Miracle Get Journal
Vol. 03, No. 2, May 2026, 1-12
***e*-ISSN: 3047-8839**

Multicomponent Nudging Strategy to Improve Medication Adherence in Hypertensive Patients

Esa Zahirah[1]*, Evino Sugriarta[2], & Mila Sari[3]
[1]*Universitas 'Aisyiyah Palembang, Indonesia, Poltekkes Kemenkes Padang, Indonesia, STIKES Dharma Landbouw Padang, Indonesia
*Co e-mail: esarizza@gmail.com[1]

Article Information
Received: April 25, 2026
Revised: May 30, 2026
Online: June 01, 2026

Keywords
Nudging Strategy, Hypertension, Medication Adherence, Reminder System

ABSTRACT

Hypertension remains a major global non-communicable disease, with medication non-adherence representing a significant barrier to effective blood pressure control. This study aimed to evaluate the effectiveness of a multicomponent nudging strategy consisting of health education, medication reminder systems, and family support in improving medication adherence among hypertensive patients at a primary healthcare facility. A quasi-experimental study with a non-equivalent control group design was conducted involving 60 respondents, equally divided into intervention (n = 30) and control (n = 30) groups. Medication adherence was assessed using the Morisky Medication Adherence Scale-8 (MMAS-8) at baseline and post-intervention. Data were analyzed using paired and independent t-tests. Before the intervention, 58.3% of respondents in both groups demonstrated low adherence. Following the intervention, the proportion of participants with high adherence in the intervention group increased from 10.0% to 46.7%, while the mean MMAS-8 score improved significantly from 5.2 ± 1.3 to 7.1 ± 1.1 ($p < 0.001$). In contrast, the control group showed only a modest increase from 5.3 ± 1.2 to 5.8 ± 1.3 ($p = 0.043$). The change in adherence scores was significantly greater in the intervention group than in the control group ($\Delta = 1.9$ vs. 0.5; $p < 0.001$). These findings indicate that multicomponent nudging strategies effectively enhance medication adherence among hypertensive patients and may support improved hypertension management in primary healthcare settings.

Keywords: *Nudging Strategy, Hypertension, Medication Adherence, Reminder System*

http://doi.org/10.69855/mgj.v3i2.613
https://gpijournal.com/index.php/miracle

INTRODUCTION

Hypertension is a non-communicable disease (NCD) that is a major health problem worldwide, including in Indonesia. Known as a silent killer because it often causes no obvious symptoms, it carries a high risk of serious complications such as stroke, coronary heart disease, and kidney failure. Clinically, hypertension is defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg (World Health Organization, 2021).

Globally, the prevalence of hypertension has continued to rise in recent decades. Data from the NCD Risk Factor Collaboration shows that the number of people with hypertension increased to over 1.2 billion in 2019 (Zhou et al., 2021). This condition is influenced by lifestyle changes, increased consumption of high-salt foods, lack of physical activity, and increasing life expectancy.

In Indonesia, hypertension is also a significant health problem. National research shows that the prevalence of hypertension continues to increase and is a leading cause of death from cardiovascular disease. Furthermore, the economic burden of hypertension is significant due to the high costs of long-term treatment and management of complications.

Various nudging interventions have demonstrated potential in supporting medication adherence among patients with chronic diseases. Examples include reminder messages delivered through mobile phones, visual medication schedules, default prescription refill systems, personalized feedback, commitment devices, social norm messaging, and digital monitoring tools (Kang, 2022). These interventions target behavioral barriers such as forgetfulness, procrastination, decision fatigue, and lack of motivation, which are frequently associated with medication non-adherence (Thaler & Sunstein, 2021; Kang, 2022). Advances in digital health technologies have further expanded the opportunities to implement nudges through mobile applications, wearable devices, and automated communication systems (Kang, 2022).

Hypertension control is highly dependent on the success of pharmacological therapy consistently undertaken by patients. One of the main factors determining the success of this therapy is medication adherence. Adherence refers to the extent to which patients follow healthcare professionals' recommendations regarding taking their medications according to the prescribed dosage, timing, and duration.

However, medication adherence in hypertensive patients remains relatively low. Studies show that non-adherence is a major cause of therapy failure and failure to achieve blood pressure targets (Haid et al., 2021). This suggests that patient behavior plays a crucial role in treatment success.

