Preventive Medicine Reports 54 (2025) 103094

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Review article

Effectiveness of mobile health technology-enabled interventions to improve management and control of hypertension and diabetes in India- a systematic review

Ramesh Kumar Huda [*,1], Rahul Singh Chowhan [1], Dileep Seervi

ICMR-National Institute for Implementation Research on Non-Communicable Diseases, Jodhpur, India

ARTICLE INFO

Keywords:
Mobile health
Technology-enabled
Mobile app
Glycemic control
Blood pressure

ABSTRACT

Objectives: In India, due to rapid urbanization, lifestyle changes, and the aging of the population, hypertension and diabetes have become the leading causes of morbidity and mortality over the past 20 years. The aim of this study is to evaluate the impact of mobile health (mHealth) technology interventions on hypertension and diabetes control in India.

Methods: A comprehensive search in PubMed, Cochrane Library, Dimensions, and Google Scholar was conducted for studies conducted in India and published from inception to October 15th, 2024. The retrieved studies assessed the impact of mHealth technology interventions on hypertension and diabetes control in India. The Population, Intervention, Comparator, Outcomes, & Study Design (PICOS) framework outlined the key elements of the review. This systematic review uses secondary data, so no ethical approval is needed.

Results: Of 782 potential articles assessed, eight met the inclusion criteria. mHealth technology-enabled Interventions were associated with significantly improved blood pressure, glycated hemoglobin (HbA1c) and Fasting Blood Glucose (FBG) in the intervention group compared to the control group. Additionally, digital health interventions, such as SMS-based education and mHealth platforms, greatly improve treatment adherence and patient satisfaction.

Conclusion: Due to an increasing burden of chronic diseases, incorporating mHealth interventions in routine healthcare could be a game-changing strategy toward improved health outcomes, especially in areas with limited resources and access to traditional care. The study provides a basis on which future research can be done to develop further and implement digital health strategies for the management and control of diabetes and hypertension.

1. Introduction

Hypertension and diabetes represent major global health burdens, with a greater prevalence in low- and middle-income countries (Sarki et al., 2015). In India, due to rapid urbanization, changes in lifestyles, and the aging of the population, these conditions have become the leading causes of morbidity and mortality in the past 20 years (Swami et al., 2015). In the recent past, hypertension and Type 2 Diabetes Mellitus (T2DM) have been on the rise. It is estimated that currently, about 30 % of adults in India suffer from hypertension, while about 77 million people suffer from diabetes (Ramakrishnan et al., 2019; Mohan and Pradeepa, 2021). Such conditions raise the risk of cardiovascular events and further complications. These diseases also generally create an economic burden on overall healthcare. Management and control of hypertension and diabetes thus hold the key to such reductions. Scalable, innovative approaches are necessary, given the diverse health infrastructure across the country (Mohan and Pradeepa, 2021).

Mobile-based intervention technologies have, however, emerged as a beacon of hope in the easing of these challenges in the management of chronic conditions such as hypertension and diabetes (Thangada et al., 2018). These include health services provided through mobile devices about how information is delivered, offering the potential for large populations with limited access to health care. mHealth (mobile health) interventions can support individually ongoing self-management,

* Corresponding author at: ICMR-National Institute for Implementation Research on Non-Communicable Diseases, New Pali Road, Jodhpur 342005, India.
E-mail address: ramesh.hudda@gmail.com (R.K. Huda).
[1] Equal first author.

https://doi.org/10.1016/j.pmedr.2025.103094
Received 14 January 2025; Received in revised form 29 April 2025; Accepted 29 April 2025
Available online 2 May 2025

deliver personalized educational content, enable remote monitoring, and facilitate timely communication with providers (Thangada et al., 2018). Worldwide, studies have demonstrated that mHealth interventions can improve clinical outcomes among patients with hypertension or diabetes by improving medication adherence, promoting lifestyle changes, and monitoring the disease (Mao et al., 2020). For these reasons, understanding the effectiveness of mHealth interventions within the Indian context, where cultural practices, socioeconomic disparities, and variations in access to healthcare may affect these outcomes, is needed.

Indeed, most of the literature on mHealth interventions in India relates to increasing health awareness or preventing chronic diseases rather than actively managing and controlling established hypertension and diabetes (Nahar et al., 2017). Besides, because of the inequalities in mobile phone ownership and access to information relevant to healthcare management, the overall effectiveness of mHealth interventions may differ between rural and urban settings (Blake et al., 2023). Therefore, detailed evidence on how the different mHealth technologies affect the actual treatment and management of hypertension and diabetes in the various Indian populations is necessary.

This systematic review will, therefore, bridge the gaps in the literature by reviewing the efficacy of mHealth technology-enabled interventions for managing and controlling hypertension and diabetes in India. The synthesized evidence relates to studies that target individuals diagnosed with either of the conditions, hence revealing changes in outcomes such as blood pressure control, glycemic management, and overall improvement in health. This study seeks to provide valuable insights to the makers of policies, healthcare providers, and researchers toward developing culturally tailored and scalable emerging mHealth solution designs that can play a role in mitigating the ever-increasing burden of hypertension and diabetes in India.

2. Methodology

2.1. Research approach

This research was carried out as a systematic literature review to evaluate the impact of mobile-based interventions on hypertension and diabetes control in India. It adhered to the guidelines put forward by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Page et al., 2021). The Population, Intervention, Comparator, Outcomes, & Study Design (PICOS) framework outlined the key elements of the review: the target populations, the intervention being evaluated, the comparator, the outcomes of interest, and the type of study design (Methley et al., 2014). It was defined as follows:

Population: Indian adults aged 30 years and above who have been diagnosed with hypertension, diabetes, or both.

