



Review Article

Behavior change features and techniques in electronic health-supported walking interventions for hypertension: A scoping reviewDwi Esti Handayani^{1,2*}, Stang Stang¹, Masyitha Muis¹, Veni Hadju¹, Ansariadi Ansariadi¹, Kadek Ayu Erika³¹Faculty of Public Health, Hasanuddin University, Makassar, Indonesia²Department of Nursing, Pelamonia Institute of Health Sciences, Makassar, Indonesia³Department of Pediatric Nursing, Faculty of Nursing, Hasanuddin University, Makassar, Indonesia

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ABSTRACT

Background & Aim: Hypertension remains a major global health challenge associated with cardiovascular morbidity and mortality. Brisk walking is widely recommended as a non-pharmacological strategy for blood pressure control; however, maintaining long-term adherence remains challenging. The integration of electronic health technologies into walking interventions may enhance motivation and behavioral engagement. This scoping review aimed to map digital behavior features and Behavior Change Techniques within eHealth-supported walking interventions for hypertension management.**Methods & Materials:** This scoping review followed the Arksey and O'Malley framework and adhered to PRISMA-ScR guidelines. Literature searches were conducted across PubMed, Scopus, ScienceDirect, ProQuest, and Google Scholar for studies published between 2016 and 2025. Eligible studies included adults with hypertension receiving electronic health-supported walking interventions incorporating digital behavior features and/or Behavior Change Techniques. Data were synthesized narratively.**Results:** A total of 21 studies were included. Frequently used eHealth technologies included mobile applications, wearable activity trackers, telemonitoring systems, and web-based platforms. Common digital behavior features included step monitoring, reminders, motivational messaging, personalized feedback, coaching support, and gamification. Frequently identified Behavior Change Techniques based on the Behavior Change Technique Taxonomy version 1 included goal setting, self-monitoring, feedback on behavior, prompts/cues, action planning, and social support. Most studies reported improved walking adherence, increased physical activity, enhanced self-management behaviors, and reduced blood pressure.**Conclusion:** Electronic health-supported walking interventions demonstrate potential for improving hypertension self-management through integrated digital behavior change strategies. Future studies should emphasize theory-driven intervention design and standardized Behavior Change Technique reporting.**Introduction**

Hypertension remains one of the leading global public health challenges and a major contributor to cardiovascular morbidity and mortality worldwide. More than 1.2 billion adults are currently living with hypertension, with most cases occurring in low- and middle-income countries where blood pressure awareness, treatment, and control remain inadequate (1). Persistent uncontrolled hypertension substantially increases the risk of stroke, coronary artery disease, heart failure, chronic kidney disease, and premature death (2,3). In addition to biological factors, sedentary

lifestyles, physical inactivity, unhealthy dietary habits, and psychosocial stress have further accelerated the global burden of hypertension (4). These conditions highlight the urgent need for sustainable lifestyle-based interventions that support long-term blood pressure control.

Regular physical activity is widely recommended as a cornerstone of non-pharmacological hypertension management (5). Among various forms of exercise, brisk walking has received considerable attention because it is inexpensive, accessible, safe, and feasible across different age groups and health conditions. Brisk



walking is a moderate-intensity aerobic exercise associated with improved vascular function, enhanced endothelial nitric oxide production, reduced peripheral vascular resistance, and improved cardiovascular fitness (6). Previous studies have demonstrated that brisk walking interventions can significantly reduce systolic and diastolic blood pressure among individuals with hypertension (7,8). Furthermore, systematic reviews and meta-analyses have confirmed the effectiveness of brisk walking in improving blood pressure outcomes and cardiovascular health (9,10).

Despite these benefits, maintaining long-term adherence to walking interventions remains challenging. Conventional walking programs frequently encounter barriers related to motivation, self-monitoring, consistency, and sustained behavioral engagement, particularly among sedentary populations (11). Consequently, the effectiveness of walking interventions may depend not only on the exercise prescription itself but also on the behavioral support mechanisms integrated within the intervention.

The rapid development of electronic health (eHealth) technologies has transformed strategies for lifestyle modification and chronic disease management. eHealth includes digital technologies such as mobile health applications, wearable devices, pedometers, smartwatches, telemonitoring systems, SMS reminders, and web-based platforms that support healthcare delivery and health promotion (12,13). In hypertension management, eHealth-supported walking interventions offer opportunities to facilitate self-monitoring, personalized feedback, goal setting, remote support, and continuous engagement in physical activity behaviors.

Importantly, many eHealth-supported interventions incorporate Behavior Change Techniques (BCTs), which are considered active intervention components designed to influence behavior through specific strategies. The Behavior Change Technique Taxonomy version 1 (BCTTv1) provides a standardized framework for classifying these techniques, including goal setting, self-monitoring, feedback, prompts/cues, action planning, reinforcement, and social support (14). In addition, digital behavior features such as step

tracking, reminders, motivational messaging, gamification, and progress visualization are increasingly integrated into interventions to improve adherence and behavioral sustainability. These components may enhance motivation and support long-term engagement in physical activity behaviors (15).

