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Evaluating the Effectiveness of Online Health Education in Managing Hypertension Among Floating Elderly Patients

Wang Yapeng[1,2], Ajau Danis[1*], Wang Ruixiao[3], Wang Xueyi[4]

[1] Department of Basic Science, Faculty of Health Sciences, Universiti Teknologi MARA Selangor, Puncak Alam Campus, Malaysia.
[2] School of Nursing, Ningxia Medical University, Yinchuan, Ningxia, China
[3] General Hospital of Ningxia Medical University, Yinchuan, Ningxia, China
[4] Yinchuan Hospital of Traditional Chinese Medicine, Yinchuan, Ningxia, China

*Corresponding Author: ajaudanis@uitm.edu.my

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Abstract: *Hypertension is a prevalent health issue among the floating elderly population in China, characterized by their mobility, which poses significant challenges for traditional offline prevention and management approaches. This often leads to poor blood pressure control, increased complications, and a diminished quality of life. To address this, this study explores an effective management model tailored for this demographic. A randomized controlled trial was conducted, dividing 150 participants into three groups: a control group (n=50), an online management group (n=50), and an offline management group (n=50). The control group received no intervention and continued self-managed blood pressure care. The offline management group received routine care from community doctors, while the online management group underwent a two-month intervention utilizing TikTok and WeChat for health education. Participants with insufficient health knowledge retention were followed up via telephone. The intervention combined systematic curriculum education and personalized knowledge dissemination to improve dietary habits, exercise routines, and medication adherence. Results indicated that the online health education group achieved a significant reduction in systolic blood pressure by 7.89 mm Hg (150.03 mm Hg vs. 142.14 mm Hg) and diastolic blood pressure by 3.09 mm Hg (89.28 mm Hg vs. 86.19 mm Hg) compared to the control group. Additionally, the online group showed marked improvements in physical activity scores (increase of 9.25), attitudes and beliefs about treatment (increase of 16.81), self-management ability (increase of 23.73), and medication adherence (increase of 0.37). No statistically significant differences were observed between the online and offline health education groups. In conclusion, the use of diversified online information technology for hypertension management in the floating elderly population effectively enhances self-management capabilities and improves health outcomes. This approach offers a viable alternative to traditional offline methods, particularly for mobile populations.*

Keywords: Hypertension; floating elderly Online; TikTok; WeChat

1. Introduction

Hypertension represents a critical public health challenge, serving as a major risk factor for cardiovascular diseases and stroke, and necessitating lifelong medical management (Furie, 2020). In China, the awareness, treatment, and control rates of hypertension remain suboptimal,

with rates of 51.6%, 45.8%, and 16.8%, respectively (Wang et al., 2022). This low control rate is largely attributed to unhealthy lifestyle behaviors among patients, including smoking, physical inactivity, excessive alcohol consumption, and poor dietary habits, such as high salt and high-fat diets, coupled with irregular medication adherence (Xiao Dandan, Xiu-hong Chen, & Su Ya, 2019). The rapid societal changes in China have further exacerbated this issue, as a segment of hypertensive patients has become part of the floating population. This mobility often results in reduced physical health, as individuals leave their familiar environments and face challenges such as diminished social capital, environmental adaptability, and social participation (Zhang et al., 2022). For hypertensive patients, this transition can lead to a lack of monitoring by community health services, poor dietary habits, sleep disturbances, decreased medication adherence, and inadequate blood pressure control, thereby increasing the risk of cardiovascular and cerebrovascular complications (Zhang Shengfa et al., 2022).

Effective health education plays a pivotal role in helping patients adopt healthier lifestyles, improve health literacy, and adhere to balanced diets, regular exercise, and consistent medication use. Implementing health education for hypertensive patients is a crucial strategy for enhancing treatment and control rates (Xie Helan, 2022). In recent years, the rise of online health platforms has introduced new opportunities and challenges for chronic disease prevention and patient management (Yan, Liu, & Li, 2022). For instance, studies utilizing the WeChat platform for hypertension education have demonstrated significant improvements in blood pressure control, treatment compliance, and self-management scores among patients following nursing interventions (You Xiu, 2022). Similarly, interventions via WeChat have been shown to enhance self-efficacy, daily lifestyle habits, health behaviors, and medication adherence in hypertensive patients (Zheng, Chu, & Qian, 2021).