Intervention: mHealth technology-enabled Interventions for managing and controlling hypertension and diabetes. Examples include, but are not limited to, mobile apps (smartphone or non-smartphone), SMS/text messaging, and all other innovative uses of mobile technologies that support service delivery, such as health education, remote monitoring, medication reminders, lifestyle modification advice, or any other type of support in disease management.

Comparator: mHealth component Vs. Usual care or standard care.

Primary outcomes: Blood pressure control, Glycated Hemoglobin (HbA1c) and Fasting Blood Glucose (FBG) i.e. Glycemic Control.

Secondary outcomes: Adherence (medication and lifestyle recommendations) and patient satisfaction.

Study design: There were no restrictions on study design; however, all included studies were based on Randomized Controlled Trials (RCTs).

Inclusion criteria: Articles were included according to the following criteria: a) Adult individuals who were hypertensive and diabetic; b) Reported mean age of 30 years and above; c) Mobile Health Interventions and Population within India; d) Studies published in English language and Full-texts were available in peer-reviewed journals.

Exclusion criteria: Studies were excluded if they met the following criteria: a) Studies addressing non-hypertensive, pre-hypertensive, pre-diabetic, and non-diabetic cases; b) Reported mean age less than 30; c) Non-mobile based interventions and Non-Indian population; d) Studies published in languages other than English and were available in Editorials, Opinion pieces, Reviews.

2.2. Search criteria

A comprehensive search in PubMed, Cochrane Library, Dimensions, and Google Scholar was conducted for articles published from inception to October 15th, 2024. The search was done to retrieve studies that assessed the impact of mobile-based interventions on hypertension and diabetes control in India. Relevant keywords from different databases were exhaustively used as follows: (mHealth OR “mobile health” OR “mobile app” OR “mobile phone” OR telemedicine OR eHealth OR “technology-enabled” OR “digital health” OR “technology-based” OR ICT OR “information communication technology”) AND (hypertension OR “high blood pressure” OR “blood pressure control” OR diabetes OR “type 2 diabetes” OR T2DM OR “diabetes mellitus” OR “blood sugar control”) AND (management OR control OR treatment OR intervention OR “disease management”) AND India (see Appendix Table 1).

2.3. Study selection and data extraction

Study selection was conducted after the initial search. The eligible studies were selected in a stepwise manner. The duplicate articles were discarded with the help of Zotero Reference Manager version 6.0, and the rest were entered into the evaluation and screening stages. Later on, all the potentially eligible articles underwent critical evaluation. All the titles and abstracts had to be scrutinized for inclusion using specified criteria. Predetermined criteria were utilized to assess the full texts of the remaining publications for inclusion and exclusion. Evidence tables were developed by data extraction for the following information: author, study design, participant characteristics, intervention characteristics, outcome measures, and main findings.

2.4. Data sources and analysis methods

The basis of making this research robust is the information reliability and validity. The electronic databases, grey literature, peer-reviewed journals, and various international organizations’ publications were considered the data sources for this study. Data interpretation methods in this research study were solely based on a qualitative analysis of the selected sources. Meta-analysis was impossible as there was a lot of heterogeneity and insufficient comparable quantitative data regarding the effectiveness of mHealth technology-enabled interventions in managing and controlling hypertension and diabetes in India.

2.5. Risk of bias assessments

The included studies that met the inclusion criteria were critically checked for quality. In this review, the methodological quality of the included Randomized Control Trials was assessed using the Cochrane Collaboration Risk of Bias Tool (Corbett et al., 2013). The following biases have been assessed in the review: Bias from the randomization process, Bias due to missing outcome data, Bias due to missing measurement of outcome, Bias in the selection of reported results, and overall risk of bias.

2.6. Ethical considerations

This systematic literature review relied on publicly available secondary data and does not involve any human subjects or personal identifiers, so it is exempt from ethical approval. Major ethical issues such as transparency and integrity were maintained throughout the

research process (Suri, 2020). Additionally, the findings were correctly presented.

3. Results

3.1. Study selection outcome

Overall, 782 studies were identified: 131 from PubMed, 78 from Cochrane Library, 278 from Dimensions, and 295 from Google Scholar. 23 studies were duplicates, and one was retracted. Following titles and abstracts screening of the remaining citations, 21 potentially relevant studies were sought for retrieval and consequently retrieved. Of the retrieved full text, 13 citations were excluded. These studies were excluded because the participants were pre-diabetic/pre-hypertensive or work in progress. Eight studies were deemed appropriate for review following the screening, as summarized in Fig. 1.

3.2. Risk of bias outcome

The risk of bias was assessed using the Cochrane Risk of Bias 2.0 assessment tool. Overall, the included studies had a low risk of bias. However, bias due to missing outcome data was common in the included studies due to the high dropout rate and loss of some participants during the follow-up duration. The results are presented as traffic light plots and summary plots, as shown in Fig. 2 and Fig. 3, respectively, for critical appraisal of the studies.

3.3. Participant characteristics

Evidence tables summarized the interventions, participants' characteristics, and main findings. A total of 12,337 participants were included. Evidence Appendix Table 2 summarizes the impact of mobile-based interventions on hypertension and diabetes control in India. Of all the studies, only one employed a mixed-method design, while the rest were RCTs. The main outcome measures included blood pressure control, glycemic control, adherence, and patient satisfaction.