Previous systematic reviews and meta-analyses have consistently demonstrated that brisk walking improves blood pressure and cardiovascular outcomes (9,10). However, these reviews have primarily focused on intervention effectiveness rather than examining the behavioral architecture underlying eHealth-supported walking interventions. Likewise, reviews evaluating digital physical activity interventions have emphasized clinical effectiveness without systematically investigating the digital behavior features and standardized Behavior Change Techniques (BCTs) incorporated into intervention design (16). Consequently, limited evidence is available regarding how technology-enabled behavioral strategies are integrated to support walking adherence among individuals with hypertension. To our knowledge, this is the first scoping review to comprehensively map both digital behavior features and standardized BCTs within eHealth-supported walking interventions targeting hypertension management. By integrating behavioral science and digital health perspectives, this review provides a framework for understanding intervention design and informing future theory-driven digital health programs.

Therefore, this scoping review aimed to systematically map the behavior change features and Behavior Change Techniques incorporated into eHealth-supported walking interventions for individuals with hypertension. Specifically, this review sought to identify the types of eHealth technologies used, describe the behavior change strategies integrated within interventions, and summarize the behavioral and clinical outcomes reported in the existing literature.

Methods

Study design

This scoping review was conducted to systematically map the digital behavior features

and Behavior Change Techniques (BCTs) incorporated within eHealth-supported walking interventions for individuals with hypertension. Considering the heterogeneous nature of digital health interventions and behavioral strategies, a scoping review methodology was considered appropriate to explore the breadth, characteristics, and conceptual patterns of the existing evidence. The review was guided by the methodological framework proposed by Arksey and O'Malley (17), further enhanced by (18), and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (19).

Review questions

This review aimed to address the following questions:

- What types of eHealth technologies are used in walking interventions for hypertension management?
- What digital behavior features and Behavior Change Techniques (BCTs) are incorporated within these interventions?
- What clinical, behavioral, and engagement outcomes are reported?

Eligibility criteria

The eligibility criteria were developed using the Population–Concept–Context (PCC) framework recommended by the Joanna Briggs Institute (JBI). The PCC framework used in this review is presented in Table 1.

Table 1. PCC framework and eligibility criteria

PCC element	Description
Population	Adults aged ≥ 18 years diagnosed with hypertension or elevated blood pressure
Concept	eHealth-supported walking interventions incorporating behavior change features and/or Behavior Change Techniques (BCTs)
Context	Community, outpatient, workplace, home-based, or clinical settings
Inclusion criteria	Original peer-reviewed studies published in English between 2016 and 2025 involving digital walking interventions for hypertension management
Exclusion criteria	Review articles, protocols, editorials, conference abstracts, pharmacological-only interventions, non-digital interventions, pediatric populations, and studies without full text

Studies were included if they involved adults with hypertension, implemented walking or brisk walking interventions, incorporated eHealth or digital health technologies, and reported digital behavior features, engagement strategies, and/or Behavior Change Techniques (BCTs). Specific hypertensive subpopulations were also considered when hypertension remained the primary condition of interest.

Studies were excluded if they lacked walking-related physical activity components, did not incorporate digital support, focused exclusively on pharmacological management, or did not provide sufficient information regarding intervention characteristics or behavior change components.

To ensure alignment with the review objective, studies were included only when walking, step-count promotion, walking-based physical activity, or physical activity enhancement through walking constituted a primary or explicitly stated component of the intervention. Studies focusing solely on hypertension self-management, medication

adherence, or general digital health support without a clear walking-related component were excluded. For interventions incorporating multiple lifestyle components, studies were retained only if walking or walking-based physical activity remained a central intervention element.

Search strategy

A comprehensive literature search was conducted across PubMed, Scopus, ScienceDirect, ProQuest, and Google Scholar. Literature published between 2016 and 2025 was included. The search strategy combined keywords and Boolean operators related to hypertension, walking interventions, eHealth technologies, and behavior change concepts. Search terms included combinations of: "hypertension" OR "high blood pressure" AND "brisk walking" OR "walking intervention" AND "eHealth" OR "mHealth" OR "wearable device" OR "mobile application" AND "behavior change techniques" OR "self-

monitoring" OR "goal setting" OR "gamification".

The search strategy was adapted according to the indexing system of each database. Additional manual searches were conducted through the reference lists of eligible studies. The final literature search was conducted on January 31, 2025. No additional studies identified after this date were considered for inclusion in the review.