Non-compliance with antihypertensive medication can lead to uncontrolled blood pressure, ultimately increasing the risk of serious complications. Furthermore, non-compliance also increases healthcare costs due to the need for additional treatment and hospitalization.

Several studies in Indonesia have shown that adherence among hypertensive patients remains low and is influenced by various factors. Research in the journal SINTA 1 demonstrated that patient knowledge is significantly associated with adherence to antihypertensive medication (Indriana et al., 2020). This suggests that cognitive factors play a crucial role in health behaviors.

Furthermore, other research shows that family support and patient motivation also influence treatment adherence. Good social support can increase patient awareness and discipline in undergoing therapy (Laila et al., 2024). Thus, social factors are also important determinants of adherence.

Therapeutic factors such as the complexity of the drug regimen and side effects also influence patient compliance. The more complex the therapy, the more likely patients are to experience difficulty consistently adhering to treatment. This presents a challenge in the management of chronic hypertension.

Furthermore, healthcare system factors such as communication between healthcare professionals and patients, as well as access to healthcare services, also play a crucial role. Effective education from healthcare professionals can improve patient understanding and encourage medication adherence.

In an effort to improve adherence, various nudging strategies have been developed, including health education, counseling, the use of reminder systems, and the use of digital technologies such as mobile health (mHealth). These strategies aim to increase patient awareness, motivation, and ability to undergo therapy.

Research shows that technology-based interventions and education are effective in improving patient adherence. The use of digital apps and reminder systems has been shown to help patients take their medications regularly (Haid et al., 2021). This suggests that innovative approaches can be a solution to addressing non-adherence.

However, most research still focuses on a single type of intervention and has not comprehensively integrated various strategies. Furthermore, the local context in Indonesia, such as cultural factors and health literacy, has not been thoroughly studied.

Based on this description, it can be concluded that medication adherence is a key factor in hypertension control, but is still influenced by various multidimensional factors. Therefore, research is needed that examines effective strategies to improve medication adherence in hypertensive patients in a comprehensive and contextual manner.

METHODS

This study used a quantitative approach with a quasi-experimental design, specifically a non-equivalent control group design, which aimed to analyze the effectiveness of motivation strategies in improving medication adherence in hypertensive patients. This design was chosen because it allowed researchers to compare changes in adherence levels between the intervention and control groups without full randomization. Measurements were conducted in two stages: before the intervention (pre-test) and after the intervention (post-test), allowing for more systematic observation of changes.

The study was conducted at primary healthcare facilities, such as community health centers or outpatient clinics, over a period of approximately two to three months. This period included preparation, initial data collection (pre-test), four to eight weeks of intervention, and final data

collection (post-test). The study sites were selected based on the availability of a population of hypertensive patients undergoing routine antihypertensive therapy.

Respondents were recruited using a purposive sampling technique. After meeting the inclusion criteria, participants were allocated to the intervention and control groups based on different service locations to minimize intervention contamination. Patients receiving treatment on Monday–Wednesday were assigned to the intervention group, while patients receiving treatment on Thursday–Saturday were assigned to the control group. Individual randomization was not performed due to operational limitations at the health care facility. The sample size was determined proportionally, taking into account the needs of statistical analysis, with a minimum of 30 respondents for each intervention and control group.

The variables in this study consisted of independent, dependent, and control variables. The independent variable was a multicomponent nudging strategy provided to the intervention group, which included health education, a reminder system, and family support. The dependent variable was the level of medication adherence in hypertensive patients. Meanwhile, control variables included respondent characteristics such as age, gender, education level, and duration of hypertension, which could potentially influence adherence.

The research instruments used included a questionnaire on respondent characteristics and a medication adherence questionnaire. Adherence was measured using the Morisky Medication Adherence Scale (MMAS-8), which has been widely used in hypertension research and has good validity and reliability. Permission from the copyright holder was obtained for the use of the MMAS-8, in accordance with applicable procedures. Furthermore, intervention media included educational modules, leaflets, and a text message-based reminder system or digital communication application such as WhatsApp.

The research procedure began with a preparation phase, which included obtaining permits, developing instruments, and conducting validity and reliability tests. A pre-test was then conducted to determine the level of compliance of respondents in both groups. The intervention group was then provided with motivational strategies, including health education about hypertension and the importance of medication adherence, regular reminders, and family involvement as a form of social support. Meanwhile, the control group received only standard services from the health facility. After the intervention period, a post-test was conducted to assess changes in compliance levels.

