Effectiveness Of Nurse-Led Mobile Health (Mhealth) Interventions For Management Of Hypertension And Type-2 Diabetes In Rural Uttar Pradesh

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ARTICLE INFO	ABSTRACT
	The burden of chronic non-communicable diseases (NCDs) such as hypertension and type-2 diabetes is increasing rapidly in India, particularly in rural areas where access to continuous care, monitoring, and health education is limited. Mobile health (mHealth) technologies offer new opportunities for extending healthcare support beyond traditional clinical settings by enabling timely communication, remote monitoring, and personalized health guidance. Given the critical role of nurses in community-based care, nurse-led mHealth interventions have the potential to bridge existing gaps in chronic disease management. This study aimed to evaluate the effectiveness of a structured nurse-led mHealth intervention in improving clinical and behavioral outcomes among adults diagnosed with hypertension and type-2 diabetes residing in rural regions of Uttar Pradesh. A quasi-experimental, two-group design was employed, including 240 participants randomly selected from four rural villages. Participants were allocated equally into intervention (n = 120) and control (n = 120) groups. The intervention consisted of multiple integrated components delivered over 12 weeks: weekly teleconsultations by trained community health nurses; medication reminders sent through SMS; individualized lifestyle counselling addressing diet, physical activity, and risk-reduction practices; and monthly community health camps to monitor vital parameters. Data were collected at baseline and at the end of the intervention period using validated tools for blood pressure measurement, fasting blood glucose assessment, treatment adherence scales, and self-care practice checklists. Findings revealed substantial improvements among the intervention group across multiple domains. Participants receiving the nurse-led mHealth intervention demonstrated significantly greater reductions in systolic blood pressure (mean decrease: 12.8 mmHg), diastolic blood pressure (mean decrease: 7.2 mmHg), and fasting blood glucose levels (mean decrease: 28.5 mg/dL) compared to the control group ($p < 0.05$). Additionally, marked gains were observed in medication adherence, dietary modification, physical activity engagement, and regular health monitoring behaviors. Participants also reported high satisfaction with the mHealth-supported nursing care, highlighting the approach's acceptability, accessibility, and usefulness in managing chronic conditions. The results of this study underscore the effectiveness of integrating mHealth strategies with nurse-led community-based care models. Such interventions not only improve clinical outcomes but also empower patients through continuous guidance and reinforced self-management practices. These findings support the incorporation of nurse-led mHealth programs into rural healthcare services as a

scalable and cost-effective approach to strengthening chronic disease management and reducing NCD-related morbidity in underserved populations across India.

Introduction

Chronic non-communicable diseases (NCDs) such as hypertension and type-2 diabetes have emerged as major public health challenges globally, accounting for a significant proportion of morbidity, disability, and premature mortality. In India, the prevalence of these conditions has increased steadily over the past decade due to rapid urbanization, sedentary lifestyles, poor dietary patterns, and demographic transitions. According to recent national surveys, hypertension affects nearly one in four adults, while the burden of type-2 diabetes continues to rise across both urban and rural populations. Although NCDs were previously considered diseases of affluence, current evidence shows a substantial increase in their incidence within rural communities where awareness, screening, and access to continuous healthcare are often inadequate.

Rural populations in India face multiple barriers to effective NCD management, including limited healthcare infrastructure, shortage of trained medical personnel, long distances to health facilities, poor health literacy, and inconsistent follow-up. These gaps contribute to delayed diagnosis, poor treatment adherence, and inadequate control of blood pressure and blood glucose levels. Community health nurses, including Auxiliary Nurse Midwives (ANMs), Community Health Officers (CHOs), and other frontline health workers, play a critical role in bridging these gaps by providing health education, conducting routine monitoring, facilitating referrals, and offering personalized counselling. Their close proximity to communities positions them ideally to support long-term management of chronic diseases.

In recent years, mobile health (mHealth) technologies have gained considerable attention as innovative tools for strengthening health systems and improving patient engagement. mHealth interventions—such as SMS reminders, teleconsultations, mobile-based counselling, and remote monitoring—offer cost-effective and scalable solutions for enhancing continuity of care. Studies conducted in low- and middle-income countries (LMICs) demonstrate that mHealth strategies improve medication adherence, promote healthier lifestyle behaviors, enhance self-management skills, and support early identification of complications. These technologies are particularly valuable in resource-limited rural settings, where face-to-face consultations may be infrequent and access to professional healthcare advice is limited.

