Jurnal Ilmiah STIKES Yarsi Mataram
http://journal.stikesyarsimataram.ac.id/index.php/jik
p-ISSN: 1978-89-40 | e-ISSN: 2807-940X
Vol. XVI, No. 2, Juli 2026, pp. 238-251

The Effect of Health Belief Model-based Health Education on Self-Management Behavior in Preventing Stroke Among Hypertension Patients

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Article History:
Received : 26-11-2025
Revised : 30-07-2026
Accepted : 28-07-2026
Online : 31-07-2026

Keyword:
Health Education;
Health Belief Model;
Hypertension;
Self-Management;
Stroke Prevention

ABSTRACT/ABSTRAK

This study examined the effect of Health Belief Model (HBM)–based health education delivered through an e-booklet on self-management behavior among patients with hypertension. A quasi-experimental, non-randomized control-group pretest–posttest study was conducted at a primary healthcare center in Surabaya, Indonesia. Forty patients with grade II hypertension were recruited through purposive sampling and allocated to intervention (n = 20) and control (n = 20) groups. The intervention group received six online educational sessions over three weeks, while the control group received routine leaflet-based education. Self-management was measured using the 40-item Hypertension Self-Management Behaviour Questionnaire. Data were analyzed using Wilcoxon signed-rank and Mann–Whitney U tests. The intervention group demonstrated significant improvements in self-integration, self-regulation, interaction with health workers, self-monitoring, and medication adherence (all p = 0.001), whereas the control group showed no significant changes. Post-intervention scores differed significantly between groups across all domains (p = 0.002, 0.025, 0.019, 0.004, and 0.022, respectively). HBM-based education through an e-booklet was associated with improved hypertension self-management and may complement routine education in primary healthcare.

Penelitian ini menganalisis pengaruh edukasi kesehatan berbasis Health Belief Model (HBM) melalui e-booklet terhadap perilaku manajemen diri pasien hipertensi. Penelitian kuasi-eksperimental dengan kelompok kontrol nonacak serta pengukuran prates–pascates dilakukan di salah satu pusat pelayanan kesehatan primer di Surabaya, Indonesia. Sebanyak 40 pasien hipertensi derajat II direkrut melalui purposive sampling dan dialokasikan ke kelompok intervensi (n = 20) dan kontrol (n = 20). Kelompok intervensi menerima enam sesi edukasi daring selama tiga minggu, sedangkan kelompok kontrol menerima edukasi rutin melalui leaflet. Manajemen diri diukur menggunakan 40 item Hypertension Self-Management Behaviour Questionnaire. Data dianalisis menggunakan uji Wilcoxon dan Mann–Whitney U. Kelompok intervensi mengalami peningkatan signifikan pada integrasi diri, regulasi diri, interaksi dengan petugas kesehatan, monitoring diri, dan kepatuhan pengobatan (seluruhnya p = 0,001), sedangkan kelompok kontrol tidak mengalami perubahan signifikan. Skor pascaintervensi berbeda signifikan antarkelompok pada seluruh domain (masing-masing p = 0,002; 0,025; 0,019; 0,004; dan 0,022). Edukasi berbasis HBM melalui e-booklet berhubungan

dengan peningkatan manajemen diri hipertensi dan dapat melengkapi edukasi rutin di pelayanan kesehatan primer.

A. INTRODUCTION

Hypertension remains one of the leading health challenges globally, with an increasing prevalence across both developed and developing countries (Mills et al., 2021). Approximately 1.28 billion people worldwide are affected by hypertension, making it a significant contributor to morbidity and mortality (World Health Organization (WHO), 2023). Despite its high prevalence, less than half of hypertensive individuals are diagnosed and adequately treated, which leads to the development of complications such as stroke, heart failure, and kidney disease (Kifle et al., 2022).

In Indonesia, the number of hypertensive cases is similarly alarming, with an estimated 72 million individuals suffering from the condition (Alfaqeeh et al., 2023; B. Islam et al., 2025). The country reports over 521,000 deaths annually attributed to hypertension, a major contributor to non-communicable diseases (NCDs) (Ministry of Health Republic Indonesia, 2024). Particularly in East Java, including Surabaya, the prevalence of hypertension is estimated at 11.7 million individuals, posing a significant public health burden. Data from a local primary healthcare facility in Surabaya indicate that hypertension cases among residents have reached 439 within a two-month period, underscoring the urgency of addressing this issue.

Hypertension management, however, is frequently hindered by poor self-management behavior among patients. This issue stems primarily from low levels of health literacy and a lack of effective educational interventions (Asseggaf et al., 2025; Golshiri et al., 2025). Many hypertensive patients fail to comprehend essential health information about their condition, leading to inadequate medication adherence, poor dietary choices, and inadequate self-monitoring of blood pressure (Mohl et al., 2025; Taderera, 2025). Traditional health education methods, such as lectures or pamphlets, often fail to engage patients effectively, rendering them insufficient in promoting meaningful behavioral changes (Sidabutar et al., 2023).

Recent studies have shown that health education based on the Health Belief Model (HBM) can effectively improve self-management behaviors in hypertensive patients (Azadi et al., 2021; Kasmaei et al., 2024; Kim et al., 2024). The HBM is a psychological model that explains and predicts health behaviors by focusing on individuals' perceptions of their susceptibility to a health issue, the severity of the condition, the benefits of taking action, and the barriers to action (Alyafei & Easton-Carr, 2024). Research suggests that HBM-based health education can significantly enhance patients' knowledge, attitudes, and practices regarding hypertension management, leading to improved medication adherence, dietary management, physical activity, and blood pressure control (Nematzad et al., 2023; Wang et al., 2024).

