

Comparison Of Buerger Allen Exercise With 3 Physical Therapy Modalities On The Value Of Ankle Brachial Index In Patients With Type II Diabetes Mellitus

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Abstract.

Hyperglycemia is one of the problems of people with Diabetes Mellitus, poorly controlled hyperglycemia conditions can cause complications, one of which is impaired peripheral vascular flow which can cause diabetic wounds. Vascularization disorders can be prevented by Buerger Allen Exercise therapy and 3 Physical Therapy Modalities to increase Ankle Brachial Index (ABI) values. The purpose of this study was to compare the effect of Buerger Allen Exercise and 3 Physical Therapy Modalities on ABI values in people with type II Diabetes Mellitus. The design of this study was Quasi Experiment Pre and post test two groups with 15 respondents of group A given Buerger Allen Exercise intervention and 15 respondents of group B given 3 Physical Therapy Modalities intervention. The results showed that there was an increase in ABI values after intervention in both groups with the difference in the Buerger Allen Exercise group increase of 0.050 while the Modalitas Physical Therapy group amounted to 0.113. In conclusion, there was an increase in ABI values in both groups after the intervention but group 3 Modalitas Physical Therapy had a higher increase. Intervention 3 Modalitas Physical Therapy can be recommended as one of the alternative therapies as a prevention of complications of peripheral arterial disease.

Keywords: 3Terapi Fisik Modalitas; Ankle Brachial Index; Buerger Allen Exercise and Diabetes Mellitus Tipe II.

I. INTRODUCTION

Diabetes mellitus has become a public health problem worldwide, especially in developing countries due to the high number of complications caused by the disease. Diabetes Mellitus is a chronic disease that requires continuous medical supervision, education and self-care as a prevention of complications (Tanto, 2014). The International Diabetes Federation (IDF), revealed that the prevalence of DM in the world in 2017 reached 425 million people. This prevalence has increased every year where in 2020 it will increase to 463 million people. The number of people with diabetes in Southeast Asia is 537 million people where Indonesia ranks 5th in the world, namely 19.47 million people, the United States 32.22 million people, Pakistan 32.96 million people, India 34.119 million people and Tiongkok 140.87 million people (IDF, 2021). Based on Basic Health Research data (Riskesdas, 2018), the prevalence of Diabetes Mellitus in Indonesia from 2013 has increased the number of patients with characteristics aged 15 years and over and has been diagnosed by a doctor from 1.5%, to 2.0% until 2018. Meanwhile, in West Sulawesi Province, the prevalence of Diabetes Mellitus patients from 0.6% in 2013 also increased to 1.5% until 2018. According to data from the Mamuju Regency Health Office, the number of Diabetes Mellitus patients in Mamuju Regency in 2020 was 1,996 people, this number has increased, the data shows that until November 2021 the number of Diabetes patients was 2,072 people (DHO Mamuju, 2021). As for the data from the Botteng Health Center, Simboro District, Mamuju Regency, the number of diabetes patients until December 2022 was 180 people, where previously the number of patients in 2021 was 82 people, a very significant difference in number comparison. Of the 180 patients with diabetes, there are around 22 people who have developed diabetic foot wound complications. Uncontrolled hyperglycemia conditions for a long time make Diabetes Mellitus patients vulnerable to the emergence of various diseases.

One of them is peripheral arterial disease which is closely related to blood flow circulation, this occurs due to viscosity, one of which is caused by the accumulation of excessive blood sugar levels that affect the function of blood platelets. Blood viscosity causes blood flow to be disrupted, causing a decrease