3.4. HbA1c

HbA1c reflects the percentage of glucose coated on hemoglobin (Bergonsi et al., 2021). It has wide applications in the management of diabetes as a method of monitoring long-term glycemic control, with levels below 6.5 % or 7 % targeted as a means of reducing the risk of diabetes-related complications (Bergonsi et al., 2021). Studies have shown varying levels of effectiveness of mHealth interventions in controlling HbA1c (Eberle and Stichling, 2020). According to Sadanshiv et al. (2020), a computer-generated SMS-based education system for diabetic healthcare workers resulted in a significant reduction in HbA1c levels. Similar outcomes were registered by Vinitha et al. (2019) following text messaging of newly diagnosed patients with T2DM, with

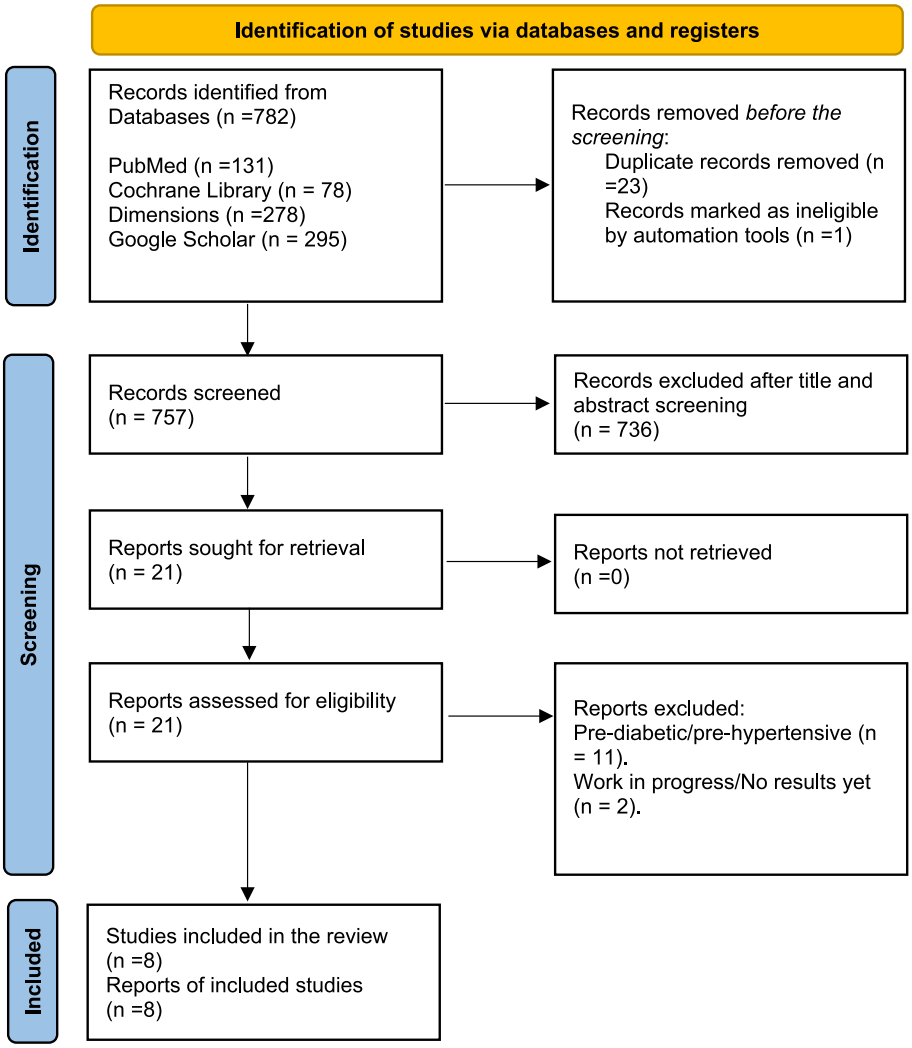

Fig. 1. Flow of studies assessing the mobile-based interventions targeting hypertension & diabetes in Indian adults from database inception to October 2024.