For instance, studies have demonstrated that interventions rooted in the Health Belief Model are associated with higher self-efficacy and improved self-regulation among patients, which are critical in managing chronic conditions like hypertension (Cao et al., 2022; Park et

al., 2025). Furthermore, these interventions have shown promise in preventing stroke and other complications associated with uncontrolled hypertension. This study aims to evaluate the effectiveness of HBM-based health education in enhancing self-management behavior among hypertensive patients in preventing stroke.

B. METHODS

Design and Participants

This study used a quasi-experimental, non-randomized control-group pretest–posttest design to evaluate the effect of Health Belief Model (HBM)-based health education on self-management behavior among patients with hypertension. The study was conducted from January to April 2025 at a primary health-care center in Surabaya, Indonesia. The health-care center provides preventive, promotive, and clinical services for patients with hypertension and other chronic conditions.

The study population comprised patients with hypertension attending the selected primary health-care center. Participants were recruited using purposive sampling based on predefined eligibility criteria. The inclusion criteria were: (1) aged 18–60 years; (2) diagnosed with grade II hypertension; (3) no history of stroke or other serious hypertension-related complications; (4) able to read and communicate in Indonesian; (5) able to access the educational materials through a smartphone; and (6) willing to participate by providing written informed consent.

Patients were excluded if they had visual, hearing, cognitive, or literacy limitations that prevented them from understanding the educational materials or completing the questionnaire. Patients who could not participate in the online educational sessions were also excluded.

A total of 40 eligible participants were enrolled and allocated non-randomly to the intervention group (n = 20) or control group (n = 20). The intervention group received HBM-based online health education, whereas the control group received routine hypertension education using a standard leaflet. Both groups completed pretest and posttest assessments over the same three-week period..

Instruments

The study used an HBM-based educational intervention and the Hypertension Self-Management Behaviour Questionnaire (HSMBQ). The educational intervention consisted of an e-booklet, educational videos, researcher-led explanations, and interactive discussions. The materials covered the definition and consequences of hypertension, healthy and balanced diets, physical activity, medication management, blood pressure monitoring, and stroke prevention. The educational content was structured according to the six principal constructs of the Health Belief Model. Perceived susceptibility was addressed by explaining participants' individual risk of stroke and other complications associated with uncontrolled hypertension. Perceived severity was strengthened by describing the potential physical, psychological, social, and economic consequences of stroke. Perceived benefits were emphasized by explaining the advantages of medication adherence, dietary modification, regular physical activity, and blood pressure monitoring. Perceived barriers were addressed through discussions and practical problem-solving strategies, including affordable dietary alternatives, feasible exercise plans,

and medication-taking routines. Cues to action were provided through WhatsApp reminders, scheduled sessions, summaries, and prompts to take medication and monitor blood pressure. Self-efficacy was strengthened through demonstrations, guided practice, goal-setting activities, and supportive feedback. Before implementation, the content, language, and clarity of the educational materials were reviewed by nursing and primary health-care practitioners.

Self-management behavior was measured using the Hypertension Self-Management Behaviour Questionnaire (HSMBQ), originally developed by Akhter (2010) and adapted into Indonesian based on the version used by Paramita et al. (2020). The questionnaire consisted of 40 items covering five domains: self-integration, self-regulation, interaction with health workers, self-monitoring, and medication adherence. Self-integration assessed participants' ability to incorporate healthy behaviors into their daily routines, whereas self-regulation evaluated their ability to recognize symptoms, establish health goals, and regulate hypertension-related behaviors. Interaction with health workers assessed communication and cooperation with health-care professionals. Self-monitoring measured routine blood pressure monitoring and awareness of changes in health status, while medication adherence assessed consistency in following the prescribed treatment regimen.

Responses were rated using a four-point Likert scale: always = 4, sometimes = 3, rarely = 2, and never = 1. Negatively worded items were reverse-scored. Domain scores were calculated by summing the relevant items, and the overall self-management score was obtained by summing all 40 items. Thus, the possible total score ranged from 40 to 160, with higher scores indicating better hypertension self-management behavior. Before the main study, the Indonesian version was pilot-tested among 30 patients with hypertension who were not included in the study sample. Item validity was evaluated using corrected item–total correlations. All 40 items exceeded the critical correlation value of 0.361 at $\alpha = 0.05$ and were therefore retained. The questionnaire demonstrated excellent internal consistency, with a Cronbach's alpha coefficient of 0.926.

Data Collection

After receiving approval from the university and the Surabaya Health Office (Dinas Kesehatan Surabaya), data collection was conducted by the researcher, who obtained information on stroke patients registered at one of the primary health care centers. Participant recruitment was conducted with support from a nurse, who assisted in identifying eligible individuals based on medical assessments and medical records. Before receiving any intervention, participants in both groups completed self-administered questionnaires covering socio-demographic characteristics and baseline self-management behaviors. Given the participants' advanced age and health conditions, accessibility during data collection was prioritized.

Health Belief Model-Based Health Education

The Health Belief Model (HBM)-based health education program was developed according to six HBM constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. These constructs were systematically incorporated into six online educational sessions conducted twice weekly for three consecutive weeks through a WhatsApp group.