The complete database-specific search strategies are provided in Supplementary Table S1 to enhance transparency and reproducibility. Searches were limited to studies published in English between January 2016 and January 2025. Manual searching was additionally performed through reference screening of included studies. No restrictions were applied regarding geographical location or study setting.

Study selection

Study selection was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (19). Duplicate studies were removed prior to the screening process. Subsequently, the selection process was conducted in two sequential stages, consisting of title and abstract screening followed by full-text eligibility assessment. Studies that fulfilled the predefined inclusion criteria were included in the final review. Following the screening and eligibility assessment process, a total of 21 eligible studies were included in the final synthesis. Two reviewers independently conducted title and abstract screening, followed by full-text eligibility assessment. Any disagreements regarding study inclusion were discussed and resolved through consensus. When consensus could not be reached, a third reviewer was consulted to make the final decision. This process was implemented to enhance the reliability and transparency of study selection.

Data charting and extraction

Data extraction was conducted using a structured charting framework developed specifically for this review. Extracted information included study characteristics, participant demographics, eHealth technologies, characteristics of walking interventions, digital

behavior features, Behavior Change Techniques (BCTs), intervention duration, and reported clinical and behavioral outcomes.

To strengthen conceptual synthesis, this review distinguished between digital behavior features and formal Behavior Change Techniques. Digital behavior features refer to technology-enabled functional components embedded within intervention platforms, including reminders, step tracking, gamification, motivational messaging, progress visualization, coaching systems, and social support functions.

Behavior Change Techniques were defined as structured behavioral strategies intended to facilitate behavior change. The identification and categorization of BCTs were guided by the Behavior Change Technique Taxonomy version 1 (BCTTv1) developed by Michie et al. (2013). Frequently identified techniques included goal setting (1.1), self-monitoring of behavior (2.3), feedback on behavior (2.2), prompts/cues (7.1), action planning (1.4), and social support (3.1). Data extraction was independently performed by two reviewers using a standardized charting form developed for this review. Extracted information was cross-checked for accuracy and consistency. Any discrepancies were discussed and resolved through consensus among the review team.

Behavior change technique coding

Behavior Change Techniques were identified and coded using the Behavior Change Technique Taxonomy version 1 (BCTTv1) developed by Michie et al. (2013). Two reviewers independently examined intervention descriptions, supplementary materials, and protocol information to identify both explicit and implicit BCTs reported within each study. Coding focused on the presence or absence of BCTs rather than intervention intensity or implementation fidelity. Following independent coding, the reviewers compared results and resolved discrepancies through discussion and consensus. Where necessary, consultation with a third reviewer was undertaken to ensure coding consistency and conceptual accuracy.

Methodological quality assessment

Although methodological quality appraisal is not mandatory in scoping reviews, a

brief narrative assessment was conducted to provide an overview of the methodological characteristics of the included studies. This assessment aimed to describe the overall quality of the evidence rather than formally evaluate the risk of bias. Study characteristics, reporting transparency, intervention descriptions, and study design considerations were reviewed to identify general strengths and limitations across the included studies.

Data synthesis

Extracted data were synthesized descriptively using narrative synthesis and evidence mapping. Consistent with the objectives of a scoping review, quantitative meta-analysis was not undertaken because the review aimed to map the breadth, characteristics, and conceptual structure of the available evidence rather than estimate intervention effectiveness.

The synthesis summarized the types of eHealth technologies, digital behavior features, Behavior Change Techniques (BCTs), and reported clinical, behavioral, and engagement outcomes. Findings were subsequently organized

into thematic categories to identify recurring intervention patterns, evidence gaps, and implications for future theory-informed eHealth-supported walking interventions for hypertension management.

Results

Search results

The initial search identified 4,838 records from PubMed, Scopus, ScienceDirect, ProQuest, and Google Scholar. After removing 2,011 duplicate records, 2,827 studies remained for title and abstract screening. Subsequently, 210 full-text articles were assessed for eligibility, and 189 studies were excluded due to non-eHealth interventions, non-hypertensive populations, absence of walking components, insufficient behavioral reporting, inappropriate study designs, or other methodological reasons. Finally, 21 studies were included in this scoping review. The study selection process is presented in Figure 1 using the PRISMA-ScR flow diagram, illustrating the stages of database identification, duplicate removal, screening, eligibility assessment, and final study inclusion.

