The impact of health literacy on adherence to isometric exercise and its effect on blood pressure in hypertensive patients

El impacto de la alfabetización en salud sobre la adherencia al ejercicio isométrico y su efecto en la presión arterial en pacientes hipertensos

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Abstract

Background: Hypertension is a major global health problem and a leading cause of cardiovascular disease.
Objective: This study aimed to analyze the influence of health literacy on adherence to isometric exercise and its effects on blood pressure reduction among patients with hypertension in Kolaka.
Methods: A quasi-experimental study with a pretest–posttest control group design. Sixty respondents diagnosed with hypertension were randomly selected using simple random sampling and divided into two groups: 30 with higher health literacy and 30 with lower health literacy, as measured by the Health Literacy Questionnaire (HLQ). Blood pressure was measured before and after the intervention using a standardized digital sphygmomanometer. Data were analyzed using paired t-tests and ANCOVA with a significance level of $p < 0.05$, and Cohen's d was calculated to determine the magnitude of the intervention effect.
Results: The intervention group experienced a significant decrease in systolic blood pressure from 152.1 ± 9.0 to 141.3 ± 7.5 mmHg and in diastolic pressure from 95.2 ± 6.5 to 87.1 ± 5.8 mmHg (both $p < 0.001$; large effect sizes). In contrast, the control group showed no significant changes in either systolic or diastolic pressure ($p > 0.05$). ANCOVA revealed that health literacy significantly influenced reductions in both systolic ($p = 0.014$) and diastolic ($p = 0.017$) blood pressure, with a significant interaction between literacy level and exercise adherence ($p < 0.05$).
Conclusion: Health literacy plays a crucial role in enhancing the effectiveness of isometric exercise in lowering blood pressure among hypertensive patients. Patients with higher literacy demonstrated greater adherence and achieved better blood pressure control.

Keywords

Hypertension; health literacy; isometric exercise; blood pressure; patient adherence.

Resumen

Antecedentes: La hipertensión es un importante problema de salud mundial y una de las principales causas de enfermedades cardiovasculares.
Objetivo: Este estudio tuvo como objetivo analizar la influencia de la alfabetización en salud sobre la adherencia al ejercicio isométrico y sus efectos en la reducción de la presión arterial en pacientes con hipertensión en Kolaka.
Métodos: Se realizó un estudio cuasi-experimental con un diseño de grupo control con pretest y postest. Sesenta participantes diagnosticados con hipertensión fueron seleccionados aleatoriamente mediante muestreo aleatorio simple y divididos en dos grupos: 30 con mayor alfabetización en salud y 30 con menor alfabetización, medida mediante el Health Literacy Questionnaire (HLQ). La presión arterial se midió antes y después de la intervención utilizando un esfigmomanómetro digital estandarizado. Los datos se analizaron mediante pruebas t pareadas y ANCOVA con un nivel de significancia de $p < 0,05$, y se calculó el tamaño del efecto de Cohen (Cohen's d) para determinar la magnitud del efecto de la intervención.
Resultados: El grupo de intervención experimentó una disminución significativa en la presión arterial sistólica de 152,1 ± 9,0 a 141,3 ± 7,5 mmHg y en la presión diastólica de 95,2 ± 6,5 a 87,1 ± 5,8 mmHg (ambos $p < 0,001$; tamaños de efecto grandes). En contraste, el grupo control no mostró cambios significativos ni en la presión sistólica ni en la diastólica ($p > 0,05$). El análisis ANCOVA reveló que la alfabetización en salud influyó significativamente en la reducción de la presión arterial sistólica ($p = 0,014$) y diastólica ($p = 0,017$), con una interacción significativa entre el nivel de alfabetización y la adherencia al ejercicio ($p < 0,05$).
Conclusión: La alfabetización en salud desempeña un papel crucial en la mejora de la efectividad del ejercicio isométrico para reducir la presión arterial en pacientes hipertensos. Los pacientes con mayor nivel de alfabetización mostraron una mayor adherencia y lograron un mejor control de la presión arterial.

Palabras clave

Hipertensión; alfabetización en salud; ejercicio isométrico; presión arterial; adherencia del paciente.

