	Y	Y	Y	Y	Moderate
10	Liu et al., 2023	Y	U	Y	N	N	U	Y	N	U	Y	Y	Y	Y	Moderate
11	Logan et al., 2012	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	High
12	McKinstry et al., 2013	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	High
13	McManus et al., 2010 (TASMINH2)	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Moderate
14	McManus et al., 2018 (TASMINH4)	Y	Y	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	High
15	Muldoon et al., 2021	Y	Y	Y	N	N	U	Y	Y	U	Y	Y	Y	Y	Moderate
16	Villafuerte et al., 2024	Y	Y	Y	N	N	Y	Y	Y	U	Y	Y	Y	Y	High

Table 4. Methodological quality assessment of quasi-experimental and nonrandomized studies using the Joanna Briggs Institute (JBI) appraisal tool.

No	Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Category
17	Jung & Lee, 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
18	Lee et al., 2019	Y	N	Y	Y	Y	N	Y	Y	Y	Moderate
19	Putri et al., 2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	High

Risk of bias assessments (**Figures 2** and **3**) indicated that most randomized trials had low risk or some concerns overall. One trial was at high risk due to substantial attrition and missing outcome data [28], while McKinstry et al. [41] was the only study judged at overall low risk. Nonrandomized studies were rated at serious risk of bias, largely attributable to potential confounding and selection bias. Strengths across the evidence base included the use of objective BP measurements (often via validated devices or ambulatory monitoring), which minimized detection bias.

