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Effects of Ergonomic Exercises on Systolic and Diastolic Blood Pressure of Hypertensive Elderly in Sitopeng Cirebon, Indonesia

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ABSTRACT

Background: Hypertension is a chronic, non-communicable disease that often shows no symptoms but can cause heart failure, stroke, myocardial infarction, atrial fibrillation, and even premature death. The majority of hypertension sufferers in Indonesia are elderly (57.6%). Ergonomic exercise is recommended in the non-pharmacological management of hypertension because it can reduce blood pressure. **Objective:** To know the effect of ergonomic exercise three times and once per week on systolic and diastolic pressure in hypertensive elderly. **Methods:** The design is an experiment consisted before and after intervention; the population is hypertensive elderly in Sitopeng, Cirebon City. The sample sizes were determined by the formula $(t\text{-}1)(r\text{-}1) > 15$, where t is the treatment group and r are the replication, so the total sample was 32 hypertensive elderly people who were selected using simple random sampling techniques, and data analysis was carried out using the independent *T*-test and paired *T*-test. **Results:** Ergonomics exercises 3 times per week can reduce systolic pressure in elderly people with hypertension ($p = 0.001<0.05$), but there was no significant difference between the ergonomic exercise groups 3 times and 1 time per week treatment in systolic ($p = 0.520$) and diastolic pressure ($p = 0.095>0.05$). **Conclusion:** Ergonomic exercise provides good benefits in reducing systole and diastole pressure in elderly people with hypertension. Maximum benefits can be obtained if the elderly perform ergonomic exercise movements perfectly, control medication adherence, and follow a low-salt diet. **Recommendation:** Give the guidebook to each participant, which they take home and are assisted by family to memorize the movements. Always maintain compliance with taking medication and a low-salt diet.

INTRODUCTION

Hypertension is a disease characterized by a slow or sudden increase in blood pressure with a systolic pressure of more than 140 mmHg and a diastolic pressure of more than 90 after 2 measurements with a gap of 5 minutes (Nurhayati *et al.*, 2023; Ramos *et al.*, 2023). It often shows no symptoms but can cause heart failure, stroke, myocardial infarction, atrial fibrillation, and even premature death (Azwaldi *et al*., 2023; Zhou *et al*., 2023). Leading to an increase in stroke and ischemic heart diseases from year to year and having an impact on reducing hope and quality of life, social losses, and becoming a huge economic burden (Lan *et al*., 2023). As people age, the likelihood of hypertension rises, with approximately 50% to 60% of individuals over 60 years old having blood pressure readings equal to or greater than 140/90 mm Hg. This condition is considered a degenerative consequence of aging, influenced by a variety of factors interacting together. Moreover, as age advances, blood pressure tends to increase correspondingly (Elvira, 2018).

The prevalence of hypertension will continue to increase over time (Nurhayati *et al*., 2023). In 2025, it is predicted to account for 29% of the world's adult population and result in around 8 million people dying each year (Indonesia - Jakarta Health Profile, 2014; Hasina *et al.*, 2024). In 2018, basic health research conducted across Indonesia indicated that 34.1% of 18-year-olds had hypertension. The highest prevalence was found in South Kalimantan at 44.1%, while the lowest was recorded in Papua at 22.2%. Hypertension rates were also observed in age groups of 31–44 years (31.6%), 45–54 years (45.3%), and 55–64 years (55.2%) (Livana & Basthomi, 2020),

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In 2018, around 34.1% of Indonesia's population suffered from hypertension, and the majority (57.6%) were elderly (Indonesia - Jakarta Health Profile, 2014; Indonesia Ministry of Health, 2018). This situation is in line with the world population, where 70–80% of the elderly population suffers from hypertension (Rego *et al*., 2019).

Hypertension can be caused by various risk factors. Age, diabetes, obesity, family history, a high-salt diet, alcohol consumption, smoking, and other unhealthy lifestyles such as physical activity and stress can trigger hypertension (Azwaldi *et al*., 2023; Indonesian Ministry of Health, 2014; Lan *et al*., 2023; Peltzer & Pengpid, 2018). Modification of eating habits and physical activity is the most important thing in hypertension management, control, and prevention of cardiovascular disease (Oseni *et al*., 2023).