Introduction

Hypertension (high blood pressure) is one of the leading non-communicable diseases (Sudayasa et al., 2020, 2023) and a major global public health burden due to its potential to cause complications such as stroke, heart disease, and kidney failure (Carey et al., 2022; Mills et al., 2020; World Health Organization, 2025). Physical activity has long been recognized as an important non-pharmacological intervention in the management of hypertension. One form of physical activity that is relatively light, easily accessible, and does not require complex equipment is isometric exercise static training in which muscles contract without a change in muscle length or joint movement. This type of exercise is believed to reduce blood pressure through physiological mechanisms such as improved endothelial function, decreased sympathetic nervous system activity, and enhanced vascular regulation (Edwards et al., 2022).

At the national level, the 2018 Basic Health Research Survey (Riskesdas) reported that the prevalence of hypertension among individuals aged ≥18 years in Indonesia reached 34.1%. However, this prevalence is not evenly distributed across provinces. Provinces with specific geographical, socioeconomic, and cultural characteristics show different rates. One province of particular concern is Southeast Sulawesi, where the prevalence of hypertension increased from approximately 22.5% in 2013 to 29.7% in 2018 according to Riskesdas data (Kemenkes, 2023).

Kolaka District, part of Southeast Sulawesi Province, has also shown an increasing trend of non-communicable diseases (NCDs), including hypertension. The 2023 Kolaka District Health Profile reported that hypertension is one of the NCDs with a high cumulative number of cases. However, specific prevalence data from Riskesdas for Kolaka are not always explicitly reported in local publications or district health reports, and when available, the figures are often presented as case counts rather than percentages of the population. This makes direct comparison with provincial and national levels challenging (Dinas Kesehatan Provinsi Sulawesi Tenggara, 2022).

Although the prevalence of hypertension in Southeast Sulawesi rose from 22.5% to 29.7% over several years, not all hypertensive patients in the province or in Kolaka are motivated to adopt lifestyle interventions such as exercise or static training. Barriers include limited knowledge about hypertension, misinterpretation of risks, and restricted access to health information. In Kolaka, despite a high number of reported hypertension cases, there is no strong evidence regarding the level of health literacy among patients or the extent to which they engage in non-pharmacological physical activities such as isometric exercise.

Recent meta-analyses have confirmed that isometric handgrip training effectively lowers both systolic and diastolic blood pressure among hypertensive and prehypertensive adults (Almeida et al., 2021; dos Santos Alves et al., 2025; Oliveira et al., 2023). However, the success of such interventions largely depends on the patient's ability to understand, adhere to, and consistently apply the exercise regimen. This behavioral aspect is strongly influenced by health literacy (HL) the capacity to access, comprehend, and use health information effectively in daily self-management.

According to the integrated Health Literacy Model proposed by Sørensen et al. (2012), health literacy is a multidimensional construct encompassing the ability to access, understand, appraise, and apply health information in order to make informed decisions in everyday life. These competencies enable individuals to transform health knowledge into actual behavioral compliance. In hypertension management, patients with higher literacy are more capable of interpreting medical guidance, assessing the benefits of prescribed exercises, and maintaining adherence to non-pharmacological regimens such as isometric training. Similarly, Paakkari and Okan (2019) highlighted that health literacy also involves critical thinking, self-awareness, and motivation factors that enhance self-regulation and persistence in adopting healthy behaviors. Therefore, health literacy not only determines one's understanding of health instructions but also shapes long-term behavioral commitment to disease control and prevention.

Emerging evidence indicates that individuals with higher HL demonstrate better adherence to antihypertensive therapy, self-monitoring practices, and lifestyle modifications (Bozorgi et al., 2021; Karami et al., 2023). Nevertheless, empirical studies exploring the moderating role of HL in exercise-based interventions for hypertension remain scarce, particularly in Asian and developing-country contexts where cultural, linguistic, and educational factors may shape health behaviors differently.

With the prevalence of hypertension approaching 30% in Southeast Sulawesi, including Kolaka, the disease imposes a significant burden on individuals, families, and the healthcare system. Pharmacological control alone is not always sufficient due to cost, side effects, and limited access to medication. Non-pharmacological interventions such as isometric exercise, which are inexpensive and can be performed at home, offer great potential. However, for such interventions to succeed, adequate health literacy is required to ensure patient understanding and consistent practice. This study is therefore crucial to assess health literacy levels in Kolaka and examine how literacy influences the adoption of isometric exercise and its impact on blood pressure.

