



Original Article

Effect of a digital application on knowledge, treatment adherence, and blood pressure control in hypertensive patients: a quasi-experimental study

Hermansyah^{1✉}, Septiyanti¹, Dwi Wulandari¹, Tri Lestari Handayani², Kuswanto Rusca Putra³

¹ Department of Nursing, Ministry of Health Polytechnic of Bengkulu, Bengkulu, Sumatera, Indonesia

² Department of Nursing, Faculty of Nursing, University of Muhammadiyah Malang, Malang, East Java, Indonesia

³ Department of Nursing, Faculty of Health Sciences, Brawijaya University, Malang, East Java, Indonesia

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CORRESPONDENCE

Phone: +6281367947929

E-mail: hermansyah1975@poltekkesbengkulu.ac.id

ABSTRACT

Background: The prevalence of hypertension increases annually, posing a significant public health concern. Digital health applications have emerged as potential tools to support hypertension management; however, most existing applications lack features that provide adequate information and education to patients.

Objective: To evaluate the effect of a digital application on patients' knowledge, treatment adherence, and blood pressure control in hypertensive patients.

Methods: A quasi-experimental study with a pre-test and post-test design and control group was conducted in 2024. Sixty respondents diagnosed with hypertension were selected through purposive sampling and divided equally into intervention (n = 30) and control (n = 30) groups. The intervention group received access to a custom-developed digital application, while the control group received standard care. Data were analysed using the Mann-Whitney test.

Results: The results showed that the use of the digital application significantly increased knowledge, improved adherence, and reduced blood pressure among hypertensive patients (p = 0.013).

Conclusion: The digital application had a positive and statistically significant effect on patients' knowledge, treatment adherence, and blood pressure control, indicating its potential as a supportive tool for hypertension management in primary health care.

INTRODUCTION

Non-communicable diseases (NCDs) are the leading cause of mortality worldwide. NCDs account for 29% of deaths in developing countries and 13% in developed countries, with annual deaths projected to reach 52 million by 2030.¹ One NCD with a notable increase in prevalence is hypertension, which rose from 34.1% in 2013 to 8.3% in 2020.² Hypertension is a chronic condition characterized by elevated blood pressure, which increases the heart's workload. Globally, approximately 1.13 billion people are living with hypertension, yet only about 20% have their blood pressure under control.³ Major risk factors contributing to the rising prevalence of hypertension in low- and middle-income countries include unhealthy diets, physical inactivity, and excessive alcohol consumption.

In Indonesia, the prevalence of hypertension is reported at 31.3% in men and 36.9% in women, with Bengkulu Province recording 11,373 cases in a single year. A high intake of salt, fat, and processed foods, combined with low fruit and vegetable consumption, has been identified as a major dietary contributor to hypertension. Management of hypertension generally involves both pharmacological and non-pharmacological approaches.⁴ Pharmacological treatments include antihypertensive agents such as diuretics, beta-blockers, vasodilators, and angiotensin-converting enzyme inhibitors. Non-pharmacological interventions focus on lifestyle modifications, including weight reduction, sodium restriction, and increased physical activity. However, despite these strategies, studies indicate that 32.3% of hypertensive patients do not take their medications regularly, and 13.3% do not take them at all,

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often due to limited education and awareness.^{5,6}

In recent years, the use of digital applications to support medication adherence and health monitoring has increased significantly. Evidence suggests that web and Android-based applications can enhance patient compliance with hypertension management by integrating medication reminders, blood pressure monitoring, activity recommendations, and educational content about hypertension complications.⁷ Previous studies have demonstrated that health applications can improve adherence to hypertension treatment.⁸ However, most research has focused solely on medication adherence. It has not comprehensively addressed integrating lifestyle management, dietary modification, physical activity, and self-monitoring of blood pressure within a single application.^{9,10} Therefore, this study aims to evaluate the effect of a digital application on improving knowledge, enhancing treatment adherence, and supporting blood pressure control among hypertensive patients.

