

## SYSTEMATIC REVIEW

# Exploring Mobile Health Interventions for Hypertension and Management: A Scoping Review

Muhammad Zul Azzat bin Baharuddin, Rosliza Abdul Manaf

Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

## ABSTRACT

**Introduction:** Hypertension is a widespread health issue globally, contributing significantly to cardiovascular disease. Effective management of hypertension is crucial, yet many individuals remain undiagnosed and undertreated. Mobile health intervention presents an opportunity to address this hypertension management. **Objective:** This scoping review aimed to systematically review and synthesize the existing literature on the type of mobile health interventions for hypertension management among adults. **Materials and methods:** A systematic search was conducted in Scopus and ScienceDirect following the PRISMA-ScR guidelines. The literature search, conducted from April to May 2024, used the keywords: (mHealth OR "Mobile Health" OR "Smartphone intervention" OR "Mobile applications") AND (Hypertension OR "Blood pressure control") AND ("Self-management"). All retrieved articles were imported into Excel for organization and review. Included articles were original studies published in English, specifically cohort and case-control studies on mHealth interventions for hypertension management. Excluded articles were mixed-methods studies, cross-sectional studies, and non-original articles, including conference proceedings, perspectives, commentaries, opinions, reports, systematic reviews, and meta-analyses. **Results:** Upon rigorous searching and screening, seven studies met the inclusion and exclusion criteria: 5 from China, 1 from South Korea, and 1 from Iran. Our findings in this scoping review categorize MHealth into messaging applications, WeChat-based interventions, and mobile application-based interventions. **Conclusion:** In conclusion, mHealth interventions have proven highly effective in managing hypertension, particularly through messaging applications like WeChat and standalone mobile applications. These interventions significantly improve blood pressure control, medication adherence, and overall quality of life among adults with hypertension.

*Malaysian Journal of Medicine and Health Sciences* (2025) 21(5): 214-223. doi:10.47836/mjmhs.21.5.25

**Keywords:** mHealth intervention, Mobile application, Hypertension, Blood pressure control, Self-management

## Corresponding Author:

Rosliza Abdul Manaf, PhD

Email: rosliza\_abmanaf@upm.edu.my

Tel : +603-97692404

Additionally, in Malaysia, data from the National Health Morbidity Survey (NHMS) indicate that the prevalence of hypertension exhibited a sustained pattern from 2011 to 2019, with rates consistently hovering around 30% (5). These statistics underscore the urgent need for improved hypertension awareness, diagnosis, and management in lower and middle-income countries.

## INTRODUCTION

Hypertension affects approximately 1.28 billion adults worldwide, posing a significant health concern, particularly in low- and middle-income countries where nearly two-thirds of those affected reside. This condition is a major contributor to cardiovascular diseases, presenting a substantial public health challenge. Despite its widespread prevalence, effective management and reduction of hypertension remain elusive. Globally, nearly 46% of individuals with hypertension are unaware of their condition, and less than 42% receive a diagnosis and subsequent treatment. Furthermore, only about 21% of those diagnosed manage to control their blood pressure(1). This challenge is especially severe in lower and middle-income countries. In Africa, studies have shown significant hypertension prevalence: 31.6% in Algeria, 20.8% in Kenya, and 29.3% in Nigeria (2-4).

Mobile health (mHealth) technology presents new opportunities to enhance global healthcare delivery. mHealth supports patient communication, monitoring, and education by leveraging features such as mobility and direct communication to swiftly disseminate health information and support medical and public health practices. These technologies range from basic apps to sophisticated solutions incorporating voice communication, text messaging (SMS), multimedia messaging, Bluetooth, and advanced communication methods like video calls and messaging applications such as WhatsApp or Telegram. The portability and accessibility of mHealth make it a transformative tool in healthcare delivery, with the potential to bridge care gaps, boost patient engagement, and significantly

improve public health outcomes (6).

Given the critical nature of hypertension and the potential benefits of mHealth, it is essential to explore innovative approaches to enhance hypertension management. The objective of this review is to systematically review and synthesize existing literature on various types of mobile health interventions for managing hypertension in adults. By examining these interventions, this review aims to provide a comprehensive understanding of how mHealth can contribute to improved hypertension management and better patient outcomes, and inform the development of future interventions.

## MATERIALS AND METHODS

This scoping review is prepared in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta Analyses- Scoping Review) updated guideline. The objective of this review is to systematically review and synthesize the existing literature on the types of mobile health interventions for hypertension management among adults. The component of mnemonic PICO (population, intervention, comparison and outcome) was established as follows: Adults diagnosed with hypertension (HPT) as the population; Mobile health (mHealth) technology interventions for hypertension management as intervention; Impact on blood pressure control, adherence to medication, lifestyle modifications, and overall management of hypertension as the outcome. Comparison: Standard care or alternative interventions without mHealth components.

