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**ORIGINAL ARTICLE**

# REDUCTION OF SYSTOLIC AND DIASTOLIC BLOOD PRESSURE IN HYPERTENSIVE ELDERLY FOLLOWING ERGONOMIC AND ISOMETRIC HANDGRIP EXERCISES

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## ABSTRACT

The largest population in Indonesia suffering from hypertension in 2023 is the elderly. Ergonomic and isometric handgrip exercises are recommended for managing hypertension. The aim of this study was to investigate the differences in systolic and diastolic blood pressure among hypertensive elderly individuals**.** The research design was a pre- and post-intervention experimental approach with two treatment groups. The study population consisted of hypertensive elderly individuals in Cirebon, Indonesia. The samples size was calculated using formula (t-1) (r-1) > 15 for each group, resulting in a total of 32 hypertensive elderly, selected through simple random sampling. Data analysis was conducted using a parametric t-test. The results indicated a significant difference in systolic ($p=0.024 < 0.05$) and diastolic ($p=0.045 < 0.05$) blood pressure between the isometric handgrip exercise and ergonomic exercise groups following the intervention. Ergonomic exercise yielded a more significant results, with a reduction of 15.3 mmHg in systolic pressure and 10.0 mmHg in diastolic pressure, compared to the isometric handgrip exercise, which resulted in reductions of 5.75 mmHg in systolic pressure and 4.0 mmHg in diastolic pressure. Ergonomic exercise can be recommended as a safe and accessible form of exercise for hypertensive elderly individuals.

Keywords: *Ergonomic exercise, elderly; handgrip Isometric, hypertension*



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## BACKGROUND

Hypertension is a condition characterized by elevated systolic blood pressure exceeding 140 mmHg and diastolic blood pressure for more than 90mmHg, after being measured on two occasions within a-5-minute interval (Indonesian Society of Hypertension, 2021). The risk factors associated with hypertension are related to unhealthy lifestyles, including smoking, lack of physical activity, and excessive alcohol consumption, poor eating patterns, and high level of stress (Peltzer & Pengpid, 2018).

The World Health Organization (WHO) has revealed that 22% of the global population suffers from hypertension, with approximately 60% of these individuals being elderly and residing in developing countries (Ministry of Health the Republic of Indonesia, 2021). In Indonesia, 30.8% of the population is affected by hypertension in 2023, with 56.8% those affected being elderly. Hypertension is responsible for 10.2% of deaths in the population (Ministry of Health the Republic of Indonesia, 2024).

The management of hypertension cannot rely solely on medication (Kandarini, 2017; Ministry of Health of the Republic of Indonesia, 2021). It needs to be combined with non-drug therapies, including lifestyle modification and increased physical activity (Kandarini, 2017; Lenggogeni et al., 2024). Exercises such as walking, running, jogging, cycling, and others can be performed for 20 to 30 minutes, three to seven (Medrano I.C. et al., 2016; Rabi et al., 2020). Higher- intensity exercises, such as weight training (using free weights, fixed weights, or hand holding) do not adversely affect to = blood pressure in elderly (Rabi et al., 2020). Hypertensive elderly can engage in cardiovascular exercises, such as aerobics and High-Intensity Interval Training (HIIT) (e.g., heart exercises, ergonomic exercises, etc.) as well as

resistance exercises such as isometric resistance trainings (e.g., isometric handgrip) (Medrano I.C. et al., 2016).

Ergonomic exercise is an effective method for maintaining physical fitness by carrying out easy and practical movements (Pratami A.Z.P. et al., 2023; Wratsongko, 2015). It can be carried out regularly, 2 to 3 times a week, with each session lasting between 30 to 60 minutes, including rest periods in between (Medrano I.C. et al., 2016; Pratami A.Z.P. et al., 2023; Wratsongko, 2015). This type of exercise can also improve the blood circulation, maximize oxygen supply to the brain, increase thinking ability, support the sweating mechanism, regulate body heating system, facilitate uric acid burning system, manage cholesterol levels, control blood sugar, reduce lactic acid, eliminate crystal oxalate, aid in carbohydrate conversion system, promote in making electrolytes or ozone in the blood, strengthen the immune system, and remove negative energy from the body (Syahrani, 2017).

