International Journal of Mechatronics and Technology, Vol. 01, No. 01, pp.1-6 (2026)

THE EFFECT OF AEROBIC EXERCISE ON BLOOD PRESSURE AMONG OLDER PEOPLE WITH HYPERTENSION IN INDONESIA

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(*Received date Nov 12 2025; Revised date Des 23, 2025; Accepted date Jan 16 2026*)

ABSTRACT– Exercising has been shown to not only lower office blood pressure (BP) in hypertensive people, but also to improve their overall health. This study would assess the acute effects of aerobic exercise on post-exercise blood pressure in older persons who participate in physical activity and have grade I high blood pressure. A randomized control trial with a longitudinal follow-up was used in this study. Daily exercises are moderate, requiring 50-70 percent of the participant's maximum VO2 HR (220 years old), and at least three sessions per week for a total of 30 minutes per section. Respondents had a higher SBP at baseline, with an average score of 132.35 (SD=22.77). While respondents had a higher DBP at baseline, with an average score of 91.42 (SD=19.55). At T3, the SBP and DBP scores continue to show decreased outcomes when compared to the control. Aerobic exercise has a significant impact on the average systolic and diastolic blood pressure of the elderly with hypertension. It is recommended that more research be conducted on the effect of exercise on blood pressure, specifically hypertension exercise.

KEY WORDS : Aerobic exercise, Blood pressure, Older people, Hypertension

1. INTRODUCTION

Hypertension affects 26 percent of the world's population (972 million people) and is anticipated to climb to 29 percent by 2025, mostly due to economic development in emerging countries. Men (47%) have higher blood pressure than women (43%) do, and only roughly one-quarter of all individuals (24%) with hypertension have their disease in controlled [1,2].

Exercising not only benefits physical but also mental health. Individualized exercise has been proven to not only lower office blood pressure (BP) in hypertensive persons, but also to be as efficient just like most antihypertensive medicines in lowering office BP [3,4]. Exercise also has minimal side effects in comparison to medicines[5]. The acute decreased blood pressure following a single session of exercise, referred to as post-exercise hypotension, demonstrated a strong positive correlation with the chronic decrease in blood pressure following eight weeks of exercise training [6], implying that the acute reduction in blood pressure may be related to long-term adaptations to exercise [7].

Hypertensives are recommended for 30 to 45 minutes daily to participate regularly in aerobic exercises like footing, jogging or swimming [6]. Regular exercise decreases systolic blood pressure by 3 to 5 mm Hg and diastolic blood pressure by 2 to 3 mm Hg in normotensives. Hypertensives have an even greater influence on systolic and diastolic blood pressure readings [3]. Despite numerous clinical trials, there is currently no scientific evidence on the impact of exercise on blood pressure. The effect of aerobic exercise on hypertension has primarily been studied in long-term exercise programs (at least three months) that are high in intensity and have a high number of sessions per week (5 days per week), according to the literature. Individuals who are unable to perform high-intensity activities, such as running, may find it difficult to participate in such exercise programs because of the increase in the number of sessions per week and the high intensity of the exercise [8].

There are a variety of responses to the numerous issues about the influence of different workouts and their varying intensities on the blood pressure of the old, some of which are inconsistent and contradictory. Numerous research studies have revealed varying findings about the effect of exercise on blood pressure, taking into account the type of exercise, its circumstances, length, and frequency throughout a specified time period, as well as its relationship to blood pressure reduction [9].

Previous study found that after three days of aerobic activity per week for three months, the intervention group's mean systolic and diastolic blood pressures decreased by 3.2 and 1.2 mmHg, respectively, while the control group's mean blood pressure remained unchanged [10]. According to previous study arterial compliance demonstrated resistance to a brief aerobic exercise program, and no drop in patients' blood pressure was seen [11].

Previous study found that when older persons were compared to aerobic short-term and long-term exercise regimens with mild and moderate intensities, the short-term program had no effect on reducing systolic blood pressure but did reduce diastolic blood pressure. The long-term therapy resulted in mean systolic and diastolic blood pressure reductions of 136 to 129 and 87 to 83 points, respectively. Additionally, both mild and moderate intensity regimens were effective at lowering blood pressure [12]. Another study investigated the effect of a moderate intensity long-term exercise program on patients with hypertension. The results indicated a decrease in blood pressure in the samples, however the decrease was not statistically significant [13]. However, it's unclear whether a diminished reaction to medication therapy is also associated with a reduced reactivity to other blood pressure treatments.