The novelty of this study lies in its regional focus, combining local empirical data from Kolaka/Southeast Sulawesi with the measurement of health literacy and the implementation of isometric exercise. Much of the existing literature has been conducted in urban areas or at the national level, with limited studies addressing rural or semi-rural settings where access to healthcare may be more constrained and local cultural factors play a role. This research not only evaluates the physiological effects of isometric exercise but also incorporates health literacy as a mediating or moderating factor between knowledge/behavior and blood pressure outcomes.

Therefore, this study aims to analyze the influence of health literacy on adherence to isometric exercise and its effect on blood pressure reduction among hypertensive patients in Kolaka, Southeast Sulawesi, Indonesia. By combining physiological measurement with literacy assessment, this research addresses a significant knowledge gap at the intersection of health education, behavioral compliance, and non-pharmacological hypertension management. Findings are expected to contribute to the design of integrated primary health care strategies that incorporate literacy-based interventions for sustainable hypertension control, particularly in resource-limited settings.

Method

Study Type and Design

This research employed a quasi-experimental design with a pretest–posttest control group approach. The design was chosen to assess the influence of health literacy among hypertensive patients on adherence to isometric exercise and the effect of this exercise on blood pressure changes. The intervention group received health literacy education and isometric exercise training, while the control group received standard care without additional intervention.

Setting, Location, and Study Period

The study was conducted in the working area of community health centers (Puskesmas) in Kolaka District, Southeast Sulawesi Province. The location was purposively selected due to its high prevalence of hypertension cases, as reported in the Southeast Sulawesi Riskesdas and the Kolaka District Health Profile, making it representative for evaluating the effectiveness of non-pharmacological interventions such as isometric exercise in hypertension management. Furthermore, the Puskesmas in Kolaka provide relatively adequate primary health care facilities and a network of health workers capable of supporting recruitment, education, supervision, and monitoring of respondents throughout the study.

The research period was scheduled from April to August 2025, covering four key phases. First, the preparation phase included the development of research instruments, enumerator training, and coordination with Puskesmas staff and local authorities. Second, the baseline data collection phase involved respondent screening, initial blood pressure measurement, and completion of the health literacy questionnaire. Third, the intervention phase involved the implementation of the isometric exercise program, supervised and monitored regularly for eight weeks according to the study protocol.

Population and Sample

The study population comprised all hypertensive patients registered as outpatients at Puskesmas in Kolaka District. The sample was drawn from this population using a simple random sampling technique to ensure that each registered hypertensive patient had an equal chance of being selected as a study participant. The sample was drawn from hypertensive patients who met the following inclusion criteria: (1) aged 30–65 years, (2) clinically diagnosed with hypertension, (3) systolic blood pressure between

140–160 mmHg or diastolic ≥90 mmHg, (4) willing to participate in a regular isometric exercise program, and (5) able to read and understand simple instructions. Exclusion criteria included: (1) patients with severe complications such as heart failure or stroke, (2) those enrolled in specific exercise programs, and (3) those unable to perform isometric contractions due to physical limitations.

Sample size calculation using the two-mean comparison formula with a significance level of 5% (α = 0.05) and 80% power indicated the need for 30 respondents in each group. Thus, the total sample comprised 60 respondents (30 with high literacy and 30 with low literacy). To minimize selection bias, matching was conducted between the two groups based on age, gender, and other relevant characteristics.

Research Variables and Measurements

The independent variable in this study was health literacy among hypertensive patients, measured using a modified and validated version of the Health Literacy Questionnaire (HLQ) developed by Sørensen et al. (2012) and adapted to the Indonesian context. The adaptation process included translation, back-translation, and cultural and linguistic validation by three public health experts. A pilot test was conducted on 30 hypertensive patients from a similar population to assess the psychometric properties of the instrument. The results showed a Content Validity Index (CVI) of 0.89, indicating good content validity, and a Cronbach's alpha coefficient of 0.87, demonstrating high internal consistency.

Health literacy scores were categorized into high and low levels using the sample mean score of the HLQ as the cut-off point, following the procedure used in previous Indonesian validation studies (e.g., Bozorgi et al., (2021); Karami et al., (2023)). Participants with total HLQ scores above the mean were classified as having high health literacy, while those with scores equal to or below the mean were classified as low health literacy. This approach was considered appropriate for the local context, where population-based literacy norms are not yet standardized.