The advent of new media has transformed the dissemination of health knowledge, with platforms like TikTok emerging as innovative tools for health communication. TikTok, a rapidly growing social media platform with over 1 billion monthly active users, has gained popularity among older adults with chronic diseases. Its algorithm-driven engagement model makes it a promising medium for delivering health-related information (D'Ambrosi et al., 2024). Research indicates that TikTok can effectively promote healthy lifestyles, with its short videos on dietary habits and health practices significantly influencing public health behaviors (Wang, 2022). The platform's health content, often shared by medical professionals, has been found to positively impact users' health beliefs and behaviors, particularly among middle-aged audiences (Xiong, 2022). As TikTok continues to grow globally, it has become a valuable channel for disseminating healthcare information (Iqbal, 2022).

This study explores a novel approach to hypertension management by utilising the TikTok platform for health knowledge dissemination, combined with WeChat for evaluating behavioral changes and follow-up telephone interventions. This integrated model aims to establish a comprehensive online health education and management pathway for hypertensive patients, emphasizing communication, assessment, and tracking. The findings of this study are expected to provide valuable insights for clinical practitioners and community health managers in designing effective hypertension management strategies and related research initiatives.

2. Methods

2.1 Study design

A randomized controlled trial (RCT) was conducted to evaluate the effectiveness of different intervention approaches. The sampling design for this study employs a stratified random

sampling approach, with stratification based on gender (male and female). This study targeted elderly individuals aged 60 and above, diagnosed with hypertension, who were part of the floating population residing in Yinchuan, Ningxia. From November 1, 2023, to December 31, 2023, a total of 1,441 primary hypertensive patients from four highly mobile communities in China were initially recruited. After screening, 150 participants met the study criteria. Using a stratified randomization approach, participants were allocated into three groups in a 1:1:1 ratio: a control group (n=50), an online intervention group (n=50), and an offline intervention group (n=50). The randomization process controlled for potential confounders, including gender. Baseline measurements, including blood pressure (BP), body mass index (BMI), medication adherence, and self-management skills, showed no statistically significant differences across the groups. The intervention period lasted two months, with outcomes assessed based on changes in BP levels and enhancements in self-care abilities. The effectiveness of the Knowledge, Attitude, and Practice (KAP) model was evaluated through metrics such as behavioral changes, intervention acceptance rates, and BP control.

2.2 Inclusion and exclusion criteria

The study enrolled patients diagnosed with primary hypertension who met the following inclusion criteria: (1) being part of the floating population for over three years, (2) possessing the ability to perform self-care and walk independently, (3) owning a smartphone with access to and proficiency in using platforms such as TikTok and WeChat, and (4) being reachable via phone calls.

Exclusion criteria were applied to ensure the integrity and safety of the study. Patients were excluded if they: (1) had hypertension accompanied by complications affecting the heart, brain, kidneys, or eyes; (2) had a documented history of mental illness or cognitive impairment; (3) declined to participate in regular follow-up sessions; (4) were currently enrolled in other hypertension health management programs; (5) lacked family consent or faced opposition from family members regarding participation; (6) had comorbid chronic conditions such as diabetes, kidney disease, chronic obstructive pulmonary disease (COPD), or other similar illnesses; (7) planned to relocate or travel extensively within the next six months; (8) required hospitalization due to severe or uncontrolled hypertension; or (9) expressed resistance to the study or an inability to trust the research team despite repeated explanations.

Ethical approval for the study was granted by the Universiti Teknologi MARA Research Ethic Committee (REC/10/2023 (PG/FB/19)). Before the intervention, written informed consent was obtained from all participants, ensuring their voluntary and informed participation in the research.

2.3 Allocated Groups

2.3.1 Control group (no intervention): The control group participants were instructed to manage their blood pressure (BP) using self-directed strategies while continuing to follow their prescribed medical treatments or personalized care plans. To ensure participant engagement and mitigate potential perceptions of neglect, the research team maintained regular communication and cultivated supportive relationships with the control group members over the course of the study.