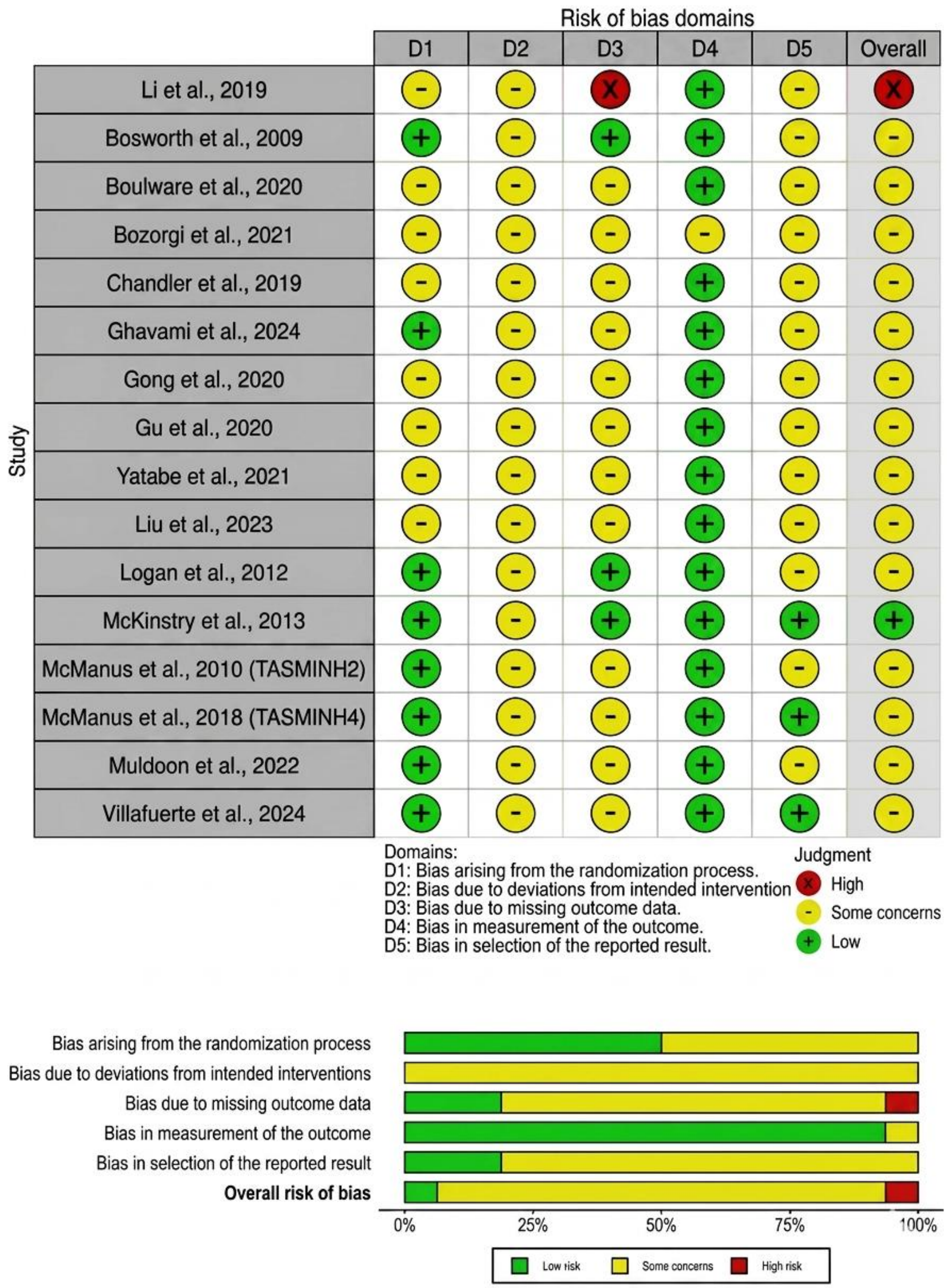

Figure 2. Risk of bias assessment of randomized controlled trials using the Cochrane RoB 2 tool across five domains, including randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results (n = 16 studies).