Here are many types of physical activity that are recommended for hypertensive elderly people. Some of them are continuous aerobic exercise (e.g., jogging, walking, swimming, etc.), resistance training (e.g., isometric resistance training, isometric handgrip, etc.), and others that have been recommended by the expert (Iván *et al*., 2016). Engaging in regular physical activity, such as exercising three or more times per week for at least ≥30 minutes at moderate intensity, can lower health risks and enhance personal satisfaction (Maksum & Indahwati, 2021). The Indonesian exercise program designed for older individuals features uncomplicated movements and gentle aerobic exercises at a mild to moderate intensity. Furthermore, this program carries a minimal risk of injury for elderly participants (Juniarti 2021).

Regular ergonomic exercise offers numerous benefits, including enhanced physical well-being such as improved joint flexibility, muscle strength, and agility, as well as better respiratory function and prevention of arterial hardening. It can be performed consistently, either 2-3 times weekly or at scheduled intervals. These exercises promote vascular flexibility, ensuring smoother blood circulation and relaxation of blood vessels, thereby aiding in lowering blood pressure for individuals with hypertension (Gultom *et al*., 2023; Rosdiana, & Cahyati, 2019). It occurs because of a decrease in sympathetic nerve activity, which in turn reduces norepinephrine levels in the synapses, resulting in a decrease in vascular resistance, as well as a decrease in renin and angiotensin II, which are factors in reducing blood pressure (Pescatello *et al*., 2004).

Numerous studies have explored the impact of ergonomic exercise on reducing blood pressure in hypertensive elderly people. In this recent study, all hemodynamic parameters—such as systolic and diastolic blood pressure, along with heart rate—demonstrated significant reductions after a 6-week intervention period (equivalent to 1½ months). Despite receiving medication and participating in an educational program that incorporates physical activity, numerous hypertensive patients find it challenging to exercise due to work obligations or time limitations. Additionally, restricted access to sports facilities adds further difficulty to their ability to engage in physical activity (Boy *et al*., 2021; Anita & Antoro, 2023; Veralia, Malini, & Gusty, 2023; Ningtias, Yuliza, & Herliana, 2023; Prima & Oktaini, 2023; Suwanti, Purwaningsih, & Setyoningrum, 2023). The other study conducted a comparative study of ergonomic exercise treatment once, twice, and three times a week, and the results showed a significant difference ($p = 0.002<0.03$), but the research subjects were limited to the elderly with first-degree hypertension (hypertension 1) only (Masriadi & Febrianto, 2023). Therefore, this study was crucial to compare ergonomic exercise treatment three times and once a week on systolic and diastolic pressure, as well as changes in the degree of hypertension, from hypertension 1 (mild) to severe hypertension 3 (severe).

Ergonomic exercises can be an intervention in hypertensive elderly nursing care. They are a vulnerable group and targets for community nursing care (Nies & McEwen, 2013). Besides that, nursing services are also an integral part of the health care team (Permenkes, 2019). So that, nursing will be involved in treating hypertensive elderly, especially in non-pharmacological therapy. But the nursing interventions that are decided to be given must be based on the strongest and best evidence (Mackey & Bassendowski, 2017). In this way, nurses can clearly determine the frequency of ergonomic exercise for the hypertensive elderly and whether it is better to do it three times or once a week is enough. Therefore, the results of this research are very important for nurses in providing nursing care for hypertensive elderly people in the community.

METHODOLOGY

The research design is experimental, with a pretest and post-test intervention approach. The sample was

divided into two groups. Group I was given ergonomic exercise treatment three times a week placed in Kedung Mendeng Sitopeng Cirebon, while Group II was given ergonomic exercise treatment once a week placed in Surapandan Sitopeng Cirebon. Treatment was carried out for a month for each group with different frequencies. To ensure the validity of the results, all respondents must comply with the inclusion and exclusion criteria and take medication every day. The sample size is obtained using the formula (t-1) (r-1) > 15, where t is the treatment group and r is the replication/sample size (Supranto, 2000). In this study, there were 2 treatment groups, so the sample size (r) was (2-1) (r-1) > 15, so r = (15/2-1) + 1, and the result was 16. The total sample size was 32 people. Research implementation in the Sitopeng area of Cirebon City.