METHOD

Study Design

This study employed a quasi-experimental method with a pre-test and post-test design.¹¹

Setting and Respondents

This study was conducted in 2024 at the Lempuing Community Health Center, Bengkulu City, with a total population of 349 individuals. Sixty hypertensive patients were recruited using purposive sampling and equally allocated into two groups: 30 in the intervention group and 30 in the control group. Inclusion criteria included hypertensive patients with blood pressure > 140/90 mmHg, aged under 60 years, willing to participate from start to finish, and having access to an Android mobile phone either personally or via a family member. Exclusion criteria included difficulty maintaining focus, absence from more than one session, or health conditions preventing participation. The sampling technique used was purposive sampling.

The Variable, Instrument and Measurement

The outcomes assessed in this study were systolic and diastolic blood pressure, patient knowledge, and treatment adherence in hypertension management. Blood pressure was measured using a calibrated sphygmomanometer, while knowledge and adherence were assessed using a validated and reliable questionnaire. The digital application used in this study provided features for information management and hypertension control, including educational materials, medication reminders, and self-monitoring tools. Data collection was conducted at baseline and after the intervention period.

Experimental Procedure

Patients in the intervention group were given access to a custom developed digital hypertension management and control application. The application included educational

modules, medication reminders, and blood pressure self-monitoring tools, and was used three times per week for four weeks. The control group received standard hypertension care provided by the health center, without access to the application. Blood pressure, knowledge, and treatment adherence were measured at baseline and reassessed at the end of the four-week intervention using the same validated instruments and procedures. The study protocol was conducted, including all intervention activities and assessments, and documentation was ensured to ensure accuracy and consistency.

Data Analysis

Differences in knowledge, treatment adherence, and systolic and diastolic blood pressure between the intervention and control groups in this study were analyzed using the Mann–Whitney test.

Ethical Consideration

This study received ethical approval from the Research Ethics Committee of Jember University (No. KEPK.BKL/171/04/2024).

RESULTS

Table 1 presents the characteristics of the respondents. The average age was higher in the control group than in the intervention group. Most respondents were female, had a secondary education level, and worked primarily as housewives. The majority had been diagnosed with hypertension for 1–5 years.

Table 1. Characteristic Responden (n= 60)

Characteristic	Intervention	Control
Age		
Mean ± SD	48.53 ± 8.266	53.10 ± 5.307
Gender		
Male	12 (40%)	7 (23.3%)
Female	18 (60%)	23 (76.7%)
Education		
Elementary School	7 (23.3%)	2 (6.7%)
Junior High School	5 (16.7%)	7 (23.3%)
Senior High School	16 (53.3%)	15 (50.0%)
College	2 (6.7%)	6 (20.0%)
Job Employment		
Housewife	16 (53.3 %)	15 (50 %)
Private	2 (6.7%)	4 (13.3%)
Interpreneur	12 (40 %)	5 (16.7%)
Civil Servant	0 (0 %)	3 (10 %)
Retiree	0 (0 %)	3 (10. %)
Long Time of Illness, yr		
1 – 5	27 (90 %)	18 (60 %)
6 – 10	2 (6.7%)	8 (26.6 %)
11 – 15	1 (3.3%)	2 (6.7%)
16 – 20	0 (0 %)	0 (0 %)
21 – 25	0 (0 %)	2 (6.7%)

Table 2 shows that the intervention group experienced greater improvements than the control group across all measured outcomes. Knowledge and treatment adherence scores were significantly higher among digital application participants ($p= 0.001$ for both). In addition, the intervention group demonstrated greater reductions in systolic ($p = 0.028$) and diastolic blood pressure ($p = 0.013$), indicating that the digital application was practical in enhancing

patient knowledge, improving adherence, and supporting blood pressure control.