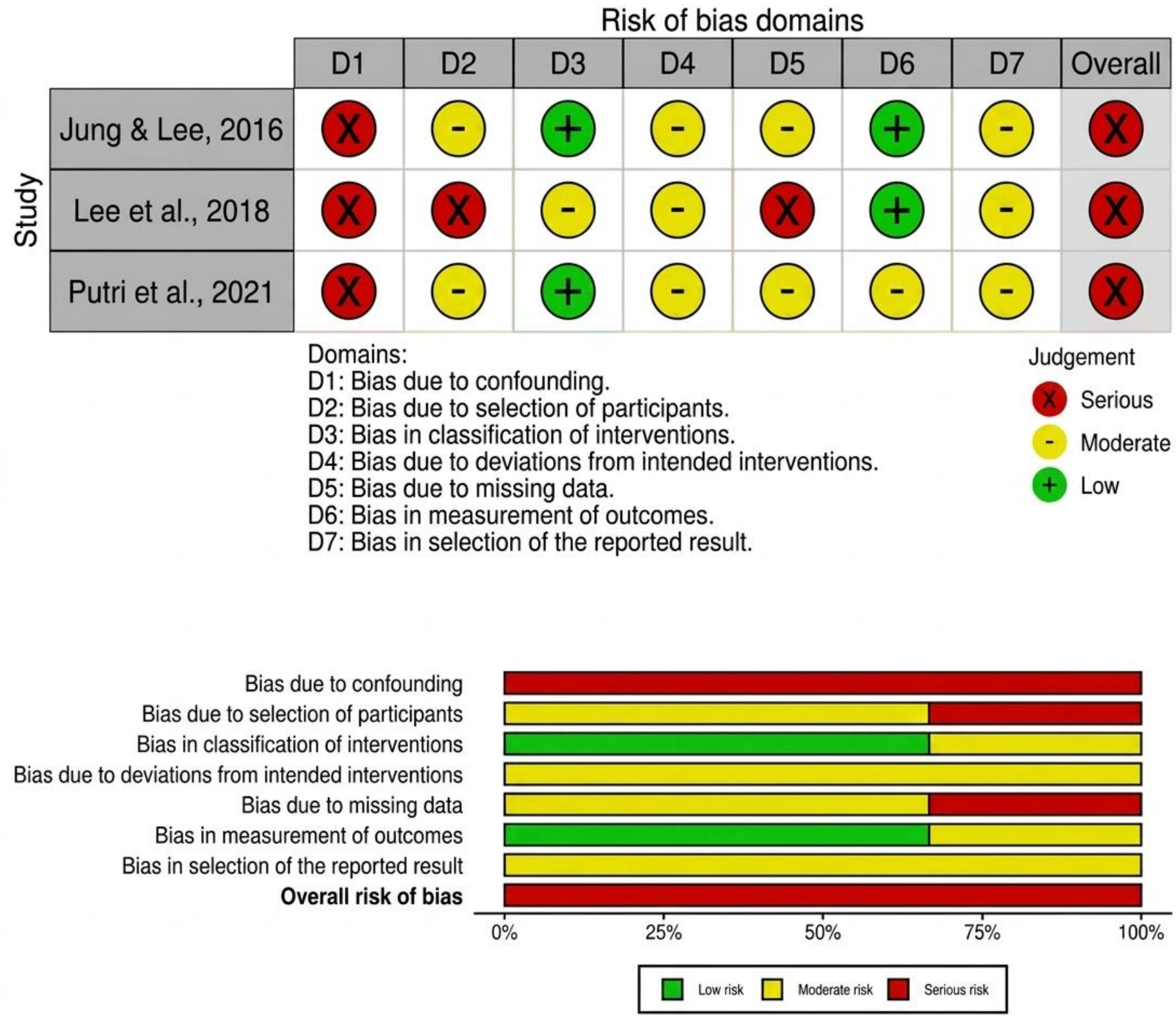

Figure 3. Risk of bias assessment of nonrandomized studies using the ROBINS-I tool across key domains, including confounding, participant selection, intervention classification, deviations from intended interventions, missing data, outcome measurement, and selection of reported results (n = 3 studies).

3.4. Effects of self-management interventions

Eleven studies examined self-management interventions. These consistently improved behavioral outcomes, including medication adherence, self-care behaviors, self-efficacy, disease knowledge, and lifestyle modifications (e.g., diet and physical activity) [28,30–36,39,44,45]. Effects on BP were positive but heterogeneous. Significant SBP reductions were reported in several digital and HBPM-supported trials (e.g., adjusted mean differences of −6.9 mmHg in Li et al. [28] and sustained reductions across multiple time points in Chandler et al. [32]). BP control rates also improved in app-based interventions [33,34,39]. However, some studies showed smaller or non-significant overall BP differences, with greater benefits observed in subgroups with higher baseline SBP [44] or when combined with additional supports [35].

3.5. Effects of telemonitoring interventions

Four studies evaluated telemonitoring approaches. These demonstrated more consistent BP reductions compared with self-management-only strategies. Significant improvements in SBP were observed when home readings were linked to clinician feedback, automated support, or telehealth consultation (e.g., between-group differences of 7.1 mmHg [40] and 4.3 mmHg daytime ambulatory SBP [41]; greater reductions in monitoring vs. non-monitoring groups, $p = 0.008$ [37]). BP control rates were also higher in the telemonitoring arms [38,40]. These interventions appeared to operate primarily through enhanced clinical responsiveness rather than behavioral change alone.

3.6. Effects of combined interventions

Four studies assessed multicomponent interventions integrating self-management, monitoring, and clinical support. These produced the largest and most sustained BP reductions. Notable findings included superior long-term BP control in the combined behavioral + HBPM arm (11.0% absolute improvement) compared with single components [29], and clinically meaningful SBP reductions with self-titration plus telemonitoring (e.g., −5.4 mmHg at 12 months [42]; −4.7 mmHg with telemonitoring support [43]. A multicomponent primary care intervention also achieved an adjusted SBP difference of 8.7 mmHg and higher control rates (54.4% vs. 32.9%) [46]. These approaches consistently outperformed usual care and single-component strategies.