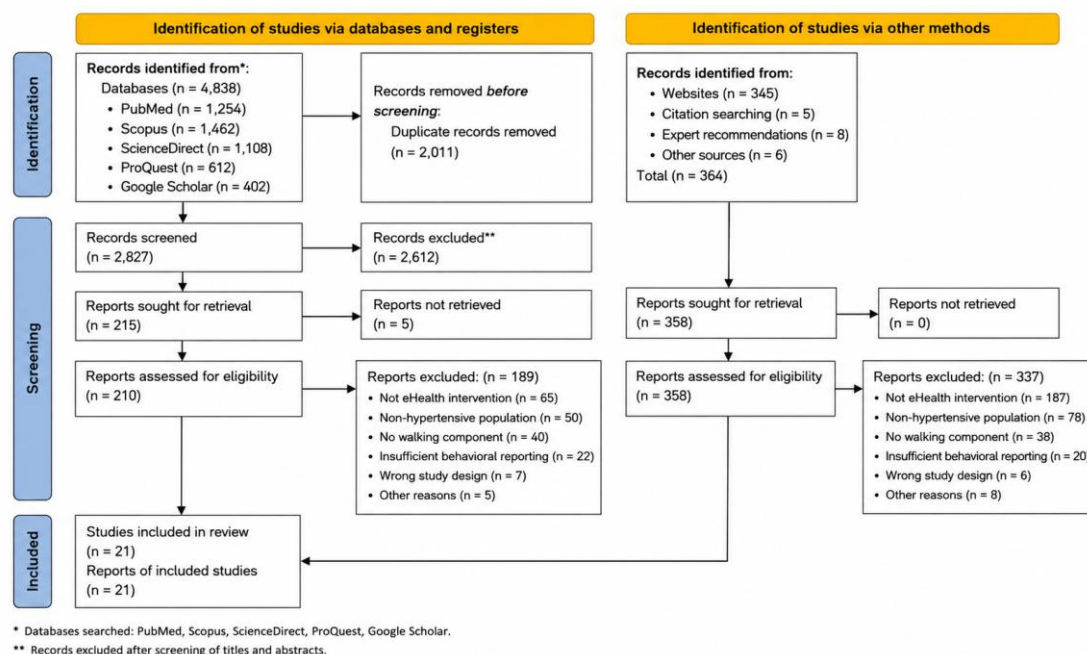


Figure 1. PRISMA-ScR flow diagram of study selection

Characteristics of included studies

The included studies were published between 2016 and 2025 and originated from Asia, North America, Europe, and Australia, indicating increasing global interest in eHealth-

supported walking interventions for hypertension management (20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40). Most studies employed randomized controlled trials, quasi-experimental, pilot, or feasibility designs involving adults with

hypertension and specific hypertensive subpopulations, including individuals with sedentary lifestyles or additional comorbid conditions (20,23,24,25,27,28,29,30,31,32,33, 34). Interventions were mainly conducted in community, outpatient, workplace, or home-based settings and ranged from several weeks to one year (24,25,27,29,33,38).

Table 2 summarizes the characteristics of included studies, including types of eHealth technologies, key digital behavior features, core Behavior Change Techniques (BCTs), and

principal clinical and behavioral outcomes reported across interventions. Although several interventions included broader lifestyle modification or hypertension self-management components, all included studies incorporated walking promotion, step-count monitoring, walking adherence support, or walking-related physical activity as an explicit intervention target. This approach ensured consistency with the predefined review objective, focusing on eHealth-supported walking interventions.

Table 2. Evidence mapping of eHealth technologies, digital behavior features, behavior change techniques, and outcomes in walking interventions for hypertension