Sampling using a simple random sampling technique was initially done by identifying hypertension sufferers in the register book who met the inclusion criteria, followed by interviews and blood pressure checks to eliminate by the exclusion criteria. After that, random sampling was carried out. Inclusion criteria 1) having been diagnosed with essential hypertension and receiving oral anti-hypertension therapy; 2) being willing to be a respondent, aged 60–65 years. Exclusion criteria are: 1) sufferers of essential hypertension who have complications from stroke or heart disease and kidney failure; 2) having physical weakness and disability; and 3) experiencing complaints of illness.

The operational definitions for hypertension:

- Normal (N): 120-129/80 mmHg
- Normal High (NH): 130-139/80-89 mmHg
- Hypertension Stage 1 (HT1): 140-159/90-99 mmHg
- Hypertension Stage 2 (HT2): ≥160/≥100 mmHg
- Hypertension Stage 3 (HT3): >180/>110 mmHg

The research data is the average of blood pressure measurements taken before and after each treatment. Parametric analysis is the data analysis technique used (Zakaria, 2022).

Ethical Consideration

The study was approved by the ethical committee of Mahardika Health & Technology Institute with reference number No.117/KEPK.ITEKESMA/VII/2023, on 1st July 2023.

RESULTS

The research sample resulted from a random sample of hypertensive elderly people who listed in the register book the non-communicable disease programme at the Sitopeng Health Center, Cirebon City, and met the inclusion and exclusion criteria. They were gathered in a meeting, then wrote their names on a piece of paper and rolled it up, put it in a closed glass, and drew lots according to the number of respondents as desired. The results obtained were 30 respondents, 4 men and 26 women, who were then divided into 2 groups with the same proportion, namely 2 men and 13 women. Researchers have tried to control confounding variables, such as narrowing the age range to 60–65 years, matching genders between groups I and II, and always recommending that all the participants take medication regularly and pay attention to their diet with a low-salt diet.

Table 1: Distribution of Pre- and Post-Intervention Systolic Blood Pressure in the Ergonomic Exercise Group Treatment 3 Times and Once a Week

Systole Hypertension	Pre-Intervention						Post-Intervention					
	Group				Total		Group				Total	
	3 times a week		Once a week				3 times a week		Once a week			
	f	%	f	%	f	%	f	%	f	%	f	%
NH	0	0.0	3	18.8	3	9.4	5	31.3	2	12.5	7	21.9
HT1	6	37.5	6	37.5	12	37.5	5	31.3	5	31.3	10	31.3
HT2	6	37.5	4	25.0	10	31.3	4	25.0	6	37.5	10	31.3
HT3	4	25.0	3	18.8	7	21.9	2	12.5	3	18.8	5	15.6
Total	16	100	16	100	32	100	16	100	16	100	32	100

Notes: NH; Normal High 130-139, HT1: Hypertension I 140-159, HT2: Hypertension 2 ≥160, HT3: Hypertension 3 >180

According to Table 1 above, there was no difference in the systolic pressure before treatment between the groups; the majority had hypertension 1 (HT1) and hypertension 2 (HT2). After treatment, only respondents in group 3 times a week had a decrease in the level of hypertension to normal high (31.3%) and hypertension 1 (31.3%), while in group once a week, no changes in level of hypertension.

Table 2: Distribution of Pre- and Post-Intervention Diastolic Blood Pressure in the Ergonomic Exercise Group Treatment 3 Times and Once a Week

Diastole Hypertension	Pre-Intervention						Post-Intervention					
	Group				Total		Group				Total	
	3 times a week		Once a week				3 times a week		Once a week			
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
N	0	0.0	3	18.8	3	9.4	1	6.3	1	6.3	2	6.3
NH	4	25.0	2	12.5	6	18.8	3	18.8	0	0.0	3	9.4
HT 1	5	31.3	4	25.0	9	28.1	7	43.8	8	50.0	15	46.9
HT 2	5	31.3	5	31.3	10	31.3	5	31.3	6	37.5	11	34.4
HT 3	2	12.5	2	12.5	4	12.5	0	0.0	1	6.3	1	3.1
Total	16	100	16	100	32	100	16	100	16	100	32	100

Notes: N; Normal <80 NH; Normal High 80-89, HT1: Hypertension I 90-99, HT2: Hypertension 2 ≥100, HT3: Hypertension 3 >110

Table 2 above concludes that there was no difference in the diastolic pressure before or after treatment for the respondents in the group who took it three times and once a week; the majority had hypertension 1 (HT1) and hypertension 2 (HT2).