3.7. Comparative synthesis across intervention types

When the 19 included studies were synthesized, three clear patterns emerged. Self-management interventions ($n = 11$) consistently enhanced behavioral outcomes, including medication adherence, self-care behaviors, disease knowledge, and self-efficacy, with variable but generally positive effects on blood pressure [28,30–36,39,44,45]. Telemonitoring interventions ($n = 4$) produced more uniform and clinically meaningful reductions in systolic blood pressure, attributable to the integration of home monitoring with structured feedback and clinical or automated decision support [37,38,40,41]. Combined interventions ($n = 4$) demonstrated the strongest and most consistent effectiveness, with the largest and most sustained blood pressure reductions observed when self-monitoring, behavioral support, medication self-titration, and lifestyle components were integrated [29,42,43,46].

Interventions that combined monitoring with clinical feedback (telemonitoring and combined strategies) yielded more consistent BP improvements than behavioral-only approaches. Higher-intensity and multicomponent interventions also tended to produce larger effects than lower-intensity or single-component strategies. Although formal meta-analysis was precluded by substantial heterogeneity in intervention design, populations, and outcome reporting, descriptive synthesis indicated that combined interventions achieved the greatest systolic blood pressure reductions overall.

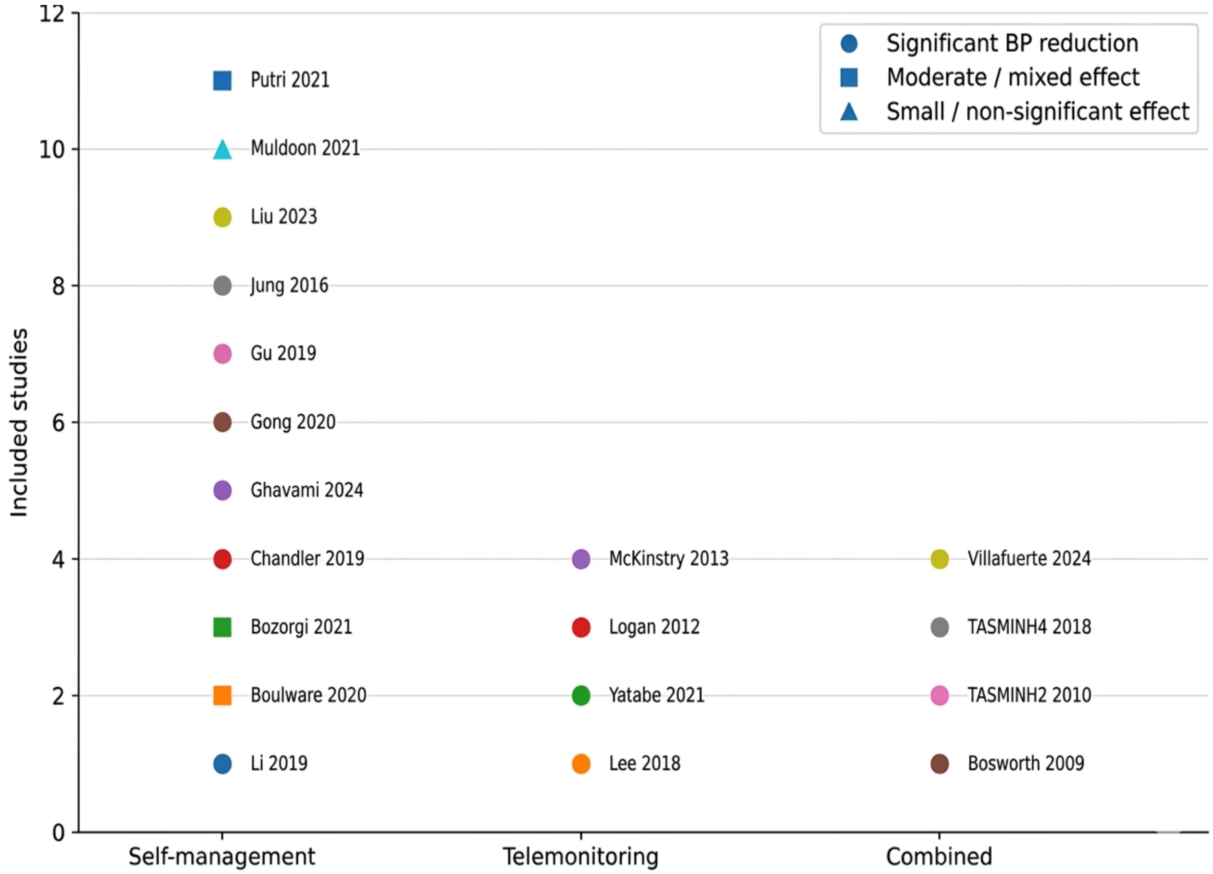