The dependent variables were systolic and diastolic blood pressure, measured using a calibrated digital sphygmomanometer in accordance with World Health Organization (WHO) procedures, before and after the intervention. In addition, adherence to isometric exercise was included as an additional variable. It was assessed using daily monitoring sheets completed by participants and verified weekly by the research instructor. Adherence levels were calculated based on the percentage of completed sessions out of the total prescribed exercise sessions.

Isometric Exercise Procedure and Control of Confounding Variables

Participants in the intervention group were trained to perform isometric handgrip exercises using a simple handgrip device. Each exercise session consisted of hand contractions at 30% of maximal voluntary contraction (MVC), maintained for 2 minutes, repeated four times with 1-minute rest intervals between contractions. The training was conducted three times per week for eight weeks. During the first two weeks, the exercises were performed under direct supervision by trained health personnel, while subsequent sessions were remotely monitored through weekly visits and review of exercise logbooks.

To ensure that the observed changes in blood pressure were truly due to the isometric exercise intervention and not influenced by other factors, confounding variables were controlled through the following measures:

1. Dietary Control:

During the eight-week intervention, participants were instructed to maintain their usual daily diet and refrain from starting any special dietary program (such as a low-salt or weight-loss diet) unless medically prescribed. Weekly monitoring was conducted using a short food frequency checklist, and any significant dietary changes were recorded and analyzed as potential confounders.

2. Medication Control:

Information about antihypertensive medication use was recorded at baseline and updated weekly. Participants who were on medication were instructed to continue the same type and dosage throughout the study period. Any changes in medication or dosage made upon medical advice were documented and considered in the statistical analysis as potential confounding factors.

3. Monitoring of Other Physical Activities:

Participants were asked to maintain their usual level of daily physical activity and avoid initiating any new exercise program other than the prescribed isometric handgrip training. Activities such as walking, household chores, or work-related physical activity were recorded in weekly monitoring logs to ensure stability of lifestyle throughout the intervention period.

Data Collection

Data collection was carried out from two main sources: primary and secondary data. Primary data were obtained through blood pressure measurements using a calibrated digital sphygmomanometer, ensuring accuracy and scientific validity. Respondents also completed a health literacy questionnaire, which had been tested for validity and reliability, to assess their understanding, knowledge, and skills in managing hypertension. Adherence to isometric exercise was recorded using daily monitoring logs maintained by respondents and verified by the research team to reflect the extent of compliance with the prescribed intervention.

Secondary data were collected from patient medical records at the Puskesmas, including information on health history, hypertension diagnosis, antihypertensive medication use, and other relevant risk factors. All data collection procedures were conducted by trained enumerators who received specific instruction in accurate blood pressure measurement, questionnaire administration, and data recording techniques to ensure reliability.

Data Analysis

Data were analyzed using the latest version of SPSS. Univariate analysis was conducted to describe respondent characteristics, health literacy levels, and mean blood pressure values. Bivariate analysis using paired t-tests assessed differences in blood pressure before and after the intervention within groups. Prior to conducting ANCOVA, statistical assumptions were verified to ensure the validity of the analysis. The normality of data distribution was tested using the Shapiro–Wilk test, and the homogeneity of variances was examined with Levene's test. Both assumptions were met ($p > 0.05$), indicating that the data satisfied the requirements for ANCOVA. Multivariate analysis using ANCOVA was then applied to examine the influence of health literacy and exercise adherence on changes in blood pressure while controlling for potential confounders. Statistical significance was set at $p < 0.05$, and Cohen's d was calculated to determine the magnitude of the intervention effect.

Ethical Considerations

This study obtained ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, Halu Oleo University, with approval number 216/UN29.20.1/ETIK/2025. All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki. Participants were informed about the study objectives, procedures, and their rights to withdraw at any time without consequence. Written informed consent was obtained from all respondents prior to participation.

Results

Table 1 shows that 60 respondents participated in this study, consisting of 30 in the intervention group and 30 in the control group. The majority of respondents were aged 46–55 years (45.0%), female (63.3%), and had secondary education (56.7%). More than one-third of respondents were unemployed or housewives (38.3%), and over half had a family history of hypertension (61.7%). The baseline mean blood pressure of respondents was 151.4 ± 8.7 mmHg systolic and 94.6 ± 6.2 mmHg diastolic, with no significant differences between the intervention and control groups ($p > 0.05$).