2.3.2 Offline health education group: During the two-month intervention period, participants in this group engaged in a structured health education program, which included weekly lectures conducted on Wednesdays and Saturdays. The curriculum was designed to cover essential topics related to hypertension, including disease-specific knowledge, dietary management, and

exercise management. The educational content was standardized and delivered uniformly to both online and offline cohorts to ensure consistency. Each lecture session lasted approximately one hour and was immediately followed by a quiz consisting of multiple-choice questions developed by the research team. These quizzes were administered to evaluate participants' understanding of the material presented during the session. In cases where incorrect responses were provided, participants received personalized feedback and detailed explanations to clarify any misunderstandings and reinforce key concepts. This approach ensured that all participants achieved a comprehensive grasp of the core educational objectives.

2.3.2 Online health education group: This cohort of patients received daily health education through concise video content, distributed via WeChat and TikTok platforms. Each video was designed to be brief, with a maximum duration of one minute and an average length of approximately 30 seconds. The educational material focused on key aspects of hypertension management, including dietary recommendations, exercise guidelines, and strategies for effective disease control.

2.4 The brief content of the intervention

The research team developed a comprehensive educational program on medication adherence in hypertension, structured into 7 chapters and comprising 28 content modules. This program was delivered through video presentations and PowerPoint lectures, with the primary objective of enhancing patients' awareness of hypertension and fostering positive changes in their attitudes and perceptions toward the disease. The intervention was divided into three key components:

Medication Adherence: This component included 27 knowledge points organized into 8 chapters. The content was delivered through 36 online video broadcasts and 8 offline lectures, with consistent material in both formats. Topics covered included the definition of normal blood pressure, the significance of medication adherence, methods for self-monitoring blood pressure, the risks associated with hypertension, the relationship between cerebral infarction and blood pressure, and other essential hypertension-related knowledge.

Dietary Habits: This segment consisted of 3 chapters and 14 knowledge points. It was implemented over 14 days, with one video broadcast daily online and 5 offline lectures (with identical content in both formats). Key dietary recommendations included increasing the intake of coarse grains, soy products, nuts, vegetables, fruits, and vegetable oils, while reducing meat consumption. Participants were also advised to avoid sugary beverages and dairy products, control salt intake, quit smoking and alcohol, maintain adequate sleep, and cultivate a positive emotional state.

Exercise: This component comprised 3 chapters and 8 knowledge points. It was delivered online through daily video broadcasts over 10 days and reinforced through 3 offline lectures. The exercise regimen emphasized gradual aerobic activities, such as a combination of slow and fast walking, with a target of 10,000 steps per day. Participants were encouraged to engage in 30-minute sessions, preferably in the morning or evening. Compliance with the exercise program was monitored using the WeChat platform, which tracked daily step counts and physical activity levels, with progress updates pushed to participants via the app.

This multifaceted approach aimed to provide patients with a holistic understanding of hypertension management, integrating medication adherence, dietary modifications, and

physical activity into their daily routines. The combination of online and offline delivery methods ensured accessibility and reinforced key health education messages.

2.5 Outcome Evaluation Tools

This study employed a comprehensive set of validated instruments to assess various outcomes among floating elderly hypertensive patients. The tools included the Physical Activity Rating Scale-3 (PARS-3), the Hypertension Treatment Attitude and Belief Evaluation Scale, the Self-Management Behavior Scale for Hypertensive Patients, and the Medication Adherence Scale (Morisky). Health records were reviewed at four community health service stations in Yinchuan City, Ningxia, before the intervention. Participants were recruited voluntarily after being informed about the study's objectives, their right to withdraw at any time without penalty, and the nature of the interventions.

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were used as primary outcome measures. Blood pressure was measured using a Digital Blood Pressure Measuring Device (Omron Sem-1 Model). Participants were instructed to rest for five minutes before measurements were taken. BP was measured with participants seated comfortably in a chair, with their left arm supported at heart level. Three BP readings were recorded at five-minute intervals. If the difference between any two readings exceeded 10 mmHg for SBP or DBP, a fourth measurement was taken. The final BP value was calculated as the average of the three lowest readings that did not differ by more than 10 mmHg. Heart rate (HR) was measured using the same protocol, with the average of three readings recorded as the final HR value. All measurements were taken at baseline and one day after the completion of the four-week intervention in both groups.

