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Original Article

The effect of walking exercise on blood pressure reduction in prehypertension and Stage 1 hypertension patients

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ABSTRACT

Hypertension is the number one risk factor for death worldwide (13%). Physical exercise is one of the non-pharmacological efforts to prevent, treat, and rehabilitate patients with hypertension. The recommended physical exercise is a dynamic aerobic exercise with moderate intensity such as walking. The study aimed to prove the effect of walking exercise 3 times per week for 4 weeks on blood pressure reduction in prehypertension and Stage 1 hypertension patients. This is a quasi-experimental study with a nonequivalent control group design. The sample of this study was 32 lecturers and educational staff at Universitas Nusa Cendana who met the inclusion and exclusion criteria. The sample was divided into two groups: The intervention group, which was given the moderate-intensity walking exercise intervention for 30 min, 3 times per week for 4 weeks, and the control group, which was not given the walking exercise intervention. The result of this study showed that there were significant changes between the pretest and posttest blood pressure in the intervention group, both in systolic ($P = 0.000$) and diastolic blood pressure ($P = 0.007$), whereas in the control group, there were no significant changes. There were also significant differences in the pretest–posttest difference in blood pressure in the intervention group compared to the control group, both in systolic ($P = 0.000$) and diastolic blood pressure ($P = 0.003$). Therefore, it can be concluded that walking exercise 3 times per week for 4 weeks reduces blood pressure in prehypertension and Stage 1 hypertension patients.

Keywords: Aerobic exercise, moderate-intensity exercise, non-pharmacological efforts

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INTRODUCTION

Hypertension or high blood pressure is a serious health problem. According to the World Health Organization estimates, there are 1.28 billion adults aged 30–79 years who have hypertension worldwide. Hypertension is also known as "the silent killer" and is the number one risk factor for death which is responsible for 13% of deaths worldwide.[1,2]

Prehypertension or an increase in blood pressure slightly above normal values is a risk factor for developing chronic hypertension in the future.[3] In 2003, the Seventh Report of the Joint National Committee 7 made this classification to show the importance of intervening and preventing or delaying the development of prehypertension into hypertension.[4]

There are two options for managing hypertension: pharmacotherapy with antihypertensive drugs and non-pharmacotherapy by lifestyle intervention. Lifestyle intervention is the first-line therapy and can also increase the efficacy of antihypertensive drugs.[5,6] Physical exercise is one of the non-pharmacological efforts to prevent, treat, and rehabilitate patients with hypertension.[7] The recommended physical exercise is a dynamic aerobic exercise with

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moderate intensity, such as walking, jogging, cycling, or swimming.[6]

Walking is a physical activity that is easy, cheap, and has a low risk of injury.[8] Prolonged walks can reduce sympathetic activity and increase vagal tone, or both which cause a decrease in peripheral resistance, resulting in a decrease in blood pressure.[9] Exercise will produce an acute effect such as an increase in blood pressure, but individuals who do regular aerobic exercise will adapt so that blood pressure will decrease.[10,11]

The study aimed to prove the effect of walking exercise 3 times per week for 4 weeks on blood pressure reduction in prehypertension and Stage 1 hypertension patients.

MATERIALS AND METHODS

Sample Criteria

The sampling method of this study was purposive sampling with a total sample of 32 people, divided into two groups: the intervention group of 16 people and the control group of 16 people. The samples were lecturers and educational staff at Universitas Nusa Cendana who met the inclusion and exclusion criteria.

Study Design

This is a quasi-experimental study with a nonequivalent control group design. This study was conducted at Universitas Nusa Cendana in August–September 2022.

Before the intervention began, pretests were conducted, consisting of blood pressure measurement with a digital sphygmomanometer, examining sample characteristics, and filling out the sample characteristics questionnaire. The intervention group was then given the intervention which was moderate-intensity walking exercise for 30 min, 3 times per week for 4 weeks, whereas the control group was not given the walking exercise intervention. Walking exercise is monitored using the Pacer Pedometer and Step Tracker app. Samples could still be able to take antihypertensive drugs that were routinely consumed. After 4 weeks of the walking exercise intervention, blood pressure was measured again as a posttest.

Data Analysis

The results were analyzed using the Statistical Program for the Social Sciences. The normality test used the Shapiro–Wilk test. Due to the normal distribution of data, the different tests of the two dependent samples used the Paired Sample *t*-test, whereas the different tests of the two independent samples used the Independent Sample *t*-test. The *P*-value is considered statistically significant if it was <0.05 with a 95% confidence interval.

Ethics

This study was conducted after receiving approval from the Health Research Ethics Commission, Faculty of Medicine and Veterinary Medicine, Universitas Nusa Cendana, with registration number UN01220530.