Table 3: Differences in Systolic and Diastolic Pressure between Pre- and Post-Intervention in the Ergonomic Exercise Treatment Group 3 Times and Once Per Week

Variable	Mean	Std. Dev	Std. Error	95% CI		*t*	*df*	Sig. (2-tailed)
				Low	Upper			
Systole 3 Times a Week	10.625	9.681	2.420	5.466	15.784	4.390	15	0.001
Diastole 3 Times a Week	5.063	12.412	3.103	-1.551	11.676	1.631	15	0.124
Systole Once a Week	-2.063	13.738	3.434	-9.383	5.258	-0.601	15	0.557
Diastole Once a Week	-3.625	8.342	2.085	-8.070	0.820	-1.738	15	0.103

Based on Table 3, it can be concluded that only the systolic pressure in the 3- times-a-week group had a difference ($p = 0.001<0.05$). Moreover, once a week exercise had a negative effect on systolic and diastolic pressure, causing an increase in systolic pressure (-2.063 mmHg) and diastolic pressure (-3.625 mmHg).

Table 4: Differences in Systolic and Diastolic Pressure between the Ergonomic Exercise Treatment Groups 3 Times and Once a Week at Pre- and Post-Intervention

Systole and Diastole Between Group	Levene's Test		*t*-test for Equality of Means						
	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean	Std. Error	95% CI	
								Low	Upper
Pre-Intervention Systole	3.162	0.085	1.037	30	0.308	8.688	8.381	-8.428	25.803
Pre-Intervention Diastole	0.003	0.955	0.457	30	0.651	2.313	5.062	-8.025	12.650
Post-Intervention Systole	0.621	0.437	-0.651	30	0.520	-4.250	6.530	-17.586	9.086
Post-Intervention Diastole	0.908	0.348	-1.723	30	0.095	-6.375	3.699	-13.930	1.180

Table 4 above concludes that before treatment, there was no difference in systolic pressure ($p = 0.308 > 0.05$) and diastolic pressure ($p = 0.651 > 0.05$) between the ergonomic exercise treatment groups three times a week and once a week. Soon after treatment, there was no difference between the ergonomic exercise treatment groups three times and once a week in systolic pressure ($p = 0.520 > 0.05$) and diastolic pressure ($p = 0.095 > 0.05$).

DISCUSSION

This research shows that ergonomic exercise three times a week causes a reduction in the level of hypertension. Some research has shown that the majority of individuals diagnosed with hypertension were aged 60-74 years, comprising 25 patients (40.9%). As age advances, the likelihood of developing hypertension rises due to natural changes affecting the heart, blood vessels, and hormones, suggesting that exercising three times a week can reduce the severity of hypertension, potentially shifting individuals from more severe (HT2) to milder (HT1) forms. According to studies conducted by Wijaya (2023), Prima & Oktaini (2020), and Wibowo (2021), the likelihood of developing hypertension increases with age due to natural changes in the heart, blood vessels, and hormones. Besides that, the ergonomic exercise three times a week also results in an effective reduction in systolic pressure (Anita & Antoro, 2023; Astuti, 2021; Wibowo, 2021).

The facts above were possible because this group's exercise movement were quite good. The frequency of exercise three times a week provides benefits for participants, making it easier to remember the movements, and they did not feel confused when following every movement in exercise. This situation gave participants an opportunity to be more active and cheerful. Therefore, correctly executed exercise movements, according to their duration, intensity, and dosage, have physiological effects on the body system, such as reducing blood pressure (Langhammer, Bergland, & Rydwik, 2018; Masriadi & Febrianto, 2018), and can elicit pleasant and joyful feelings, thereby reducing stress (Sagiran, 2012; Saputra & Budayati, 2024).