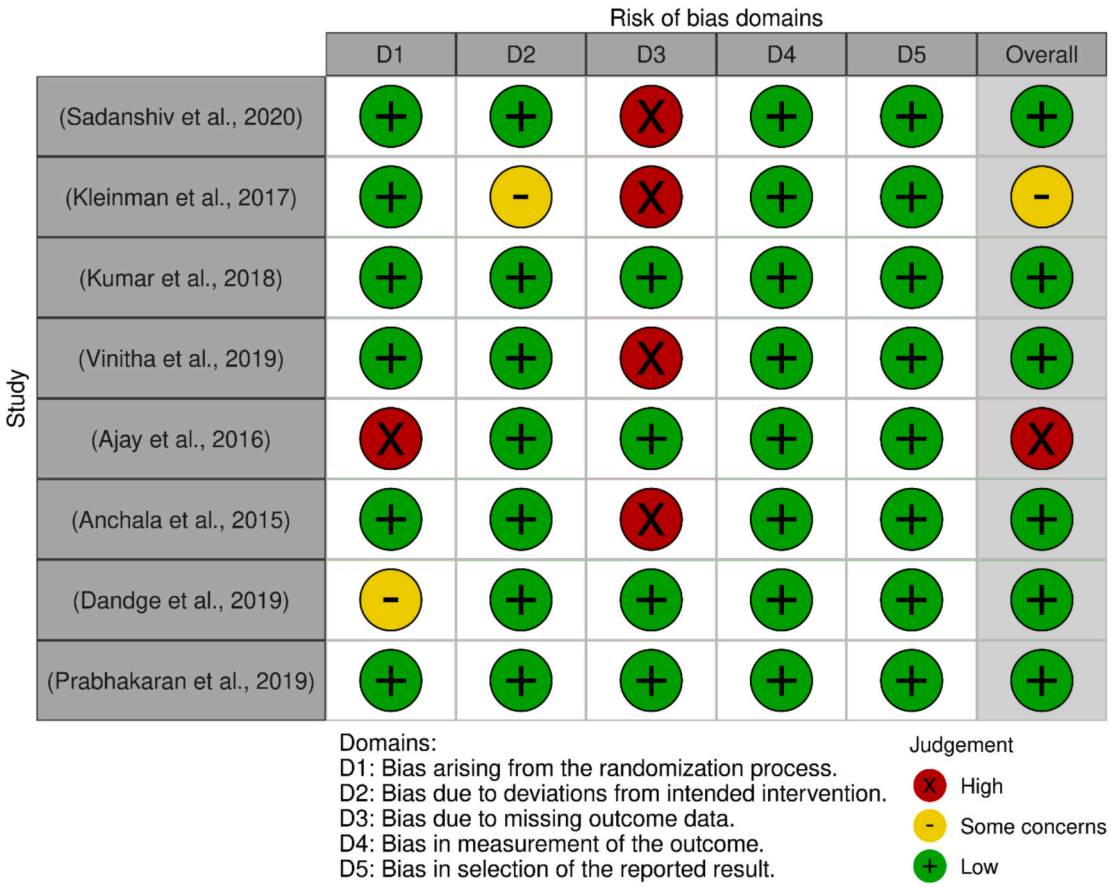

Fig. 2. Visual risk of bias assessment using the Cochrane risk of bias 2.0 tool for randomized controlled trials of mobile health interventions in Indian adults with hypertension and diabetes from inception to October 2024.

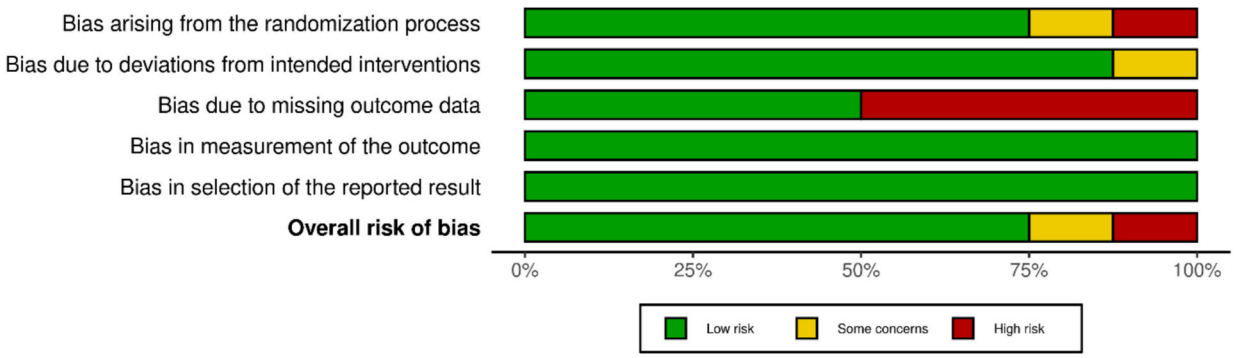

Fig. 3. Overview of bias risk distribution across studies evaluating digital health approaches for chronic disease management in India from inception to October 2024.

more participants reaching an HbA1c level of less than 7 % over two years. Conversely, Prabhakaran et al. (2019) evaluated a mHealth-based electronic decision support system for managing diabetes. The intervention and the control groups showed a reduction in HbA1c; however, the difference was not statistically significant.

3.5. FBG and blood sugar levels

FBG measures the amount of glucose in the blood following an overnight fast, typically about eight to 12 h without food. It is used for the diagnosis of diabetes as well as for monitoring the blood glucose control of persons with diabetes. Blood sugar refers to one's blood glucose level at any time. Across the studies, mobile-based interventions were associated with improved fasting blood glucose and blood sugar control (Kumar et al., 2018; Ajay et al., 2016; Dandge et al., 2019). For instance, Kumar et al. (2018) evaluated the effectiveness of mobile-based SMS intervention on FBG among patients with T2DM. The subjects in the intervention group were provided with personalized SMS messages related to target levels of FBG and follow-up for FBG testing for 12 months. Results showed that these subjects had a net reduction of mean FBG from 163.7 to 152.8 mg/dl, although not very high, but significant in the intervention group.

Similarly, Ajay et al. (2016) evaluated a nurse-led, mobile phone-enabled Clinical Decision Support System (CDSS) in the setting of the mPower Heart Project in India. The mean FBG significantly decreased (by 50.0 mg/dl), which showed that integrating technology like mobile

phones with healthcare delivery can help improve diabetes management by continuous monitoring and evidence-based care. Dandge et al. (2019) evaluated the Technology-Enabled Task-Sharing for Rural Areas project, where non-physician health workers within rural households implemented the mHealth tool for monitoring blood sugar. Regular follow-ups, digital consultations, and medication adherence resulted in 34.1 % of the diabetic population achieving blood sugar control after 24 months.

3.6. Blood pressure control

Blood pressure control is important in reducing cardiovascular disease risks because it controls both Systolic Blood Pressure (SBP), the pressure in the arteries when the heart contracts, and Diastolic Blood Pressure (DBP), or the pressure when the heart is resting. Across the studies, mHealth and digital interventions demonstrated significant potential to improve blood pressure control (Dandge et al., 2019; Vinitha et al., 2019; Ajay et al., 2016; Anchala et al., 2015). According to Vinitha et al. (2019), SBP and DBP decreased significantly after 24 months of text messaging intervention in patients newly diagnosed with T2DM. Additionally, Dandge et al. (2019) evaluated using non-physician health workers with mHealth tools to manage hypertension and diabetes in rural areas. The study recorded a cumulative improvement of 12 % in blood pressure control within 24 months; 54 % of the hypertensive patients attained target levels (Dandge et al., 2019).