Table 2. Effect of Digital App on Patients' Knowledge, Compliance and Blood Pressure

Variable	Intervention Group	Control Group	Mean diff	U	p-value
Knowledge Score	3.83±1.262	2.7±1.236	1.13±0.026	233.500	0.001
Compliance Score	3.83±1.262	2.7±1.236	1.13±0.026	233.500	0.001
Systolic BP Reduction	11.03±8.198	6.83±4.997	4.2±3.201	312.000	0.028
Diastolic BP Reduction	9.17±4.794	5.5±4.798	3.67±0.049	298.500	0.013

Exp: BP: Blood Pressure

DISCUSSION

The findings of this study indicate that age, gender, education, occupation, and duration of illness influence hypertension incidence and management. Middle-aged and older adults were more prone to hypertension, consistent with previous studies demonstrating a significant association between age and hypertension.^{2,12} Women had a higher likelihood of developing hypertension, aligning with prior findings reporting a greater prevalence among females.¹³ Higher educational attainment was associated with a better understanding of hypertension management, whereas lower education posed barriers to receiving and comprehending health information.¹⁴ Housewives and individuals with lower socioeconomic status were at greater risk of hypertension, which is consistent with studies showing a higher prevalence in lower socioeconomic groups.¹⁵ Furthermore, patients with a disease duration of one to five years tended to be more compliant with medication, driven by curiosity and the desire for recovery, supporting earlier research findings.¹⁶

Statistical analysis further demonstrated that the development of a digital application for information management and hypertension control significantly impacted patients' knowledge, adherence, and blood pressure regulation. These results suggest that digital interventions can enhance patients' understanding of hypertension management, improve treatment adherence, and effectively control systolic and diastolic blood pressure. There was a statistically significant difference in mean knowledge scores between the intervention and control groups. This finding is in agreement with studies demonstrating a significant relationship between knowledge of hypertension and the ability to manage blood pressure effectively.^{17,18} Knowledge levels in hypertensive patients may be influenced by disease duration, with more extended illness duration often associated with better understanding of the causes, treatment, and the importance of regular medication use.¹⁹⁻²⁰

Compliance with hypertension management also showed a statistically significant improvement among patients using the digital application. This supports prior research highlighting the role of structured interventions in fostering medication adherence and behavioral changes necessary for effective hypertension control.^{21,22} Compliance can also be used as a proxy for patients' knowledge level in following medical instructions, which includes understanding prescriptions, taking medication regularly, and adopting recommended lifestyle changes.²³

Regarding blood pressure regulation, using the digital

application significantly affected systolic ($p=0.028$) and diastolic ($p=0.013$) blood pressure. These findings are consistent with prior studies reporting that technology-based interventions contribute to improved cardiovascular outcomes through continuous monitoring and timely health interventions. Patients with hypertension who received digital health management support achieved better blood pressure control than those who received conventional hypertension management education.^{9,24} Similar results have been reported in studies involving hypertensive patients, showing significant reductions in both systolic and diastolic blood pressure following digital health interventions.²⁵

These findings are consistent with previous research demonstrating the relationship between patient knowledge, adherence, and health outcomes. A significant correlation was observed between higher knowledge levels and improved adherence, as well as between adherence and optimal blood pressure control. This study reinforces the perspective that digital health applications can address gaps in hypertension education by offering accessible, user-friendly platforms that promote patient engagement and self-monitoring.²⁶ Integrating digital applications into hypertension management may represent an effective strategy to improve patient outcomes. Such applications can store patient histories, send medication reminders, and schedule consultations, enhancing adherence and enabling better health monitoring. Furthermore, digital health interventions allow for personalized care tailored to individual needs while reducing the burden on healthcare providers.

CONCLUSIONS AND RECOMMENDATION

This study demonstrated that the digital application effectively improved patients' knowledge, enhanced treatment adherence, and supported blood pressure control among hypertensive patients. Digital health applications can serve as a complementary strategy to strengthen self-care and optimize hypertension management at the community health center level. It is recommended that health centers continue to develop and implement digital applications for hypertension management, accompanied by adequate training for health workers and cadres. Future studies should involve larger populations and consider additional influencing factors such as diet, physical activity, and genetic predisposition to strengthen the generalizability of the results.

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