Medication adherence was evaluated using the Morisky Medication Adherence Scale, which consists of four items scored dichotomously (yes/no). A score of 0 was assigned for "yes" responses, and 1 for "no" responses, with total scores ranging from 0 to 4. Higher scores indicated better adherence, while one or more "yes" responses suggested poor adherence. The scale demonstrated acceptable reliability, with a Cronbach's alpha coefficient of 0.61 (Gavrilova et al., 2019).

The Physical Activity Rating Scale-3 (PARS-3), revised by Liang Deqing (1994) from the Wuhan Institute of Physical Education, Hubei, China, was used to assess participants' physical activity levels. The scale calculates physical exercise volume using the formula: Exercise Intensity Score × (Exercise Time Score - 1) × Exercise Frequency Score. Each component is rated on a five-point scale (1–5), with total scores ranging from 0 to 100. Scores below 19 indicate low physical activity, 20–42 indicate moderate activity, and scores above 43 indicate high activity. The scale has demonstrated high reliability and validity (Mu et al., 2024).

The Hypertension Treatment Attitude and Belief Evaluation Scale, developed by Tang Hongying et al. (2011), was used to assess participants' attitudes and beliefs toward hypertension treatment. The scale comprises 21 items rated on a five-point Likert scale, ranging from 1 ("completely agree") to 5 ("completely disagree"). Total scores range from 20 to 100, with higher scores reflecting more positive attitudes and beliefs toward treatment (Tang Hongying, 2011).

Self-management behaviors were evaluated using the Hypertension Self-Management Behavior Evaluation Scale, which includes six dimensions: condition monitoring, diet management, exercise management, rest and work management, emotion management, and

tobacco and alcohol addiction management. The scale demonstrated high internal consistency, with a Cronbach's alpha coefficient of 0.914. Higher scores on this scale indicate better self-management abilities (Zhao Qiuli & Liu Xiao, 2012).

These measures collectively provided a robust framework for evaluating the impact of the intervention on hypertension management among the study population.

2.6 Statistical analysis

Two months post-intervention, the groups were assessed and compared utilizing a paired t-test. The collected data were confirmed to follow a normal distribution, and homogeneity of variance was verified through one-way analysis of variance (ANOVA). A significance level of $\alpha = 0.05$ was applied for all statistical tests. Data analysis was performed using SPSS version 20.0.

3. Results

The normality test was conducted on the data sets for the three groups, and the results indicated that the data were approximately normally distributed. Consequently, analysis of variance (ANOVA) was selected for the statistical analysis. The findings revealed no significant differences in body mass index (BMI) across the three groups, with the results failing to reach statistical significance ($P > 0.05$). However, statistically significant differences were observed among the groups for systolic blood pressure (SBP), diastolic blood pressure (DBP), treatment attitude and belief scores, physical activity scores, self-management scores, and medication adherence scores ($P < 0.05$). Detailed results are presented in Table 1.

Table 1: Baseline characteristics of the study population

Patients' baseline Characteristics	Control group	Online group	Offline group	$\chi 2/F$	p-value
	N = 50	N = 50	N = 50		
Mean age (years) (SD)	64.6±7.6	63.9±8.4	66.7±10.9	12.98	0.95
Number (%) of education level					
Low	34(68)	30(62)	32(65)	6.31	0.47
Middle	15(30)	17(34)	18(35)		
High	1(2)	3(4)	0(0)		
Alcohol (g/wk)	61.2±121	26.1±50.5	35.8±73.3	2.73	0.58
Number (%) Current smoker	10(20)	12(24)	9(18)	9.11	0.64
SBP (mm Hg)					
Mean ± SD	151.21±7.5	147.83±6.7	149.22±9.3	10.64	0.09
Number (%) 140–159.9	29(58)	32(65)	30(60)		
Number (%) 160–179.9	19(38)	17(34)	19(39)		