Anchala et al. (2015) estimated the effect of the CDSS in managing hypertension in primary health centers in India. The results showed that the CDSS significantly reduced the SBP by an average of 6.59 mmHg compared to a traditional chart-based system, thus proving that digital decision support tools effectively control hypertension. Similarly, Ajay et al. (2016) developed a smartphone-based clinical decision support system that managed hypertension and diabetes in primary healthcare facilities (mPower Heart Project). The Clinical decision support system decreased the systolic and diastolic blood pressure by 14.6- and 7.6-mmHg, respectively, over 18 months.

3.7. Adherence and patient satisfaction

Other studies assessed adherence to medications and lifestyle modification as well as patient satisfaction and found that mobile-based interventions significantly improve treatment adherence and patient satisfaction (Sadanshiv et al., 2020; Kleinman et al., 2017). For instance, Sadanshiv et al. (2020) assessed the impact of a computer-generated telephonic messaging system on diabetic healthcare workers. The study found that 95.65 % received the texts regularly, while 93.17 % read them regularly. Moreover, 80.12 % followed the advice for better compliance with lifestyle modification. This intervention decreased Body Mass Index and yielded better results in terms of patient satisfaction: 93.17 % were more satisfied with their care. Compared with usual care, participants randomly assigned to the mHealth platform demonstrated significantly higher rates of medication adherence, 39.0 % versus 12.8 %, and frequency of blood glucose self-testing, 39.0 % versus 10.3 % (Kleinman et al., 2017). The platform was well accepted, with 75 % of participants using the app regularly over the six-month duration, thus potentially supporting long-term self-management behavior (Kleinman et al., 2017). Besides this, 80 % of the participants mentioned that the tool was satisfying and highly rated by all the involved healthcare providers.

3.8. Grading of recommendations assessment, development and evaluation (GRADE) quality evaluation

The overall confidence in the evidence for Blood Pressure Control, Fasting Blood Glucose and Blood Sugar Levels, Adherence and Patient Satisfaction was high due to consistent results across various studies. Nonetheless, varying outcomes compromised the certainty of the evidence for Glycated Hemoglobin, as summarized in Appendix Table 3.

4. Discussion

This study aimed to evaluate the impact of mobile-based interventions on hypertension and diabetes control in India. The goal is to provide valuable insights to the makers of policies, healthcare providers, and researchers toward developing culturally tailored and scalable emerging mHealth solution designs that can play a role in mitigating the ever-increasing burden of hypertension and diabetes in India.

The results demonstrated that mHealth technology-enabled interventions had a positive effect on controlling glycated hemoglobin levels. Previous systematic reviews and meta-analyses found similar (Mao et al., 2020). Mobile-based intervention technologies manage the level of glycated hemoglobin in diabetic patients effectively through better maintenance of behavioral changes and improvement in self-management of the condition (Sadanshiv et al., 2020). Text messaging and telephonic follow-ups can educate people with reminders for lifestyle modifications to maintain dietary and exercise recommendations. Studies have indicated that mHealth interventions result in significant HbA1c reductions, hence better long-term glycemic control (Kim and Hur, 2021). For instance, personalized messages may encourage patients to practice healthy behaviors and activities, such as regular exercise and proper nutrition, to keep their glucose within their target ranges. These interventions reduce the risk of diabetes-related complications and improve health outcomes by increasing engagement and enabling continuous monitoring (Kim and Hur, 2021). Integrating mHealth solutions into routine diabetes care improves adherence and patient satisfaction, enhancing glycemic control and reducing the burden of diabetes in India (Kim and Hur, 2021). This aligns with the study by Jackson et al. (2021), which highlights that Continuous Glucose Monitoring (CGM), initially used for Type 1 Diabetes Mellitus management, is now widely utilized for T2DM and is associated with lower HbA1c levels without an increased risk of hypoglycemia.

Mobile-based interventions were also associated with improvement in fasting blood glucose and blood sugar control. According to Kumar et al. (2018), the observed improvement across multiple studies was increased awareness and proactive management of such conditions through these digital health tools. Interventions keep patients on schedule and allow for timely examinations of problems that may arise, reducing the possibility of sustained hyperglycemia (Dandge et al., 2019). Such findings have practical implications for how mHealth interventions might provide a cornerstone in extending access to care and management of diabetes in resource-constrained areas where access to health care is limited. They are also cost-effective, scalable means to improve patient engagement and empower self-management, with the possible resultant improvement in long-term health outcomes and reduced healthcare costs due to diabetes-related complications (Ajay et al., 2016; Dandge et al., 2019).

This review also demonstrated that mHealth and other digital interventions improve blood pressure control. Mobile-based and digital interventions like mobile apps, text messaging, and telemedicine platforms supply health information at individual levels, including medication reminders and advice on lifestyle modifications (Thangada et al., 2018). One possible reason for improved blood pressure control is enhanced medication adherence, healthy lifestyle behavior, and regular self-monitoring. For example, reminders on medication intake enabled patients to maintain the regular antihypertensive therapy necessary to reduce SBP and DBP levels (Vinitha et al., 2019; Anchala et al., 2015). Secondly, the content of the digital interventions provided advice on dietary changes, such as a reduction in daily salt intake while also encouraging physical activity (Kurniasari and Yuniartika, 2024); this plays a contributory role in blood pressure management (Altawili et al., 2023). These interventions enable patients to make informed choices and immediately take corrective actions through real-time feedback and support, such as contacting a health provider when BP (Blood Pressure)

readings are high. Besides, mHealth tools provide for remote monitoring, in which case the healthcare provider frequently has access to patients' BP data and can make necessary timely adjustments in the treatment (Altawili et al., 2023). This proactive approach enables the screening and addressing of fluctuations in BP before they culminate into complications (Vinitha et al., 2019; Anchala et al., 2015). The convenience of accessing health information and support digitally makes these interventions particularly valuable in settings where traditional access to healthcare may be poor. Overall, mHealth and digital interventions have found their place in hypertension management, enabling continuous engagement of patients by enhancing adherence and offering sustainable lifestyle modifications that support long-term BP control (Vinitha et al., 2019; Anchala et al., 2015).