Older adult studies are limited and studies for active people with high blood pressure are not available. In addition, controversial results were outlined for BP reactions based on the intensity of practice[7,8] or physical fitness status of subjects (trained or untrained), like some researches did not show any differences [9], while other research indicate that undertrained participants had a higher BP decrease than highly skilled subjects [10]. As such, this study would compare the acute effects of aerobic exercise on post-exercise blood pressure in older adults with grade I high blood pressure who participate in physical activity.

2. METHODS

2.1. Study Design

This study used a randomized control trial with a longitudinal follow-up to assess the effect of 3-month individualized aerobic exercise in older people with grade I hypertension. The evaluation was carried out at the beginning (T0), one week after the intervention (T1), one month after the intervention (T2), and three months after the intervention (T3) (T3).

2.2. Partcipants

Participants were recruited from a public health center in Cimahi, West Java, Indonesia, for this study. The participants had to be at least 65 years old and have been diagnosed with hypertension for at least six months. 3) Blood pressure was between 130 and 140/90 and 100 mmHg. 4). Not getting enough exercise (three times a week in recent 6 months). 5) Could walk without being hindered by others' sickness at baseline. 5) Be able to communicate in Bahasa Indonesia verbally and in writing. If a participant had a condition that was known to impede cognitive function or had a mental problem, they were not allowed to participate.

G-Power Software Version 3.1.6 was used to calculate the sample size, which was calculated using the F test with the assumptions of = 0.05, effect size= 0.2, power level=0.80, 3 repetitions, and 2 groups. The estimation for the minimum sample size that will be obtained is 62, and assuming an attrition rate of 15% for those who have been followed up for more than 6 months, the total minimal sample size that was recruited is 114.This is an example of the equation.

2.3 Randomization

A computer-generated sequence of random numbers was allocated randomly for participants that accepted participating in this study either to the intervention or control groups. The groups were assigned using equal allocation and randomization. Participants were randomly allocated to one of two groups: intervention group or the control group (CG) (IG).

2.4 Intervention

Participants who agreed to take part in the trial were allocated to a 3-month walking intervention program based on the American Heart Association's recommendation for hypertension, departing a BP-lowering treatment, and older adults. In everyday exercises, exercises are moderate, 50-70 percent max VO2 HR (220-years old) per participant, and at least three sessions per week for a period of 30 minutes per section, respectively. Each session began with a five-minute warm-up, followed by moderate-intensity exercises and a five-minute cool-down.

Three stages comprised the intervention: 1) Preparation stage (1st month); the goal of this stage was to help participants transition from their intervention program to regular activity. Participants were asked to exercise three times a week, for ten minutes each time. 2) Improvement phase (the second week); participants were asked to pre-walk 3 times in the week for 20 minutes per section, intensities were 50 percent of the maximum HR. (2) The purpose of this stage was to improve their walking strength to achieve our settings. 3). The continuation stage (1 to 3 months), participants requested reforms to be performed within at least 3 times a week, with an intensity of 30 minutes per section being 50-70% of the HR maximum.

For determining physical fitness, the measurement of maximal oxygen uptake is considered as the gold standard. The validity of the results, on the other hand, is dependent on the subjects exercising until they are exhausted. Muscle or joint discomfort, rather than fatigue, limits the length of the activity test in the elderly.

2.5 Measurements

On enrolment, demographic data such as age, marital status, years of education, religious affiliation, employment, living alone, lives alone, and hand were gathered. Clinical variables including blood pressure, diastolic blood pressure, medicine against hypertension, and length of hypertension.

The BP measuring procedures are performed both before and after patients and in sitting position with uncrossed legs, flat feet on the floor, and with a cardiac-supported left arm. BP was also measured using a non-invasive automatic calibrated BP, automatically validated oscillometer device. The mean blood pressure is calculated using the SBP and DBP values. All blood pressure (SBP and DBP) measurements were performed on the mean value used for analysis. All blood pressure measurements were taken by the same researcher between 9:00 a.m. and 2:00 p.m. at a controlled room temperature.

2.6 Procedure

Ethical approval was obtained from the Institutional Review Board of affiliated university (E34/089/II/2020). Participants who meet the inclusion criteria for subject recruitment are identified by the physician, who then informs the nurse.

Potential participants were invited to a quiet room where researchers explained the study's goal, data gathering technique, and protection of their rights, such as respect for their autonomy and confidentiality. They must sign an informed consent form if they agree. Researchers first described the intervention program details, including: the benefit of walking, how to do walking exercises, preparation before exercising (e.g. measuring BP and pulse rate before exercises, using comfortable clothing), risk monitoring of high blood pressure, diary book filling content (date & time walking periods, total step, BP and HR before and after after).