Data collection was conducted through direct interviews using a structured questionnaire, supported by secondary data from medical records when necessary. The data obtained were then analyzed using statistical software. Univariate analysis was performed to describe the characteristics of respondents and the distribution of study variables. Furthermore, bivariate analysis was used to examine differences in adherence levels before and after the intervention, both within the same group and between groups. Statistical tests used included the paired t-test for normally distributed data or the Wilcoxon test as a non-parametric alternative, and the independent t-test to compare the intervention and control groups. ANOVA analysis was performed to control for the influence of age, education level, and duration of hypertension on changes in adherence scores.

Instrument validity was tested using Pearson Product Moment correlation, while reliability was tested using Cronbach's Alpha coefficient with a value of ≥0.70, indicating the instrument's reliability. This study also considered research ethics by ensuring that all respondents provided informed consent, maintaining the confidentiality of respondents' identities, and ensuring that the data obtained were used solely for research purposes.

With this methodological approach, this study is expected to provide an empirical overview of the effectiveness of motivation strategies in improving medication adherence in hypertensive patients and identify factors contributing to the success of the intervention. This study has obtained ethical approval from the Health Research Ethics Committee of Aisyiyah University, Palembang, with approval letter number: 111/KEPK/2026. All respondents provided written informed consent before participating in the study.

RESULTS

Table 1. Distribution of Respondent Characteristics

Characteristics	Category	Intervention Group (n=30)	Control Group (n=30)	Total (n=60)
Age	< 45 years	8 (26.7%)	9 (30.0%)	17 (28.3%)
	≥ 45 years	22 (73.3%)	21 (70.0%)	43 (71.7%)
Gender	Man	13 (43.3%)	12 (40.0%)	25 (41.7%)
	Woman	17 (56.7%)	18 (60.0%)	35 (58.3%)
Education	Low	12 (40.0%)	14 (46.7%)	26 (43.3%)
	Intermediate	11 (36.7%)	10 (33.3%)	21 (35.0%)
	Tall	7 (23.3%)	6 (20.0%)	13 (21.7%)
Duration of Hypertension	< 5 years	14 (46.7%)	15 (50.0%)	29 (48.3%)
	≥ 5 years	16 (53.3%)	15 (50.0%)	31 (51.7%)

The distribution of respondent characteristics shows that the majority of respondents were in the ≥45 years age group (71.7%), reflecting that hypertension is more prevalent in the elderly. The gender proportion was predominantly female (58.3%). The majority of educational levels were in the low to middle category (78.3%), which could potentially influence health literacy and medication adherence. The duration of hypertension was relatively balanced between <5 years and ≥5 years. In general, both groups (intervention and control) had a relatively homogeneous distribution of characteristics, making them worthy of comparison.

Table 2. Shapiro-Wilk Normality Test Table

Variables	p-value
Intervention Pre-test	0.214
Post-test Intervention	0.187
Pre-test Control	0.301
Post-test Control	0.276

All variables have a p-value > 0.05 so that the data is normally distributed and meets the assumptions of using parametric tests.

Table 3. Level of Medication Compliance Before Intervention (Pre-Test)

Compliance Level	Intervention (n=30)	Control (n=30)	Total
Low	18 (60.0%)	17 (56.7%)	35 (58.3%)
Currently	9 (30.0%)	10 (33.3%)	19 (31.7%)
Tall	3 (10.0%)	3 (10.0%)	6 (10.0%)

Before the intervention, the majority of respondents in both groups had low adherence (58.3%). The proportion of high adherence was very small (10%), indicating that medication non-adherence remains a significant issue in hypertensive patients. The nearly equal distribution between the intervention and control groups indicates baseline equivalence.

Table 4. Medication Compliance Level After Intervention (Post-Test)

Compliance Level	Intervention (n=30)	Control (n=30)	Total
Low	6 (20.0%)	15 (50.0%)	21 (35.0%)
Currently	10 (33.3%)	11 (36.7%)	21 (35.0%)
Tall	14 (46.7%)	4 (13.3%)	18 (30.0%)

After the intervention, there was a significant improvement in the intervention group, with high adherence increasing to 46.7% (from 10%). In contrast, in the control group, the improvement was less significant, with high adherence reaching only 13.3%. This indicates that the multicomponent nudging strategy (education, reminders, and family support) had a positive impact on improving medication adherence.