No.	Study	eHealth Technology	Key digital features	Core Behavior Change Techniques (BCTs)	Main Outcomes
1.	Hargreaves et al. (2016)	Web-based walking support	Online prompts, self-monitoring	1.1 Goal setting (behavior); 7.1 Prompts/cues; 2.3 Self-monitoring of behavior	Improved walking participation
2.	Okura et al. (2016)	Pedometer-based monitoring	Walking feedback	2.3 Self-monitoring of behavior; 2.2 Feedback on behavior	Reduced blood pressure
3.	Dye et al. (2016)	Mobile walking intervention	Activity tracking	1.1 Goal setting (behavior); 2.3 Self-monitoring of behavior	Improved exercise engagement
4.	Dasgupta et al. (2017)	Telehealth lifestyle program	Coaching, remote monitoring	1.1 Goal setting (behavior); 1.4 Action planning; 3.1 Social support	Improved hypertension management
5.	Nolan et al. (2018)	eHealth self-management platform	Remote monitoring, coaching	1.1 Goal setting (behavior); 2.3 Self-monitoring of behavior; 3.1 Social support	Improved blood pressure control
6.	Leung et al. (2019)	Smartphone-based intervention	Motivational messaging, reminders	2.2 Feedback on behavior; 7.1 Prompts/cues; 1.4 Action planning	Increased exercise adherence
7.	Li et al. (2019)	Mobile health intervention	Progress tracking, group support	2.3 Self-monitoring of behavior; 1.1 Goal setting (behavior); 3.1 Social support	Improved physical activity
8.	Schlenk et al. (2020)	Remote coaching system	Monitoring and coaching	1.1 Goal setting (behavior); 3.1 Social support; 8.1 Behavioral practice/rehearsal	Improved self-management
9.	Jahan et al. (2020)	Telemonitoring intervention	SMS reminders, feedback	7.1 Prompts/cues; 1.1 Goal setting (behavior); 3.1 Social support	Improved adherence
10.	Weerahandi et al. (2020)	Mobile self-management system	Remote engagement	1.4 Action planning; 2.3 Self-monitoring of behavior; 3.1 Social support	Improved blood pressure self-management
11.	Rodriguez et al. (2021)	Wearable monitoring system	Real-time tracking, clinician feedback	2.3 Self-monitoring of behavior; 2.2 Feedback on behavior	Reduced blood pressure
12.	Nau et al. (2021)	Digital walking intervention	Personalized messaging	1.1 Goal setting (behavior); 7.1 Prompts/cues; 5.1 Information about health consequences	Improved behavioral engagement
13.	Bai et al. (2022)	Mobile health platform	Activity monitoring, feedback	1.1 Goal setting (behavior); 2.2 Feedback on behavior; 2.3 Self-monitoring of behavior	Increased daily step counts
14.	Lewey et al. (2022)	Telemonitoring system	Remote support, gamification, virtual teams	6.2 Social comparison; 10.4 Social reward; 2.3 Self-monitoring of behavior	Improved hypertension management
15.	Abel et al. (2023)	Smartphone intervention	Coaching and reminders	3.1 Social support; 1.1 Goal setting (behavior); 2.3 Self-monitoring of behavior	Improved lifestyle adherence
16.	Willms et al. (2023)	Mobile incentive application	Financial incentives, educational modules, reminders	10.1 Material incentive (behavior); 7.1 Prompts/cues	Improved exercise consistency
17.	Leitner et al. (2022)	AI-supported wearable system	Intelligent behavioral feedback	2.2 Feedback on behavior; 1.1 Goal setting (behavior); 2.3 Self-monitoring of behavior	Higher participant engagement
18.	Lefferts et al. (2023)	Wearable exercise monitoring	Real-time activity tracking	1.1 Goal setting (behavior); 3.1 Social support; 2.3 Self-monitoring of behavior	Enhanced physical activity
19.	Razai et al. (2023)	Mobile-based lifestyle intervention	Motivational support	1.1 Goal setting (behavior); 2.2 Feedback on behavior	Improved adherence
20.	Zhu et al. (2024)	Integrated digital health system	Personalized behavioral support, reminders, virtual rewards	1.1 Goal setting (behavior); 2.3 Self-monitoring of behavior; 7.1 Prompts/cues; 10.4 Social reward	Improved behavioral outcomes
21.	Heidari et al. (2025)	Digital hypertension platform	Automated coaching	1.1 Goal setting (behavior); 2.2 Feedback on behavior; 6.2 Social comparison	Improved blood pressure management

Abbreviations: AI = Artificial Intelligence; BCTs = Behavior Change Techniques; eHealth = Electronic Health; SMS = Short Message Service.

Table note: Behavior Change Techniques (BCTs) were identified and categorized according to the Behavior Change Technique Taxonomy version 1 (BCTTv1) developed by Michie et al. (2013). Some included studies involved specific hypertensive subpopulations (e.g., pregnancy-related hypertension), but were retained because hypertension remained the primary target condition.

Types of eHealth technologies used

A wide range of eHealth technologies was identified across the included studies. Mobile health applications were the most commonly used platforms and were frequently integrated with wearable activity trackers, pedometers, smartwatches, telemonitoring systems, SMS-based support, and web-based platforms (25,26,29,32,33,35,38).

Several studies combined wearable monitoring with clinician feedback, remote coaching, incentive systems, or telemonitoring approaches to improve physical activity

adherence and blood pressure management (27,30,34,36,38). Overall, these technologies supported self-monitoring, real-time tracking, automated feedback, and remote self-management (29,32,37).

Figure 2 presents the geographical distribution of included studies and summarizes the dominant categories of eHealth technologies used in walking interventions for hypertension, highlighting the widespread use of mobile applications, wearable activity trackers, telemonitoring systems, SMS-based interventions, and web-based platforms.