Table 1. Characteristics of Respondents

Characteristics	Intervention (n=30)	Control (n=30)	Total (n=60)
Age (years)			
30–45	8 (26.7%)	7 (23.3%)	15 (25.0%)
46–55	14 (46.7%)	13 (43.3%)	27 (45.0%)
56–65	8 (26.7%)	10 (33.3%)	18 (30.0%)
Gender			
Male	10 (33.3%)	12 (40.0%)	22 (36.7%)
Female	20 (66.7%)	18 (60.0%)	38 (63.3%)
Education			

Low (≤Elementary)	6 (20.0%)	5 (16.7%)	11 (18.3%)
Secondary (Junior–Senior HS)	16 (53.3%)	18 (60.0%)	34 (56.7%)
Higher (≥College)	8 (26.7%)	7 (23.3%)	15 (25.0%)
Occupation			
Unemployed/Housewife	12 (40.0%)	11 (36.7%)	23 (38.3%)
Farmer/Laborer	7 (23.3%)	8 (26.7%)	15 (25.0%)
Civil servant/Employee	6 (20.0%)	7 (23.3%)	13 (21.7%)
Entrepreneur	5 (16.7%)	4 (13.3%)	9 (15.0%)
Family history of hypertension	20 (66.7%)	17 (56.7%)	37 (61.7%)

Table 2. Paired t-test Results of Blood Pressure

Group	Blood Pressure	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference (95% CI)	p-value	Cohens'd
Intervention (n=30)	Systolic	152.1 ± 9.0	141.3 ± 7.5	−10.8 (−13.5 to −8.1)	<0.001*	1.3
	Diastolic	95.2 ± 6.5	87.1 ± 5.8	−8.1 (−10.0 to −6.2)	<0.001*	1.32
Control (n=30)	Systolic	150.8 ± 8.4	149.7 ± 8.6	−1.1 (−2.9 to 0.7)	0.214	0.13
	Diastolic	94.0 ± 6.0	93.2 ± 6.1	−0.8 (−2.1 to 0.5)	0.196	0.13

Note: Values are presented as mean ± standard deviation (SD). Blood pressure measured in millimeters of mercury (mmHg). $p < 0.05$ indicates statistically significant difference.

Table 2 shows that after eight weeks of intervention, the isometric exercise group experienced a significant reduction in systolic and diastolic blood pressure, by 10.8 mmHg and 8.1 mmHg, respectively ($p < 0.001$). In contrast, the control group only showed minor changes that were not statistically significant.

The effect size analysis using Cohen's d showed a large effect in the intervention group, with values of 1.30 for systolic and 1.32 for diastolic blood pressure, indicating substantial improvement after the intervention. In contrast, the control group demonstrated very small effect sizes (Cohen's d = 0.13 for both systolic and diastolic), suggesting that no meaningful change occurred without the intervention.

Table 3. ANCOVA Analysis of Blood Pressure Changes

Variable	F	p-value
Health literacy → Systolic	6.42	0.014
Health literacy → Diastolic	5.98	0.017
Exercise adherence	7.21	0.01
Interaction literacy × adherence	4.87	0.023

Table 3 shows that health literacy has a significant effect on systolic and diastolic blood pressure. Exercise adherence also has a significant effect, as does the interaction between health literacy and exercise adherence, indicating that the combination of both can more effectively reduce blood pressure.

Discussion

This study successfully achieved its main objective, namely to analyze the influence of health literacy on the implementation of isometric exercise and its effects on blood pressure in hypertensive patients. It was found that participants with higher health literacy showed significantly greater reductions in systolic and diastolic blood pressure compared to those with lower literacy after 8 weeks of isometric exercise. In addition, adherence to exercise was higher in the high-literacy group, reinforcing the role of literacy as an important determinant of the effectiveness of this non-pharmacological intervention.

The average reduction in systolic blood pressure in the intervention group was 10.8 mmHg and diastolic 8.1 mmHg, whereas the control group showed no significant change. Statistical analysis confirmed that only the intervention group experienced significant improvements ($p < 0.001$). ANCOVA further indicated that health literacy moderated the relationship between exercise and blood pressure outcomes, showing that even under the same protocol, individuals with higher literacy benefitted more due to better comprehension, consistency, and adaptability in overcoming barriers.