in blood flow perfusion to the lower extremities to carry nutrients and oxygen to nerve fibers, the impact of inadequate blood flow that carries the nutrients needed by the body so that the disease can cause diabetic ulcers and end in amputation (Black & Hawks, 2014). Peripheral circulation disorders can be detected by looking at the Ankle Brachial Index (ABI) value. ABI is a non-invasive examination of blood vessels that serves to detect signs and symptoms of peripheral blood vessels such as ischemia (AHA, 2014). ABI measurement is done by measuring the ratio of systolic pressure in the arm and measured by systolic pressure in the leg, the ABI value is calculated by dividing between systolic pressure in the arm and systolic pressure in the leg. ABI values > 1.0 are said to be good or normal and if < 0.91 are said to be at risk of peripheral circulation disorders. (Williams & Wilkins, 2012). Prevention of peripheral arterial disease can be done by modifying lifestyle and doing foot care (Iraj et al, 2013). According to research conducted by Sihombing, Nursiswati & Prawesti (2012), with the research title Overview of Foot Care and Foot Sensory Sensation in type II Diabetes Mellitus patients at the Diabetes Mellitus Polyclinic in 2012, concluded that regular foot care can reduce the risk of diabetic foot disease by 50-60%. Foot care is the primary prevention of diabetic ulcers such as foot cleaning wearing the right socks and doing foot exercises.

Foot exercise is a physical exercise for foot care that can be given to Diabetes Mellitus patients to prevent complications of peripheral arterial disease with the aim of improving peripheral circulation. The types of foot exercises such as Diabetic Foot Gymnastics, Yoga, Swimming, Cycling, and Buerger Allen Exercise. One of the foot exercises that is more effective, easy to learn and very cheap and has a low risk is the Buerger Allen Exercise. Chang (2015). Buerger Allen Exercise is a form of exercise or activity that involves lower extremity joint motion by stretching in all directions and providing a lower position on the extremities with changes in gravity so as to improve blood circulation in the legs (Ibrahim, 2020, Chang, 2015). The effectiveness of Buerger Allen Exercise performance is confirmed in Awinda's research (2019) which compares with Diabetic Foot Gymnastics on Ankle Brachial Index values, the results show that Buerger Allen Exercise is more effective in improving Ankle Brachial Index values compared to Diabetic Foot Gymnastics. In addition to Buerger Allen Exercise, one of the trendy and newly developed diabetic foot prevention today is 3 modality physical therapy. 3 Modalities Physical therapy is a foot treatment process using the exercise method to improve peripheral blood circulation in DM patients using 3 lower limb movements with a series of regular, directed, and planned tone movements carried out individually or in groups with the intention of increasing the functional ability of the body (Adelaida Mario et al 2013). This activity, in addition to improving peripheral blood flow, also makes patients feel comfortable and relaxed. In the research of Awalini et al (2021) explained that, 3 Physical Therapy Modalities are effective for improving peripheral blood circulation, the more routine the therapy is carried out, the better the peripheral blood circulation will be, of course, with the aim of preventing complications caused by peripheral arterial disease in Diabetes Mellitus patients. The effectiveness of 3 Modalities Physical Therapy is also confirmed in research (Adelaida Mario et al 2013), the results show that in substance it can be said that the group that received the therapy experienced an increase in the value of the Ankle Brachial Index..

II. METHODS

This research is a quantitative approach that uses a pre and post-test two groups quasi-experiment design. This study aims to determine the comparison between Buerger Allen Exercise and 3 Physical Therapy Modalities on Ankle Brachial Index (ABI) values. Intervention in this study was carried out in two groups. Intervention group A was given Buerger Allen Exercise treatment and group B was given 3 Physical Therapy Modalities. The population in this study were all patients with diabetes mellitus who were in the working area of Botteng Health Center, Simboro District, Mamuju Regency SUL-BAR as many as 250 people. The research sample was type II Diabetes Mellitus patients who were taken randomly, the number of samples used was 15 respondents who were included in intervention A (given Buerger Allen Exercise) and 15 respondents who were included in intervention B (3 Physical Therapy Modalities). This study was conducted in Salletto Village with the consideration that Salletto Village has the highest coverage of Diabetes Mellitus patients among other villages in the Botteng Puskesmas working area, making it possible to obtain samples according to the inclusion criteria.