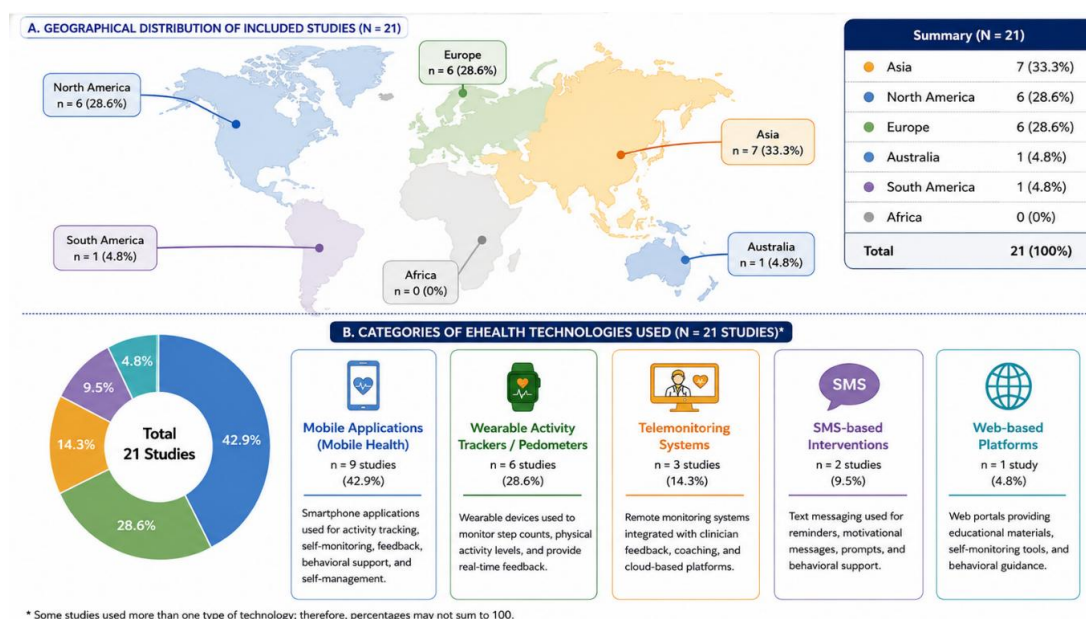


Figure 2. Global distribution and types of eHealth technologies used in walking interventions for hypertension

Digital behavior change features

The included studies incorporated various digital behavior change features to improve motivation and adherence to walking behaviors. Common features included step monitoring, reminders, motivational messaging, personalized feedback, coaching support, and goal-setting functions (25,29,30,32,33).

Gamification components such as achievement badges, rewards, competitions, and behavioral challenges were increasingly integrated into interventions to strengthen participant engagement (33,35,36). Several studies also incorporated peer support, clinician interaction, and remote coaching systems (24,27,34). The interaction between digital behavior features and patient engagement is described narratively because these components varied considerably across the included studies.

Across the included studies, step monitoring and activity tracking emerged as the most frequently reported digital behavior features, followed by personalized feedback, reminders, motivational messaging, coaching support, and goal-setting functions. Gamification elements such as rewards, achievement badges, competitions, and behavioral challenges were identified less frequently but were often associated with higher participant engagement. These findings suggest that self-regulation and behavioral reinforcement mechanisms constitute the dominant digital strategies used to support walking adherence among individuals with hypertension.

Behavior change techniques (BCTs)

The included studies applied multiple Behavior Change Techniques consistent with the Behavior Change Technique Taxonomy

version 1 (BCTTv1) (14). Frequently identified techniques included goal setting (1.1), self-monitoring of behavior (2.3), feedback on behavior (2.2), prompts/cues (7.1), action planning (1.4), and social support (3.1).

Self-monitoring of behavior was the most frequently applied BCT and was commonly facilitated through wearable devices and mobile applications, enabling real-time tracking of physical activity (29,30,32,33). Feedback was delivered through progress summaries, visual dashboards, and coaching messages (25,26,29). Several interventions also incorporated social comparison, incentives, and reward systems to enhance long-term adherence and participant engagement (33,35,36).

Self-monitoring of behavior (2.3) and goal setting (1.1) emerged as the dominant BCTs across the included studies, appearing in the majority of interventions. Feedback on behavior (2.2), social support (3.1), prompts/cues (7.1), and action planning (1.4) were also frequently identified. Collectively, these findings indicate that self-regulation processes represent the primary behavioral pathway through which eHealth-supported walking interventions seek to improve adherence and blood pressure self-management.

Methodological quality summary

Consistent with scoping review methodology, a formal risk-of-bias assessment was not undertaken because the primary objective of this review was to map the scope and characteristics of the available evidence rather than evaluate intervention effectiveness. Nevertheless, a descriptive review of study characteristics indicated substantial variation in study design, sample size, intervention duration, and reporting quality. Several studies employed randomized controlled trial designs, whereas others utilized pilot, feasibility, or quasi-experimental approaches. These methodological differences should be considered when interpreting the reported outcomes.

Clinical and behavioral outcomes

Most studies reported positive clinical and behavioral outcomes associated with

eHealth-supported walking interventions. Clinically, interventions demonstrated reductions in systolic and diastolic blood pressure, increased physical activity levels, improved cardiovascular fitness, and enhanced self-management behaviors (21,23,30,32).