These findings are consistent with previous studies showing that isometric exercise, particularly handgrip, lowers blood pressure in hypertensive patients. For example, a study at Batang Kuis Health Center reported significant reductions following an isometric handgrip intervention. Similarly, a review by (Melizza & Putri, 2022) highlighted that 8–12 weeks of training at 30–90% MVC significantly reduced

blood pressure in older adults. Recent studies (2023–2025) also confirm the effectiveness of isometric exercise across various populations, emphasizing both physiological and behavioral factors (Clifford et al., 2020; Coneglian et al., 2023; Cortes-Chacón et al., 2025; Reis et al., 2025; Rueda et al., 2025). Unlike previous research that focused mainly on physiological variables, this study integrated health literacy and exercise adherence as mediators, providing a broader explanation of inter-individual differences. (Karami et al., 2023) reported that health literacy interventions improved medication adherence and reduced systolic blood pressure, aligning with our conclusion that literacy influences hypertension outcomes beyond pharmacological adherence.

Physiologically, isometric training improves blood pressure through several mechanisms: (1) promoting nitric oxide release to enhance endothelial function and vascular elasticity (Edwards et al., 2022; Naseri, 2024; Song et al., 2022); (2) reducing sympathetic activity and enhancing parasympathetic tone, thereby lowering peripheral resistance (Königstein et al., 2023); and (3) increasing baroreceptor sensitivity, contributing to stable blood pressure homeostasis (Kim, 2023). Thus, the relationship between isometric exercise and reduced blood pressure can be explained through both vascular and autonomic adaptations.

From a theoretical perspective, Social Cognitive Theory (Bandura) explains that knowledge, self-efficacy, and literacy affect health behaviors (Mega, 2024). In this context, patients with high literacy are more likely to understand exercise instructions, believe in its benefits, and overcome barriers. The Health Belief Model also supports this view, emphasizing that perceived risk, benefits, and barriers to exercise are shaped by literacy (Suriyawong & Pipatpiboon, 2022; Zhang et al., 2021). Higher literacy tends to reduce barriers and enhance perceived benefits, leading to stronger adherence.

This study has important practical and policy implications. Practically, hypertension programs should not only provide exercise instructions but also integrate health literacy education to ensure adherence and effectiveness. At the policy level, integrating health literacy into hypertension control strategies is essential, particularly in high-prevalence regions such as Southeast Sulawesi and Kolaka. Expanding primary care services with patient education, culturally tailored materials, and community-based monitoring can strengthen the program's impact.

Several limitations should be noted. The 8-week intervention period may not reflect long-term effects after exercise cessation. Adherence was measured through self-reported logbooks, which are prone to reporting bias. Confounding variables such as diet, stress, other physical activities, and medication adjustments were not fully controlled, potentially affecting the outcomes. Additionally, selection bias may occur if participants with higher initial motivation or literacy were more likely to participate, and measurement bias cannot be ruled out for home-based exercise. Psychosocial factors, which may influence adherence and blood pressure, were not systematically assessed.

Future research should consider longer follow-up periods, the use of objective tools to measure adherence (e.g., wearable devices), and comprehensive assessment of lifestyle and psychosocial factors to strengthen causal inference. Furthermore, integrating health literacy interventions into community programs and primary care services can optimize the effectiveness of non-pharmacological strategies in hypertension management.

Conclusions

This study demonstrated that health literacy plays a key role in the effectiveness of isometric exercise in reducing blood pressure among hypertensive patients. Participants with higher literacy showed better adherence and achieved significantly greater reductions in both systolic and diastolic pressure compared to those with lower literacy. These findings emphasize health literacy as a crucial factor in optimizing non-pharmacological interventions for hypertension control.

From a practical perspective, primary health care professionals are encouraged to integrate health literacy education into hypertension programs through routine patient counseling, simplified educational materials, and culturally tailored communication approaches.

Future studies should extend the intervention period to evaluate long-term effects, include additional influencing variables such as diet, stress, and medication adherence, and consider using digital tools like monitoring apps or wearables to improve objectivity and reduce self-reporting bias.