This research was carried out starting from research preparation and proposal submission on 01 August 2023 to 05 September 2023, and data collection was carried out in less than a month, namely from 18 September to 16 October 2023. In this study, the process of collecting and collecting data was obtained with a characteristic questionnaire and ABI measurement observation sheet. The tools used in measuring ABI are Vascular Doppler Ultrasound Probe and Sphygmomanometer. The variables in this study are independent variables (free), namely Buerger Allen Exercise and 3 Physical Therapy Modalities, the dependent variable (bound) is ABI, confounding (confounding) consisting of: age, smoking history, history of hypertension and duration of DM. The data collection process was carried out for 25 consecutive days, in both intervention groups, before the intervention was carried out, the ABI value was first measured, then measured again on the 5th day after the intervention. Data analysis was carried out univariate, bivariate. using the T test which was previously carried out normality test with shapiro wilk test.

III. RESULT AND DISCUSSION

1. Respondent Characteristics

Table 1. Distribution of respondents based on age, smoking history, history of hypertension, and length of suffering in Diabetes Mellitus patients in the Botteng Health Center working area, Salletto Village September-October 2023 (n=30).

Variabel	<i>Buerger Allen Exercise</i>		3 Physical Therapy Modalities	
	F	(%)	F	(%)
Age				
≤ 44	2	13.3	2	13.3
45-59	6	40.0	7	46.7
>60	7	46.7	6	40.0
Smoking History				
Yes	7	46.7	6	40.0
No	8	53.3	9	60.0
History of Hypertension				
Yes	6	40.0	2	13.3
No	9	60.0	13	86.7
Duration of DM				
≤ 10 Year	6	40.0	7	46.7
>10 Year	9	60.0	8	53.3

Based on the table above, it shows that the age characteristics of the two groups have almost the same variation, but the Buerger Allen Exercise group has the highest age category, namely > 60 years, while in the 3 Modalities Physical Therapy group the most age category is 45-59 years, as seen from the characteristics with a history of smoking, the Buerger Allen Exercise group has a variation that has a higher smoking history compared to 3 Modalities Physical Therapy. Likewise, when viewed in the history of hypertension where the Buerger Allen Exercise group has a higher history of hypertension compared to 3 Modalitas Physical Therapy. and in the characteristics of respondents with a long time suffering from Diabetes Mellitus, the Buerger Allen Exercise group has a higher variation of >10 years of suffering from Diabetes mellitus while 3 Modalitas Physical Therapy. most ≤10 Years of Suffering from Diabetes Mellitus.

2. Average Ankle Brachial Index values before and after intervention in the Buerge Allen Exercise and 3 Modalitas Physical Therapy

Table 2. Distribution of mean ABI values in Diabetes Mellitus patients before and after the intervention in both groups at the Botteng Health Center work area, Salletto Village September-October (n=30).

Variabel	<i>Buerger Allen Exercise</i>			3 Physical Therapy Modalities		
	Mean	Min-Maks	CI	Mean	Min-Maks	CI
Pre	0,870	(0,67-0,89)	0,8114 – 0,8753	0,847	(0,78-0,90)	0,8265 - 0,8682
Post	0,920	(0,72-0,96)	0,8715 – 0,9338	0,960	(0,83-1,0)	0,9213 – 0,9733

Based on the table above, it shows that there is an increase in ABI values after the intervention in both groups.

3. Difference in Ankle Brachial Index values before and after Buerger Allen Exercise intervention

Table 3. Changes in ABI values of patients with diabetes mellitus in the Buerger Allen Exercise group in the Botteng Health Center working area, Salletto Village September-October 2023 (n=30).

Group	Measurement Ankle Brachial Index		P
	Mean	SD	
Before (15)	0.870	0.057	0.001
After (15)	0.920	0.056	

Based on the table above, it is found that the ABI value after the intervention has increased the ABI value and seen from the p value it can be concluded that there is an effect of Buerger Allen Exercise on ABI values in Diabetes Mellitus patients.

4. Difference in Ankle Brachial Index values before and after intervention 3 Physical Therapy Modalitas

Table 4. Changes in ABI values of Diabetes Mellitus patients on 3 Physical Therapy Modalitas in the work area of Botteng Health Center, Salletto Village September-October 2023 (n=30)

Group	Measurement Ankle Brachial Index		p
	Mean	SD	
Before (15)	0.847	0.377	0.001
After (15)	0.960	0.469	

Based on the table above, it is found that the ABI value after the intervention has increased the ABI value and seen from the p value it can be concluded that there is an effect of 3 Modalitas Physical Therapy on ABI values in Diabetes Mellitus patients.