Isometric exercise, specifically isometric handgrip, is an effective option for the elderly. It involves a resistance contraction of the muscles through a gripping motion, without any change in the length of thetargeted muscle group and joint movement (Hansford et al., 2021). It can be performed anywhere, at mild to moderate intensity, using relatively inexpensive equipment and requiring minimal time commitment. Therefore, this exercise has the potential to be complied with by clients (McGowan et al., 2017). The American Heart Association (AHA) explains that isometric handgrips are an effective adjunct therapy for lowering blood pressure and promote this exercise for clinical use as therapeutic intervention (Wiles et al., 2018).

## METHOD

### Study design

The design of this research is quasi-experimental, utilizing a pre-test and post-test intervention approach (Notoatmodjo, 2018). The sample consisted of 32 hypertensive elderly, divided into two groups. Group I received ergonomic exercise treatment, while Group II underwenthandgrip isometric exercise.

### Intervention

Ergonomic exercises and isometric handgrip training were conducted at a mild to moderate intensity. The program was implemented three times a week for one month, consisting of two training sessions each week, with each session lasting 60 minutes and interspersed with 10-minute rest periods. The exercises were carried out in different rooms for each exercise group, guided by 2 (two) instructors who had been trained and prepared by the researchers.

Ergonomic exercise movements resemble the movements of prayer. The sequence of movements includes :1) Opening Movement: Perfect standing, 2) Open chest movement for enhancing breathing by raising the hands upward, 3) Bowing movement: Expressing gratitude through a bow, 4) Sitting similar to a sitting position between 2 (two) prostrations, 5) Sitting movement burning and prostration of gratitude, akin to the act of prostration, and 6) Lying down in submission with the body moving backwards while sitting. Meanwhile, isometric handgrip exercises are performed by holding a handgrip device, which has been modified a toy rubber ball approximately the size of an adult's hand. Each exercise lasts for with 30 seconds duration is repeated three times, with a 10-second rest interval between each repetition.

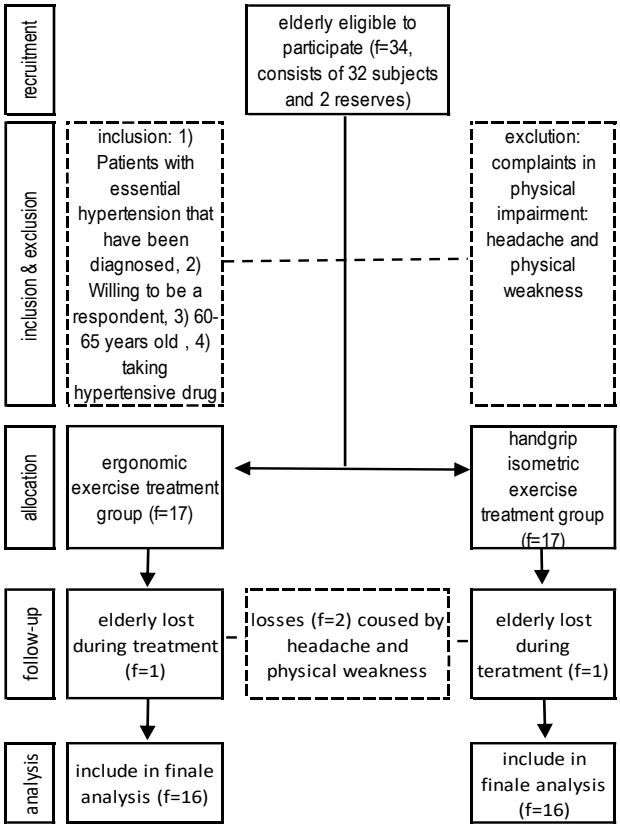


**Figure 1 Consort Diagram of Metodologi (adapted from Villegas-Pantoja et al., 2020)**

Health workers from the Sitopeng Health Centre consistently monitor participants r during the exercise. This is importance as an precautionary measure in case any complaints arise, such as injuries or complications due to the exercise. If necessary, the exercise can be postponed to allow participants to rest or receive assistance.

### Participant

The number of samples in this study, was determined using the formula (t-1) (r-1) > 15, where [t] represented the treatment group and [r] denoted the sample size of each group (Indratma & Yenita, 2020). Based on these calculations, the minimum sample size was 16 for each group, resulting in a total of 32 samples. Although this is a small number if the samples are chosen randomly, they can accurately reflect the population (Lakens, 2022). This sample size is sufficient for experimental and comparative research (Whitehead et al., 2016).