Number (%) ≧180	2(4)	1(1)	1(1)		
DBP (mm Hg)					
Mean±SD	90.16±2.8	89.71±5.3	90.84±0.8	7.14	0.38
Number(%)＜90	26(52)	31(62)	29(58)		
Number (%)90–99	20(40)	17(34)	21(42)		
Number (%) 100–109	2(4)	2(4)	0(0)		
Number (%) ≧110	2(4)	0(0)	0(0)		
Body Mass Index (kg/m^2)					
Mean ±SD	31.2±5.8	32.3±4.5	31.4±1.7	1.27	0.81
Number (%) normal weight (<25)	3(6)	3(8)	0(0)		
Number (%) overweight (25–30)	7(14)	7(12)	15(30)		
Number (%) obese: (≧30)	40(80)	40(80)	35(70)		
Physical activity score (mean ± SD)	39.28 ±14.65	40.17±13.47	42.69 ±9.78	2.92	0.25
Therapeutic attitudes and beliefs score (mean ± SD)	39.14±21.54	47.28±24.85	52.70±17.47	11.45	0.63
Self-management score(mean ± SD)	68.27±19.35	73.19±12.36	67.25±31.26	3.74	0.31
Adherence to medication score(mean ± SD)	2.35±0.26	2.97±0.54	2.36±0.18	6.25	0.89

As presented in Table 2, following a two-month intervention period, the three groups were assessed for normality across several variables, including BMI, physical activity scores, treatment attitudes and beliefs scores, self-management behaviors scores, medication compliance scores, and blood pressure. Data that adhered to a normal distribution were analyzed using one-way ANOVA, while non-normally distributed data were evaluated using the Kruskal-Wallis test, a nonparametric statistical method. The results revealed statistically significant differences across all groups for the measured variables ($P < 0.05$).

Table 2: Comparison of BMI, physical activity, treatment attitude and belief, self-management behavior, medication compliance, and blood pressure among the four groups in the intervention of two months

Domain assessed	Control group	Online group	Offline group	t-ratio	P value
BMI (kg/m$^{2)}$	30.14±2.7	31.99±7.8	30.26±1.9	1.04	0.62
SBP(mm Hg)	150.03±5.8	142.14±4.5	146.81±7.1	11.21	0.03
DBP (mm Hg)	89.28±4.7	86.19±7.5	84.73±1.2	65.12	0.013

Physical activity score	42.14 ±16.43	51.39±17.24	67.45±10.56	18.23	<0.01
Therapeutic attitudes and beliefs score	41.36±10.76	58.17±13.41	64.34±26.25	48.02	0.025
Self-management score	69.50±11.13	93.23±26.47	93.14±20.81	10.44	0.00
Adherence to medication score	2.65±1.92	3.02±1.43	3.59±0.61	6.9	0.046

Table 3 indicates that the online health education intervention group experienced a statistically significant reduction in both systolic and diastolic blood pressure levels compared to the control group following a two-month intervention period. Specifically, the mean systolic blood pressure decreased by 7.89 mm Hg (from 150.03 mm Hg to 142.14 mm Hg), while the mean diastolic blood pressure decreased by 3.09 mm Hg (from 89.28 mm Hg to 86.19 mm Hg). The results of the independent samples t-test demonstrated that these differences were statistically significant ($P < 0.001$). These findings underscore the potential of online health education platforms as an innovative and effective approach to improving health outcomes among patients with hypertension. The observed reductions in blood pressure metrics suggest that such digital interventions may serve as a valuable tool in the management and education of hypertensive individuals.

Table 3: Changes in blood pressure in the online health education model group compared with the control group after two months of intervention

Pressure Mean ± SD	Control group	Online group	t	p-value
	N = 50	N = 47		
SBP (mm Hg)	150.03±5.8	142.14±4.5	17.1	<0.001
DBP (mm Hg)	89.28±4.7	86.19±7.5	6.28	<0.001

The results presented in Table 4 demonstrate that the online health education group exhibited significant improvements across multiple self-care measures compared to the control group two months post-intervention. Specifically, the intervention group showed a 9.25-point increase in physical activity scores (51.39 vs. 42.14), a 16.81-point increase in attitudes and beliefs about treatment (58.17 vs. 41.36), and a 23.73-point increase in self-management ability scores (93.23 vs. 69.50). Additionally, a modest yet notable improvement of 0.37 points was observed in medication adherence scores (3.02 vs. 2.65).