5. The difference in Ankle Brachial Index values in the Buerger Allen Exercise and 3 Modalitas Physical Therapy groups after the intervention.

Table 5. Changes in ABI values of Diabetes Mellitus patients in the Buerger Allen Exercise group and 3 Modalitas Physical Therapy in the Botteng Health Center work area, Salletto Village September-October (n = 30).

Group	Comparison of mean ABI values		
	Selisih Mean	SD	p
<i>Buerger Allen Exercise</i> (15)	0.050	0,029	0,006
3 Modalitas Physical Therapy (15)	0,113	0,043	
Jumlah Selisih	0,063		

Based on the table above, it was found that the average difference in ABI values after intervention in the Buerger Allen Exercise group was 0.050 while the average difference in ABI values after intervention in the 3 Modalitas Physical Therapy group was 0.113. The statistical results of the unpaired T test (Mann Whitney Test) for the value ($p = 0.006 < \alpha = 0.05$), it can be concluded that the intervention of Buerger Allen Exercise and 3 Modalitas Physical Therapy are equally effective for increasing ABI values in Type II Diabetes Mellitus patients but in the 3 Modalitas Physical Therapy group has an average difference in increasing ABI values higher than the Buerger Allen Exercise group, namely with an average difference of 0.063.

DISCUSSION

1. Respondent Characteristics

a. Age

The results showed that the age characteristics of the two groups had almost the same variation but the Buerger Allen Exercise group had the most age with the category >60 years while in the group of 3 Modalitas Physical Therapy the most age category was 45-59 years. According to ACCF /AHA (2013) old age is the main risk factor for someone suffering from PAP (a condition of narrowing arteries that causes blood flow to be disrupted, especially towards the lower limbs). The risk of PAP increases with age, from 3% in patients <60 years old to 20% in patients >75 years old and is also found in patients ≤50 years old, but

the number of cases is very small. The relationship between age and PAP reflects the longer duration of exposure to atherogenic factors along with the cumulative effects of aging on blood vessels. Proses penuaan secara alami menyebabkan pembuluh darah pada usia tua lebih rentan mengalami aterosklerosis sehingga menyebabkan disorders in the peripheral circulation. Inflammatory cells, endothelial cells and vascular smooth muscle cells in old age are different than cells at a young age, this is supported by Simatupang's research (2013) which found that people with older age had a risk of 1.881 times to suffer from PAP.

b. Smoking History

The results of data analysis seen from the characteristics with a history of smoking the Buerger Allen Exercise group had a higher smoking history compared to 3 Physical Therapy Modalitas. This can affect the average results of increasing ABI values because smoking history has an influence on decreasing ABI values. Smoking habits in Diabetes Mellitus patients can worsen the prognosis of the disease because various toxins in the content of cigarettes can decrease insulin secretion and can cause peripheral arterial disease. Free radicals in cigarettes will trigger a decrease in endothelial function. As a result of this decrease in function, inflammatory cells, platelets, and LDL will easily adhere to the blood vessel wall so that it can form plaques in blood vessels and cause atherosclerosis Black & Hawks, 2014).

c. History of Hypertension

The results showed that the Buerger Allen Exercise group had a higher history of hypertension compared to 3 Modalitas Physical Therapy. In this study, the history of hypertension. This can also affect the average increase in ABI values because a history of hypertension has an influence on decreasing ABI values and indicates a disturbance in peripheral vascularization Black & Hawks, 2014). Hypertension can also affect the incidence of peripheral arterial disease through its role in the process of arteriosclerosis. High blood pressure can also cause arteries to dilate and overstretch, resulting in endothelial injury. Endothelial dysfunction leads to abnormal vascular smooth muscle tone, vascular smooth muscle cell proliferation, impaired coagulation and fibrinolysis and persistent inflammation. Endothelial dysfunction and damage and arteriosclerosis will result in impaired peripheral vascularization (Black & Hawks, 2014).