### Searching Strategy

The literature search was conducted in April 2024, using Scopus and ScienceDirect databases. The following were keywords used for searching related articles: (mHealth OR "Mobile Health" OR "Smartphone intervention" OR "Mobile applications") AND (Hypertension OR "Blood pressure control") AND ("Self-management"). All retrieved articles were imported into excel and duplication was removed. The remaining articles were imported into Excel library for further storage and review processes. Self-management was included in the search criteria to facilitate a more focused exploration of the literature. Although the primary objective of the review is to examine the types of mHealth interventions, incorporating these terms allows for a more comprehensive understanding of the context in which these interventions are utilized.

### Eligibility Criteria

The included articles were: (1) published in English language; (2) original articles including cohort, case-control in Mobile health (mHealth) technology interventions for hypertension management as intervention. In contrast, mixed methods, cross sectional study as well as non-original articles such as conference

proceedings, perspective, commentary, opinion, reports, systematic review, and meta-analyses were excluded as these types of articles may not provide the depth of analysis or empirical evidence required like in the observational types of study review. The publication period was decided from year 2019 until 2024.

### Study Selection

Two independent reviewers screened the titles and abstracts of the retrieved materials based on the inclusion and exclusion criteria. The potential articles identified during the main screening were retained, and the full texts were reviewed independently by both reviewers in detail according to the established criteria. This dual-review process helped enhance the rigor and reliability of the selection.

### Data Extraction, synthesis, and charting

The authors independently extracted the data from the included studies using standardised electronic data extraction form. The form was developed in Microsoft Excel spreadsheet to extract relevant information from each study. The relevant information extracted were the characteristics of the study, encompassing its design, population demographics, intervention description, comparison group details, and conclusions. Regarding the study design, it is essential to determine whether the study employed a randomized controlled trial, quasi-experimental study, or observational study methodology. Population characteristics and sample size details provide insights into the demographics of the study participants, such as age, gender, and country of origin, as well as the size of the study sample. The intervention description outlines the mobile health intervention's specifics, including its duration, type, delivery method, effectiveness, and follow-up duration. Additionally, information about the comparison group sheds light on how it was managed or treated in contrast to the intervention group. Finally, the conclusion section summarizes the study's main findings, particularly focusing on the types of the mobile health intervention compared to the control or comparison group in achieving desired outcomes. Then, a descriptive analysis was performed by the authors based on the data extracted from all the included studies with the used Mobile health (mHealth) technology interventions for hypertension management.

## RESULTS

The search yielded 175 articles from ScienceDirect and 98 articles from Scopus. Only seven articles were included in the full-text assessment after rigorous selection screening, as shown in the PRISMA flow diagram Figure 1, where duplication of articles and articles not meeting the eligibility criteria were excluded. The findings from seven studies were included in this review, as shown in Table I. Five eligible articles were from China, one from Iran, and one from South Korea.

**Table I: Summary of accepted articles**

No	Author (year)	Title	Study design	Population	Intervention	Comparison	Conclusion
	(Li et al., 2019)	A WeChat-Based Self-Management Intervention for Community Middle-Aged and Elderly Adults with Hypertension in Guangzhou, China: A Cluster-Randomized Controlled Trial	Cluster-randomized control trial	253 middle-aged and elderly adults. (45-70 years) (intervention, n=110; control, n=143)	Health education, health promotion, group chat and BP monitoring via WeChat for 6 months	Health lectures and one chronic disease follow up every 3 months	The adjusted mean differences in changes in systolic and diastolic blood pressure between the intervention and control groups were -6.9 mmHg (95% CI -11.2 to -2.6; p = 0.002) and -3.1 mmHg (95% CI -5.7 to -0.6; p = 0.016), respectively
	(Sun et al., 2024)	Development of a Health Behavioral Digital Intervention for Patients With Hypertension Based on an Intelligent Health Promotion System and WeChat: Randomized Controlled Trial	2-arm, randomized trial design	54 individuals aged > 60 with hypertension (intervention, n=23; control, n=31)	12-week behaviour intervention (physical activity, Healthy diet, taking medication and monitoring of blood pressure) via WeChat	Routine health education and self-management manual	The experimental group showed significant improvements in systolic BP (-7.36 mm Hg, P=.002), exercise time (856.35 MET-min/week, P<.001), medication adherence (0.56, P=.001), BP monitoring frequency (P=.02), and learning performance (3.23, P<.001)
	(Wang et al., 2023)	Efficacy of a WeChat-Based Multimodal Digital Transformation Management Model in New-Onset Mild to Moderate Hypertension: Randomized Clinical Trial	Randomized controlled trial	175 aged 20-80 years with new onset mild to moderate hypertension (intervention, n=88; control, n=87)	Personalized lifestyle modification programs via WeChat, online multimodal health education includes internet and online communication, text-based health education, medical graphic narratives, and animation-supported health education (follow up online once a week, outpatient at 3 month and 6 month)	Usual Care (follow up at 3 month and 6 month)	<p>In the multimodal intervention group, mean home BP decreased from 151.74/94.22 mm Hg to 126.19/82.28 mm Hg. In the usual care group, it decreased from 150.78/91.53 mm Hg to 133.48/84.45 mm Hg. The mean differences were -8.25 mm Hg for systolic BP (95% CI -11.71 to -4.78; P&lt;.001) and -4.85 mm Hg for diastolic BP (95% CI -8.41 to -1.30; P=.008)</p> <p>In the multimodal intervention group, mean office BP decreased from 153.64/93.56 mm Hg to 127.81/82.16 mm Hg, while in the usual care group, it decreased from 151.48/91.31 mm Hg to 134.92/85.09 mm Hg. The mean differences were -9.27 mm Hg for systolic BP (95% CI -12.62 to -5.91; P&lt;.001) and -5.18 mm Hg for diastolic BP (95% CI -8.47 to -1.89; P=.002). After 6 months, 72.7% of the multimodal group achieved home BP control &lt;140/90 mm Hg compared to 52.9% of the usual care group (P=.007), and 36.4% of the multimodal group achieved &lt;130/80 mm Hg compared to 18.4% of the usual care group (P=.008). The multimodal group also showed significant improvements in quality-of-life scores, anxiety (P=.04), depression (P=.03), and sleep quality (P&lt;.001)</p>