Perceived susceptibility was addressed by helping participants recognize their personal risk of stroke and other complications of uncontrolled hypertension. Participants received information about hypertension as a frequently asymptomatic condition, individual risk factors, persistently elevated blood pressure, unhealthy dietary patterns, physical inactivity, inconsistent medication use, and inadequate blood pressure monitoring. The researcher encouraged participants to relate these risk factors to their own health conditions and daily behaviors.

Perceived severity was strengthened by explaining the clinical, psychological, social, and economic consequences of uncontrolled hypertension, including stroke, disability, and premature mortality. Perceived benefits were addressed by highlighting how medication adherence, a healthy diet, physical activity, blood pressure monitoring, and regular consultation could reduce complications. Perceived barriers were explored through interactive discussions and practical problem-solving regarding medication routines, affordable diets, suitable exercise, and access to blood pressure monitoring. Cues to action were provided through WhatsApp reminders, videos, e-booklet summaries, and prompts for recommended self-management activities. Self-efficacy was reinforced through demonstrations, guided practice, realistic goal setting, and supportive feedback on blood pressure monitoring, medication schedules, meal planning, and physical activity.

The Health Belief Model-based health education was delivered online and facilitated by a researcher. The educational sessions were designed to be simple, clear, and visually supportive. Educational sessions were conducted twice a week, specifically on Mondays and Wednesdays. Each session is conducted online via a WhatsApp group, allowing flexible participation in the digital learning booklet (e-booklet). Attendance was recorded at every session using an online presence checklist. To enhance understanding, the content was divided into shorter segments, accessible anytime through participants' smartphones. The researcher, as group administrator, provided reminders for each session and offered assistance when needed. During video sessions, participants had 10 minutes to review the video, followed by a 20-minute discussion for questions and clarification. A comment box remained open during discussions, and each session concluded with a summary of the material, confirmation of the next meeting schedule, and acknowledgment of participants' engagement. The educational materials were delivered using a combination of methods, including discussions, lectures, and educational videos. The full schedule of the intervention program is presented in **Table 1.** In the control group, the researcher explained the study procedures and provided standard health education typically offered in primary health care settings, primarily through leaflet distribution, without interactive sessions. During the third week, participants in the control group completed the post-test concurrently with the intervention group**.**

Table 1. Three-Week Health Belief Model–Based Health Education Program for the Intervention Group

Session	Topic	HBM constructs	Week	Duration
1	Hypertension management	Perceived susceptibility and severity	Week 1	30 minutes
2	Healthy and balanced diet	Perceived benefits and barriers	Week 1	20 minutes

Session	Topic	HBM constructs	Week	Duration
3	Physical activity	Perceived benefits, barriers, and self-efficacy	Week 2	20 minutes
4	Medication management	Perceived benefits, barriers, and cues to action	Week 2	30 minutes
5	Use of a digital blood pressure monitor	Self-efficacy and cues to action	Week 3	30 minutes
6	Stroke prevention	Perceived susceptibility, severity, and cues to action	Week 3	30 minutes

Data Analysis

Data were analyzed using IBM SPSS Statistics version 27. Categorical variables were summarized using frequencies and percentages, whereas continuous variables were summarized using means and standard deviations. Baseline categorical characteristics were compared between groups using the chi-square test or Fisher's exact test, as appropriate. Participants' ages were compared using an independent-samples t-test.

The distribution of self-management domain scores was assessed before inferential analysis. Because the scores did not meet the normality assumption, pretest–posttest differences within each group were analyzed using the Wilcoxon signed-rank test. Post-intervention differences between the intervention and control groups were examined using the Mann–Whitney U test. Statistical significance was set at $p < 0.05$.

Cohen's d was calculated using the post-intervention group means and pooled standard deviations to provide a standardized estimate of the magnitude of the intervention effect. Effect sizes were interpreted as small ($d = 0.20$), moderate ($d = 0.50$), and large ($d \geq 0.80$). A per-protocol analysis was performed because all enrolled participants completed the assigned study procedures and post-intervention assessment.

C. RESULT AND DISCUSSION

1. Result

A total of 40 patients with hypertension were assessed for eligibility, and all met the eligibility criteria. The participants were allocated non-randomly to the intervention group (n = 20) or control group (n = 20). All participants completed the pretest, assigned study procedures, and posttest assessment. No withdrawals or losses to follow-up occurred; therefore, all 40 participants were included in the per-protocol analysis. The participant recruitment and follow-up process is presented in **Figure 1.**