Figure 4. Harvest plot summarizing the direction and consistency of systolic blood pressure (SBP) outcomes across included studies (n = 19), categorized into self-management (n = 11), telemonitoring (n = 4), and combined interventions (n = 4). Circles indicate statistically significant reductions, squares indicate moderate or mixed effects, and triangles indicate small or non-significant effects.

Visual synthesis reinforced these findings. The harvest plot (**Figure 4**) illustrated greater consistency of statistically significant SBP reductions in telemonitoring and combined intervention studies compared with the more variable results in self-management trials. **Figure 5** further highlights that all telemonitoring and combined intervention studies reported significant BP improvements, whereas self-management studies showed greater heterogeneity in the proportion of significant versus non-significant effects. Approximate magnitude of SBP reductions across studies with quantitative data was generally largest in combined interventions, followed by telemonitoring, with more heterogeneous effects in self-management approaches (**Figure 6**).

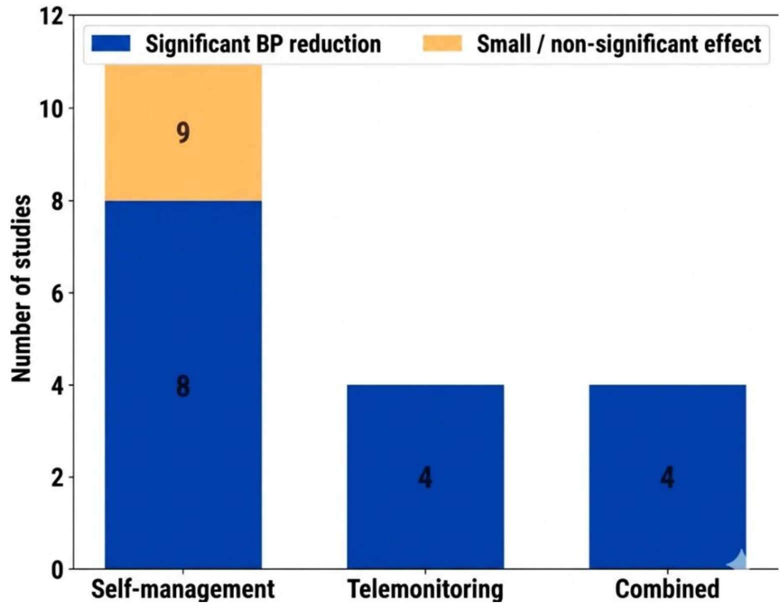

Figure 5. Distribution of studies reporting significant versus non-significant reductions in systolic blood pressure (SBP) across intervention types, including self-management (n = 11), telemonitoring (n = 4), and combined interventions (n = 4).

Overall, while both self-management and telemonitoring interventions improved hypertension outcomes, the most robust clinical benefits were achieved through multicomponent strategies that synergistically combined behavioral self-management with structured monitoring and treatment support.