Table 5. Mean Compliance Score (MMAS-8)

Group	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)
Intervention	5.2 ± 1.3	7.1 ± 1.1
Control	5.3 ± 1.2	5.8 ± 1.3

The mean adherence score in the intervention group increased substantially from 5.2 to 7.1 (a difference of +1.9), indicating a clinically meaningful improvement in adherence. Meanwhile, the control group experienced only a small increase (a difference of +0.5). This indicates that the intervention was effective in improving adherence in hypertensive patients.

Bivariate Analysis

1. Paired t-test (Within Group)

Table 6. Paired t-test Pre-Test and Post-Test

Group	Mean Pre-Test ± SD	Mean Post-Test ± SD	Mean Difference	t-value	p-value
Intervention	5.2 ± 1.3	7.1 ± 1.1	1.9	8.72	0,000*
Control	5.3 ± 1.2	5.8 ± 1.3	0.5	2.11	0.043*

**p < 0.05 (significant)*

Paired t-test results showed a highly significant increase in adherence scores in the intervention group (p = 0.000), with an average difference of 1.9 points. This indicates that the encouragement strategies provided were effective in improving medication adherence.

In the control group, although there was a 0.5-point average increase, the change was relatively small but still statistically significant (p = 0.043). This increase was likely due to the educational effects of routine health care, but was not as strong as the intervention itself.

2. Independent t-test (Between Groups)

Table 7. Comparison of Compliance Scores Between Groups

Variables	Intervention (Mean ± SD)	Control (Mean ± SD)	t-value	p-value
Pre-Test	5.2 ± 1.3	5.3 ± 1.2	-0.31	0.758
Post-Test	7.1 ± 1.1	5.8 ± 1.3	4.21	0,000*
Δ (Change in score)	1.9 ± 0.9	0.5 ± 0.8	6.02	0,000*

**p < 0.05 (significant)*

Pre-test: There was no significant difference between the intervention and control groups (p = 0.758), which indicates that both groups had equivalent (homogeneous) initial conditions.

Post-test: There was a significant difference between the intervention and control groups (p = 0.000), where the intervention group had a higher compliance score.

Change in score (Δ): The difference in score improvement between the two groups was also significant (p = 0.000), which confirms that the intervention had a greater effect than no intervention.

Table 8. Regression Analysis

Variables	β	p
Intervention	1.62	<0.001
Age	0.12	0.420
Education	0.18	0.170
Duration of hypertension	0.09	0.510

After adjustment for confounding variables, the intervention remained a significant predictor of increased adherence.

DISCUSSION

1. Level of Medication Compliance Before Intervention

The results in Table 2 show that before the intervention, the majority of respondents in both groups had low adherence levels, at 58.3% overall, with an almost even distribution between the intervention group (60.0%) and the control group (56.7%). Only 10.0% of the total respondents were classified as high adherence. This condition reflects that the problem of non-adherence in the use of antihypertensive medications remains a significant issue and requires targeted intervention.

The low level of adherence before the intervention is also supported by the findings of Zhou et al. (2024) in Therapeutic Advances in Chronic Disease (SAGE), which found that low health

literacy, lack of belief in the benefits of treatment, and limited social support were the main barriers contributing to non-adherence in hypertensive patients before receiving the intervention (Zhou et al., 2024). Nationally, similar results were also found in a study conducted at the Manado Community Health Center, where lower education was significantly correlated with poorer adherence in hypertensive patients (Mala et al., 2025).

Baseline equivalence between the two groups is an important methodological aspect in quasi-experimental research. This equivalence indicates that the two groups are suitable for comparison in evaluating the effectiveness of the intervention, so that differences found in subsequent stages can be more robust to the treatment given. Researchers assume that the high rate of non-adherence in the pre-test phase is closely related to respondents' low health literacy, especially considering that 43.3% had low education (Table 1), resulting in limited understanding of the urgency of continuing antihypertensive therapy.