CONTINUE

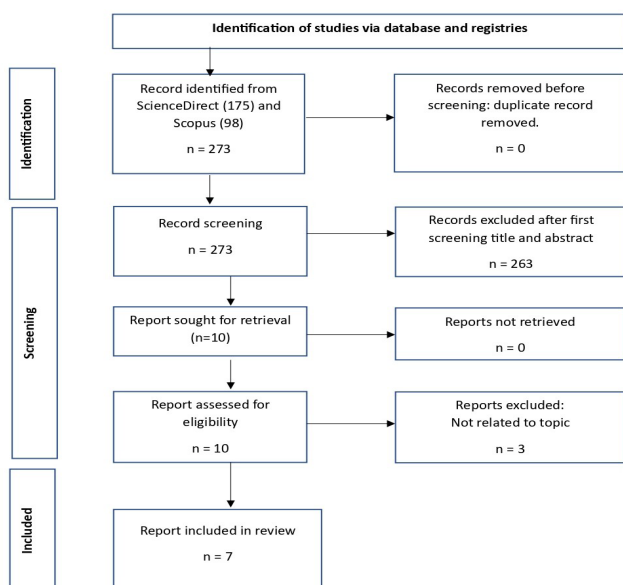
**Table I: Summary of accepted articles (CONT.)**

No	Author (year)	Title	Study design	Population	Intervention	Comparison	Conclusion
	(Yun et al., 2020)	Efficacy of an Electronic Health Management Program for Patients With Cardiovascular Risk: Randomized Controlled Trial	2-arm randomized controlled trial	106 patients who had hypertension, diabetes or hypercholesterolemia. (intervention, n=53; control, n=53)	12-weeks electronic program, in the form of a mobile app and a Web-based PC application. The program covered 4 areas: self-assessment, self-planning, self-learning, and self-monitoring by automatic feedback	Educational booklet	Patients with hypertension showed a significant improvement in SBP from baseline compared to the control group (72.7% vs. 35.7%; P<.05).
	(Liu et al., 2023)	Efficacy of an mHealth App to Support Patients' Self-Management of Hypertension: Randomized Controlled Trial	2-arm randomized controlled trial	297 patients with hypertension (intervention, n=148; control, n=149)	Intervention group participants were trained and asked to use an mHealth app named Blood Pressure Assistant for 6 months. They could use the app to record and upload vital signs, access educational materials, and receive self-management reminders and feedback from health care providers	telephone follow-ups or outpatient clinic management	The mean systolic and diastolic BP were significantly reduced by 25.83 (SD 8.99) and 14.28 (SD 3.74) mm Hg in the intervention group (P<.001) and by 21.83 (SD 6.86) and 8.87 (SD 4.22) mm Hg in the control group (P<.001). The differences in systolic and diastolic BP between the groups were significant (P<.001 and P=.01, respectively)
	(Bozorgi et al., 2021)	The effect of the mobile "blood pressure management application" on hypertension self-management enhancement: a randomized controlled trial	2-arm Randomized controlled clinical trial	120 patient age 30-60 years old (intervention, n=60; control, n=60)	8 weeks -The mobile application-based educational-supportive intervention, alongside routine treatment, was designed based on the educational needs of hypertensive patients. The app featured: 1. Recording blood pressure and receiving feedback. 2. Saving and plotting recorded BP levels on a chart. 3. Reminders for medication, visits, and BP measurements. 4. Healthy diet plans (DASH and low-salt) and weight loss plans. 5. Information on hypertension management and treatment. 6. Motivational and supportive programs for smoking cessation. 7. Notifications to family members about critical BP levels. 8. General and individualized motivational messages about treatment adherence. 9. Saving user-recorded information on a portal for physician and researcher access.	Usual Care	In the intervention group, the treatment adherence score increased by an average of 5.9 (95% CI 5.0–6.7) compared to the control group. Adherence to low-fat and low-salt diet plans improved with scores of 1.7 (95% CI 1.3–2.1) and 1.5 (95% CI 1.2–1.9), respectively. Additionally, moderate physical activity increased by 100.0 minutes per week (95% CI 61.7–138.3) in the intervention group.