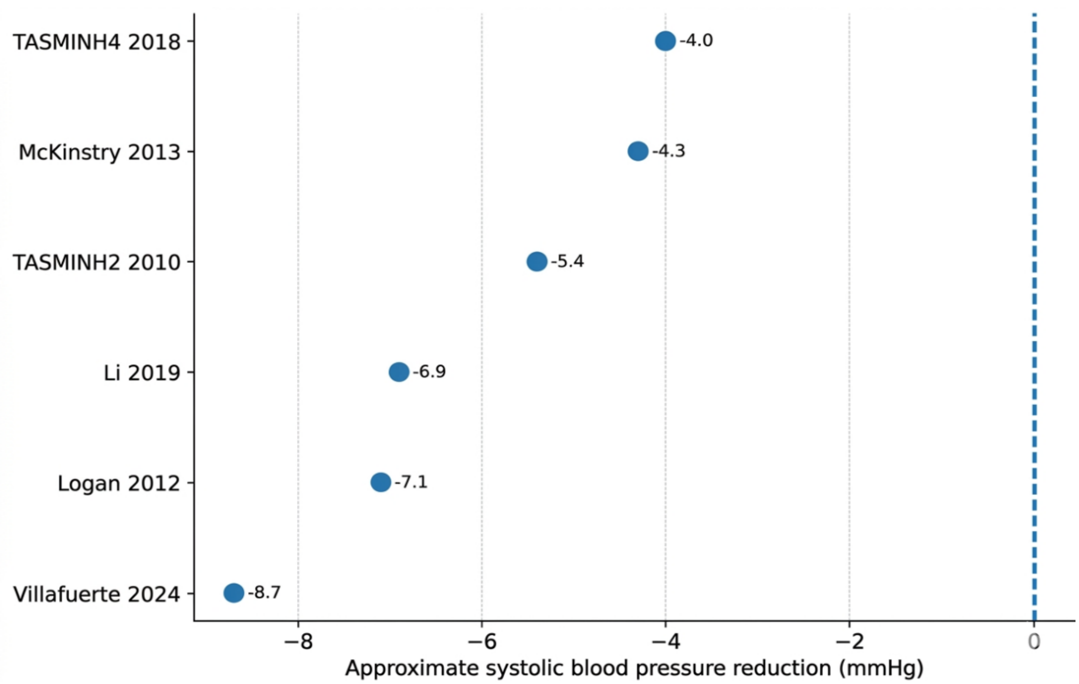

Figure 6. Approximate reductions in systolic blood pressure (SBP) across selected studies with available quantitative data, comparing self-management, telemonitoring, and combined interventions.

A conceptual framework (**Figure 7**) illustrates the underlying mechanisms: self-management interventions primarily strengthen behavioral pathways (adherence, self-efficacy, lifestyle change); telemonitoring enhances clinical responsiveness via data feedback loops; and combined interventions synergistically integrate both, yielding the most robust and sustained BP improvements. All telemonitoring and combined intervention studies reported significant BP benefits, reinforcing the added value of integrating monitoring with behavioral and clinical support.