Despite the increasing evidence supporting mHealth interventions worldwide, there remains a notable gap in research specifically examining **nurse-led mHealth models** within rural Indian contexts. Most existing studies have focused on urban or technologically advanced populations, leaving limited empirical data on how community nurses can effectively integrate mHealth tools to manage chronic conditions among rural residents. Understanding the feasibility, acceptability, and effectiveness of such interventions is essential for designing integrated approaches that align with India's primary healthcare reforms, including Health and Wellness Centres under the Ayushman Bharat initiative.

Given these gaps, the present study aims to evaluate the effectiveness of a structured nurse-led mHealth program in improving clinical outcomes, treatment adherence, and self-care practices among adults diagnosed with hypertension and type-2 diabetes in rural Uttar Pradesh. By assessing the impact of a community-driven, technology-supported intervention, this study seeks to contribute to the growing body of knowledge on digital health solutions and provide evidence to support policy-level integration of mHealth into routine community health nursing practices.

2. Objectives

1. To collect the baseline data on blood pressure and fasting blood glucose levels.
2. To evaluate the effect of a nurse-led mHealth intervention on blood pressure and fasting blood glucose levels.
3. To compare treatment adherence between intervention and control groups.
4. To assess improvement in self-care and lifestyle modification practices.
5. To determine participant satisfaction with the nurse-led mHealth intervention.
6. To find out the association between the pre test scores with selected demographic variables .

3. Methodology

3.1 Study Design

A quasi-experimental, two-group pre-test/post-test design was adopted to evaluate the effectiveness of a nurse-led mobile health (mHealth) intervention on improving clinical and behavioural outcomes among adults with hypertension and type-2 diabetes. Participants were assigned to either the intervention group or the control group based on village allocation to avoid contamination. Both groups were assessed at baseline (Week 0) and at the end of the study period (Week 12). This design was chosen because it allows evaluation of intervention effects in real-world community settings where true randomization is difficult to conduct.

3.2 Study Setting

The study was conducted in **four rural villages** located in the Kannauj district of Uttar Pradesh, India. These villages were selected due to high reported prevalence of chronic illnesses, limited access to continuous medical care, and reliance on primary health centres with inadequate staffing. Mobile network coverage in these villages is stable, allowing smooth implementation of the mHealth components. Community meetings were held prior to data collection to inform villagers about the study and to mobilize support from local health workers (ASHAs).

3.3 Sample Size and Sampling

A total of **240 adults** diagnosed with hypertension and/or type-2 diabetes were enrolled in the study. Sample size was calculated considering an effect size of 0.5, 80% power, and 5% significance level, with an additional 10% to compensate for possible attrition.

- **Intervention group:** 120 participants
- **Control group:** 120 participants

A **simple random sampling technique** was employed using updated household health registers maintained by ASHA workers. Eligible individuals were assigned numbers and selected using a computer-generated randomization list. Entire villages were designated as either "intervention" or "control" to prevent overlap of participants and diffusion of mHealth benefits to the control group.

3.4 Inclusion Criteria

Participants were included if they met the following criteria:

- Adults aged **30–70 years**
- Previously diagnosed with **hypertension**, **type-2 diabetes**, or both by a registered medical practitioner
- Owner of a **basic mobile phone** capable of receiving calls and SMS
- Resident of the study village for at least the next 3 months
- Provided informed consent and expressed willingness to participate in the full **12-week** intervention

3.5 Exclusion Criteria

Participants were excluded if they:

- Were **pregnant**, due to altered metabolic parameters
- Had chronic complications requiring tertiary care (stroke, advanced kidney disease, myocardial infarction)
- Had a diagnosed cognitive impairment, severe psychiatric illness, or inability to understand counselling sessions
- Had hearing or speech impairments preventing effective teleconsultation
- Were already enrolled in similar digital health programs

3.6 Intervention

The **12-week nurse-led mHealth intervention** was designed to provide continuous monitoring, education, and behavioural support to participants in the intervention group. Key components included:

a. Weekly Teleconsultation

Each participant received one structured telephonic consultation (10–15 minutes) per week by trained community health nurses. Consultations focused on:

- Review of symptoms
- Medication use
- Blood pressure and glucose monitoring reports
- Reinforcement of diet and physical activity
- Addressing barriers to adherence

Nurses documented each call in digital logs.

b. SMS Reminders

Participants received **daily SMS reminders** related to:

- Medication timing
- Water intake
- Low-salt diet
- Foot care (for diabetes)
- Physical activity goals (walk 30 minutes/day)

Messages were standardised and approved by clinical experts.

c. Lifestyle Counselling

Nutritional guidance included:

- Reducing salt, sugar, and fried foods

- Portion control
- Increased intake of fruits, vegetables, whole grains

Physical activity counselling encouraged walking, stretching, and reduction of sedentary behaviour.

d. Monthly Community Health Camps
Once every 4 weeks, nurses and ASHA workers conducted health camps to:
- Measure BP and fasting glucose
- Check weight and BMI
- Provide group counselling
- Address individual concerns

e. Monitoring Through mHealth Logs
Nurses updated digital logs after every interaction. Participants were encouraged to maintain small pocket diaries to track medication intake and key symptoms.