Behaviorally, participants demonstrated improved walking adherence, greater engagement in self-monitoring activities, and stronger motivation toward physical activity (27,29,31). Interventions incorporating personalized feedback, gamification, and clinician support generally produced higher engagement compared with monitoring-only interventions (33,34,35).

Several studies also reported high acceptability and feasibility of mobile- and wearable-supported interventions among adults with hypertension and sedentary populations (20,35,38). Nevertheless, heterogeneity in intervention duration, digital platforms, and outcome measurements limited direct comparison across studies (36,39).

Evidence gaps and research opportunities

This review identified several evidence gaps. First, although several studies incorporated behavior change components, only a limited number explicitly reported standardized BCT coding using the Behavior Change Technique Taxonomy version 1 (BCTTv1) (14,39). Second, long-term sustainability outcomes remained underexplored, with most studies focusing primarily on short-term blood pressure improvements.

In addition, evidence regarding culturally tailored interventions, older adults, and low-resource populations remained limited (34,38). Future eHealth-supported walking interventions should therefore emphasize theory-driven behavioral design, standardized BCT reporting, culturally adaptive implementation, and long-term engagement strategies to strengthen hypertension self-management outcomes (12,14).

Discussion

This scoping review mapped the digital behavior features and Behavior Change Techniques (BCTs) embedded within eHealth-

supported walking interventions for hypertension management. Overall, the findings demonstrate increasing integration of digital health technologies, wearable monitoring systems, and behavioral science approaches to improve walking adherence and blood pressure self-management. The reviewed studies indicate that walking interventions are evolving from conventional exercise recommendations into interactive and patient-centered digital behavior programs.

One of the main findings was the dominant use of mobile health (mHealth) applications and wearable technologies. Most interventions integrated smartphone applications with pedometers, wearable trackers, smartwatches, telemonitoring systems, or web-based platforms to facilitate self-monitoring and real-time activity tracking (25,26,29,32,33,38). This trend reflects a global shift toward digitally supported chronic disease management. The World Health Organization has emphasized that digital health technologies can improve healthcare accessibility, continuity of care, and patient engagement among individuals with chronic diseases (12). Similarly, wearable technologies have demonstrated benefits for physical activity participation and cardiovascular risk management through continuous monitoring and personalized feedback systems (41,42).

Another important finding was the widespread use of digital behavior change features such as step monitoring, reminders, motivational messaging, personalized feedback, coaching support, and goal-setting functions (25,29,30,32,33). These features may strengthen behavioral adherence through self-regulation processes involving behavioral awareness and continuous feedback. Previous evidence suggests that interventions integrating self-monitoring and personalized feedback are more effective in promoting long-term physical activity adherence than passive educational approaches (14,16).

Gamification emerged as an increasingly important strategy within eHealth-supported walking interventions. Several studies incorporated achievement badges, rewards, competitions, and behavioral challenges to improve motivation and engagement (33,35,36). Previous studies suggest that gamification can

improve exercise participation and sustain behavioral engagement through reinforcement and social interaction mechanisms (43,44). In hypertension management, these approaches may help address sedentary lifestyles and poor long-term exercise adherence.

Self-monitoring of behavior (2.3) was the most consistently implemented Behavior Change Technique across included studies. Mobile applications and wearable systems enabled participants to monitor daily step counts and walking performance in real time (29,30,32,37). According to the Behavior Change Technique Taxonomy version 1 (BCTTv1), self-monitoring represents one of the most effective strategies for improving physical activity adherence because it strengthens behavioral awareness and self-regulation processes (14). Previous evidence further suggests that combining self-monitoring with feedback on behavior (2.2) can improve long-term lifestyle adherence and cardiovascular self-management behaviors (45).

The prominence of self-monitoring and feedback identified in this review is consistent with several established behavior change theories, including Self-Regulation Theory, Social Cognitive Theory, and Self-Determination Theory (15). These theoretical frameworks emphasize self-efficacy, autonomy, behavioral awareness, and reinforcement as key determinants of sustained health behavior change. The widespread incorporation of self-monitoring, feedback, and goal-setting techniques across the included studies suggests that theory-informed intervention design may enhance participant engagement, strengthen walking adherence, and support long-term hypertension self-management. Furthermore, these findings reinforce the importance of integrating behavioral theory into the development of eHealth-supported interventions to maximize their effectiveness and sustainability.

In addition to self-monitoring, frequently identified Behavior Change Techniques included goal setting, prompts/cues, action planning, social support, and feedback on behavior. Interventions incorporating multiple BCTs generally demonstrated stronger participant engagement and adherence than those relying on isolated behavioral components

(23,24,27). Although this scoping review did not permit formal comparisons of intervention effectiveness, studies reporting favorable clinical and behavioral outcomes most commonly combined self-monitoring, feedback, and goal-setting strategies. These findings suggest that integrating multiple complementary Behavior Change Techniques within digital platforms may provide a more comprehensive behavioral support system, thereby facilitating sustained walking participation and improved hypertension self-management.