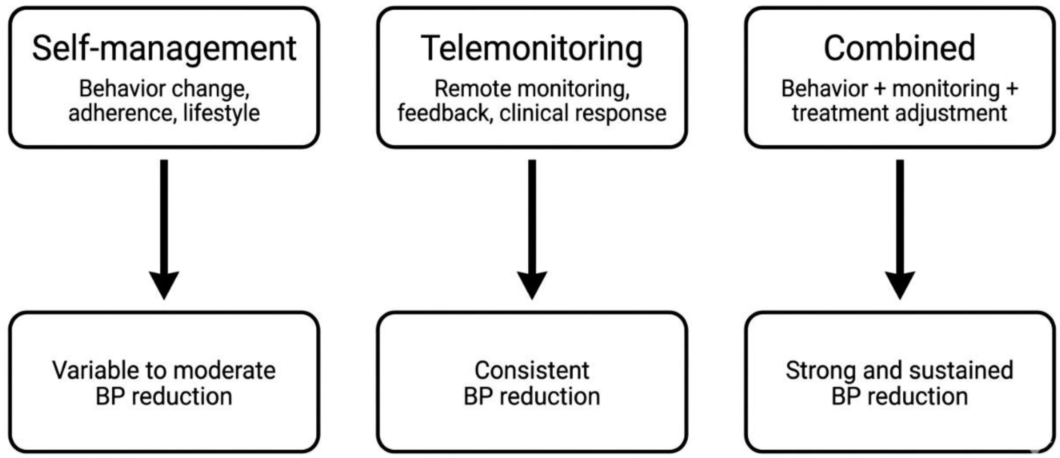

Figure 7. Conceptual framework illustrating the pathways linking self-management, telemonitoring, and combined interventions to behavioral and clinical outcomes in hypertension management, highlighting the integration of adherence, monitoring, and treatment adjustment.

4. DISCUSSION

This systematic review of 19 studies provides a comparative synthesis of self-management, telemonitoring, and combined interventions for blood pressure control in patients with hypertension. The findings demonstrate that while all three approaches improve hypertension outcomes, their effectiveness varies substantially in magnitude, consistency, and underlying mechanisms. Self-management interventions primarily strengthened behavioral domains, telemonitoring enhanced clinical responsiveness, and combined (multicomponent) interventions produced the largest and most sustained blood pressure reductions.

Self-management interventions: beneficial but not uniformly effective

A central finding of this review is that self-management interventions were generally beneficial, particularly in improving medication adherence, self-care behavior, and self-efficacy, although their effects on systolic blood pressure (SBP) were more variable across studies. Interventions delivered through digital platforms, community-based programs, and nurse-led approaches consistently enhanced behavioral outcomes and, in many cases, contributed to clinically meaningful BP reductions, although effect sizes differed depending on intervention intensity, patient engagement, and integration with clinical support [51].

This pattern aligns with previous evidence showing that self-management can improve BP control, but with heterogeneous effect sizes [52]. Importantly, the present review highlights that self-management is not a uniform intervention category; rather, its effectiveness appears to depend on whether behavioral activation is supported by structured reinforcement mechanisms such as feedback, monitoring, or treatment adjustment. This may explain why interventions limited to reminders or education alone showed smaller effects compared with multicomponent or culturally tailored programs integrating behavioral and clinical pathways [31,32,39].

Telemonitoring interventions: consistent bp reduction through feedback

Telemonitoring interventions demonstrated more consistent BP-lowering effects than self-management-only approaches, particularly when home BP monitoring was integrated with clinician feedback, telehealth consultation, or automated decision support. This finding is consistent with prior evidence suggesting that telemonitoring is most effective when linked to active clinical response rather than functioning as passive data collection [53,54]. However, these interventions improve clinical responsiveness and BP control, they often require increased healthcare utilization, digital infrastructure, and patient engagement capacity. This suggests that telemonitoring should be understood not merely as a technological enhancement, but as a service model that links measurement to clinical action, raising important considerations regarding scalability and sustainability.

Combined interventions: strongest evidence and the clearest added value

The most robust and sustained BP reductions in this review were observed in combined interventions integrating behavioral self-management with home BP monitoring, telemonitoring, or structured lifestyle support. These findings reinforce prior evidence that multicomponent strategies outperform single-component approaches in chronic disease management [55,56].

Importantly, this review provides more specific insight into the mechanisms underlying this effect. The strongest outcomes were observed when self-monitoring was directly linked to actionable treatment pathways, such as medication titration or structured feedback loops. This suggests that effective hypertension control depends not only on patient engagement but also on the integration of behavioral and clinical processes within a coordinated care pathway.