CONTINUE

**Table I: Summary of accepted articles (CONT.)**

No	Author (year)	Title	Study design	Population	Intervention	Comparison	Conclusion
	(Ma et al., 2022)	The effects of a smartphone-enhanced nurse-facilitated self-care intervention for Chinese hypertensive patients: A randomised controlled trial	2-arm randomized controlled trial	210 patients with hypertension (intervention, n=105; control, n=105)	the participants in the intervention group received a 12-week SNS intervention. This intervention involved six weekly individual education and consultation sessions and a series of smartphone-enhanced self-care activities on such topics as health related decision-making, self-monitoring of BP, weight control, reducing sodium intake, healthy diets, actively engaging in physical activities, smoking cessation, reducing alcohol consumption, and emotion control	usual care provided by the community health service centres, including medical follow-ups and health education. A medical follow-up was conducted every 3 months, and participants received one medical follow-up during the study period	Compared to the control group, the intervention group showed significant reductions in systolic BP (T1: $\beta = -7.29$ , T2: $\beta = -11.07$ ) and diastolic BP (T1: $\beta = -4.80$ , T2: $\beta = -7.50$ ) at the 6th and 12th week follow-ups. The intervention group also had significant reductions in body weight, BMI, and waist circumference, and improvements in self-care (behaviour, motivation, and self-efficacy). At the 12th week follow-up, 31% of participants in the intervention group had BP < 140/90 mmHg, compared to 9% in the control group (p = 0.003).



**Figure 1: PRISMA flow diagram for the scoping review**

The articles analyzed were published between May 2019 and May 2024. Types of mHealth were used for intervention can be categorized in messaging-based WeChat intervention. Li et al. 2019 (7), Sun et al. 2024 (8), Wang et al. 2023 (9) and Mobile application-based intervention Yun et al. 2020 (10), Liu et al. 2023 (11), Bozorgi et al. 2021 (12) and Ma et al. 2022 (13).

Based on our findings in this scoping review it can be categorized to Messaging application; WeChat-based intervention and mobile applications-based interventions.

From the reviewed literature, seven randomized controlled trials employed mobile health interventions for managing hypertension. Among these, three studies utilized messaging applications with a focus on WeChat, while the remaining four studies employed interventions based on mobile applications.

Three studies utilized WeChat-based interventions for managing hypertension. In the cluster-randomized controlled trial by Li et al., 2019 (7), 253 middle-aged and elderly adults (45-70 years) in Guangzhou, China, participated in a 6-month intervention incorporating health education, promotion, group chat, and blood pressure monitoring via WeChat. The 6-month WeChat-based intervention, which included health education, promotion, group chats, and blood pressure monitoring, significantly reduced both systolic blood pressure (SBP) by -6.9 mmHg (95% CI: -11.2 to -2.6, p = 0.002) and diastolic blood pressure (DBP) by -3.1 mmHg (95% CI: -5.7 to -0.6, p = 0.016) in the intervention group. Significant reductions in both systolic and diastolic blood pressure were observed in the intervention group. The 2-arm randomized controlled trial by Sun et al., 2024 involved 54 individuals aged over 60 in Hefei, China, in a 12-week WeChat-based behavioural intervention (8). The WeChat-based behavioural intervention resulted in significant reductions in systolic blood pressure (SBP) by 7.36 mmHg (p = 0.002), a substantial increase in exercise time of 856.35 MET-min/week (p < 0.001), and improved medication adherence, reflected by a score increase of 0.56 (p = 0.001). Additionally, participants in the intervention group demonstrated more frequent blood pressure monitoring and enhanced learning performance, highlighting the intervention's comprehensive benefits. Wang et al. (2023) evaluated a 6-month WeChat-based intervention involving 175 participants aged 20–80 in Wuhan, China. The multimodal intervention group demonstrated significant reductions in home blood pressure (BP) from 151.74/94.22 mmHg to 126.19/82.28 mmHg, compared to 150.78/91.53 mmHg to 133.48/84.45 mmHg in the usual care group, with mean differences of -8.25 mmHg for systolic BP (95% CI: -11.71 to -4.78, p < .001) and -4.85 mmHg for diastolic BP (95% CI: -8.41 to -1.30, p = .008). Office BP reductions were also greater in the multimodal group (153.64/93.56 mmHg to 127.81/82.16 mmHg) compared to the usual care

group (151.48/91.31 mmHg to 134.92/85.09 mmHg), with mean differences of -9.27 mmHg for systolic BP (95% CI: -12.62 to -5.91,  $p < .001$ ) and -5.18 mmHg for diastolic BP (95% CI: -8.47 to -1.89,  $p = .002$ ). After six months, 72.7% of the multimodal group achieved home BP control (<140/90 mmHg) compared to 52.9% in the usual care group ( $p = .007$ ), while 36.4% achieved BP <130/80 mmHg compared to 18.4% ( $p = .008$ ) (9). The multimodal group also reported significant improvements in quality of life, with reductions in anxiety ( $p = .04$ ) and depression ( $p = .03$ ), as well as better sleep quality ( $p < .001$ ).