RESULTS

Samples Characteristics

Table 1 shows that most of the samples in the intervention and control groups were male, aged between 30 and 39 years, from the Faculty of Medicine and Veterinary Medicine, and had no family history of hypertension. In the intervention group, most of the samples worked as educational staff, had the nutritional status of obesity I, and have Stage 1 hypertension, whereas in the control group, most of the samples worked as lecturers, had the nutritional status of obesity I and obesity II, and have prehypertension.

Intervention Group Blood Pressure

Table 2 shows significant changes between the pretest and posttest blood pressure in the intervention group, both in systolic ($P = 0.000$) and diastolic blood pressure ($P = 0.007$).

Control Group Blood Pressure

Table 3 shows no significant changes between the pretest and posttest blood pressure in the control group, both in systolic ($P = 0.583$) and diastolic blood pressure ($P = 0.117$).

Intervention Group versus Control Group

Table 4 shows significant differences in the pretest-posttest difference in blood pressure in the intervention group compared to the control group, both in systolic ($P = 0.000$) and diastolic blood pressure ($P = 0.003$).

DISCUSSION

Intervention Group

The results showed significant changes in blood pressure before and after the intervention of moderate-intensity walking exercise for 30 min, 3 times per week for 4 weeks in the intervention group. This is in line with the study conducted by Punia *et al*., 2022, where the 30-min walking intervention, 3 times per week for 8 weeks given to inactive people with prehypertension and Stage 1 hypertension results in significant changes in blood pressure in systolic ($P = 0.001$) and diastolic blood pressure ($P = 0.000$).[12]

Several mechanisms can cause this significant decrease in blood pressure. The walking exercise can reduce sympathetic activity, increase vagal tone, or both, leading to a decrease in peripheral resistance.[9] Walking exercise also reduces plasma norepinephrine levels which play a role in vascular constriction

Table 1: Sample characteristics in the intervention and control groups

Variable	Intervention group		Control group	
	Frequency (*n*=16)	Percentage	Frequency (*n*=16)	Percentage
Gender				
Man	10	62.5	11	68.8
Woman	6	37.5	5	31.3
Age				
<20 years	0	0	0	0
20–29 years	0	0	1	6.3
30–39 years	7	43.8	7	43.8
40–49 years	4	25	6	37.5
50–59 years	5	31.3	2	12.5
Faculty or institution				
Faculty of medicine and veterinary medicine	5	31.3	6	37.5
Faculty of public health	3	18.8	4	25
Faculty of teaching and science	0	0	3	18.8
Faculty of law	3	18.8	1	6.3
LP2M	4	25	2	12.5
Rectorate	1	6.3	0	0
Profession				
Lecturer	1	6.3	11	68.8
Educational Staff	15	93.8	5	31.3
Nutritional status based on BMI				
Normal (18.5–22.9 kg/m^2)	3	18.8	2	12.5
Overweight (23–24.9 kg/m^2)	3	18.8	4	25
Obesity I (25–29.9 kg/m^2)	8	50	5	31.3
Obesity II (≥30 kg/m^2)	2	12.5	5	31.3
Have a Family History of Hypertension				
Yes	7	43.8	7	43.8
No	9	56.3	9	56.3
Blood Pressure				
Prehypertension	6	37.5	11	68.8
Stage 1 Hypertension	10	62.5	5	31.3

BMI: Body mass index

Table 2: Intervention group blood pressure

Variable	Intervention group						*P*
	Pretest		Posttest		Differences Pretest-Posttest		
	Mean	SD	Mean	SD	Mean	SD	
SBP	137.13	8.188	124.13	8.988	13.00	5.538	0.000*
DBP	89.13	6.917	83.94	6.392	5.188	6.595	0.007*

Paired sample *t*-test *significant (P<0.05)

and increased heart rate frequency. It also reduces plasma renin activity which causes vasoconstriction as well as salt and water retention.[7,12,13] Decreased blood pressure can also occur due to release of vasodilator substances such as endorphins,

Table 3: Control group blood pressure

Variable	Control group						*P*
	Pretest		Posttest		Differences pretest-posttest		
	Mean	SD	Mean	SD	Mean	SD	
SBP	127.06	10.188	128.81	11.250	−1.750	12.471	0.583
DBP	85.63	7.126	89.31	8.122	−3.687	8.867	0.117

Paired sample *t*-test

Table 4: The difference in pretest-posttest blood pressure in the intervention group versus the control group

Variable	Group				*P*
	Intervention		Control		
	Mean	SD	Mean	SD	
Blood pressure					
Sistolic pretest-posttest	13.00	5.538	−1.75	12.471	0.000*
Diastolic pretest-posttest	5.19	6.595	−3.69	8.857	0.003*