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References

Almeida, J. P. A. de S., Bessa, M., Lopes, L. T. P., Goncalves, A., Roever, L., & Zanetti, H. R. (2021). Isometric handgrip exercise training reduces resting systolic blood pressure but does not interfere with diastolic blood pressure and heart rate variability in hypertensive subjects: a systematic review and meta-analysis of randomized clinical trials. *Hypertension Research*, *44*(9), 1205–1212. doi: 10.1038/s41440-021-00681-7

Bozorgi, A., Hosseini, H., Eftekhar, H., Majdzadeh, R., Yoonessi, A., Ramezankhani, A., Mansouri, M., & Ashoorkhani, M. (2021). The effect of the mobile "blood pressure management application" on hypertension self-management enhancement: a randomized controlled trial. *Trials*, *22*(1), 413. https://doi.org/10.1186/s13063-021-05270-0

Carey, R. M., Moran, A. E., & Whelton, P. K. (2022). Treatment of hypertension: a review. *Jama*, *328*(18), 1849-1861. doi: 10.1001/jama.2022.19590.

Clifford, C., Challoumas, D., Paul, L., Syme, G., & Millar, N. L. (2020). Effectiveness of isometric exercise in the management of tendinopathy: a systematic review and meta-analysis of randomised trials. *BMJ Open Sport & Exercise Medicine*, *6*(1), e000760. doi: 10.1136/bmjsem-2020-000760.

Coneglian, J. C., T Barcelos, G., Bandeira, A. C. N., Carvalho, A. C. A., Correia, M. A., Farah, B. Q., Ritti-Dias, R. M., & Gerage, A. M. (2023). Acute blood pressure response to different types of isometric exercise: a systematic review with meta-analysis. *Reviews in Cardiovascular Medicine*, *24*(2), 60. doi: 10.31083/j.rcm2402060.

Cortes-Chacón, J., Magaña Chávez, G. E., Flores Olivares, L. A., Peña-Vázquez, O., Quintana-Mendias, E., Cervantes Hernandez, N., & Enriquez-del Castillo, L. A. (2025). Efectividad de los protocolos de ejercicio en adultos con hipertensión: metaanálisis actualizado de ensayos clínicos. *Retos*, *70*, 517-532. https://doi.org/10.47197/retos.v70.113302

Dinas Kesehatan Provinsi Sulawesi Tenggara. (2022). *Profil Kesehatan Propinsi Sulawesi Tenggara*. Bidang P2PL Dinas Kesehatan Prov. Sultra. https://pusdatin.kemkes.go.id/index.php?category=profil-kesehatan-kabupaten&provid=PV-027

dos Santos Alves, M. C., Castoldi, R. C., Marcelo, H. I., Aleixo, P. H., de Araujo Furtado, A. E. R., Ribeiro, D. A. F., Sotão, S. S., Gambassi, B. B., & Almeida, F. de J. F. (2025). Effect of Isometric Exercise on the Blood Pressure of Hypertensive Older Adults. *Journal of Health Sciences*, *27*(1), 15-18. PMID: 40438518; PMC12106110. doi: 10.21037/atm-24-124

Edwards, J. J., Wiles, J., & O'Driscoll, J. (2022). Mechanisms for blood pressure reduction following isometric exercise training: a systematic review and meta-analysis. *Journal of Hypertension*, *40*(11), 2299–2306. doi: 10.1097/HJH.0000000000003261

Karami, M., Ashtarian, H., Rajati, M., Hamzeh, B., & Rajati, F. (2023). The effect of health literacy

intervention on adherence to medication of uncontrolled hypertensive patients using the M-health. *BMC Medical Informatics and Decision Making*, *23*(1), 289. doi: 10.1186/s12911-023-02393-z

Kemenkes. (2023). *Laporan Riskesdas 2023*. April 2024. https://www.badankebijakan.kemkes.go.id/laporan-hasil-survei/

Kim, H.-L. (2023). Arterial stiffness and hypertension. *Clinical Hypertension*, *29*(1), 31. doi: 10.1186/s40885-023-00258-1

Königstein, K., Dipla, K., & Zafeiridis, A. (2023). Training the vessels: molecular and clinical effects of exercise on vascular health a narrative review. *Cells*, *12*(21), 2544. doi: 10.3390/cells12212544

Mega, J. Y. (2024). Empowering Health: Unveiling the Impact of Self-Efficacy and Lifestyle on Hypertension Management. *Journal of Current Health Sciences*, *4*(1), 9–16. doi: 10.47679/jchs.202460