Statistical analysis using a two-sample t-test revealed that the differences between the groups were highly significant for all measured outcomes, with p-values <0.001. These findings suggest that online health education, delivered through a multimedia platform, effectively enhances self-care behaviors by positively influencing patients' cognitive perceptions. The intervention appears to promote health-favorable outcomes by improving physical activity,

treatment-related attitudes, self-management capabilities, and adherence to medication regimens.

Table 4: After two months of intervention, the self-care ability of the online health education model group was compared with that of the control group

Domain assessed (mean ± SD)	Control group	Online group	t	p-value
	N = 50	N = 47		
Physical activity score	42.14 ±16.43	51.39±17.24	3.86	<0.001
Therapeutic attitudes and beliefs score	41.36±10.76	58.17±13.41	11.58	<0.001
Self-management score	69.50±11.13	93.23±26.47	6.07	<0.001
Adherence to medication score	2.65±1.92	3.02±1.43	8.34	<0.001

Two months post-intervention, the observed differences in systolic blood pressure (SBP) and diastolic blood pressure (DBP) between the online and offline health education groups were 4.67 mm Hg (142.14 mm Hg vs. 146.81 mm Hg) and 1.46 mm Hg (84.73 mm Hg vs. 86.19 mm Hg), respectively. These differences were not statistically significant, indicating that traditional offline health education continues to hold substantial value and remains a pivotal platform for health education among elderly hypertensive patients in China. Nevertheless, the limitations of this fixed-location approach have become increasingly apparent, particularly in light of the growing floating population. Offline health education often fails to provide practical guidance and adequate supervision for elderly hypertensive patients who are part of this mobile demographic.

In contrast, online health education tools have emerged as a viable solution to address these shortcomings. They offer flexibility and accessibility, effectively complementing the limitations of traditional offline methods. However, it is important to note that online health education does not demonstrate a statistically significant advantage over offline methods. Therefore, a hybrid approach that integrates both online and offline health education strategies is recommended. This combined model highlights the strengths of each method, thereby maximizing their collective impact. Such an integrated approach is particularly beneficial for addressing the unique needs of elderly hypertensive patients within the floating population, ensuring more comprehensive and effective health education outcomes.

Table 5: Changes in blood pressure in the online health education model group compared with the control group after two months of intervention

Pressure Mean ± SD	Online group	Offline group	t	p-value
	N = 47	N = 47		
SBP(mm Hg)	142.14±4.5	146.81±7.1	4.02	<0.71
DBP (mm Hg)	86.19±7.5	84.73±1.2	2.96	<0.25

This study evaluated the comparative effectiveness of online and offline health education interventions among floating elderly hypertensive patients over two months. The findings revealed significant differences in outcomes between the two groups, particularly in physical activity scores and attitudes toward treatment. The offline health education group demonstrated a statistically significant improvement in physical activity scores, with an increase of 16.06 points (from 51.39 to 67.45), compared to the online group. Additionally, the offline group showed a 6.17-point improvement (from 58.17 to 64.34) in attitudes and beliefs about treatment, though this difference was not statistically significant.

In terms of self-management ability, the online group exhibited a marginal improvement of 0.09 points (from 93.23 to 93.14), while the offline group showed a slight decline of 0.57 points (from 3.02 to 3.59) in medication adherence scores. However, these differences were not statistically significant. The results suggest that offline health education was more effective in enhancing physical activity levels and fostering a belief among participants that exercise could help lower blood pressure and improve self-management.

The offline approach provided a sense of trust and facilitated face-to-face communication, which appeared to contribute to its superior outcomes in physical activity scores. In contrast, the online health education platform lacked these advantages, resulting in significantly lower exercise scores compared to the offline group. Despite this, both groups showed no significant differences in treatment attitudes and beliefs, medication adherence, and self-management abilities.

The findings highlight the persistent advantages of traditional offline health education, particularly for floating elderly hypertensive patients who may have lost access to health education in their original communities. However, the study also underscores the potential of online health education as a complementary approach, especially for populations with limited access to in-person interventions. While both methods have distinct strengths and limitations, a combined approach integrating online and offline health education strategies may optimize the overall effectiveness of health education interventions for this demographic (refer to Table 6).