The sampling technique employed random sampling, with the following inclusion criteria: 1) Patients diagnosed with essential hypertension who are currently receiving oral antihypertensive therapy; 2) individuals willing to participate as respondents; 3) Age between 60 and 65 years; 4) registered in the Reporting Information System for Non-Communicable Diseases (SIPTM) Puskesmas Sitopeng;5) consistently taking antihypertensive medication. The exclusion criteria include 1) Patients with essential hypertension who have complications from other diseases, such as stroke, heart disease, or kidney failure; 2) Individuals experiencing complaints in physical impairments, such as visual impairment, hearing loss, or limb weakness and disability.

The selected samples were checked for blood pressure and interviewed regarding any complaints of illness prior to the intervention. The results were recorded and consulted with a doctor at the Sitopeng Health Centre to get recommendation on whether the samples were eligible to participate in the research activity.

**Instrument**
The instrument used in this study was a sheet that recorded the results of blood pressure measurements taken before and after treatment. The tools for measuring respondents' blood pressure were several automatic blood pressure monitors, all of which had been calibrated in the laboratory of Tasikmalaya Health Polytechnic.

**Data collection**
Participants' blood pressure was measured before and after exercise and recorded on the provided form. For each exercise session, health workers took blood pressure measurements from fifteen minutes prior to the start. Afterward, all participant engaged in the exercise procedure. Once the exercise period concluded, participants were given a 15-minute rest period, after which health workers rechecked their blood pressure and interviewed to assess how the participants felt, including any complaints or discomfort. The results were recorded on the provided form. Similarly, at the end of the training period, health workers repeated this process to ensure that there was no increase in the severity of the disease or complications resulting from the exercise.

**Data analysis**
In this study, data analysis was carried out using Independent t-Test and Paired t-Test, which were determined based on results of the normality test.

**Ethical consideration**
This research received ethical approval from the Health Research Ethical Comittee of Tasikmalaya Health Polytechnic (No. 2021/KEPK/PE/VI/00124), issued on July 30,2021.

## RESULT

The results of this research are presented in Table 1 and Table 2 below.

**Tabel 1. Change in Blood pressure between Before and After Treatment**

| Variabel | | Mean | Std. Dev | SE Mean | 95% CI | | t | sig |
|---|---|---|---|---|---|---|---|---|
| | | | | | Low | Upp | | |
| Ergonomic exercise | Systole | 15,313 | 6,87 | 1,717 | 11,653 | 18,972 | 8,92 | 0,000 |
| | Diastole | 10,000 | 4,79 | 1,197 | 7,448 | 12,552 | 8.353 | 0,000 |
| Handgrip isometric | Systole | 5,750 | 4,92 | 1,230 | 3,129 | 8,371 | 4,68 | 0,000 |
| | Diastole | 4,000 | 2,13 | 0,532 | 2,865 | 5,135 | 7,52 | 0,000 |

*Notes: The paired t test result, the test of different between before and after in the both of intervention groups, statistically meaningful if Sig value of variable less than 0,05*

Based on Table 1 above, it can be concluded that there were significant differences in systolic and diastolic pressure between before and after the intervention both for ergonomic exercise and isometric handgrip ($p = 0.000 < 0.05$). However, ergonomic exercise resulted in more substantial reductions in both systolic and diastolic pressure. This is evident decreases in systolic and diastolic pressure: ergonomic exercise showed a reduction of 15.313 mmHg in systolic pressure and 10.00 mmHg in diastolic pressure, while isometric handgrip demonstrated reductions of 5.750 mmHg in systolic pressure and 4.00 mmHg in diastolic pressure. This difference was very clear after testing, as shown in Table 2.

**Table 2. Difference in blood Pressure reduction between Ergonomic exercise & Handgrip Isometric treatment**

| Variabel | | Leven's Test | | t-test for Equality of Means | | | | 95% CI | |
|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig | t | sig | Mean diff | SE Diff | Low | Upp |
| systole | Before | 0,000 | 0,990 | -0,181 | 0,857 | -0,857 | 5,168 | -11,493 | 9,618 |
| | After | 1,756 | 0,195 | -2,374 | 0,024 | -10,50 | 4,422 | -19,532 | -1,468 |
| Diastole | Before | 0,016 | 0,900 | 0,351 | 0,728 | 1,063 | 3,030 | -5,126 | 7,251 |
| | After | 1,997 | 0,168 | -2,088 | 0,045 | -4,938 | 2,364 | -9,766 | -0,109 |

