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The Effect of Walking Exercise on Blood Pressure and Blood Glucose in the Elderly

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ABSTRACT

Background: Walking exercise is a physical activity that stimulates various components of physical fitness. Particularly in the elderly, it improves blood circulation, strengthens bones, lowers blood pressure and glucose. **Objective:** This study aimed to determine the effect of walking exercise on blood pressure and blood glucose in the elderly. **Method:** This research was experimental research that used a quantitative approach. Participants were elderly aged 60 years with a history of hypertension and high blood glucose. The samples in this study were 34 people who were determined based on a simple random sampling technique. The experimental group was given physical activity treatment for walking 3x a week with mild to moderate intensity for 60 minutes for three weeks. The control group did not participate in any treatment. The walking program took place outside on a 1 mile/1,609 meter track. Before beginning the exercise program, participants should warm up for 5-10 minutes with a leisurely walk. In this case, the participant's mileage is 1 mile. The instrument used to measure blood pressure in this study was an aneroid sphygmomanometer, while a glucometer was used to measure blood glucose levels. **Results:** This study found that: Based on the Mann-Whitney test, it showed that there was a significant effect of walking exercise on decreasing systolic blood pressure ($p < 0.005$), diastolic blood pressure ($p < 0.018$), and reducing blood sugar ($p < 0.031$). **Conclusion:** Walking exercise has a significant effect on blood pressure and blood glucose in the elderly.

Key words: Aged, Blood Glucose, Blood Pressure, Physical Fitness, Hypertension

INTRODUCTION

The process of getting old that occurs in a person's life cycle has several characteristics, including decreased organ function, such as physical, emotional, psychological conditions, and weakened social abilities, causing the body's resistance to drop and become vulnerable to various diseases (Anuar et al., 2021; Pranata et al., 2021). Elderly morbidity rates are the proportion of older adults who experience health problems that interfere with daily activities (Hardika & Pranata, 2019). The impact that occurs in the elderly is metabolic disturbances in the function of body organs that trigger degenerative diseases such as hypertension, obesity, blood glucose, cholesterol, gout, and others (Mighra & Djaali, 2019). Aging is a natural process that will be experienced by everyone, which is characterized by a decrease in body function, especially in cardiovascular function, causing health problems, including hypertension (Bungsu, Rekawati, & Wiarsih 2019; de Cabo & Mattson, 2019; North & Sinclair, 2012).

Hypertension in recent years has become one of the most common chronic diseases for the elderly (Yu et al., 2018). Elevated blood pressure or hypertension is characterized by an increase in blood pressure that exceeds normal (Mighra & Djaali, 2019). Hypertension often causes dangerous conditions because its presence is usually not realized and often does not cause significant complaints until complications occur in the heart, brain, kidneys, eyes, blood vessels, or other vital organs (Aronow et al., 2011; Ihsan Kurniawan, 2019).

Based on a meta-analysis of 61 studies, including data from 1 million adults without previous cardiovascular disease, it was found that the risk of cardiovascular disease increases progressively from a blood pressure level of 115/75 mm Hg with a doubling of the incidence of coronary heart disease and stroke every 20/10 mm Hg increases (Kannel et al., 2003). This indicates that hypertension is a major modifiable risk factor for cardiovascular cases and mortality rates in the world (Lim et al., 2012). The elderly are more susceptible to hypertension due to a decline in physical function (Bungsu et al., 2019). Hypertension cases are spread evenly in all public health centers and increase every year. Based on the latest data, cases of hypertension in 2013 were 19,275 cases and grew to 47,772 cases in 2014 and 66,764 cases in 2015 (Bungsu et al., 2019).

Aging is associated with changes in body composition that lead to insulin resistance, glucose levels, and an in-