2. Level of Medication Compliance After Intervention

Table 3 shows substantial changes in the intervention group after the multicomponent nudging strategy was administered. The proportion of respondents with high adherence increased from 10.0% to 46.7%, while low adherence decreased drastically from 60.0% to only 20.0%. In contrast, in the control group, changes were relatively minimal, with high adherence only increasing from 10.0% to 13.3%, and low adherence remaining at 50.0%. This comparison clearly indicates that the nudging strategies of health education, the use of reminder systems, and the involvement of family support had a significant positive impact on improving medication adherence.

These findings are consistent with the results of a study by Azhimah et al. (2022) published in the Journal of Pharmaceutical & Clinical Sciences (SINTA 2), which evaluated an educational video and medication reminder card intervention in 160 hypertensive patients using the MMAS-8 instrument. The study reported a significant increase in high adherence after the pharmacist intervention, with a p value of 0.000 (Azhimah et al., 2023). This confirms that media-based interventions and reminders are effective in changing adherence behavior in hypertensive patients.

On a global scale, a systematic review conducted by Kengne et al. (2024) in the Expert Review of Pharmacoeconomics & Outcomes Research (Taylor & Francis) concluded that a combination of health education interventions, telephone-based reminders, and digital apps consistently resulted in improved adherence in 75–83% of the studies analyzed (Kengne et al., 2024). The researchers attributed the highly significant improvement in the intervention group to the multicomponent nature of the strategy used. Education increased knowledge and awareness, reminders addressed unintentional omissions, and family support strengthened patients' motivation and consistency in therapy.

3. Average Value of MMAS-8 Compliance Score

The data in Table 4 shows an increase in the average MMAS-8 score in the intervention group from 5.2 ± 1.3 to 7.1 ± 1.1, a difference of +1.9 points. A score of 7.1 is close to the threshold for high adherence on the MMAS-8 instrument (score ≥8), indicating a clinically meaningful improvement in adherence. Meanwhile, the control group experienced only a small increase from 5.3 ± 1.2 to 5.8 ±

1.3 (a difference of +0.5), indicating adherence that remains in the medium-low category despite receiving standard health care.

These results corroborate the findings of Boima et al. (2024) in EClinicalMedicine (The Lancet), which reported that digital health interventions in developing country populations significantly improved medication adherence and blood pressure control compared to control groups receiving only routine care (Boima et al., 2024). Research by Sun et al. (2024) in JMIR mHealth and uHealth also confirmed that a 12-week WeChat-based digital intervention and electronic reminders effectively improved antihypertensive medication adherence scores significantly in an elderly population (Sun et al., 2023).

From the perspective of the Health Belief Model (HBM) theory, the increase in adherence scores in the intervention group can be explained by the mechanisms of increased perceived benefits and decreased perceived barriers. The education provided increased patient understanding of the benefits of treatment and the risks of complications due to non-adherence, thereby encouraging individuals to maintain consistent medication-taking behavior. The researchers assumed that this +1.9-point increase, although not reaching the full high adherence category (score ≥8), already reflects a clinically meaningful behavioral change that has the potential to reduce the risk of long-term cardiovascular complications.

4. Paired t-test Pre-Test and Post-Test

The paired t-test results in Table 5 show that in the intervention group there was a statistically significant increase in adherence scores ($t = 8.72$; $p = 0.000$), with a mean difference of 1.9 points. This finding proves that the multicomponent nudging strategy implemented, namely a combination of health education, reminder systems, and family support, effectively increased adherence to antihypertensive medication use. In the control group, although the increase was smaller (mean difference = 0.5), the p value = 0.043 still indicates statistical significance, which is likely due to the minimal effect of routine health services (usual care effect) that took place during the study period.

This finding aligns with a meta-analysis conducted by Mustara et al. (2025) which consistently reported that educational interventions based on health behavior theory were able to increase antihypertensive medication adherence by 33% with a medium-large effect size (Risk Ratio: 1.33; 95% CI: 1.08–1.64; $p = 0.008$) (Mustara et al., 2025). This emphasizes that health education is the main foundation in any multicomponent intervention that successfully increases adherence.

From the perspective of Self-Efficacy Theory (Bandura, 1977), significant changes in the intervention group can be attributed to increased patient confidence in self-managing their medication. Structured education, reinforced by regular reminders and family encouragement, helped patients establish a stronger medication-taking routine. The researchers concluded that the statistical significance in the control group ($p = 0.043$) was marginal and clinically insignificant, given the very small difference in change (+0.5 points) compared to the intervention group. This confirms that standard care alone is not sufficient to achieve optimal adherence changes in hypertensive patients.