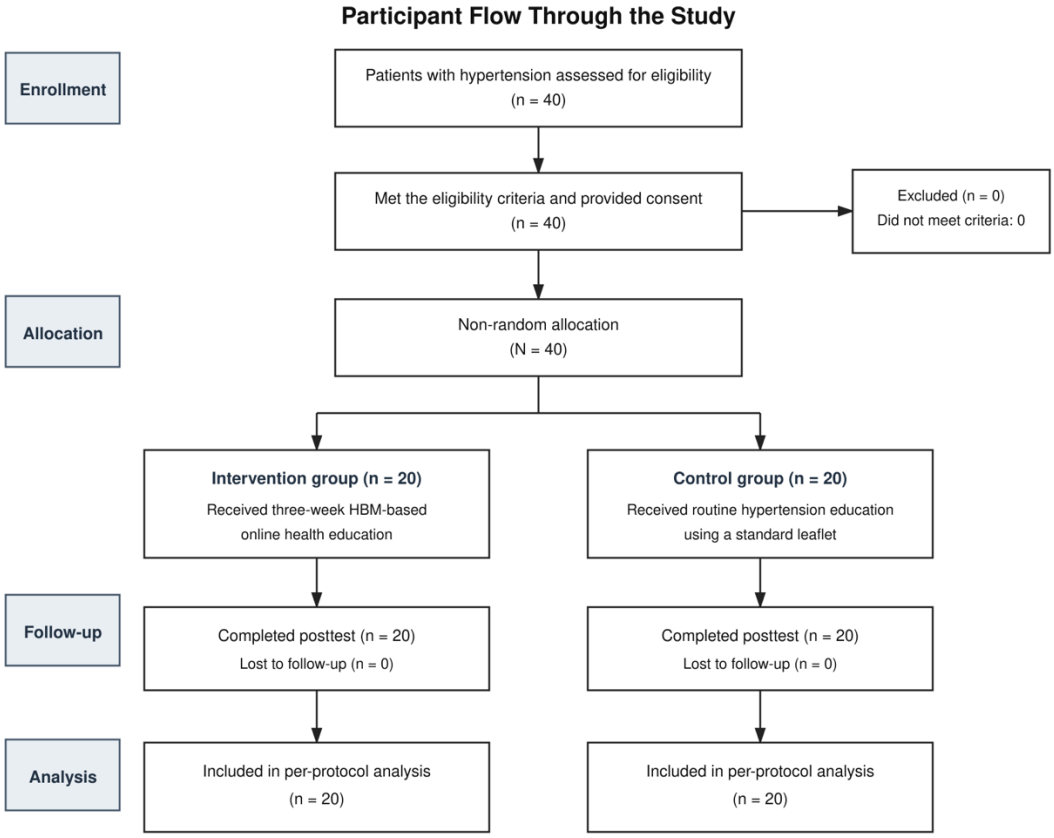

Figure 1. Participant flow through the study

The mean age was 40.95 years (SD 8.21) in the intervention group and 44.60 years (SD 7.35) in the control group. Most participants were women, accounting for 80.0% of the intervention group and 75.0% of the control group. Secondary education was the most common educational level in the intervention group, whereas secondary and higher education were equally represented in the control group. Most participants in both groups were employed. Income below the regional minimum wage was reported by 75.0% of participants in the intervention group and 45.0% in the control group.

No statistically significant differences were identified between the groups in age, sex, education, occupation, or income at baseline (all $p > 0.05$). Thus, the groups were comparable with respect to the measured baseline characteristics, as presented in **Table 2.**

Table 2. Baseline characteristics of participants by study group

Characteristics	Intervention group (n=20) f (%)	Control group (n=20) f (%)	*p-value*[2]
Age, *Mean±SD*	40.95 ± 8.211	44.6 ±7.351	0.155
Gender			
Male	4 (10)	5 (12.5)	1.000
Female	16 (40)	15 (37.5)	
Pendidikan			
Primary	4 (10)	2 (5)	0.177
Secondary	13 (32.5)	9 (22.5)	
Higher	3 (7.5)	9 (22.5)	
Occupation			
Working	11 (27.5)	15 (37.5)	0.320

Characteristics	Intervention group (n=20) f (%)	Control group (n=20) f (%)	*p-value*[2]
Not working	9 (22.5)	5 (12.5)	
Income			
<RMW[1]	15 (37.5)	9 (22.5)	0.105
≥RMW	5 (12.5)	11 (27.5)	

[1] RMW = regional minimum wage.
[2] p-values were obtained using independent t-tests for continuous variables and Chi-square or Fisher's exact tests for categorical variables

Table 2 presents the comparison of self-management behavior between the intervention and control groups before and after the health education program. At baseline, there were no significant differences in any self-management domains between the two groups.

Self-management domain	Intervention group			Control group			
	Pre-test Median (IQR)	Post-test Median (IQR)	Within-group *p*	Pre-test Median (IQR)	Post-test Median (IQR)	Within-group *p*	Between-group *p*
Self-integration	30.00 (25.00–33.50)	37.00 (34.25–41.75)	0.001	33.00 (26.50–35.75)	33.00 (26.50–35.75)	0.157	0.002
Self-regulation	21.50 (14.25–27.25)	26.50 (21.50–30.25)	0.001	22.00 (17.00–26.25)	22.00 (17.00–26.25)	1.000	0.025
Interaction with health workers	21.50 (13.75–26.00)	27.50 (24.25–32.00)	0.001	24.00 (22.25–26.50)	24.00 (22.25–26.50)	1.000	0.019
Self-monitoring	11.00 (8.00–15.00)	15.00 (13.00–16.00)	0.001	12.00 (10.25–14.00)	12.50 (10.25–14.00)	0.157	0.004
Medication adherence	15.00 (12.25–17.00)	17.50 (16.00–20.00)	0.001	15.00 (14.00–18.00)	15.00 (14.00–18.00)	1.000	0.022

**Wilcoxon sign rank test, **Mann whitney*

Table 3 presents the self-management scores before and after the three-week educational program. Because the domain scores were not normally distributed, the results are reported as medians with the first and third quartiles (Q1–Q3). At baseline, the median scores showed no substantial descriptive differences between the intervention and control groups across the five self-management domains. In the intervention group, statistically significant improvements were observed in all domains. The median self-integration score increased from 30.00 (Q1–Q3: 25.00–33.50) at pretest to 37.00 (Q1–Q3: 34.25–41.75) at posttest. The median self-regulation score increased from 21.50 (14.25–27.25) to 26.50 (21.50–30.25), while interaction with health workers increased from 21.50 (13.75–26.00) to 27.50 (24.25–32.00). The median self-monitoring score increased from 11.00 (8.00–15.00) to 15.00 (13.00–16.00), and medication adherence increased from 15.00 (12.25–17.00) to 17.50 (16.00–20.00). All pretest–posttest differences in the intervention group were statistically significant (all p = 0.001).