Limitations and Future Research: This study was not without limitations. Most included studies had relatively short follow-up durations of less than two years. The long-term effects and sustainability of mHealth interventions remain unclear. The limited number of studies exploring the impact of mobile-based interventions on hypertension and diabetes control in Indian adults and diverse intervention types made it challenging to draw better conclusions. Future research should examine the integration of mHealth interventions with other health services, the assessment of user engagement and cost-effectiveness, and the cultural and socio-economic factors influencing the effectiveness of interventions.

5. Conclusion

This review evidences the exciting potential for mHealth technology-enabled interventions in managing various chronic conditions, such as high blood pressure and diabetes. The results indicated that mHealth interventions significantly improved blood pressure and glycemic control, including HbA1c and FBG. Evidence supports that mHealth interventions, including SMS-based education through the mHealth platforms, have proven effective in improving treatment adherence and patient satisfaction. Due to an increasing burden of chronic diseases, incorporating mHealth interventions in routine healthcare could be a game-changing strategy toward improved health outcomes, particularly in resource-constrained settings where access to traditional care remains limited. The study provides a basis on which future research can be done to develop further and implement digital health strategies for the management of chronic diseases.

CRediT authorship contribution statement

Ramesh Kumar Huda: Writing – review & editing, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Rahul Singh Chowhan:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Dileep Seervi:** Writing – review & editing, Resources, Data curation.

Ethics approval and consent to participate

This study utilizes publicly available data and does not involve human participants; therefore, as a systematic review, it is exempted from the requirement of ethical approval.

Disclaimer

This study is based on a systematic review that analyses existing literature and relies only on secondary data available in the public domain. The findings, interpretations, and conclusions expressed in this manuscript are solely those of the authors and do not necessarily represent the views of any affiliated institution or organization. We have made every effort to ensure the accuracy and completeness of the information, but the possibility of errors or omissions cannot be completely excluded. For specific guidance, seeking advice from healthcare professionals and policymakers is recommended when implementing mobile health interventions in practice.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors did not use generative AI or AI-assisted technologies in the writing process of this manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Ramesh Kumar Hudda reports financial support was provided by ICMR-National Institute for Implementation Research on Non-Communicable Diseases. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgment

None.

Appendix A. Appendix

Table A1
Search strategy used to identify studies on mobile health interventions for managing hypertension and type 2 diabetes in Indian adults above 30 years from inception to October 2024.

Concept	Main keywords	Alternative Keywords/Synonyms
1	mHealth	Mobile health, mobile app, mobile phone, telemedicine, eHealth, Digital health, technology-based, Technology-enabled, Information Communication Technology (ICT)
2	Hypertension	High blood pressure, blood pressure control
3	Diabetes	Type 2 diabetes, T2DM, diabetes mellitus, blood sugar control
4	Management	Control, treatment, intervention, disease management
5	India	Indian

1. mHealth: Mobile Health

2. ICT: Information and Communication Technology
3. T2DM: Type 2 Diabetes Mellitus

Table A2
Summary of study characteristics, populations, interventions, and key-findings from mobile-based interventions on hypertension and type 2 diabetes control in India since database inception to October 2024.

Author	Study design	Participant characteristics		Intervention characteristics		Outcome measured	Main Findings
		Size, Sex	Mean Age/ Age Range yrs.	Type	Duration (Months)		
(Sadanshiv et al., 2020)	RCT	321, Male = 176. Female = 144	Inter. = 48.7 (7.4): Cont. =47.9 (8.0)	SMS-based educational messaging + standard diabetic care	3	Feasibility Glycemic control, patient satisfaction, adherence to lifestyle modifications.	Feasible, with 95.65 % of participants in the intervention arm receiving regular messages, and 93.17 % reading them regularly. 93.17 % reported greater satisfaction with their healthcare. Significant reduction in BMI (−0.6, $p < 0.001$) and HbA1c (−0.48, $p < 0.001$) in the intervention group.
(Kleinman et al., 2017)	RCT	90, Male = 63. Female = 27	48.4 (9.2)	m-Health diabetes management platform (Gather Health)	6	Change in HbA1c medication adherence, blood glucose testing frequency, diabetes self-care.	Significant improvements in medication adherence (39.0 % intervention vs. 12.8 % control; $p = 0.03$) and frequency of blood glucose self-testing (39.0 % intervention vs. 10.3 % control; $p = 0.01$) at six months. High app engagement (75 % active usage at week 24).
(Kumar et al., 2018)	RCT	955, Male = 333. Female = 622	Inter. = 57.5 (10.8): Cont. =57.0 (10.7)	Mobile phone-based SMSs	12	FBG	The mean FBG of the intervention group decreased significantly from 163.7 to 152.8 mg/dl, with a decrease from 150.5 to 149.2 mg/dl in the control group. The intervention was significantly effective, OR: 1.7, 95 % CI: 1.2–2.6, after adjustment for baseline FBG.
(Vinitha et al., 2019)	RCT	248, Male = 168. Female = 80	43.3 (8.7)	Text messaging	24	Blood pressure and glycemic variables.	The intervention and control groups demonstrated significant reduction from baseline to 24 months in both blood pressure and glycemic variables. Low density lipoprotein Cholesterol was significantly lower in the intervention group. Reduction of HbA1c was related to the text messaging intervention.
(Ajay et al., 2016)	Mixed method	6797, NR	30+	Mobile phone-based CDSS	18	SBP, DBP, FPG	By 18 months, the following significant reductions were observed: SBP -14.6 mmHg, DBP -7.6 mmHg, FPG −50.0 mg/dl. Improvements remained statistically significant when controlled for age, sex, and CHC location.
(Anchala et al., 2015)	RCT	1634, Male = 824. Female = 810	35–64	Mobile phone-based CDSS	12	SBP	In the DSS group, SBP was significantly lower than in the CBS group. The cost-effective ratio was $36.57 per mm of SBP reduction for DSS and $96.01 for CBS, thus indicating that DSS is more cost-effective in managing hypertension in resource-constrained PHC settings.
(Dandge et al., 2019)	RCT	602, Male = 291. Female = 311	40.0 (14.5)	mHealth and task-sharing strategies	24	Blood pressure, blood sugar levels	Blood pressure control was at 54.0 % and improved by 12 % among known hypertensives, while blood sugar control was 34.1 % among diabetic people. The prevalence of hypertension was found to be 23.6 %, with 38.9 % of cases being newly detected. Diabetes prevalence was 11.2 %, of which 28.6 % were newly detected.
(Prabhakaran et al., 2019)	RCT	3324, Male = 2041. Female = 1283	55.1 (11)	The mWellcare system	12	SBP and HbA1c	No significant difference in mean change in SBP ($\Delta = -0.98$) or HbA1c ($\Delta = 0.11$) between the mWellcare and enhanced usual care groups. There were reductions in SBP and HbA1c for both groups:

P-values mentioned in main findings were determined by the authors of the original studies, who employed various statistical tests to do so. These include standard statistical tests, but not limited to, chi-sqaure test or *t*-test, where appropriate.

1. Inter.: Intervention Group
2. Cont.: Control Group
3. mHealth: Mobile Health
4. FBG: Fasting Blood Glucose

5. CDSS: Clinical Decision Support System
6. SBP: Systolic Blood Pressure
7. DBP: Diastolic Blood Pressure
8. FPG: Fasting Plasma Glucose
9. HbA1c: Glycated Hemoglobin
10. RCT: Randomized Control Trial
11. CBS: Chart-Based Support
12. DSS: Decision Support Decision
13. CHC: Community Health Centre
14. PHC: Primary Health Care

Table A3
Certainty of evidence for effectiveness of mobile health tools in blood pressure and glycemic control among Indian adults with hypertension or diabetes from inception to October 2024.

Outcome	No. of Studies	Quality of Evidence
Glycated Hemoglobin	3	Moderate
Fasting Blood Glucose and Blood Sugar Levels	3	High
Blood Pressure Control	4	High
Adherence and Patient Satisfaction	2	High

Data availability

No data was used for the research described in the article.

References

Ajay, V.S., Jindal, D., Roy, A., Venugopal, V., Sharma, R., Pawar, A., Kinra, S., Tandon, N., Prabhakaran, D., 2016. Development of a smartphone-enabled hypertension and diabetes mellitus management package to facilitate evidence-based care delivery in primary healthcare facilities in India: the mPower heart project. J. Am. Heart Assoc. 5 (12). https://doi.org/10.1161/jaha.116.004343.

Altawili, A.A., Altawili, Mohammed Ahmad, Al-Wadai, Abdulah, Alahmadi, A.S., Alshehri, M.A., Muyini, B.H., Alshwwaf, A.R., Almarzooq, A.M., Alqarni, H.A., Zain, Mamdouh Mohammed, Al-Harbi, Alrashed, Y. M., & Almuhanna, N. M., 2023. An Exploration of Dietary Strategies for Hypertension Management: a Narrative Review. Cureus 15 (12). https://doi.org/10.7759/cureus.50130.

Anchala, R., Kaptoge, S., Pant, H., Di Angelantonio, E., Franco, O.H., Prabhakaran, D., 2015. Evaluation of effectiveness and cost-effectiveness of a clinical decision support system in managing hypertension in resource-constrained primary health care settings: results from a cluster randomized trial. J. Am. Heart Assoc. 4 (1). https://doi.org/10.1161/jaha.114.001213.

Bergonsi, C., Coelli, S., Satler, F., Brondani, L., Zelmanovitz, T., Silveiro, S.P., 2021. Glycated hemoglobin and blood pressure levels in adults with type 2 diabetes: how many patients are on target? Can. J. Diabetes 45 (4), 334–340. https://doi.org/10.1016/j.jcjd.2020.10.002.

Blake, A., Hazel, A., Jakurama, J., Matundu, J., Bharti, N., 2023. Disparities in mobile phone ownership reflect inequities in access to healthcare. PLOS Digital Health 2 (7), e0000270. https://doi.org/10.1371/journal.pdig.0000270.

Corbett, M.S., Higgins, J.P.T., Woolacott, N.F., 2013. Assessing baseline imbalance in randomized trials: implications for the Cochrane risk of bias tool. Res. Synth. Methods 5 (1), 79–85. https://doi.org/10.1002/jrsm.1090.

Dandge, S., Jeemon, P., Reddy, P.S., 2019. Technology enabled non-physician health workers extending telemedicine to rural homes to control hypertension and diabetes (TETRA): a pre-post demonstration project in Telangana, India. PLoS One 14 (2). https://doi.org/10.1371/journal.pone.0211551.