2.7 Data analysis

This study conducted intention-to-treat analyzes. The regression models employed were implemented in the intervention and control groups, taking into account the baseline levels of the dependent variable. The variances between baseline and T2 in intervention versus control groups were calculated when comparing the DI Differences (DID) (DID). All analyzes were performed using version 23 of SPSS.

3. RESULTS

The characteristics of the participants in the intervention group that were compared to the control group are listed in “Table I”. In terms of demographic and clinical data, there were no significant differences between the intervention and control groups.

Table 1. Comparison of selected baseline characteristics of intervention and control participants (N=114)

Variables	**Experimental , (n=57) %**	**Control, (n=57 %)**	**p-value**
Demographic characteristics			
Age in year (Mean ± SD)	67.54±9.88	68.90±11.34	0.453
Gender			
Male	27 (47.3)	25 (43.8)	0.277
Female	30 (52.6)	31 (54.4)	
Marital status			
Married	44 (77.2)	37 (64.9)	0.114
Single/Widow/ Divorce	13 (22.8)	20 (35.1)	
Education level			
Below senior high school	41 (71.9)	40 (70.2)	0.111
Above senior high school	16 (28.1)	17 (29.8)	
Clinical information			
Duration of hypertension (Mean ± SD)	6.18 ± 2.27	6.73 ± 2.11	0.546
Receiving medication			
Yes	3 (5.3)	5 (8.8)	0.727
No	52 (91.2)	51 (89.5)	

In the SBP score, at baseline, respondents showed a higher SBP, with an average score of 132.35 (SD=22.77). While, the DBP score, at baseline, respondents showed a higher DBP, with an average score of 91.42 (SD=19.55). SBP scores decreased over time as respondents in the intervention groups scored 124.31 (SD=21.43), and respondents in the control group scored 133.02 (SD=18.78) at T3. DBP scores decreased over time as respondents in the intervention groups scored 82.54 (SD=15.52), and respondents in the control group scored 93.56 (SD=14.32) at T3.

The change of BP scores is shown in Table 3. The exercise program improved outcomes relative to the control at T3 across four outcomes: 1) SBP score decreased 11.33% (95% CI 5.72–15.19), 2) DBP saw a modest decreased 6.8% (95% CI 2.54–13.54). At T3, decreased outcomes relative to the control are still observed in SBP and DBP score.

Table 2. Estimated difference-in-differences (DID) with fixed effect model

Variables	T1 DID coefficient (95% CI)	T2 DID coefficient (95% CI)
SBP	0.088* (0.061–0.263)	0.318* (0.054–0.792)
DBP	0.067** (0.053–0.425)	0.259** (0.065–0.535)

All models adjust for age, and pre-test score; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

4. DISCUSSION

Hypertension is one of the most prevalent disorders in developed countries and a major risk factor for atherosclerosis, which can result in a variety of complications. Our results show that both systemic BP and diastolic BP aerobic exercises decrease. The systolic BP findings are consistent with those of a previous study that comprised 65 trials and found an immediate systolic BP reduction of 8 mm Hg in hypertensive people [10]. In this study, we found that after the session, systolic blood pressure dropped between 8.7- and 10-mm Hg in the 30% session and between 10.5- and 11.4-mm Hg in the 60% session. A recent study in very old people with hypertension who did not engage in regular exercise found that two 10-minute walks at an intensity of 40 percent to 60 percent of HR reduced systolic BP but did not affect diastolic BP [6]. The lack of a significant reduction in diastolic BP is unsurprising, given that the baseline values were close to normal, making a lower BP after exercise less likely.

Good physical fitness consists of muscle strength, joint flexibility, motion agility, flexibility, cardio-vascular fitness and neuromuscular fitness. When people do exercise, the blood circulation is smooth and blood volume increases. In addition, 20% of the blood is in the brain, so endorphins form a norepinephrine hormone that causes feelings of joy, pain, addiction (movement dependence), and depression. The least result is that the elderly feel happy, happy, can sleep better, keep their minds fresh [11] when they follow elderly gymnastics. Regular exercise reduces blood pressure and persists as long as exercise or gymnastics continues. Physical exercise or gymnastics can also control the blood pressure, helping the cardiac muscle to grow and the heart chambers. Both will increase the efficiency of the cardiovascular work, increase the elasticity of the vessels so that the blood flow becomes smoother.