Behavioral pathways: an important mechanism often under-discussed in earlier reviews

Another important finding is that many interventions improved proximal behavioral outcomes, including medication adherence, self-care, self-efficacy, social support, lifestyle behavior, and disease knowledge [28,30,31,36,39,44,45]. This is consistent with behavioral and nursing literature emphasizing that adherence, self-efficacy, and patient engagement are major determinants of chronic disease outcomes [57–61]. Yet many earlier hypertension reviews treated these outcomes as secondary or peripheral, focusing primarily on SBP and DBP change [62–64].

In several studies, improvements in self-care or adherence were more consistent than immediate BP reductions, particularly in short-term or community-based interventions [30,31,45]. This raises the possibility that behavioral improvements may function as intermediate pathways that precede more stable clinical benefit. The findings suggest a potential pathway in which behavioral improvements may contribute to clinical outcomes; however, direct causal mechanisms cannot be confirmed due to the absence of mediation analysis and longitudinal pathway testing. This interpretation is supported by chronic disease self-management theory and by evidence from nursing interventions. [65-67].

Population context and health equity

The included studies also demonstrate that intervention effectiveness is strongly shaped by population context. Effectiveness was context-dependent, with promising results observed in diverse populations, including older adults, ethnic minorities, socially disadvantaged groups, and patients in low-resource settings [30,32,36,37,45]. Culturally tailored and community-based delivery models appeared particularly valuable [30,32].

These findings are particularly relevant for low- and middle-income settings, where resource constraints may limit the implementation of high-intensity digital or telemonitoring interventions. Adaptation to local context, including simplified monitoring strategies, community-based support, and culturally tailored approaches, is essential to ensure feasibility and sustainability of hypertension management interventions.

Methodological considerations and limitations

The overall methodological quality was moderate to high, with objective BP measurements representing a key strength. However, limitations include the inherent challenges of blinding in behavioral and digital interventions, variable allocation concealment, and occasional attrition issues [28]. Substantial heterogeneity in intervention components, follow-up duration, and outcome reporting precluded meta-analysis. Most studies were limited to 6–12 months, leaving questions about long-term sustainability. Restriction to English-language publications may have introduced language bias. Nonrandomized studies carried serious risk of bias, primarily from confounding [36,37,45].

Implications for practice and future research

From a practice perspective, this review suggests that home BP monitoring should be embedded within a broader management strategy rather than treated as an isolated act of measurement. Self-management interventions are especially valuable for improving adherence and self-care, telemonitoring improves responsiveness and BP consistency, and combined interventions most effectively link these mechanisms into clinically meaningful BP control [68-72].

From a research perspective, future work should address three major gaps. First, trials should identify the active ingredients of successful interventions, including the separate contributions of monitoring frequency, behavioral reinforcement, clinician feedback, lifestyle support, and medication titration. Second, more direct comparisons are needed between self-management-only, telemonitoring-only, and combined strategies within similar populations and health systems. Third, studies should incorporate longer follow-up and more standardized outcome reporting to improve comparability and enable stronger quantitative synthesis.

5. CONCLUSION

Overall, self-management, telemonitoring, and multicomponent interventions were generally associated with improvements in blood pressure and behavioral outcomes, although effects were not consistent across all studies. Self-management primarily enhances adherence and behavioral change, with variable effects on blood pressure, whereas telemonitoring provides more consistent reductions through feedback-driven clinical responsiveness. The greatest and most sustained effects are observed in combined interventions integrating monitoring, behavioral support, and treatment adjustment. These findings suggest that effective hypertension control depends on linking self-monitoring to actionable care pathways. Future strategies should prioritize integrated, patient-centered models while addressing heterogeneity in reporting and limited long-term evidence.

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CONFLICTS OF INTEREST

The authors have no competing interests.

ETHICS STATEMENT

This study did not involve any experiments on human participants or animals.

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