Three studies utilized messaging platforms like WeChat to deliver hypertension management interventions. These interventions commonly included features such as health education, self-monitoring tools, and group chats for peer support. For example, Li et al. (2019) conducted a six-month intervention targeting middle-aged and elderly adults, achieving significant reductions in systolic blood pressure by 6.9 mmHg ( $p=0.002$ ). Similar results were observed in Sun et al. (2024) and Wang et al. (2023), where multimodal WeChat-based interventions demonstrated improved blood pressure control and enhanced quality of life.

Four studies examined mobile app-based interventions for hypertension management. Yun et al. (2020) conducted a two-arm randomized controlled trial in South Korea, involving 106 patients with hypertension, diabetes, or hypercholesterolemia. The study assessed a 12-week electronic health management program delivered through a mobile app and a web-based PC application. The intervention group showed significant improvements in systolic blood pressure (SBP), with 72.7% of participants reaching target SBP levels, compared to 35.7% in the control group ( $p < .05$ ) (10). Liu et al. (2023) conducted a two-arm randomized controlled trial with 297 hypertensive patients (intervention group,  $n=148$ ; control group,  $n=149$ ) to evaluate the efficacy of the Blood Pressure Assistant mHealth app in supporting self-management. Over a 6-month period, participants in the intervention group used the app to monitor vital signs, access educational materials, and receive reminders and feedback from healthcare providers (11). The results showed a significant reduction in both systolic (25.83 mm Hg) and diastolic (14.28 mm Hg) blood pressure in the intervention group ( $P < .001$ ), compared to the control group, which exhibited reductions of 21.83 mm Hg (systolic) and 8.87 mm Hg (diastolic) ( $P < .001$ ). The differences between the groups were statistically significant for both systolic ( $P < .001$ ) and diastolic ( $P = .01$ ) blood pressure. Bozorgi et al. (2021) conducted a two-arm randomized controlled trial with 120 hypertensive patients aged 30-60 years to evaluate the impact of a mobile "blood pressure management application" on self-management. Over 8 weeks, the intervention group ( $n=60$ ) used the app alongside routine treatment, which was tailored to address the educational needs of patients

(12). The intervention group showed a significant improvement in treatment adherence, with an average increase of 5.9 points (95% CI 5.0–6.7) compared to the control group. Adherence to low-fat and low-salt diets improved by 1.7 (95% CI 1.3–2.1) and 1.5 (95% CI 1.2–1.9) points, respectively. Furthermore, moderate physical activity increased by an average of 100 minutes per week (95% CI 61.7–138.3) in the intervention group. Ma et al. (2022) also conducted a two-arm randomized controlled trial with 210 hypertensive patients (intervention group,  $n=105$ ; control group,  $n=105$ ) to assess the effects of a smartphone-enhanced, nurse-facilitated self-care intervention (13). At the 6th and 12th week follow-ups, the intervention group demonstrated significant reductions in both systolic (T1:  $\beta = -7.29$ , T2:  $\beta = -11.07$ ) and diastolic blood pressure (T1:  $\beta = -4.80$ , T2:  $\beta = -7.50$ ) compared to the control group. Additionally, the intervention group showed significant improvements in body weight, BMI, waist circumference, and self-care behaviours, including motivation and self-efficacy. By the 12th week, 31% of participants in the intervention group achieved blood pressure levels < 140/90 mmHg, compared to only 9% in the control group ( $p = 0.003$ ). Four studies examined mobile health applications for hypertension management, utilizing features such as self-monitoring tools, educational content, reminders, and real-time feedback. The variability in app design and functionality demonstrates their adaptability to diverse patient needs, highlighting their potential to support personalized care and enhance self-management in hypertension across different populations and settings.

In conclusion, Liu et al. (2023) conducted the study with the largest sample size of 297 participants, while Sun et al. (2024) included the smallest cohort of 54 participants. The participant age range varied significantly across studies, with the youngest participants being 20 years old in the study by Wang et al. (2023), and the oldest exceeding 70 years in the study by Li et al. (2019). The longest study duration, 6 months, was shared by both Li et al. (2019) and Liu et al. (2023). Li et al.'s study involved a WeChat-based intervention, targeting 253 middle-aged and elderly adults in Guangzhou, China, while Liu et al. (2023) implemented a mobile app-based intervention with 297 participants. In contrast, Bozorgi et al. (2021) had the shortest study duration of 8 weeks, utilizing a mobile app intervention for a cohort of 200 participants.

WeChat-based interventions were commonly used in studies lasting 6 months and tended to show consistent reductions in systolic blood pressure, averaging 6–9 mmHg. On the other hand, app-based interventions were more varied in their outcomes, with some showing more substantial reductions in blood pressure, particularly in shorter study durations like those of Liu et al. (2023). WeChat interventions focused on engaging participants in a community-oriented platform, facilitating interaction

and adherence through social media. App-based interventions, such as those by Liu et al. (2023), typically relied on providing personalized feedback, tracking, and reminders via the mobile app. These differences in intervention types—WeChat-based messaging platforms versus mobile app-based personalized interventions—highlight the adaptability of digital tools in hypertension management and their ability to cater to diverse user preferences and technological access across different populations.