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creased risk of diabetes (Meneilly & Tessier, 2001). Blood glucose in the elderly tends to increase due to the weakening of the sensitivity of the elderly organs to insulin. WHO projects that diabetes will be the 7th leading cause of death by 2030. It is recommended that a healthy diet and maintenance of average body weight be an effort to prevent diabetes. In addition, the elderly are recommended to do at least 30 minutes of regular physical activity with moderate intensity five times a week (Mathers & Loncar, 2006). Lack of physical activity in the elderly is also a significant factor that causes a person to experience obesity and weaken vital organs such as the heart, liver, kidneys, and pancreas. Thus, lack of physical activity triggers diabetes mellitus due to increased blood glucose levels (Yitno & Riawan Wahyu, 2017; Hamidiyeh et al., 2021). Exercise and walking are two of the most effective ways for people with diabetes to manage their condition and improve health (Di Loreto et al., 2005). Walking 10,000 steps or 5 miles per day can reduce insulin use by almost 25%, according to studies, and walking 3-4 times per week for 30-60 minutes can help people with diabetes lower blood pressure and blood sugar levels (Karstoft et al., 2013; Praet et al., 2008; Tjønna et al., 2008). Therefore, if walking, dietary regulation, and education about managing diabetes-related complications are carried out regularly, diabetes complications such as heart problems and hypertension will be more easily prevented to reduce diabetes and difficulties in the elderly. However, a gap in previous research is a lack of knowledge about the effect of regular walking exercise, which includes a walking exercise program (Wang et al., 2021; Karstoft et al., 2013; Sung & Bae, 2012). This study aimed to determine the effect of walking exercise on blood pressure and blood sugar in the elderly. The hypotheses of this study are (1) there is an effect of walking exercise on reducing blood pressure in the elderly; (2) there is an effect of walking exercise on reducing blood sugar in the elderly.

METHOD

Participants and Study Designs

This is an experimental research design. Thirty-four participants were randomly divided into two experimental and control groups in this study. A pre-test was conducted to determine the initial state difference between the experimental and control groups. The inclusion criteria were all members of the elderly posyandu (post integrated service), who had a history of hypertension and blood sugar, aged 60 years and over, people with hypertension and blood sugar >1-5 years, willing to participate in this research. Exclusion criteria were people with diabetes, heart disease, people with a history of stroke. The following formula is used to calculate the sample size using the Slovin formula with a 5% error rate (Susanti et al., 2019):

$n = N/(1+(N \times e^2))$

$n = 37/(1 + (37 \times 0{,}05^2))$

$n = 33{,}86$

Thirty-four participants were selected and calculated according to the Slovin formula. The random sampling technique was used to choose sample members from a population at random, without regard for the population's existing strata (Sugiyono, 2019). The sample was completed by randomization, resulting in a sample of 17 people for the experimental group and 17 people for the control group. Based on expert judgment, content validity was the basis for this study's validity. The blood pressure of the sample was measured using a sphygmomanometer and a tool called Microlife AFIB with AKL number Kemenkes RI 20501313186. Meanwhile, the instrument used to measure blood glucose was a glucometer and a device called BeneChek with AKL number at the Ministry of Health RI 20101112792. The independent variable in this study was walking, while the dependent variable was blood pressure and blood sugar.

Exercise Procedure

Before conducting the study, participants were asked to avoid consuming food 3 hours and caffeine 4 hours before the exercise program. The participants were advised to get adequate sleep (7-8 hours) the night before the test to avoid the effects and diet on the findings. The walking exercise program is carried out in an open space, on a 1 mile/1609 meter long track. Participants warm up for 5-10 minutes before beginning the exercise program. After warming up, participants were asked to walk as fast as possible, following their ability. The participant's walking distance, in this case is 1 mile. The walking exercise program for the elderly is arranged in the Table 1.

The control group did not do any exercise. Practice sessions are held between 7-9 a.m under the supervision of a researcher and a doctor.

Measurement of Blood Pressure and Blood Sugar

Participants' blood pressure (systolic and diastolic) was measured using Aneroid Sphygmomanometer, Exacta LF1350 (participant was calm and relaxed in a sitting position with the cuff on the left arm supported at heart level). Heart Rate was measured in eight states of time and recorded on a beat-by-beat basis using a Polar Heart Rate recorder. Using a Polar Heart Rate recorder, heart rate was calculated in eight states of time and recorded on a beat-by-beat basis. According to American Heart Association guidelines, blood Pressure and Heart Rate are measured twice before and after exercising on an exercise program that has been prepared (Dorans et al., 2018). The blood pressure test results will be expressed as two numbers in millimeters per unit of mercury (mmHg). These measurements are known as systolic and diastolic. The systolic blood pressure is the pressure in the arteries when the heartbeats, and the first is diastolic blood pressure. Meanwhile, the second number is diastolic blood pressure, which is the pressure in the arteries between heartbeats. According to the American Heart Association (AHA), blood pressure measures are classified as follows: 1) Normal: Below 120/80 mmHg; 2) Increased: Between 120-129 mmHg for systolic pressure and below 80 mmHg for diastolic pressure; 3) Hypertension grade 1: 130/80 mmHg to 139/89 mmHg; 4) Hypertension grade 2: 140/90 mmHg or more.