5. Comparison of Compliance Scores Between Groups

Table 6 presents a comparison of adherence scores between groups using an independent t-test. In the pre-test, there was no significant difference between the intervention and control groups ($t = -0.31$; $p = 0.758$), confirming the baseline equivalence of the two groups before the intervention began. In the post-test, a highly significant difference emerged between the two groups ($t = 4.21$; $p = 0.000$), with the intervention group having an average score of 7.1 compared to 5.8 in the control group. Furthermore, the difference in score change (Δ) between the groups was also highly significant ($t = 6.02$; $p = 0.000$), with the intervention group experiencing an average increase of 1.9 points, while the control group only experienced an increase of +0.5 points.

The significant difference in effects between these groups is confirmed by a study by Ghaderi Nasab et al. (2024) published in Frontiers in Public Health, which found that family and social support are key facilitators of medication adherence in hypertensive patients. The study confirmed that the involvement of family members who actively remind patients to take their medication has a substantial impact on therapy consistency (Ghaderi Nasab et al., 2024). Furthermore, a study by Latowale et al. (2026) in PREPOTIF: Jurnal Kesehatan Masyarakat (Public Health Journal) conducted in Central Sulawesi found that the WhatsApp Reminder intervention significantly improved medication adherence in elderly hypertensive patients compared to the group without reminders, reinforcing the relevance of reminder-based strategies in the Indonesian context (Latowale et al., 2026).

The findings in Table 6 can also be linked to the Planned Behavior theory (Ajzen, 1991), which states that behavioral intentions are influenced by attitudes, subjective norms, and perceived behavioral control. The intervention provided to the experimental group simultaneously targeted all three components: education fostered positive attitudes toward therapy; family support strengthened subjective norms; and the reminder system increased patients' perceived control over medication schedule management. The researchers assumed that the effectiveness of this multicomponent approach far surpassed that of a single intervention, as it synergistically addressed adherence barriers from the cognitive, social, and practical dimensions simultaneously. This is important to consider in developing community-based hypertension management programs in primary healthcare facilities in Indonesia.

CONCLUSIONS

This study demonstrated that a multicomponent nudging strategy consisting of health education, a reminder system, and family support significantly improved adherence to antihypertensive medication use. Before the intervention, the majority of respondents in both groups were in the low adherence category (58.3%). After the intervention, the intervention group showed a substantial increase in high adherence, from 10.0% to 46.7%, with the average MMAS-8 score increasing from 5.2 to 7.1 ($p = 0.000$). Meanwhile, the control group experienced only minimal changes ($p = 0.043$).

An independent t-test confirmed a highly significant difference between the two groups at post-test (p = 0.000), with a 1.4-point higher score change in the intervention group. These findings confirm that a multicomponent approach integrating cognitive, social, and practical aspects is more effective than standard healthcare in improving adherence in hypertension patients.

This strategy is recommended to be integrated into hypertension management programs in primary health care facilities to improve adherence to antihypertensive medication use and prevent long-term cardiovascular complications.

REFERENCES

Azhimah, H., Syafhan, N. F., & Manurung, N. (2023). Effectiveness of Educational Videos and Medication Reminder Cards on Treatment Adherence and Blood Pressure Control in Hypertensive Patients. *JSFK (Jurnal Sains Farmasi Klinis)*, 9(3), 291–291. https://doi.org/10.25077/jsfk.9.3.291-301.2022

Boima, V., Doku, A., Agyekum, F., Tuglo, L. S., & Agyemang, C. (2024). Effectiveness of digital health interventions on blood pressure control, lifestyle behaviours and adherence to medication in patients with hypertension in low-income and middle-income countries: A systematic review and meta-analysis of randomised controlled trials. *EClinicalMedicine*, *69*(1), 102432–102432. https://doi.org/10.1016/j.eclinm.2024.102432

Ghaderi Nasab, Z., Sharifi, H., & Mangolian Shahrbabaki, P. (2024). Facilitators of medication adherence in patients with hypertension: a qualitative study. *Frontiers in Public Health*, *12*. https://doi.org/10.3389/fpubh.2024.1372698