## DISCUSSION

Mobile health (mHealth) has become an increasingly valuable tool in healthcare, facilitating patient communication, health monitoring, and education, and creating new possibilities for global healthcare delivery. Its defining features, such as portability and real-time communication, enable rapid sharing of health information to support medical and public health initiatives. mHealth technologies range from basic apps to advanced features like voice calls, SMS, multimedia messaging, Bluetooth, and modern platforms such as video calls and messaging apps like WhatsApp or Telegram. This adaptability makes mHealth a transformative force in healthcare delivery. The findings of this scoping review underscore the critical role of mHealth in hypertension management, with two key intervention types emerging as particularly effective: messaging applications, notably WeChat, and mobile application-based solutions

### Messaging Applications: WeChat

WeChat, a widely used messaging platform in China, has demonstrated notable efficacy as a medium for delivering hypertension interventions. Studies by Li et al. (2019), Sun et al. (2024), and Wang et al. (2023) showcased the effectiveness of WeChat-based interventions in improving blood pressure control, enhancing medication adherence, promoting healthy behaviours, and facilitating patient-provider communication. These interventions leveraged WeChat's features such as group chat, health education modules, self-monitoring tools, and personalized feedback to engage participants and support self-management efforts.

The cluster-randomized controlled trial by Li et al. (2019) revealed significant reductions in both systolic and diastolic blood pressure among middle-aged and elderly adults participating in a WeChat-based self-management intervention compared to standard care. Similarly, Sun et al. (2024) demonstrated improvements in blood pressure, physical activity, medication adherence, and learning performance among older adults receiving a health behavioural intervention via WeChat. Wang et al. (2023) further emphasized the benefits of a multimodal digital transformation management model delivered through WeChat, leading to significant reductions in both home and office blood pressure and improvements

in quality of life.

The success of WeChat-based interventions can be attributed to several factors. Firstly, WeChat's widespread adoption and user-friendly interface make it accessible to diverse populations, facilitating broad reach and engagement. Secondly, the interactive nature of WeChat allows for personalized communication and continuous support, fostering patient empowerment and accountability. Lastly, the integration of various features within the platform, including health education materials, self-monitoring tools, and social support networks, creates a holistic and immersive intervention environment conducive to behaviour change.

All the studies mentioned above were conducted in China and utilized WeChat as a common intervention platform, given its widespread use in the country. According to statistic 80% of China population use WeChat around 1.3 billion active users (14). WeChat has evolved into a cornerstone application on smartphones in China, offering a multifaceted smartphone experience that extends beyond mere messaging. Its integration of messaging, socialization, and mobile payment services has made it an indispensable tool for daily life. Moreover, WeChat has expanded its capabilities to include delivery health services, reflecting its adaptability to meet evolving user needs (15).

### Mobile Applications

In addition to messaging platforms like WeChat, standalone mobile applications have emerged as valuable tools for hypertension management. Studies by Yun et al. (2020), Liu et al. (2023), Bozorgi et al. (2021), and Ma et al. (2022) investigated the efficacy of mobile apps in promoting self-care behaviours, enhancing treatment adherence, and improving blood pressure control among patients with hypertension.

The study by Yun et al. (2020) demonstrated the effectiveness of an electronic health management program delivered through a mobile app and web-based platform in improving systolic blood pressure among patients with hypertension, diabetes, or hypercholesterolemia. Similarly, Liu et al. (2023) reported significant reductions in mean blood pressure levels among patients utilizing an mHealth app for self-management support. Bozorgi et al. (2021) and Ma et al. (2022) highlighted the positive impact of mobile applications on treatment adherence, lifestyle modification, and clinical outcomes, including reductions in blood pressure, BMI, and waist circumference.

Mobile applications offer several advantages for hypertension management. They provide a convenient platform for self-monitoring, allowing users to track blood pressure readings, medication adherence, and lifestyle behaviours in real-time. Moreover, mobile apps can deliver educational content, behaviour change

strategies, and motivational support tailored to individual needs. The integration of features such as reminders, goal-setting tools, and progress tracking enhances user engagement and facilitates sustained behaviour change over time (10-13).

### **Similarities Between Messaging Applications and Mobile Applications**

Both WeChat-based interventions and standalone mobile applications play a crucial role in implementing lifestyle interventions for managing hypertension. Lifestyle modifications are essential components of hypertension management, focusing on practices such as maintaining adequate sleep patterns, increasing physical activity, adopting a nutritious diet, and implementing strategies for smoking cessation (16).

(17) emphasize the importance of aerobic exercise as a primary form of physical activity for young adults dealing with hypertension, given its direct and sustained positive impact on blood pressure. WeChat-based interventions and mobile applications offer platforms for delivering personalized exercise regimens, tracking physical activity levels, and providing motivational support to encourage adherence to exercise routines.

Moreover, health education interventions incorporated into both modalities promote lifestyle changes aimed at lowering blood pressure. (18) highlight the efficacy of health education interventions in reducing blood pressure by encouraging behaviours such as regular physical activity, increased consumption of fruits and vegetables, and smoking cessation. These interventions not only help manage hypertension but also have the potential to prevent the progression from prehypertension to hypertension, thereby reducing the risk of cardiovascular disease (CVD).