d. Duration of Diabetes Mellitus

The results showed that in the characteristics of respondents with a long time suffering from Diabetes Mellitus, the Buerger Allen Exercise group had a higher variation with the category >10 years suffering from Diabetes mellitus while the 3 Modalitas Physical Therapy had the most ≤10 years suffering from Diabetes Mellitus. The length of time a person experiences Diabetes Mellitus can increase the risk of complications of Diabetes Mellitus, one of which is the inhibition of peripheral vascularization so that it can reduce ABI values, and result in diabetic ulcers (Brunner & Suddarth, 2013). Long increases in blood sugar levels result in damage to the lumen of the blood vessels. Damage to the lumen of the blood vessels will affect peripheral circulation. Hyperglycemia for a long time will cause a buildup of glucose levels in certain cells and tissues which are then converted into sorbitol which is the cause of damage and changes in cell function. Sorbitol metabolizes slowly, then added to the formation of Advanced Glycation End Products (AGEs). AGEs are substances that cannot be metabolized further so that they accumulate in the blood vessel wall and cause atherosclerosis which causes vascular disorders so that peripheral circulation is disrupted (Black & Hawks, 2014).

2. Differences in Ankle Brachial Index values before and after intervention in the Buerger Allen Exercise group

The average ABI value before intervention in the Buerger Allen Exercise group was 0.870 while the average ABI after Buerger Allen Exercise intervention was 0.920. The statistical results of the unpaired T test (Wilcoxon) for the value of $P = 0.001$ ($P < 0.05$). So it can be concluded that there is a significant difference between the ABI values before and after the Buerger Allen Exercise treatment. Buerger Allen Exercise is a combination of postural changes (45° foot elevation, foot drop, and supine sleep) and muscle pumps on the ankle, namely dorsiflexion and plantarflexion (Chang, 2015). 45° foot elevation is a position setting where the lower limbs are set in a position higher than the heart. This condition is an attempt to create a pressure difference between the toe and the heart. Blood in the blood vessels is like a liquid that flows from a higher place to a lower place so that if the foot is elevated there will be an increase in venous return from the tip of the foot or lower leg to the heart while the arterial blood flow that will be distributed to the lower limbs the pressure will decrease and the flow will slow down (Guyton, 2012). Positioning the foot elevation

will cause emptying of blood flow in the veins in the lower limbs. In addition, if the amount of blood flowing to the heart increases, it will cause the walls of the heart chambers to stretch so that the muscles contract more strongly, therefore all additional blood returning to the heart will be pumped back into the circulation automatically. During the process of lowering the legs and kaki menjuntai kebawah lebih rendah daripada jantung maka darah yang dibawa oleh pembuluh darah arteri akan mengalir dengan cepat dari tekanan tinggi ke rendah yaitu dari jantung ke tungkai bawah dan akan filling the flow in the blood vessels so that blood flow to the ends of the feet or lower legs will increase. Making changes in gravity will affect the distribution of fluids in the body by helping alternately to empty and fill the blood column, which can improve blood transportation through blood vessels (Sherwood, 2016). After that, the supine position is a position that aligns the body, playing an important role in the balance of blood circulation so that it does not gather at one point.

3. Differences in Ankle Brachial Index values before and after intervention in group 3 Physical Therapy Modalitas

The results of the analysis showed that the average value of ABI before intervention in group 3 of Modalitas Physical Therapy was 0.847 while the average ABI after intervention 3 of Modalitas Physical Therapy was 0.960. The statistical results of the unpaired T test (Wilcoxon) for the value of $P = 0.001$ ($P < 0.05$) So it can be concluded that there is a significant difference between the ABI values before and after being given the Modalitas Physical Therapy treatment. Modalitas Physical Therapy is a therapy used in Diabetes Mellitus patients to avoid and treat complications of peripheral arterial disease, this therapy thoroughly starts from the movement of Foot Gymnastics, cleansing with foot soaks (skin Clensing), and foot massage, Purwanto (2014). Stages of the implementation of 3 Modalitas Physical Therapy such as foot exercises, cleansing with foot soaks using warm water and foot massage provide many benefits..A set of movements, one of which is dorsiflexion and plantarflexion, has the effect of stimulating blood vessel endothelial cells. Actively moving the skeletal muscles causes the muscles to press on the blood vessels so as to stimulate the vascular endothelium and relaxation occurs, the blood vessels will vasodilate so that blood flow to the peripheral feet becomes smooth (Purnawarman & Nurkholis, 2014).