In the control group, the median scores remained relatively stable. No statistically significant pretest–posttest changes were found in self-integration (p = 0.157), self-regulation (p = 1.000), interaction with health workers (p = 1.000), self-monitoring (p = 0.157), or medication adherence (p = 1.000). Post-intervention comparisons demonstrated significantly higher self-management scores in the intervention group than in the control group for self-integration (p = 0.002), self-regulation (p = 0.025), interaction with health workers (p = 0.019),

self-monitoring (p = 0.004), and medication adherence (p = 0.022). These results indicate that participation in the HBM-based educational program was associated with greater improvement in hypertension self-management behavior than routine leaflet-based education.

2. Discussion

This study aimed to examine the effect of Health Belief Model (HBM)–based health education delivered through an e-booklet on self-management behavior for stroke prevention among patients with hypertension. The findings showed that the intervention group experienced significant improvements in all five self-management domains (self-integration, self-regulation, interaction with health workers, self-monitoring, and medication adherence) whereas no significant improvements were observed in the control group receiving routine leaflet-based education. These findings suggest that structured HBM-based health education was associated with better hypertension self-management behavior. However, because this study employed a non-randomized quasi-experimental design, the findings should be interpreted as evidence of an association rather than definitive causation.

The observed changes may have occurred because the intervention addressed not only patients' knowledge but also the perceptions and motivations underlying their health behaviors. According to the HBM, individuals are more likely to adopt preventive behaviors when they recognize their susceptibility to a health problem, understand the seriousness of its consequences, believe that the recommended actions are beneficial, perceive that barriers can be overcome, receive cues that prompt action, and feel confident in their ability to perform the behavior (Rosenstock, 1974). In this study, information about the relationship between uncontrolled hypertension and stroke may have increased perceived susceptibility and severity. Explanations of the benefits of medication adherence, dietary control, physical activity, and blood pressure monitoring may have strengthened perceived benefits. Practical recommendations and discussions about managing difficulties may have reduced perceived barriers, whereas WhatsApp reminders, educational videos, and interaction with healthcare providers served as cues to action. Demonstrations, repetition, and feedback may also have strengthened self-efficacy.

This interpretation is consistent with Wang et al. (2024), who found that HBM-based education involving lectures, brochures, videos, and counselling improved patients' health beliefs, self-efficacy, medication adherence, and blood pressure control. Similarly, Nematzad et al. (2023) reported that HBM-based education improved self-care behavior among older adults with hypertension by modifying perceived severity, benefits, barriers, cues to action, and self-efficacy. These findings support the proposition that theory-based education is more likely to influence behavior when it systematically targets the psychological determinants of action rather than merely providing information.

Self-Integrity

Self-integration improved significantly, indicating that participants increasingly incorporated dietary modification, physical activity, stress management, medication use, and blood pressure monitoring into their daily routines. This change may have occurred because the HBM-based education increased perceived susceptibility to stroke, emphasized the severity of uncontrolled hypertension, and clarified the benefits of sustained preventive behavior (Nematzad et al., 2023; Rosenstock, 1974; Suhat et al., 2022). Practical recommendations may also have reduced perceived barriers and strengthened patients' confidence in managing an often-asymptomatic condition (Bakshi et al., 2022; Wang et al., 2024). Moreover, repeated access to the e-booklet allowed participants to review and adapt the recommendations to their routines, thereby reinforcing behavioral engagement (Cao et al., 2022). However, because self-

integration was self-reported, the findings represent improvements in reported self-management practices rather than objectively verified lifestyle changes.

Self-Regulation

Self-regulation improved significantly following the intervention, indicating better ability to set goals, plan activities, evaluate progress, and adjust health behaviors (Bandura, 1997). This improvement may have resulted from structured education, repeated learning, demonstrations, reminders, and interaction with healthcare providers (Cai et al., 2026). From an HBM perspective, practical guidance on meal planning, physical activity, medication schedules, and blood pressure monitoring may have reduced perceived barriers and strengthened self-efficacy, thereby making recommended behaviors easier to initiate and maintain (M. T. Islam et al., 2025; Park et al., 2025). Moreover, repeated access to the e-booklet and online support may have promoted continuous engagement and behavioral reinforcement. Previous reviews have similarly identified engagement, interactivity, tailoring, and professional support as important components of digital interventions for hypertension self-management (Cao et al., 2022; Katz et al., 2024).

Interaction with Health Workers

Interaction with health workers improved significantly, indicating greater willingness among participants to ask questions, communicate concerns, seek clarification, and participate in hypertension management. Healthcare providers, scheduled sessions, discussions, and digital reminders may have served as external cues to action, while supportive communication may have reduced perceived barriers and strengthened patients' self-efficacy (Nematzad et al., 2023; Rosenstock, 1974; Suhat et al., 2022). Improved knowledge may also have enabled participants to communicate their needs more clearly and understand professional recommendations. These findings are consistent with evidence that HBM-based counselling and interactive digital support enhance patient engagement, medication adherence, and confidence in hypertension self-management (Bakshi et al., 2022; Cao et al., 2022; Katz et al., 2024). Thus, the improvement likely resulted from the combined effects of theory-based education, accessible communication, and active patient participation.