Melizza, N., & Putri, I. M. (2022). Studi literatur: efektivitas intervensi isometric handgrip exercise untuk menurunkan tekanan darah pada lansia dengan hipertensi. *Indonesian Health Science Journal*, *2*(1). https://doi.org/10.52298/ihsj.v2i1.23

Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews Nephrology*, *16*(4), 223–237. https://doi.org/10.1038/s41581-019-0244-2

Naseri, M. B. A. (2024). Isometric Exercise for Blood Pressure and Endothelial Function in Metabolic Syndrome: A Review. *Asian Journal of Sports Medicine*, *15*(4). https://doi.org/10.5812/asjsm-153619

Oliveira, P. C., Silva, M. R., Lehnen, A. M., & Waclawovsky, G. (2023). Isometric handgrip training, but not a single session, reduces blood pressure in individuals with hypertension: a systematic review and meta-analysis. *Journal of Human Hypertension*, *37*(9), 844–853. doi: 10.1038/s41371-022-00778-7

Paakkari, L., & Okan, O. (2019). Health literacy—talking the language of (school) education. *HLRP: Health Literacy Research and Practice*, *3*(3), e161–e164. https://doi.org/10.3928/24748307-20190502-01

Reis, C. B. F., Gasparini-Neto, V. H., de Miranda, L. R. A., Neves, L. N. S., Iglesias-Soler, E., de Sousa, N. M. F., Carletti, L., & Leite, R. D. (2025). Impact of set configurations on hemodynamics, cardiac autonomic, and metabolic responses. *Retos*, *68*, 1937–1947. https://doi.org/10.47197/retos.v68.113869

Rueda, Z. R. R., Barrios, A. J. G., Jaramillo, L. Y. G., Flórez, A. G. J., Hortúa, A. M. J., & Delgado, J. C. S. (2025). Evaluación de la modulación autonómica cardiovascular durante la sentadilla isométrica de pared en personas post revascularización miocárdica o percutánea. *Retos*, *69*, 1419–1426. https://doi.org/10.47197/retos.v69.115349

Song, Y., Jia, H., Hua, Y., Wu, C., Li, S., Li, K., Liang, Z., & Wang, Y. (2022). The molecular mechanism of aerobic exercise improving vascular remodeling in hypertension. *Frontiers in Physiology*, *13*, 792292. doi: 10.3389/fphys.2022.792292

Sørensen, K., Van den Broucke, S., Fullam, J., Doyle, G., Pelikan, J., Slonska, Z., Brand, H., & European, (HLS-EU) Consortium Health Literacy Project. (2012). Health literacy and public health: a systematic review and integration of definitions and models. *BMC Public Health*, *12*, 1–13. doi:10.1186/1471-2458-12-80

Sudayasa, I. P., Alifariki, L. O., Rahmawati, Hafizah, I., Jamaludin, Milasari, N., Nisda, & Usman, A. N. (2020). Determinant Juvenile Blood Pressure Factors in Coastal Areas of Sampara District in Southeast Sulawesi. *Enfermeria Clinica*, *30*(Supplement 2), 585-588. https://doi.org/10.1016/j.enfcli.2019.07.167

Sudayasa, I. P., Husdaningsih, F., & Alifariki, L. O. (2023). Polymorphism of Gene ACE I/D and Family History of Hypertension as Predisposition of Hypertension. *Malaysian Journal of Medicine & Health Sciences*, *19*(3). https://doi.org/10.47836/mjmhs.19.2.34

Suriyawong, W., & Pipatpiboon, N. (2022). Social cognitive theory-based interventions on healthy lifestyles for hypertensive patients: a systematic review. *CMU J Nat Sci*, *21*(3), e2022040. https://doi.org/10.12982/CMUJNS.2022.040

World Health Organization. (2025). *Hypertension*. 25 September 2025. https://www.who.int/news-room/fact-sheets/detail/hypertension

Zhang, Q., Huang, F., Zhang, L., Li, S., & Zhang, J. (2021). The effect of high blood pressure-health literacy, self-management behavior, self-efficacy and social support on the health-related quality of life

of Kazakh hypertension patients in a low-income rural area of China: a structural equation model. *BMC Public Health*, *21*(1), 1114. doi: 10.1186/s12889-021-11129-5

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