An important observation from this review is that different eHealth technologies appeared to support distinct behavior change mechanisms. Mobile applications were commonly associated with goal setting, reminders, motivational messaging, and progress visualization (25,26,29,32). Wearable activity trackers primarily facilitated self-monitoring and real-time feedback (29,32,37,46). Telemonitoring systems frequently incorporated clinician support and personalized coaching, whereas gamified platforms often utilized social comparison and reward-based techniques to enhance engagement (33,34,36). These findings suggest that technology selection should be aligned with intended behavioral pathways rather than being viewed solely as a delivery platform.

Beyond individual intervention components, the findings suggest that intervention effectiveness may depend on the interaction between digital behavior features and Behavior Change Techniques. For example, wearable activity trackers frequently enabled self-monitoring, while mobile applications often delivered feedback, reminders, and goal-setting support. Together, these components may create a reinforcing behavioral system that promotes sustained engagement in walking behaviors. Although causal relationships cannot be established within a scoping review, the repeated co-occurrence of these elements across successful interventions suggests that multi-component approaches may be more effective than isolated intervention strategies.

The included studies generally demonstrated favorable clinical and behavioral outcomes. Several interventions reported reductions in systolic and diastolic blood pressure, increased daily step counts, improved

physical activity participation, and enhanced self-management behaviors (21,23,30,32). These findings are consistent with previous systematic reviews indicating that brisk walking and moderate-intensity physical activity significantly improve blood pressure control among individuals with hypertension (10). Furthermore, recent hypertension guidelines continue to emphasize physical activity as a key non-pharmacological strategy for blood pressure management (47).

Nevertheless, several evidence gaps remain. Considerable heterogeneity existed regarding intervention duration, digital platforms, behavioral components, and outcome measurements. In addition, relatively few studies explicitly categorized intervention components using standardized frameworks such as BCTTv1, limiting transparency and reproducibility. Most studies also focused primarily on short-term outcomes, while evidence regarding long-term adherence and sustainability remains limited.

Another important gap relates to accessibility and equity. Most included studies originated from high-income or technologically advanced settings, potentially limiting generalizability to low-resource populations and individuals with limited digital literacy. Previous evidence suggests that disparities in technology access and digital competence may influence the effectiveness of eHealth interventions (26). Therefore, future interventions should prioritize inclusive and culturally adaptable digital health designs.

Beyond addressing issues of accessibility, the findings of this review provide several practical considerations for the development of future eHealth-supported walking interventions. Self-monitoring and goal-setting functionalities emerged as the most consistently identified behavior change components and therefore should be considered foundational elements of intervention design. Wearable technologies may be most effective when combined with personalized feedback systems rather than being used solely for passive activity monitoring. In addition, gamification features and social support mechanisms may help sustain motivation and reduce participant attrition over time. Future interventions should also explicitly incorporate theory-based

Behavior Change Techniques and provide transparent reporting of intervention components to facilitate replication, scalability, and implementation across diverse healthcare settings. These recommendations are consistent with previous evidence indicating that self-monitoring, feedback, and goal-setting strategies represent key determinants of successful physical activity interventions (14,16,45).

Despite encouraging findings, the available evidence should be interpreted cautiously. Considerable heterogeneity existed across intervention duration, participant characteristics, digital platforms, outcome measures, and reporting practices. Furthermore, many studies employed pilot or feasibility designs with relatively small sample sizes. These limitations reduce confidence in determining which specific intervention components are most effective and highlight the need for more rigorously designed trials incorporating standardized BCT reporting and long-term follow-up assessments.

Overall, this scoping review demonstrates that eHealth-supported walking interventions represent a promising approach for hypertension self-management. The integration of wearable technologies, digital behavior features, and structured BCTs may improve walking adherence, strengthen patient engagement, and support sustainable blood pressure control. Greater emphasis on theory-driven intervention development, standardized BCT reporting, and equitable digital accessibility may further enhance the effectiveness and scalability of future interventions.

Conclusion

This scoping review demonstrates that eHealth-supported walking interventions have considerable potential to improve hypertension self-management through the integration of digital behavior features and theory-informed Behavior Change Techniques. Mobile health applications, wearable activity trackers, telemonitoring systems, and web-based platforms most frequently incorporated self-monitoring, goal setting, feedback, reminders, and social support to enhance walking adherence and promote sustained physical activity. The findings highlight the importance

of aligning digital technologies with evidence-based behavioral strategies to strengthen intervention effectiveness. Future research should prioritize standardized reporting of Behavior Change Techniques, theory-driven intervention development, and long-term evaluation across diverse healthcare settings to support the scalability and implementation of digital walking interventions for hypertension management.

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