Table 6: After 2 months of intervention, the self-care ability of the online health education model group was compared with that of the control group

Domain assessed	Online group	Offline group	t	p-value
	N = 47	N = 47		
Physical activity score (mean ± SD)	51.39±17.24	67.45±10.56	9.17	<0.001
Therapeutic attitudes and beliefs score (mean ± SD)	58.17±13.41	64.34±26.25	14.28	<0.741
Self-management score (mean ± SD)	93.23±26.47	93.14±20.81	6.31	<0.201
Adherence to medication score (mean ± SD)	3.02±1.43	3.59±0.61	1.15	<0.583

4. Discussion

Hypertension represents a significant public health challenge, characterized by its high prevalence and low control rates in China, posing substantial health risks to both society and individuals (Cao et al., 2024). Addressing the issue of blood pressure control among hypertensive patients, particularly in the context of limited medical resources, has emerged as a critical area of research (Allouch et al., 2024). Numerous studies have highlighted the strong association between hypertension management and lifestyle factors, such as smoking, alcohol consumption, poor dietary habits, and physical inactivity, all of which are recognized as key risk factors for hypertension. Modifying these health behaviors has been shown to play a pivotal role in the prevention and control of hypertension (Filippou et al., 2020).

In recent years, Chinese researchers have explored various approaches and theoretical models for chronic disease management, particularly through health education strategies. These studies have demonstrated that implementing a closed-loop management pathway for chronic diseases can enhance the efficiency of healthcare providers and facilitate continuous care for hypertensive patients beyond clinical settings (Fu et al., 2020). However, the current application of closed-loop management for hypertension primarily focuses on basic patient care, often falling short in standardizing health education and lifestyle interventions. Challenges such as the lack of standardized health education materials and insufficient professional guidance have limited the effectiveness of interventions targeting patients' health behaviors (Piotrowicz et al., 2020). Consequently, there is an urgent need to develop systematic and standardized health education resources, establish a practical and scalable health education model, and integrate these elements into the hypertension management pathway. Such efforts would enhance patients' health literacy and behavioral adaptability, empowering them to engage in effective self-management and derive long-term benefits from chronic disease management (Heinert, Riggs, & Prendergast, 2022).

This study developed a comprehensive set of standardized health education materials for hypertension, integrating the Knowledge, Attitude, and Practice (KAP) model into the health education process. The approach emphasized a structured progression from knowledge acquisition to awareness building and behavioral change, with tailored educational content and intervention techniques designed for each stage of follow-up care (De Laet, Malbrain, & De Waele, 2020). Key outcomes of the research included the creation of a systematic curriculum, a personalized knowledge recommendation system based on a domain ontology model, and a follow-up and behavioral intervention framework grounded in execution intention theory. These components were integrated into the hypertension closed-loop management pathway, with enhancements made to the patient-facing interface of a WeChat mini-program. The expanded platform, which incorporated features such as health classes, behavior plans, and online follow-ups, aimed to support patients in managing their condition more effectively (Chia & Kario, 2020).

From the perspective of healthcare providers, this model enables general practitioners to utilize fragmented time for hypertension management, reducing the need for in-person consultations and improving intervention efficiency. Additionally, the platform facilitates the long-term storage of patient behavioral data, enabling subsequent analysis and personalized care. Comparative analysis of two patient groups revealed that the online management group demonstrated higher compliance rates in self-monitoring blood pressure, medication adherence, and lifestyle modifications compared to the offline management group. This suggests that the model can enhance the quality of health management and foster better self-

management behaviors among patients (Thomas, 2023). However, the study's analysis of self-management behaviors was limited in scope, necessitating further validation through larger-scale studies to assess the long-term efficacy of the online management model. Moreover, resistance to the adoption of online hypertension health education was observed, with patients citing reasons such as time constraints, difficulty using the platform, or perceived improvements in health as barriers to sustained engagement (Aravinthan, 2023). These findings highlight the need for ongoing refinement and promotion of the model to address patient concerns and improve accessibility.

Authors' contributions
All authors contributed to the study and drafted the written article for publication.

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Ethics approval and consent to participate
The protocol of this study was approved by the Ethics Committee of Universiti Teknologi MARA (REC/10/2023 (PG/FB/19)). Before the intervention, written informed consent was obtained from all the participants.

Data Availability Statement
Not applicable

Conflicts of Interest
The authors have no conflict of interest to declare.

Consent for publication
All authors have given their consent to publish.

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