Self-Monitoring

Self-monitoring improved significantly, indicating greater attention to blood pressure measurement, symptom recognition, and health-status evaluation. Because hypertension may remain asymptomatic despite increasing cardiovascular and cerebrovascular risk, perceived susceptibility and severity may motivate patients to monitor their condition regularly (Nematzad et al., 2023; Rosenstock, 1974; Suhat et al., 2022). Practical demonstrations may have transformed risk awareness into achievable actions, while reminders, repeated messages, and monitoring records functioned as cues to action and reinforced self-efficacy (Xu et al., 2026) This interpretation is supported by evidence that multicomponent digital interventions incorporating remote monitoring and professional support improve hypertension management (M. T. Islam et al., 2025; Katz et al., 2024; Lehrer et al., 2021). However, because blood pressure outcomes and objectively verified monitoring frequency were not assessed, further studies are needed to determine whether improved self-monitoring results in sustained blood pressure control.

Medication Adherence

Medication adherence improved significantly, possibly because the intervention addressed limited understanding of asymptomatic hypertension, concerns about long-term treatment, forgetfulness, adverse effects, and uncertainty regarding medication benefits. Information about stroke complications may have increased perceived susceptibility and severity, while explanations of antihypertensive treatment strengthened perceived benefits (Nematzad et al., 2023; Rosenstock, 1974). Discussions about side effects and medication schedules may have reduced perceived barriers, whereas WhatsApp reminders served as cues to action and

practical strategies strengthened self-efficacy (Bakshi et al., 2022; Cao et al., 2022). These findings are consistent with studies reporting that HBM constructs are associated with medication adherence and that HBM-based education improves adherence and self-efficacy among patients with hypertension (Kasmaei et al., 2024; Shojaeifar et al., 2022; Wang et al., 2024). Thus, adherence may improve when education addresses both patients' health perceptions and their practical treatment barriers.

Comparison with Control Group

The absence of significant changes in the control group suggests that routine leaflet-based education alone was insufficient to produce measurable behavioral changes during the three-week study period (Nematzad et al., 2023; Wang et al., 2024). Although leaflets can provide useful information, their passive and one-directional format offers limited opportunities for clarification, feedback, reinforcement, and adaptation to individual barriers (Pock et al., 2025). Consequently, increased knowledge may not necessarily lead to behavioral change when perceived barriers, self-efficacy, and cues to action are not adequately addressed.

This finding does not imply that printed materials have no value; instead, they may be more influential when incorporated into a structured, theory-based, and interactive educational program. Previous studies have identified engagement, interactivity, tailoring, reminders, monitoring, and professional support as important components of digital interventions for hypertension management (Giguère et al., 2020; Pock et al., 2025). Therefore, the improvement in the intervention group likely reflected the combined effects of HBM-based content, repeated digital exposure, demonstrations, reminders, and interaction with healthcare providers rather than the e-booklet as an isolated educational medium.

Implications for Practice

These findings have practical implications for nurses and primary healthcare providers. HBM-based health education can be incorporated into hypertension services by assessing each patient's perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy before delivering education. This approach allows healthcare workers to provide education that responds to the reasons underlying non-adherence rather than giving the same information to every patient.

An e-booklet distributed through WhatsApp represents a relatively accessible and scalable method for reinforcing face-to-face education. Nevertheless, digital education should complement rather than replace patient–provider interaction. Patients with limited digital literacy, restricted internet access, visual impairment, or no personal smartphone may require assisted use or alternative formats. Because engagement influences the effectiveness of digital interventions, future implementation should also monitor whether patients actually open, understand, and apply the materials..

Study Limitations

This study has several limitations. First, the small sample and single-center setting limit the generalizability of the findings. Second, the non-randomized allocation of participants increases the possibility of selection bias and residual confounding, even though the measured baseline characteristics were statistically comparable. Third, the three-week follow-up period was insufficient to determine whether the behavioral improvements were maintained over time or resulted in better blood pressure control and reduced stroke risk. Fourth, self-management outcomes were measured using a self-reported questionnaire and may therefore have been influenced by recall and social-desirability bias.

In addition, eligibility for the digital intervention may have favored patients with access to smartphones and sufficient digital literacy. Most participants were women, which may also limit the applicability of the results to men with hypertension. Finally, the study did not

measure changes in the individual HBM constructs. Consequently, the proposed pathways involving perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy represent theoretically supported explanations rather than formally tested mediators. Future multicenter randomized studies should include longer follow-up, objective measurements of medication adherence and blood pressure, assessments of digital engagement, and mediation analyses of the HBM constructs..

D. CONCLUSION AND SUGGESTIONS

Health Belief Model–based health education delivered through an e-booklet was associated with significant improvements in self-integration, self-regulation, interaction with health workers, self-monitoring, and medication adherence among patients with hypertension. In contrast, routine leaflet-based education produced no significant changes during the study period. The intervention may have supported behavioral change by strengthening perceived susceptibility, severity, benefits, cues to action, and self-efficacy while reducing perceived barriers. Nevertheless, given the non-randomized design, small sample, and short follow-up period, the findings should not be interpreted as definitive evidence of causality. Primary healthcare providers are encouraged to integrate HBM-based digital education into routine hypertension services as a complement to direct counselling. Future studies should employ randomized multicenter designs, larger and more diverse samples, and longer follow-up periods. They should also assess individual HBM constructs, objectively measured medication adherence, digital engagement, blood pressure control, and the sustainability of behavioral changes.