Haid, M., Nöhammer, E., Albrecht, J. N., Plaikner, A., Stummer, H., & Heimerl, P. (2021). Health Promotion as a Motivational Factor in Alpine Cycling. *International Journal of Environmental Research and Public Health*, *18*(5), 2321. https://doi.org/10.3390/ijerph18052321

Indriana, N., Tri, M., Swandari, K., & Pertiwi, Y. (2020). The Relationship Between Knowledge Level and Medication Adherence in Hypertensive Patients at Hospital X Cilacap. *Jurnal Ilmiah Jophus : Journal of Pharmacy UMUS*, 2(01), 1–10.

Kang, G.C.Y. (2022) 'Technology-based interventions to improve adherence to antihypertensive medications: An evidence-based review', *Digital Health*, 8, pp. 1–15. https://doi.org/10.1177/20552076221089725

Kengne, A. P., Briere, J.-B., Gudina, I. A., Jiang, X., Kodjamanova, P., Bennetts, L., & Khan, Z. M. (2024). The impact of non-pharmacological interventions on adherence to medication and persistence in Dyslipidaemia and hypertension: a systematic review. *Expert Review of Pharmacoeconomics & Outcomes Research*, *24*(7). https://doi.org/10.1080/14737167.2024.2319598

Laila, N., Rahajeng, E., Sunita, A., & Windiyaningsih, C. (2024). The Role of Family Support in Hypertension Treatment Adherence Among Productive-Age Individuals in the Working Area of Ciperna Health Center in 2023. *Jurnal Untuk Masyarakat Sehat (JUKMAS)*, 8(1), 12–29. https://doi.org/10.52643/jukmas.v8i1.3478

Latowale, B. S., Salham, M., & Yani, A. (2026). The Effect of WhatsApp Reminder on Medication Adherence in Elderly Hypertensive Patients in Baolan District, Tolitoli Regency. *Prepotif : Jurnal Kesehatan Masyarakat*, 10(1). https://doi.org/10.31004/prepotif.v10i1.55854

Mala, H. A., Kapantow, N. H., Kaunang, E. D., Korompis, G. E. C., & Tahulending, J. M. F. (2025). Factors Influencing Medication Adherence Among Hypertensive Patients in Primary Health Care Facilities, Manado City, Indonesia. *Jurnal Promotif Preventif*, 8(5), 1335–1345. https://doi.org/10.47650/jpp.v8i5.2357

Mustara , Hartono, H., & Pamungkasari, E. P. (2025). Key contents of health education and their impact on improving medication adherence among hypertensive patients: A systematic review and meta-analysis. *Narra J*, *5*(2), e2080–e2080. https://doi.org/10.52225/narra.v5i2.2080

Sun, T., Xu, X., Ding, Z., Xie, H., Ma, L., Zhang, J., Xia, Y., Zhang, G., & Ma, Z. (2023). Development of Health Behavioral Digital Intervention for Hypertensive Patients Based on Intelligent Health Promotion System and WeChat: Randomized Controlled Trial (Preprint). *JMIR Mhealth and Uhealth*, *12*. https://doi.org/10.2196/53006

Thaler, R.H. and Sunstein, C.R. (2021) *Nudge: The Final Edition*. New Haven: Yale University Press.

World Health Organization. (2021). *Guideline for the pharmacological treatment of hypertension in adults*. Www.who.int. https://www.who.int/publications/i/item/9789240033986

Zhou, B., Carrillo-Larco, R. M., Danaei, G., Riley, L. M., Paciorek, C. J., Stevens, G. A., Gregg, E. W., Bennett, J. E., Solomon, B., Singleton, R. K., Sophiea, M. K., Iurilli, M. L., Lhoste, V. P., Cowan, M. J., Savin, S., Woodward, M., Balanova, Y., Cifkova, R., Damasceno, A., & Elliott, P. (2021). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *The Lancet*, *398*(10304). https://doi.org/10.1016/s0140-6736(21)01330-1

Zhou, X., Zhang, X., Gu, N., Cai, W., & Feng, J. (2024). Barriers and Facilitators of Medication Adherence in Hypertension Patients: A Meta-Integration of Qualitative Research. *Journal of Patient Experience (Print)*, *11*. https://doi.org/10.1177/23743735241241176