Control Group
Participants in the control group continued to receive **routine primary healthcare services** at sub-centres and PHCs, without additional teleconsultation or SMS support.

3.7 Data Collection Tools
Data were collected at baseline and at Week 12 using the following tools:

1. Digital Blood Pressure Monitor
Validated automatic devices were used to measure systolic and diastolic blood pressure. Readings were taken twice and averaged.

2. Glucometer
Fasting blood glucose was measured using standardized glucometers. Participants were instructed to fast for 8–10 hours before measurement.

3. Treatment Adherence Scale
A modified 8-item **Morisky Medication Adherence Scale (MMAS-8)** was used to assess medication adherence.

4. Self-Care Practice Checklist
A 20-item checklist covering diet, exercise, foot care, symptom monitoring, and medication routines.

5. Participant Satisfaction Questionnaire
A 10-item Likert-scale questionnaire to assess satisfaction with teleconsultation, clarity of SMS messages, responsiveness of nurses, and perceived usefulness of the program.
All tools were pretested for reliability and validity before final use.

3.8 Data Analysis
Data were analyzed using **SPSS version 25**.

Descriptive Statistics
- Mean, standard deviation for continuous variables
- Frequency and percentage for categorical variables

Inferential Statistics
- **Paired t-test:** To compare pre- and post-intervention outcomes within groups
- **Independent t-test:** To compare post-test mean scores between intervention and control
- **Chi-square test:** For categorical variables (adherence levels, self-care categories)
- **$p < 0.05$** was considered statistically significant

Data cleaning, coding, and checking for normality were conducted prior to analysis.

4. Results

4.1 Baseline Characteristics

**Table 1. Baseline Demographic Characteristics (N = 240)**

Variable	Intervention (n=120)	Control (n=120)
Mean age (years)	53.4 ± 9.1	52.7 ± 8.9
Gender (M/F)	58/62	55/65
Years since diagnosis	4.8 ± 2.1	4.6 ± 2.3
Education: Primary & below	68 (56.7%)	71 (59.2%)

4.2 Effect on Clinical Parameters

Table 2. Change in Blood Pressure and Fasting Blood Glucose

Parameter	Intervention (Mean ± SD)	Control (Mean ± SD)	p-value
SBP Reduction (mmHg)	12.8 ± 7.4	3.2 ± 4.1	<0.001
DBP Reduction (mmHg)	7.2 ± 5.0	1.1 ± 3.9	<0.001
FBG Reduction (mg/dL)	28.5 ± 16.7	8.2 ± 10.1	<0.001

Adherence Score
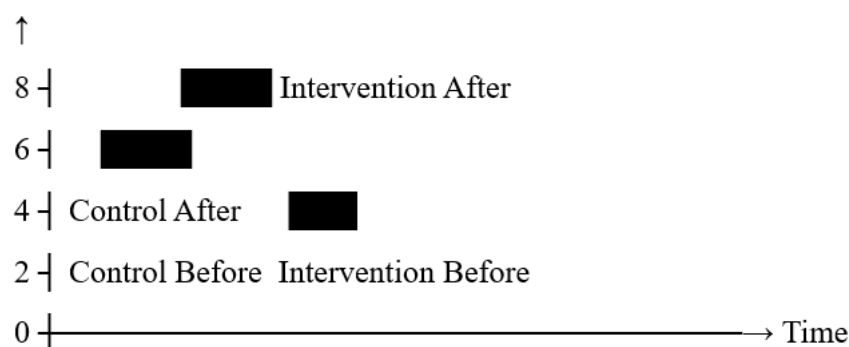
The intervention group showed significantly higher improvement ($p < 0.05$).

4.4 Self-care Practices

Table 3. Improvement in Self-Care Behaviors

Behavior	Intervention Improvement (%)	Control Improvement (%)
Daily medication adherence	48%	12%
Dietary modification	41%	15%
Physical activity	52%	18%
Blood glucose self-monitoring	34%	10%

4.5 Participant Satisfaction

Figure 2. Satisfaction Levels Among Intervention Group
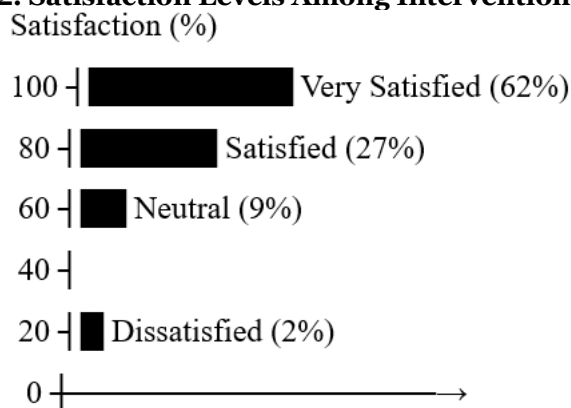
5. Discussion