Both WeChat and standalone mobile applications offer convenient access to health information, personalized communication, interactive features, real-time data collection, and social support networks. These shared characteristics enhance engagement and adherence to hypertension management behaviours, empowering users to make informed decisions about their health while fostering a sense of ownership and accountability in their health journey.

### **Comparison between MHealth Intervention and routine management for hypertension**

The management of hypertension routinely involves in-person clinical visits, medication adherence, and lifestyle modifications, often facing challenges such as patient non-adherence and limited access to healthcare facilities (19). In contrast, mHealth interventions, including mobile applications and messaging platforms, offer continuous real-time monitoring, reminders for medication adherence, and educational resources, which can enhance patient engagement and self-

management behaviours (7, 9). These digital platforms also can deliver personalized feedback and intervention can be tailored according to individual needs, enhancing the relevance and impact of the health messages (11).

Studies demonstrate significant reductions in blood pressure among participants using mHealth interventions compared to those receiving usual care, highlighting the potential for improved outcomes through more frequent and convenient patient interactions (Sun et al., 2024; Wang et al., 2023). Moreover, mHealth technologies increase accessibility for patients in remote areas, bridging healthcare disparities and ensuring timely care (20).

Despite the benefits, challenges such as the digital divide and concerns about data privacy remain barriers to widespread adoption (19). Ensuring user-friendly and culturally sensitive designs is crucial to maximize effectiveness and acceptance. While traditional methods are fundamental, mHealth interventions offer substantial benefits that complement and enhance conventional approaches, providing a promising avenue for improving hypertension management (7, 20).

In the context of existing literature, we recognize that numerous systematic reviews have addressed mHealth interventions for hypertension management. However, our review provides a distinct contribution by categorizing and synthesizing the various types of mHealth interventions rather than solely evaluating their effectiveness. By highlighting the diversity of these interventions and their applicability across different contexts, we aim to fill a gap in the literature that previous reviews may not fully address. Furthermore, our systematic approach encompasses a broader range of study designs, allowing for a more comprehensive examination of the mHealth strategies employed in hypertension management. This thorough analysis of intervention types is designed to inform future research efforts and facilitate practical implementations within various healthcare settings

### **CONCLUSION**

In conclusion, mHealth interventions have shown significant effectiveness in managing hypertension. This scoping review highlights two primary categories in mHealth messaging application, which are WeChat based and Mobile application intervention. Both types of interventions provide platforms for self-monitoring, personalized educational content, behavior change strategies and motivational support tailored to individual needs and preferences.

For recommendation and implementations, it is recommended that healthcare providers, policymakers and technology developers collaborate to continuously monitor and evaluate the effectiveness of these

modalities. Addressing equity and accessibility concerns is essential to ensure that all segments of population regardless of the socioeconomic status of geographical area can benefit from mhealth interventions. By leveraging the strengths of mhealth, healthcare systems can enhance their capacity to deliver comprehensive and personalized care to individual with hypertension, ultimately improving the outcomes.

A key recommendation for implementation is to integrate mHealth interventions into routine clinical practice to complement existing care pathways and ensure seamless data sharing and care coordination via electronic health records (EHRs). Furthermore, it is critical to provide healthcare providers with training and ongoing support so that they can effectively use mHealth tools and interpret the data generated by these interventions, allowing for informed clinical decisions and timely patient feedback. Creating educational programs to increase patient awareness and engagement with mHealth interventions is also critical, emphasizing the benefits of self-monitoring and personalized feedback in hypertension management.

Addressing the digital gap is another important aspect, which involves implementing strategies to overcome barriers related to digital literacy and access to technology. This may include providing devices, offering technical support, and developing user-friendly interfaces for a various kind of populations. Furthermore, establishing method for regular evaluation of mHealth interventions is necessary to assess their effectiveness, user satisfaction, and impact on health outcomes, using this feedback to make necessary adjustments and improvements to the interventions.

By implementing these recommendations, the healthcare system will fully harness the potential of mHealth interventions, resulting in better hypertension management and public health outcomes.

## ACKNOWLEDGEMENT

No grant was allocated for this scoping review. All selected studies received ethical approval from respective boards and authorities.

## REFERENCES

1. World Health Organization W. Hypertension 2023 [updated 16 march 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension>.
2. Moussouni A, Sidi-yakhlef A, Hamdaoui H, Aouar A, Belkhatir D. Prevalence and risk factors of prehypertension and hypertension in Algeria. *BMC Public Health*. 2022;22(1):1571. <https://doi.org/10.1186/s12889-022-13942-y>
3. Mecha JO, Kubo EN, Odhiambo CO, Kinoti FG,