E. ACKNOWLEDGEMENT

The authors sincerely thank all participants for their time and valuable cooperation throughout the study. The authors also acknowledge the Surabaya City Health Office and the participating primary healthcare center in Surabaya for granting permission and facilitating data collection. This study was funded by the Undergraduate Thesis Research Grant from the Institute for Research and Community Service (LPPM), Universitas Nahdlatul Ulama Surabaya (Grant No. 1333/UNUSA-LPPM/Adm.I/V/2025). The funder had no role in the study design, data collection, analysis, interpretation, manuscript preparation, or decision to submit the article for publication.

F. REFERENCES

Alfaqeeh, M., Alfian, S. D., & Abdulah, R. (2023). Factors Associated with Hypertension Among Adults: A Cross-Sectional Analysis of the Indonesian Family Life Survey. *Vascular Health and Risk Management*, *19*(November 2023), 827–836. https://doi.org/10.2147/VHRM.S438180

Alyafei, A., & Easton-Carr, R. (2024). The Health Belief Model of Behavior Change. In *StatPearls [Internet]*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK606120/

Asseggaf, S. N. Y. R. S., Zakiah, M., Ulfah, R., Putri, T. H., Len, J. F., & Qatrunnada, A. (2025). Influence of Self-Care Management on Blood Pressure Control in Hypertensive Patients: A Literature Review. *Healthy Tadulako Journal (Jurnal Kesehatan Tadulako)*, *11*(2), 169–178. https://doi.org/10.22487/htj.v11i2.1550

Azadi, N. A., Ziapour, A., Lebni, J. Y., Irandoost, S. F., Abbas, J., & Chaboksavar, F. (2021). The effect of education based on health belief model on promoting preventive behaviors of hypertensive disease in staff of the Iran University of Medical Sciences. *Archives of Public Health = Archives Belges de Sante Publique*, *79*(1), 69. https://doi.org/10.1186/s13690-021-00594-4

Bakshi, A., Cao, Y., Orchard, S. G., Carr, P. R., Joshi, A. D., Manning, A. K., Buchanan, D. D., Umar,

A., Winship, I. M., Gibbs, P., Zalcberg, J. R., Macrae, F., McNeil, J. J., Lacaze, P., & Chan, A. T. (2022). Aspirin and the Risk of Colorectal Cancer According to Genetic Susceptibility among Older Individuals. *Cancer Prevention Research (Philadelphia, Pa.)*, *15*(7), 447–454. https://doi.org/10.1158/1940-6207.CAPR-22-0011

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman. https://doi.org/https://doi.org/10.1037/10522-094

Cai, S., van Berlo, Z. M. C., & Nguyen, M. H. (2026). The effectiveness of health belief model in predicting intentions for environmentally sustainable behavior: A meta-analysis. *Journal of Environmental Psychology*, *111*(March), 103019. https://doi.org/10.1016/j.jenvp.2026.103019

Cao, W., Milks, M. W., Liu, X., Gregory, M. E., Addison, D., Zhang, P., & Li, L. (2022). mHealth Interventions for Self-management of Hypertension: Framework and Systematic Review on Engagement, Interactivity, and Tailoring. *JMIR MHealth and UHealth*, *10*(3), e29415. https://doi.org/10.2196/29415

Giguère, A., Zomahoun, H. T. V., Carmichael, P. H., Uwizeye, C. B., Légaré, F., Grimshaw, J. M., Gagnon, M. P., Auguste, D. U., & Massougbodji, J. (2020). Printed educational materials: effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*, *2020*(8). https://doi.org/10.1002/14651858.CD004398.pub4

Golshiri, P., Amini, S., & Najimi, A. (2025). Impact of health literacy educational intervention on improve medication adherence and blood pressure level in patients with ischemic heart disease. *Journal of Education and Health Promotion*, *14*(1), 1–6. https://doi.org/10.4103/jehp.jehp_1659_23

Islam, B., Ibrahim, T. I., Tingting, W., Wu, M., & Jiabi, Q. (2025). Current status of elevated blood pressure and hypertension among adolescents in Asia: a systematic review. *Journal of Global Health*, *15*, 04115. https://doi.org/10.7189/jogh.15.04115

Islam, M. T., Arafat, S. M., Chowdhury, A., Orchi, K., Sultana, S., Bushra, T., Islam, M. R., Fatema, K., Khan, M. M. H., & Haque, M. A. (2025). Role of the Health Belief Model in the Management of Hypertension: A Systematic Review. *Cureus*, *17*(10). https://doi.org/10.7759/cureus.94139

Kasmaei, P., Yousefi, P., Farmanbar, R., Omidi, S., Karimy, M., Bab Eghbal, S., Shakiba, M., & Molaee, M. (2024). The Impact of Health Belief Model-Based Education on Self-Care Behaviors of Hypertensive Patients. *Caspian Journal of Health Research*, *9*(4), 237–248. https://doi.org/10.32598/CJHR.9.4.1916.1

Katz, M. E., Mszar, R., Grimshaw, A. A., Gunderson, C. G., Onuma, O. K., Lu, Y., & Spatz, E. S. (2024). Digital Health Interventions for Hypertension Management in US Populations Experiencing Health Disparities A Systematic Review and Meta-Analysis. *JAMA Network Open*, *7*(2), E2356070. https://doi.org/10.1001/jamanetworkopen.2023.56070