Independent *t*-test *significant (P<0.05)

decreasing insulin resistance, thereby reducing peripheral vascular resistance, and increased production of nitric oxide which mediates vasodilation.[9,13,14] Another factor that can cause a slight decrease in blood pressure is the effect of exercise on body weight and waist circumference.[9] Weight loss leads to reduced sympathetic activity resulting in a decrease in blood pressure.16 Thirty-min of moderate-intensity physical activity can reduce serum cortisol levels. High cortisol can increase appetite and lead to obesity and eventually increasing blood pressure.[15-17] Therefore, moderate physical activity can inhibit or improve obesity and lower blood pressure.[15]

Control Group

The results showed no significant changes in blood pressure before and after the intervention in the control group. The mean blood pressure of the control group even increased. The same thing also happened in a study conducted by Aliftitah and Oktavianisya, 2020, which showed no difference between systolic blood pressure before and after the intervention in the group that did not do the 30-min walking intervention ($P = 0.442$).[18]

Several reasons can cause these insignificant changes. All control group samples were only exercised with a frequency of fewer than 3 times per week, even seven samples (43.75%) did not exercise. A study by Putriastuti, 2016, found a significant relationship between exercise status and hypertension incidence, where most hypertension respondents did not exercise. The study also showed that the majority of respondents who have hypertension exercised <3 times per week and most of the respondents who exercised ≥3 times per week did not have hypertension.[19]

In addition, most of the control group samples had excess weight, where 4 samples were overweight, 5 samples were obese I, and 5 samples were obese II. Obesity can cause the expansion of extracellular fluid volume, leading to increased venous return and cardiac output. Volume expansion occurs due to increased sodium reabsorption in the renal tubules caused by increased sympathetic nervous system activity, increased renin-angiotensin-aldosterone system, and compression of the kidney by visceral fat, retroperitoneal and renal sinuses.[16]

Most control group samples also worked as lecturers (68.8%). According to the Rector Regulation of Universitas Nusa Cendana Number 05 of 2018, a lecturer must work 40 h full-time per week with a workload of at least 12 credits each semester.[20] These long working hours are associated with weight gain, higher body mass index, unhealthy behaviors such as smoking, alcohol and coffee consumption, unbalanced diet, and a lack of physical activity due to a lack of free time.[21] This can be seen from the questionnaire data filled out by the samples, where most of the control group samples often consumed caffeinated foods/drinks (68.8%) and salty foods/drinks (56.3%). According to a study by Aristi *et al*., 2020, the frequency of consumption of salty or high-sodium foods/drinks and caffeinated foods/drinks has a relationship with the incidence of hypertension.[22]

Intervention Group versus Control Group

The results showed significant differences in the mean difference in blood pressure before and after the intervention between the intervention group and the control group. The same thing also happened in a study conducted by Sukarmin *et al*., 2014, where it was found that, with the brisk walking exercise carried out 4 times per week for 2 weeks, there were significant differences in systolic and diastolic blood pressure between the control group and the intervention group with $P = 0.000$ for systolic blood pressure and $P = 0.026$ for diastolic blood pressure.[23]

These significant differences could be caused by regular aerobic exercise performed by the intervention group, which was walking exercise 3 times per week for 4 weeks. The acute effect of physical exercise is an increase in cardiac output and blood pressure, but individuals who do regular aerobic exercise will adapt and produce a decrease in resting heart

rate and cardiac hypertrophy. Heart rate will decrease due to increased vagal tone and parasympathetic activity. Physical exercise also increases the workload of the heart which will trigger myocyte proliferation, resulting in cardiac hypertrophy. This hypertrophy increases the heart's efficiency in delivering oxygen to the muscles and reduces cardiac output at rest. In addition, aerobic exercise will also increase the diameter of the arteries and reduce the thickness of the arterial walls, thereby increasing the capacity of the blood volume that can be accommodated. Some of these mechanisms will reduce cardiac output and peripheral vascular resistance, thereby reducing blood pressure. This change in chronic adaptation may occur as early as 30 days after the start of regular aerobic exercise.[10,11,24]

This study did not control the antihypertensive drug variables. Lifestyle modification, such as regular exercise, can also increase the effect of antihypertensive treatment, as happened in the intervention sample who routinely took antihypertensive drugs and did walking exercises where systolic blood pressure decreased by 24 mmHg and diastolic blood pressure decreased by 16 mmHg, higher when compared to the control group sample who only regularly took antihypertensive drugs where systolic blood pressure decreased by 17 mmHg and diastolic blood pressure increased by 1 mmHg.[5]

Based on the study's results, it can be proven that there is an effect of walking exercise on blood pressure reduction in prehypertension and Stage 1 hypertension patients in the intervention group. This can be seen from the results of the pretest and posttest, which also showed a statistically significant decrease.

The limitations of this study were that the sample diet could not be monitored in detail and other physical activities carried out by the sample could not be fully controlled.

CONCLUSION

Based on the study's results, it can be concluded that walking exercise 3 times per week for 4 weeks reduces blood pressure in prehypertension and Stage 1 hypertension patients.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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