Blood pressure will rise considerably when doing physical activity in elderly gymnastics. For example, systolic blood pressure will increase by 110 mmHg at rest by 150 mmHg. On the other hand, when the exercise is over, your blood pressure drops below normal and lasts between 30 and 120 minutes. If your exercise is performed repeatedly, your blood pressure will decrease for a long time. Therefore, regular physical activity can reduce blood pressure. The kind of exercise that lowers blood pressure is exercise 3-5 times a week and 2060 minutes of exercise each time [12]. The researchers assumed that elderly exercise was very helpful in reducing blood pressure for the elderly by hypertension, based on the results of the above study. Elderly practice benefits from easier circulation of the blood, reducing the risk of degenerative diseases such as high blood pressure, coronary heart disease and diabetes mellitus.

A meta-analysis of the impacts of blood pressure and blood pressure-regulating systems discovered that a decrease in peripheral permeability causes a decrease in workout tension, with the sympathetic nervous system and the renin-angiotensin system playing essential roles [13]. The sympathetic nervous system is among the three fundamental components of the autonomic nervous system, and it is important for a range of functions, including the regulation of the cardiovascular system throughout physical activity [14]. The renin-angiotensin system (RAS) is a hormonal system that controls blood pressure, body fluid balance, and peripheral vascular resistance [15]. A number of different research studies have demonstrated that physical exercise reduces circulating levels of renin and sympathetic nervous system activity. As a result, it is accepted that both types of training—endurance and resistance—lower blood pressure, with few differences between the two.

Although there is no scientific proof of the combination of BP of exercise and drug, significant evidence from of the RCTs shows potentiated by 6 mm Hg with conventional types of exercise; while evidence for DBP was inadequate [16]. The benefits of lowering blood pressure in people with hypertension are undeniable; nevertheless, the ways by which blood pressure is reduced are a source of disagreement about their relative effectiveness [17]. Additionally, our findings together should support the widely held belief that antihypertensive medications have a greater impact on reducing BP than physical activity [18]. Finally, aerobic has a more prominent impact on reducing BP than traditional types of exercise, but the evidence is stronger for alternative forms of exercise.

In everyday life, a sophisticated approach such as leucocyte is rarely used to measure fitness levels in hypertension. Consequently, the training intensity suggestion must be kept more workable. The patients were normally never fatigued to conduct conversations during a training program with the current alginate exercise regimen. The average training heart rate was around 100 beats per minute [19]. However, it should be noted that 68 percent of the exercise group's participants were taking -blockers. This type of training was well tolerated and resulted in a meaningful improvement in cardiovascular health. In addition, regular exercise doesn't just help to reduce blood pressure. It has numerous other beneficial effects, including improving the health of the cardiovascular system. Regular aerobic exercise serves as an excellent tool in combating additional cardiovascular risk factors, including weight loss for obese patients, increased HDL and decreased LDL cholesterol, improved insulin sensitivity, and decreased endothelial dysfunction [20].

Physical activity promotes cardiovascular adaptation, lowering heart rate and resting heart rate while increasing left ventricle filling, venous return, and stroke volume [21]. Hinderliter et al. observed that after a six-month aerobic exercise program, patients with hypertension experienced a significant decrease in left ventricular hypertrophy [22]. This decrease in hypertrophy was associated with a decrease in blood pressure and a decrease in body weight in individuals. Additionally, these researchers discovered that weight loss is critical in reversing left ventricular hypertrophy [23]. Furthermore, another study demonstrated that aerobic exercise can result in decreased hypertrophy in hypertensive people [24]. Despite this, eccentric contractions occur following aerobic activity, increasing the ventricle volume; hypertrophy in the ventricle is also possible, though to a lesser amount (in healthy subjects). However, when patients are hypertensive, the mechanism is different due to pathologic enlargement of the ventricular wall. This indicates that when the ventricle dimensions grow physiologically (as a result of aerobic activity), the stroke volume increases and hence pathologic ventricular wall hypertrophy decreases [25].

This study did not explore (recall) the foods and drinks the respondents consumed prior to the exercise. The results of the systematic and diastolic reduction of blood pressure and the impact of food consumption were not measured prior to the procedure. Furthermore, the investigators have not examined the use by respondents of hypertension medicines, so it is recommended to add intake variables consumed by respondents and to consider the use of hypertensive medicines during the exercise.

An important effect of elderly exercise is a reduction in the average systolic and diastolic blood pressure of the elderly with hypertension, prior to and after the elderly. The Program Owner regularly increases the frequency of elderly workouts in the Prolanis Group every two weeks by empowering the trained gymnastic instructors. Health care workers at Prolanis take the blood pressure measurements of the elderly regularly after every exercise. Further research on the effect of exercise on blood pressure, namely hypertension exercise, is recommended.

ACKNOWLEDGEMENT– We thanks to all participants to join in this study and to STIKes Ahmad Yani to provide funding.

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