The following equation calculated the mean blood pressure (MBP):

1/3 SBP+2/3 DBP, and the rate pressure product (RPP) was evaluated according to the HR×SBP value.

A blood sugar checker, also known as a glucometer, is used to measure blood sugar levels. The fingertips are used to collect samples. Normal blood sugar levels are 110 mg/dL, 70-110 mg/dL for fasting blood sugar, and 140 mg/dL for fasting blood sugar (Figuera et al., 2019). The test is carried out by a nurse and supervised by a doctor. Following the examination, a walking exercise test is performed under the supervision of a doctor.

Statistical Analysis

The data were processed using SPSS 25. The first step in data processing was to compare descriptive data with the size of the entire population and the distribution of variables. The next stage was to determine the mean, followed by a Mann-Whitney analysis to determine the effect of walking exercise on blood pressure and blood glucose in the elderly. The basis for decision making as referred to in the Mann-Whitney test is as follows: 1) The hypothesis is accepted if the significance value or asymmp.sig (2-tailed) < 0.05; 2) the hypothesis is rejected if the significance value or asymmp.sig (2-tailed) > 0.05. The following are descriptive results related to blood pressure and blood glucose variables.

RESULTS

The mean Pre-Test value for the systolic blood pressure variable in the control group (Mean=148.41) was found to be higher than the experimental group (Mean=155.59). The Mann-Whitney test in this case showed no statistically significant difference p >.323. The mean value of Pre-Test on the diastolic blood pressure variable for the control group (Mean=92.12) was found to be higher than the experimental group (Mean=94.41). The Mann-Whitney test showed no statistically significant difference p >.195 before the treatment, while the average value of the Pre-Test blood sugar variable in the control group (Mean = 194.12) was higher than the experimental group (Mean = 148.82). Based on the Mann-Whitney test, there was no statistically significant difference p >.060 (Table 2).

The average value of Post-Test in the control group systolic blood pressure variable (Mean= 138.71) was lower than the experimental group (Mean= 135.18). The Mann-Whitney test showed a statistically significant difference, $U\ (N_{Control} = 17, N_{Experiment} = 17,) = 64.000, z = -2.787, p < .005$. The average value of Post-Test in the control group diastolic blood pressure variable (Mean=85.24) was lower than the experimental group (Mean=84.18). The Mann-Whitney test showed a statistically significant differences, $U\ (N_{Control} = 17, N_{Experiment} = 17,) = 77.000, z = -2.363, p < .018$. Meanwhile, the average value of Post-Test on the control group's blood sugar variable (Mean= 179.82) was lower than the experimental group (Mean= 122.88). The Mann-Whitney test showed a statistically significant difference, $U\ (N_{Control} = 17, N_{Experiment} = 17,) = 94.500, z = -1{,}728, p < .031$ (Table 2).

Mann-Whitney test as the basis for decision-making concludes that the hypothesis is accepted. In other words, these findings indicate a significant difference in the scores of the control and experimental groups. This significant difference leads to the answer to the problem statement of this research, namely that walking exercises affect reducing blood pressure and blood glucose in the elderly.

DISCUSSION

This study aims to determine the effect of walking exercise on blood pressure and blood sugar in the elderly. Summarizing the results of the study, it is known that the average post-test result in the control group for systolic blood pressure was 138.71, diastolic was 85.24, and blood glucose was 179.82. Meanwhile, the average values of systolic, diastolic, and blood glucose in the experimental group that applied the walking exercise method, respectively were 135.18, 84.18, and 122.88. The average value indicates that all the average values of the experimental group who apply walking exercises are higher than the control group. These findings showed a significant difference in the decrease in systolic (p <.005) and diastolic (p <.018) blood pressure in the elderly and a significant effect of walking on decreasing blood sugar (p <.031) in the elderly. In conclusion, the control group as the group that did not apply the walking exercise program and the experimental group that used the walking exercise program had significant differences.

It is explained in some literature reviews that walking is an activity that is classified as economical and has a low risk. The walking exercise led to a decrease in systolic (3 mm Hg) and diastolic (2 mm Hg) pressure in a well-designed exercise program. Walking is a highly beneficial recommendation and activity for lowering blood pressure (Kelley & Kelley, 1999; Lee et al., 2010; Mutrie & Hannah, 2004). Walking can reduce blood pressure in the elderly with obesity and nutritional status hypertension, considering that systolic and diastolic blood pressure will decrease after doing this exercise (Rohimah & Dewi, 2022). In line with Sharkley (2011), it is stated that regular physical activity can reduce blood pressure and maintain the elasticity of blood vessels. Regular and systematic exercise will also direct the body to send blood to the muscles during walking properly. Programmed exercise can affect lowering blood pressure. In some studies, it is described that physical exercise has a good impact on the cardiorespiratory system. The heart's capacity will also increase according to the changes that occur through good and regular exercise. The decrease in blood pressure occurs due to a reduction in a heart-pumping activity where the heart muscle in people who often exercise will contract less than people who do less exercise (Syatria, 2006).