- Njau K, Yonga G, et al. Burden of prehypertension among adults in Kenya: a retrospective analysis of findings from the Healthy Heart Africa (HHA) Programme. *BMC Public Health*. 2020;20(1):281. <https://doi.org/10.1186/s12889-020-8363-z>
4. Umuerrri EM, Aiwuyo HO. Prevalence and correlates of prehypertension and hypertension among adults in Delta State, Nigeria: a cross-sectional community-based study. *Ghana Med J*. 2020;54(1):48-57. <https://doi.org/10.4314/gmj.v54i1.8>
5. National Institutes of Health N. NHMS2019, NCDs-Non-Communicable Disease: Risk Factors and other Health Problem 2020 [28]. Available from: [https://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2019/Report\\_NHMS2019-NCD\\_v2.pdf](https://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2019/Report_NHMS2019-NCD_v2.pdf).
6. Marcolino MS, Oliveira JAQ, D'Agostino M, Ribeiro AL, Alkmim MBM, Novillo-Ortiz D. The Impact of mHealth Interventions: Systematic Review of Systematic Reviews. *JMIR Mhealth Uhealth*. 2018;6(1):e23. <https://doi.org/10.2196/mhealth.8873>
7. Li X, Li T, Chen J, Xie Y, An X, Lv Y, et al. A WeChat-Based Self-Management Intervention for Community Middle-Aged and Elderly Adults with Hypertension in Guangzhou, China: A Cluster-Randomized Controlled Trial. *Int J Environ Res Public Health*. 2019;16(21). <https://doi.org/10.2196/53006>
8. Sun T, Xu X, Ding Z, Xie H, Ma L, Zhang J, et al. Development of a Health Behavioral Digital Intervention for Patients With Hypertension Based on an Intelligent Health Promotion System and WeChat: Randomized Controlled Trial. *JMIR Mhealth Uhealth*. 2024;12:e53006. <https://doi.org/10.2196/53006>
9. Wang Y, Guo F, Wang J, Li Z, Tan W, Xie M, et al. Efficacy of a WeChat-Based Multimodal Digital Transformation Management Model in New-Onset Mild to Moderate Hypertension: Randomized Clinical Trial. *J Med Internet Res*. 2023;25:e52464. <https://doi.org/10.2196/52464>
10. Yun YH, Kang E, Cho YM, Park SM, Kim YJ, Lee HY, et al. Efficacy of an Electronic Health Management Program for Patients With Cardiovascular Risk: Randomized Controlled Trial. *J Med Internet Res*. 2020;22(1):e15057. <https://doi.org/10.2196/15057>
11. Liu F, Song T, Yu P, Deng N, Guan Y, Yang Y, et al. Efficacy of an mHealth App to Support Patients' Self-Management of Hypertension: Randomized Controlled Trial. *J Med Internet Res*. 2023;25:e43809. <https://doi.org/10.2196/43809>
12. Bozorgi A, Hosseini H, Eftekhari H, Majdzadeh R, Yoonessi A, Ramezankhani A, et al. The effect of the mobile "blood pressure management application" on hypertension self-management enhancement: a randomized controlled trial. *Trials*. 2021;22(1):413. <https://doi.org/10.1186/>

- s13063-021-05270-0
13. Ma Y, Cheng HY, Sit JWH, Chien WT. The effects of a smartphone-enhanced nurse-facilitated self-care intervention for Chinese hypertensive patients: A randomised controlled trial. *International Journal of Nursing Studies*. 2022;134:104313. <https://doi.org/https://doi.org/10.1016/j.ijnurstu.2022.104313>
  14. Tu F. WeChat and civil society in China. *Communication and the Public*. 2016;1. and civil society in China. *Communication and the Public*, 1. <https://doi.org/10.1177/2057047316667518>
  15. Montag C, Becker B, Gan C. The Multipurpose Application WeChat: A Review on Recent Research. *Front Psychol*. 2018;9:2247. <https://doi.org/10.3389/fpsyg.2018.02247>
  16. Charchar FJ, Prestes PR, Mills C, Ching SM, Neupane D, Marques FZ, et al. Lifestyle management of hypertension: International Society of Hypertension position paper endorsed by the World Hypertension League and European Society of Hypertension. *J Hypertens*. 2024;42(1):23-49. [10.1097/HJH.0000000000003563](https://doi.org/10.1097/HJH.0000000000003563)
  17. Ma J, Xiang Y. The management of prehypertension in young adults. *Saudi Medical Journal*. 2020;41(3):223. <https://doi.org/10.15537/smj.2020.3.24998>
  18. Xia T, Zhao F, Nianogo RA. Interventions in hypertension: systematic review and meta-analysis of natural and quasi-experiments. *Clin Hypertens*. 2022;28(1):13. <https://doi.org/10.1186/s40885-022-00198-2>
  19. Zhou L, He L, Kong Y, Lai Y, Dong J, Ma C. Effectiveness of mHealth interventions for improving hypertension control in uncontrolled hypertensive patients: A meta-analysis of randomized controlled trials. *J Clin Hypertens (Greenwich)*. 2023;25(7):591-600. <https://doi.org/10.1111/jch.14690>
  20. Almasi S, Hosseini A, Emami H, Sabahi A. Mobile Health Technology for Hypertension Management: A Systematic Review. *ACTA MEDICA IRANICA*. 2020;58. <https://doi.org/10.18502/acta.v58i6.4050>