*Notes: The independent t test result, the test of different between ergonomik and isometric handgrip groups, statistically meaningful if Sig value of equality of mean variabel less than 0,05*

The information presented in Table 2 indicates that all of the data are homogeneous in both systolic and diastolic pressure measurement, both before and after the intervention This is supported by the results of Levene's test, which show that all p-values are greater than 0.05. Furthermore, it can be concluded that there is a significant difference between ergonomic exercise and isometric handgrip after intervention, with p-values of 0.024 for systolic blood pressure and 0.045 for diastolic blood pressure.

## DISCUSSION

The ergonomic exercise has a more significant effect than isometric handgrip exercises in reducing systolic and diastolic blood pressure in hypertensive elderly individuals. This finding further strengthens previous studies indicating that ergonomic exercise has a significant effect on lowering both systolic and diastolic pressure in this population (Fernalia F et al., 2021; Rohmana O. & Rochayati A.S., 2024; Wibowo A.B., 2021). Another study showed a higher average reduction in systolic pressure of 12.90 mmHg and diastolic pressure of 6.04mmHg (Handayani S et al., 2023), with even higher decrease of 14.75mmHg in systolic pressure and 6.75 to 7mmHg in diastolic pressure, which were statistically significance (p value = 0.000) (Jumari & Putri, 2021).

The different effects between ergonomic exercises and isometric handgrip exercises may arise from variations in their movement characteristics. Although both types of

exercises are easy and simple, the ergonomic exercises require more thoroughness and movement during performance(Wratsongko, 2015). Almost all parts of the body are moves actively moved, stimulating the functions of the body organs, enhancing bio-electricity activity, and launching oxygen circulation, which contributes to a sense of freshness in the body (Triwibowo H et al., 2015).

Dynamic movement in ergonomic exercise creates a pleasant and uplifting effect, alleviates tension, enhances comfort, maintains a balance of body homeostasis, and refreshes the mind (Pratamiet al., 2023). It stimulates the release of endorphins, which can inhibit cellular activity, leading to a state of calmness, happiness, and relaxation. This, in turn, fosters emotional balance and promotes peace of mind (Hasina et al., 2020).

Ergonomic exercise benefits all body systems, including the cardiovascular, urinary, and reproductive systems, enabling the body to prevent functional disorders. It helps restore the nervous system and blood circulation, increases oxygen supply to the brain, maintains vigorous health, and facilitates the removal of negative energy from the body (Syahrani, 2017). Additionally, it has an autoregulatory function, as its movements involve the work of the heart, mouth, and limbs (Ayu et al., 2024).

Ergonomic exercises are preferred by many people (Medrano I.C. et al., 2016). These exercises are highly beneficial for enhancing quality of life, maintaining physical body integrity, promoting healthy living, and reducing the risk of suffering chronic diseases (Malkoç et al., 2024). When performed regularly, these exercises contribute to physical vitality, which includes improved joint flexibility, increased muscle strength, enhanced agility, better respiratory function, and the prevention of arterial hardening, ultimately boosting heart efficiency (Gultom et al., 2023).

The other effect of ergonomic exercise is the enhancement of function of the nervous system and improved blood flow (Hayati et al., 2024). It is also effective in declining sympathetic nerve activity, which decreases norepinephrine levels at the synapse. This reduction leads to decreased levels of renin and angiotensin II, which facilitate a reduction in blood vessel resistance and, further a decrease in blood pressure (Reia et al., 2020; Septianingrum & Susanto, 2020) The study had limitations. The study did not compare in different exercise frequencies, so the most effective exercise frequency per a week is not yet known with certainty. Therefore, future research should compare various exercise frequencies or conduct longitudinal studies to assess long-term effects across different age ranges for each intervention group.

## CONCLUSION AND RECOMMENDATION

Ergonomic exercises and isometric handgrip exercises are two types of physical activities that can be utilized as treatments for elderly individuals with hypertension. Both are safe, simple, and easy to perform. Ergonomic exercises demonstrate a more significant effect when compared to isometric handgrip exercises, particularly in decreasing both systolic and diastolic blood pressure. Healthcare professionals or community health cadres can facilitate group ergonomic exercises sessions for hypertensive elderly individuals in their living environment, ideally on a regular basis, at least once a week.

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