Kifle, Z. D., Adugna, M., Chanie, G. S., & Mohammed, A. (2022). Prevalence and associated factors of hypertension complications among hypertensive patients at University of Gondar Comprehensive Specialized Referral Hospital. *Clinical Epidemiology and Global Health*, *13*(October 2021), 100951. https://doi.org/10.1016/j.cegh.2021.100951

Kim, H., Han, A., Lee, H., Choi, J., Lee, H., & Cho, M.-K. (2024). Impact of Mobile Health Literacy, Stroke-Related Health Knowledge, Health Beliefs, and Self-Efficacy on the Self-Care Behavior of Patients with Stroke. *Healthcare (Basel, Switzerland)*, *12*(19). https://doi.org/10.3390/healthcare12191913

Lehrer, C., Eseryel, U. Y., Rieder, A., & Jung, R. (2021). Behavior change through wearables: the interplay between self-leadership and IT-based leadership. *Electronic Markets*, *31*(4), 747–764. https://doi.org/10.1007/s12525-021-00474-3

Mills, K. T., Stefanescu, A., & He, J. (2021). The global epidemiology of hypertension. *Nat Rev Nephrol.*, *16*(4), 223–237. https://doi.org/10.1038/s41581-019-0244-2.

Ministry of Health Republic Indonesia. (2024). *Prevalence, Impact, and Efforts In Controlling Hypertension*. https://repository.badankebijakan.kemkes.go.id/id/eprint/5531/

Mohl, J. T., Moreno, C. A., Sadik, K., Singhal, M., Rooney, A., & Ciemins, E. L. (2025). Evaluation of Blood Pressure Control, Medication Adherence, and Therapeutic Inertia in US Patients With Hypertension Prescribed Multiple Antihypertensives. *Journal of the American Heart Association* , *14*(12), 1–12. https://doi.org/10.1161/JAHA.124.034787

Nematzad, P., Pourghane, P., Besharati, F., & Gholami-Chaboki, B. (2023). Effects of health belief model in promoting self-care behaviors among hypertensive older adults. *Journal of Education and Health Promotion*, *12*(1), 1–6. https://doi.org/10.4103/jehp.jehp_689_22

Park, J.-H., Sherman, L. D., Smith, M. L., Patterson, M. S., & Prochnow, T. (2025). The Association Between Health Belief Model Components and Self-Care Practices Among Black/African American Men with Type 2 Diabetes. *International Journal of Environmental Research and Public Health*, *22*(3), 414. https://doi.org/10.3390/ijerph22030414

Pock, E. M. L., Lohrmann, C., Hoffmann, M., Schwarz, C. M., & Schoberer, D. (2025). Evaluation of the usefulness and understandability of information leaflets on fall prevention from the perspective of hospital patients and their relatives. *Health Information and Libraries Journal*, *42*(1), 83–95. https://doi.org/10.1111/hir.12531

Rosenstock, I. M. (1974). The health belief model and personal health behavior. *Health Education Monographs*, *2*(4), 354–386.

Shojaeifar, H., Sobhani, A., & Shojaeifar, S. (2022). The Effect of Educational Intervention Based on Health Belief Model on Blood Pressure Control in Patients With Hypertension Referring to the Clinic of Shariati Hospital in Isfahan 2017-2018. *Jundishapur Journal of Medical Sciences*, *20*(6), 506–517. https://doi.org/10.32598/jsmj.20.6.1889

Sidabutar, S., Harahap, V., & Ermafina, P. (2023). Comparative Study of Traditional and Interactive Health Education Models on Community Behavior Changes. *Jurnal Ilmiah METADATA*, *5*(3), 416–430. https://doi.org/10.47652/metadata.v5i3.838

Suhat, S., Suwandono, A., Adi, M. S., Nugroho, K. H., Widjanarko, B., & Wahyuni, C. U. (2022). Relationship of Health Belief Model with Medication Adherence and Risk Factor Prevention in Hypertension Patients in Cimahi City, Indonesia. *Evidence Based Care Journal*, *12*(2), 51–56. https://doi.org/10.22038/EBCJ.2022.64141.2664

Taderera, B. H. (2025). Barriers to Anti-Hypertensive Medication Adherence Among Patients in Private Healthcare in Edenvale, South Africa. *Healthcare (Switzerland)*, *13*(18), 1–15. https://doi.org/10.3390/healthcare13182267

Wang, H.-M., Chen, Y., Shen, Y.-H., & Wang, X.-M. (2024). Evaluation of the effects of health education interventions for hypertensive patients based on the health belief model. *World Journal of Clinical Cases*, *12*(15), 2578–2585. https://doi.org/10.12998/wjcc.v12.i15.2578

World Health Organization (WHO). (2023). Global Report on Hypertension: The Race Against a Silent Killer. In *Global Report on Hypertension:* (Vol. 01). https://www.who.int/publications/i/item/9789240081062

Xu, W., Xing, C., Chen, C., Huang, Y., Li, P., & Zhai, J. (2026). Efficacy of an e-education program based on the Health Belief Model on exercise management in women with gestational hypertension: A randomized controlled clinical trial. *International Journal of Nursing Sciences*, *13*(1), 19–26. https://doi.org/10.1016/j.ijnss.2025.12.015