Systole and diastole pressure in the ergonomic exercise group once a week did not decrease; average systole or diastole even increased. On the contrary, ergonomic exercises have been shown to effectively lower blood pressure among hypertension patients in Indonesia. A three-day regimen of these exercises can lead to a significant decrease in systolic blood pressure for up to an hour after training. Engaging in ergonomic exercises triggers the release of endorphins, promoting relaxation and stress reduction. These exercises are a straightforward approach to maintaining overall health, offering multiple benefits that include blood pressure reduction through client-initiated movements (Noor & Budianto, 2023). Less-than-optimal exercise movements could potentially contribute to this outcome. The infrequent frequency of exercising once a week causes respondents to have difficulty remembering exercise movements, so the movements performed are less than optimal. The participants were preoccupied with their thoughts and sometimes even confused about the movements they intended to perform. This condition was consistent with observations made by field observers. Many elderly people seemed confused about following the exercise instructors. As a result, participants became inactive and made inappropriate movements.

This condition causes an optimal effect on reducing blood pressure that cannot be obtained (Masriadi & Febrianto, 2018). Movements and frequencies that are not in accordance with standard operating procedures (SOP) mean that the benefits of this exercise cannot be achieved to the maximum (Fernalia, Listiana, & Monica, 2021). Ergonomic exercises can provide good effects and benefits if done continuously, at least 2-3 times a week ± 30 minutes, and all movements must be done perfectly (Wratsongko, 2015). Ergonomic exercises that are done correctly can encourage relaxation of the body from all physical and mental tension (Prima & Oktaini, 2020), can restore and improve the functioning of the nervous system and blood flow, and optimize oxygen supply to the brain (Shariat *et al*., 2018). The American Heart Association (AHA) recommends that adults exercise for at least 30 minutes every day or 20 minutes three times a week; this will help reduce systolic pressure by 4–9 mmHg (Lewis *et al.*, 2014).

The effect of ergonomic exercise three times a week on reducing systolic pressure and the level of hypertension in hypertensive elderly people is very clear. However, if we compare the systolic pressure of the hypertensive elderly after treatment between the three-times-a-week and once-a-week groups, there were no significant difference ($p = 0.520 > 0.05$). The other studies actually show differences, which stated that there were differences in systolic pressure after implementing ergonomic exercises between 1 time, 2 times, and 3 times per week ($p = 0.002<0.005$) (Masriadi & Febrianto, 2021). Thus, it can be assumed that the ergonomic exercises carried out by the treatment group three times a week still showed a less-than-optimal effect on reducing systolic pressure. This is possibly caused by the movements being carried out not being perfect, so the results are not optimal. The perfection of movements influences the beneficial effects of ergonomic exercises (Fernalia, Listiana, & Monica 2021; Wratsongko, 2015). Apart from that, the intensity of the implementation of ergonomic

exercises is also very important to pay attention to. According to a study, patients with pulmonary arterial hypertension (PAH) and chronic thromboembolic pulmonary hypertension who follow a low-intensity exercise program (performed 4–7 days per week) experience improved exercise capacity and quality of life (Rakhmawati *et al.*, 2020). Training intensity is the length of time needed 3-5 times a week with a duration of between 20 and 60 minutes per training session (Iván *et al*., 2016). Exercise with the right frequency and duration can cause blood vessels to dilate, lower blood pressure, and increase cardiorespiratory endurance (Wiatma *et al*., 2024). Another cause may be that medication compliance and low salt diet habits cannot be completely controlled. It's important to combine modifying lifestyle (e.g., a low salt diet, physical activity, etc.) and pharmacological therapy for the success of treating hypertension (Fadillah & Rindarwati, 2023).

Limitations

This research cannot completely control anti-hypertension medication adherence and a low-salt diet for all respondents in the study. The results might have been improved if these two factors had been adequately managed. Further studies should aim to address these variables more effectively to provide a clearer understanding of their impact on hypertension outcomes.

CONCLUSION

Ergonomic exercise three times a week provides significant health benefits for the elderly, particularly in reducing systolic pressure in hypertensive individuals. Maximum benefits can be achieved if the elderly perform movements accurately and adhere to guidelines, standard operating procedures (SOP), medication adherence, and a low-salt diet. Future research should involve individuals who can monitor medication adherence and low-salt diet habits among elderly participants. This approach could lead to improved health outcomes by ensuring consistent and accurate adherence to prescribed treatments and dietary guidelines.

Recommendation

- Elderly participants in ergonomic exercise should receive proper socialization on how to perform each movement correctly.
- Patients must be provided with a guideline book to take home, ensuring that family members can assist in understanding and executing each movement.

Conflict of Interest

The authors declare that they have no conflict of interests.

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