Previous research has found that exercise can change the effectiveness and absorption of blood glucose levels. Aging can trigger an increase in glucose intolerance in the blood. Therefore, walking, a primary physical activity for human life is highly recommended. Walking is a physical activity that can also be called exercise if it is programmed regularly. The benefits of exercise in the elderly include reducing the risk of diabetes mellitus, hypertension, and heart

Table 1. Exercise program

Exercise Form	Exercise		
	1-6	**7-12**	**13-18**
a.Warming Up exercise -Bending head forward -Bending head left and right -Stretching the shoulders to the right and the left -Stretching the shoulders back -Stretching the shoulders up and down -Stretching the right and left triceps -Bending the ankle -Leisurely walking	Intensity/Duration 60% Maximum Pulse Rate (5-10 minutes)	60% Maximum Pulse Rate (5-10 minutes)	60% Maximum Pulse Rate (5-10 minutes)
b.Core Exercise -Walking	65-70% Maximum Pulse Rate (30 minutes)	70-75% Maximum Pulse Rate (35 minutes)	70-80% Maximum Pulse Rate (40 minutes)
c.Colling down exercise -Bending head left and right -Performing gymnastic movements by turning the head left and right -Doing gymnastics bending down -Doing the S shoulder exercise -Doing the L shoulder exercise -Lunges -Leisurely walking	65-70% Maximum Pulse Rate (5-10 minutes)	60% Maximum Pulse Rate (5-10 minutes)	60% Maximum Pulse Rate (5-10 minutes)

Table 2. The results of the Mann Whitney test analysis

Pre-Test							
Variable	**Group**	**N**	**Mean**	**Mann-Whitnay**	**Wilcoxon W**	**Z**	**Asymp. Sig. (2-tailed)**
Systolic Blood Pressure	Experiment	17	155.59	116.000	269.000	-0.989	0.323
	Control	17	148.41				
Diastolic Blood Pressure	Experiment	17	94.41	108.000	261.000	-1.297	0.195
	Control	17	92.12				
Blood sugar	Experiment	17	148.82	90.000	243.000	-1.878	0.060
	Control	17	194.12				
Post-Test							
Variable	**Group**	**N**	**Mean**	**Mann-Whitnay**	**Wilcoxon W**	**Z**	**Asymp. Sig. (2-tailed)**
Systolic Blood Pressure	Experiment	17	135.18	64.000	217.000	-2.787	0.005
	Control	17	138.71				
Diastolic Blood Pressure	Experiment	17	84.18	77.000	230.000	-2.363	0.018
	Control	17	85.24				
Blood sugar	Experiment	17	122.88	94.500	247.500	-1.728	0.031
	Control	17	179.82				

disease. Walking at moderate and high intensity can lower blood glucose because it will increase glucose uptake by muscles compared to hepatic glucose release during activity (Pulsford et al., 2017). During exercise, the muscles use the glucose stored in the muscles. If glucose is reduced, then the muscles fill the void by taking glucose from the blood. This shows that walking can reduce blood glucose levels by 10.15% (Jiwintarum et al., 2019). Walking can reduce blood glucose levels due to contractions between skeletal muscles that occur during walking so that muscle work metabolism will increase and glucose will decrease (Pai et al., 2016; Song et al., 2015; Richter & Wojtaszewski, 2001).

This study focused on walking exercise to lower blood pressure and blood glucose in the elderly. The results of this

study have proven that walking can lower blood pressure and blood glucose. However, the sample used in this study is relatively small.

These findings suggest several courses of action; the results of this study can practically be used as a reference or consideration in preparing an appropriate exercise program for health instructors to improve physical fitness, lower blood pressure, and lower blood sugar levels. Thus, structured and programmed exercise can improve health for the elderly

CONCLUSION

Based on the results and discussion, the authors concluded that the walking exercise program that had been prepared had an increase in the experimental group. Then based on the results of the Mann-Whitney analysis test that walking exercise has a significant effect on reducing blood pressure and blood sugar in the elderly

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