Eberle, C., Stichling, S., 2020. Telemetric interventions improve HbA1c and management of type 2 diabetes effectively: a systematic meta-review (preprint). J. Med. Internet Res. 23 (2). https://doi.org/10.2196/23252.

Jackson, M.A., Ahmann, A., Shah, V.N., 2021 Mar 1. Type 2 diabetes and the use of real-time continuous glucose monitoring. Diabetes Technol. Ther. 23 (S1). https://doi.org/10.1089/dia.2021.0007. S-27.

Kim, J., Hur, M.-H., 2021. The effects of dietary education interventions on individuals with type 2 diabetes: a systematic review and Meta-analysis. Int. J. Environ. Res. Public Health 18 (16), 8439. https://doi.org/10.3390/ijerph18168439.

Kleinman, N.J., Shah, A., Shah, S., Phatak, S., Viswanathan, V., 2017. Improved medication adherence and frequency of blood glucose self-testing using an m-health platform versus usual Care in a Multisite Randomized Clinical Trial among People with type 2 diabetes in India. Telemedicine and E-Health 23 (9), 733–740. https://doi.org/10.1089/tmj.2016.0265.

Kumar, D., Raina, S., Sharma, S., Raina, S., Bhardwaj, A., 2018. Effectiveness of randomized control trial of mobile phone messages on control of fasting blood glucose in patients with type-2 diabetes mellitus in the northern state of India. Indian J. Public Health 62 (3), 224. https://doi.org/10.4103/ijph.ijph_199_17.

Kurniasari, E., Yuniartika, W., 2024. Controlling blood sugar levels with diet in diabetes mellitus sufferers: literature review. Int. J. Public Health 1 (3), 1–8.

Mao, Y., Lin, W., Wen, J., Chen, G., 2020. Impact and efficacy of mobile health intervention in the management of diabetes and hypertension: a systematic review and meta-analysis. BMJ Open Diabetes Res. Care 8 (1), e001225. https://doi.org/10.1136/bmjdrc-2020-001225.

Methley, A.M., Campbell, S., Chew-Graham, C., McNally, R., Cheraghi-Sohi, S., 2014. PICO, PICOS, and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. BMC Health Serv. Res. https://doi.org/10.1186/s12913-014-0579-0, 14(1), 1–10. NCBI.

Mohan, V., Pradeepa, R., 2021. Epidemiology of type 2 diabetes in India. Indian J. Ophthalmol. 69 (11), 2932. https://doi.org/10.4103/ijo.ijo_1627_21.

Nahar, P., Kannuri, Nanda Kishore, Mikkilineni, S., Murthy, G., Phillimore, P., 2017. mHealth and managing chronic conditions in rural areas: a note of caution from southern India. Anthropol. Med. 24 (1), 1–16.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Br. Med. J. 372 (71). https://doi.org/10.1136/bmj.n71.

Prabhakaran, D., Jha, D., Prieto-Merino, D., Roy, A., Singh, K., Ajay, V.S., Jindal, D., Gupta, P., Kondal, D., Goenka, S., Jacob, P., Singh, R., Kumar, B.G.P., Perel, P., Tandon, N., Patel, V., Venkat, C., Ram, S., Saxena, S., Venugopal, K., 2019. Effectiveness of a mHealth-based electronic decision support system for integrated Management of Chronic Conditions in primary care. Circulation 139 (3), 380–391. https://doi.org/10.1161/circulationaha.118.038192.

Ramakrishnan, S., Zachariah, G., Gupta, K., Shivkumar Rao, J., Mohanan, P.P., Venugopal, K., Sateesh, S., Sethi, R., Jain, D., Bardolei, N., Mani, K., Kakar, T.S., Kidambi, B., Bhushan, S., Verma, S.K., Bhargava, B., Roy, A., Kothari, S.S., Gupta, R., Bansal, S., 2019. Prevalence of hypertension among Indian adults: results from the great India blood pressure survey. Indian Heart J. 71 (4), 309–313. https://doi.org/10.1016/j.ihj.2019.09.012.

Sadanshiv, M., Jeyaseelan, L., Kirupakaran, H., Sonwani, V., Sudarsanam, T.D., 2020. Feasibility of computer-generated telephonic message-based follow-up system among healthcare workers with diabetes: a randomized controlled trial. BMJ Open Diabetes Res. Care 8 (1), e001237. https://doi.org/10.1136/bmjdrc-2020-001237.

Sarki, A.M., Nduka, C.U., Stranges, S., Kandala, N.-B., Uthman, O.A., 2015. Prevalence of hypertension in low- and middle-income countries. Medicine 94 (50), e1959. https://doi.org/10.1097/md.0000000000001959.

Suri, H., 2020. Ethical considerations of conducting systematic reviews in educational research. Systematic Reviews in Educational Research: Methodology, Perspectives and Application 41–54. https://doi.org/10.1007/978-3-658-27602-7_3.

Swami, S.S., Swami, S.C., Patil, V.W., Kanhere, Anuradha M., 2015. Hypertension and diabetes in India: a review. Int J Clin Biochem Res 2 (1), 54–58.

Thangada, N.D., Garg, N., Pandey, A., Kumar, N., 2018. The emerging role of Mobile-health applications in the Management of Hypertension. Curr. Cardiol. Rep. 20 (9). https://doi.org/10.1007/s11886-018-1022-7.

Vinitha, R., Nanditha, A., Snehalatha, C., Satheesh, K., Susairaj, P., Raghavan, A., Ramachandran, A., 2019. Effectiveness of mobile phone text messaging in improving glycaemic control among persons with newly detected type 2 diabetes. Diabetes Res. Clin. Pract. 158, 107919. https://doi.org/10.1016/j.diabres.2019.107919.