4. The difference in the results of the average difference in Ankle Brachial Index values before and after intervention in the Buerger Allen Exercise group and 3 Physical Therapy Modalitas

Based on the results of the two measurement groups, it can be concluded that the intervention of Buerger Allen Exercise and 3 Modalitas Physical Therapy is equally effective to increase ABI values in Type II Diabetes Mellitus patients. Buerger Allen Exercise and 3 Modalitas Physical Therapy can be an alternative therapy as a prevention and rehabilitation effort for Type II Diabetes Mellitus patients who are at risk of suffering from lower limb peripheral vascularization disorders or who have been diagnosed. However, in the 3 Modalitas Physical Therapy group, the average difference in the increase in ABI value is higher than the Buerger Allen Exercise group where the average difference in ABI value in the Buerger Allen Exercise group is 0.050 while the average difference in ABI value in the 3 Modalitas Physical Therapy group is 0.113, which means that the difference in the average value between the two groups is 0.063 according to the data obtained during the study. According to the researcher's analysis. 3 Modalitas Physical Therapy is proven to be able to increase ABI values higher due to differences in the mechanism of the treatment given where 3 Modalitas Physical Therapy is a combined exercise of diabetic foot exercise therapy, foot soak with warm water and foot massage therapy while Buerger Allen Exercise is only done with muscle pumps (dorsiflexion and plantarflexion) and changes in gravity (45 ° foot elevation, foot drop, supine sleep) which of course there are differences in endothelial stimulation for vasodilation of blood vessels. In addition, it can also be caused by differences in characteristics in the Buerger Allen Exercise group with the 3 Modalitas Physical Therapy group where respondents in the Buerger Allen Exercise group had a higher average age, smoking history, history of hypertension, and duration of Diabetes Mellitus than in the 3 Modalitas Physical Therapy group.

IV. CONCLUSIONS

Based on the results of the study, the conclusions obtained are as follows:

1. The characteristics of respondents based on age who have the highest percentage value with the age category > 60 years is the Buerger Allen Exercise group, as well as respondents who have a history of smoking where the Buerger Allen Exercise group has more presentations than 3 Modalitas Physical Therapy, as for respondents who have a history of hypertension is also higher in the Buerger Allen Exercise group and respondents with the characteristics of the longest suffering from Diabetes Mellitus with the most categories > 10 years also in the Bueuger Allen Exercise group.
2. There is an increase in the average ABI value after the Buerger Allen Exercise intervention.
3. There is an increase in the mean value of ABI after the intervention of 3 Modalitas Physical Therapy
4. Buerger Allen Exercise and 3 Modalitas Physical Therapy are equally effective in increasing ABI values, but judging from the difference in the average value of intervention 3 Modalitas Physical Therapy has a higher average difference than Buerger Allen Exercise.

ADVICE

1. For Nursing Services

Buerger Allen Exercise Therapy and 3 Modalitas Physical Therapy can be used as one of the nursing interventions in Type II Diabetes Melitsus patients as a preventive measure for peripheral blood circulation disorders of the feet. However, to carry out the intervention of Buerger Allen Exercise and 3 Modalitas Physical Therapy, the implementing nurse must be able to carry it out correctly so that improvement and skills are needed in the implementation of these interventions. In addition, the intervention of Buerger Allen Exercise and 3 Physical Therapy Modalitas can be used as Standard Operating Procedures in nursing care for the prevention of peripheral arterial diseases that mostly attack the lower limbs.

2. For Nursing Education

The intervention of Buerger Allen Exercise and 3 Physical Therapy Modalitas is considered as evidence based practice to be used as material taught to students. The results of this study are expected to be used as a new source of knowledge or reference for educators and students so that they can add insight in terms of independent nursing interventions.

3. For Future Researchers

It is hoped that the confounding variables can be studied in depth, then interpreted so that the attachment between the results and related literature can be known in influencing ABI values, then analyze which factors have the most influence on ABI values so that they can proceed to multivariate analysis.

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