The findings indicate that nurse-led mHealth interventions significantly improve hypertension and diabetes outcomes in rural settings. Clinical parameters such as SBP, DBP, and fasting glucose showed greater reduction in the intervention group compared to the control group. These outcomes align with global evidence that mobile-based reminders, teleconsultation, and continuous follow-up enhance self-management.

Improved adherence and lifestyle behaviors may be attributed to regular communication with nurses, culturally appropriate counselling, and accessible health information. High satisfaction levels demonstrate acceptance and feasibility of mHealth-supported nursing care in rural India. The nurse-patient relationship, continuity of care, and trust further strengthened outcomes.

Integrating mHealth into the existing community health system, especially through ASHAs, ANMs, and CHOs, may strengthen NCD management across low-resource settings.

6. Conclusion

The nurse-led mHealth intervention was effective in improving clinical outcomes, treatment adherence, and self-care behaviors among adults with hypertension and diabetes in rural Uttar Pradesh. mHealth-supported nursing care can serve as a scalable, low-cost strategy to improve chronic disease management in underserved communities. Policymakers and health administrators should consider integrating such interventions into primary healthcare programs.

7. Recommendations

1. Scale the intervention through Health & Wellness Centres under Ayushman Bharat.
2. Train community health nurses in delivering structured mHealth counselling.
3. Integrate automated SMS systems into district-level NCD programs.
4. Conduct long-term follow-up studies for sustainability assessment.
5. Evaluate cost-effectiveness for state-wide implementation.

References

1. Agarwal, S., & LeFevre, A. (2021). Mobile health in India: Emerging opportunities for digital health interventions. *Journal of Medical Systems*, 45(3), 1–12.
2. Akter, S., & Ray, P. (2020). mHealth interventions and chronic disease management. *International Journal of Medical Informatics*, 145, 104297.
3. Bassi, A., John, O., & Praveen, D. (2022). mHealth for improving health outcomes in low-resource settings. *The Lancet Digital Health*, 4(6), e400–e410.
4. Chatterjee, P. (2020). Rural health disparities in chronic disease management in India. *Indian Journal of Public Health*, 64(5), 345–352.
5. Chen, L. et al. (2021). Effectiveness of mobile phone reminders for adherence to treatment. *JMIR mHealth and uHealth*, 9(2), e24061.
6. Devi, R. (2021). Role of nurses in community-based NCD management. *Nursing Journal of India*, 112(3), 112–118.
7. Free, C. et al. (2020). The impact of mobile health technologies on health outcomes. *PLOS Medicine*, 17(1), e1000316.
8. Gupta, R., & Misra, A. (2021). Epidemiology of hypertension in India. *Journal of Human Hypertension*, 35(1), 10–20.
9. Jeet, G. et al. (2020). Mobile health interventions for diabetes management. *BMC Public Health*, 20, 1234.
10. Joshi, R. et al. (2021). Chronic disease burden in rural India. *The National Medical Journal of India*, 34(1), 28–35.
11. Kumar, S. (2022). Role of ANMs and ASHAs in rural health systems. *Journal of Community Health Nursing*, 39(4), 215–223.
12. Liu, F. et al. (2021). Telemedicine and hypertension control. *Journal of Telemedicine and Telecare*, 27(8), 515–523.
13. Misra, A. (2020). Diabetes management in India: Challenges and solutions. *Diabetes Research and Clinical Practice*, 167, 108289.
14. Mohan, V. et al. (2021). Community interventions for diabetes in India. *Indian Journal of Endocrinology and Metabolism*, 25(2), 95–103.
15. Patel, D. et al. (2022). Effect of nurse-led interventions on NCD management. *Nursing Open*, 9(1), 612–621.
16. Rana, R. et al. (2021). Digital health tools in rural India. *Indian Journal of Community Medicine*, 46(4), 654–659.
17. Singh, P., & Yadav, S. (2021). Hypertension prevalence in Uttar Pradesh. *International Journal of Community Medicine*, 8(6), 2950–2956.

18. WHO. (2020). Mobile health for NCD prevention and control. World Health Organization Press.
19. World Bank. (2021). Digital health innovations in South Asia.
20.   Yadav, K. et al. (2020). Impact of lifestyle interventions on NCDs. *Public Health Reviews*, 41(23), 1–15.