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The Effect of Buerger Allen Exercise on The Lower Extremity Peripheral Circulation in Type 2 Diabetic Patients

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ABSTRACT
Prolonged elevated blood glucose levels leads to chronic microvascular complications, neuropathy complications and lower extremity peripheral circulation disorders. Actions that can be taken care in non-pharmacological that is Buerger Allen exercise.
To determine the effect of Buerger Allen Exercise in lower limb peripheral circulation in diabetes mellitus patients.
Study used a quantitative method with a pre-experimental design using a pre-post test without control group. Sampling technique is non-probability sampling with accidental sampling approach is obtained 5 respondents.
The Wilcoxon Signed Rank Test results of the ABI value in the right limb are 0.043 or p <0.05 and the ABI value on the left limb are 0.025 or p <0.05.
Buerger Allen Exercise is effective in improving peripheral circulation of the lower extremities and is an alternative for repairing impaired tissue perfusion in diabetic feet. Future research can examine the most appropriate frequency and duration.

Keywords: Buerger Allen Exercise, Lower Extremity Peripheral Circulation, Type 2 Diabetes Mellitus

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BACKGROUND

Diabetes mellitus is now an increasingly hot phenomenon issue. This health problem is caused by the increasing prevalence of patients each year. Diabetes mellitus is part of the target for handling the World Leaders in 2030.The Agenda for the Political Declaration on The Prevention on Control of NDCs states that diabetes mellitus is one of the priorities for serious non-communicable diseases and must be addressed (United Nations, 2011). Global data released by the World Health Organization (WHO) shows diabetes mellitus is the seventh leading cause of death in the world in 2016 and it is predicted that around 1.6 million people will experience death from this disease before the age of 70 (WHO, 2021). In line with International Diabetes Federation (IDF) (2017) every seven seconds an individual dies in the range of 4 million people per year under the age of 60 worldwide.

Along with the increase in cases of death in the world, data released by IDF states that the prevalence of diabetes mellitus is increasing from year to year. IDF recorded that as many as 151 million people in the world or with a prevalence of 4.6% suffering from diabetes mellitus, in 2018. Patients with this disease then increased to 463 million people with a prevalence of 9.3% by 2019. IDF predicts an increase in prevalence towards 10.2% or 578 million people in the world will suffer from diabetes in 2030 (IDF, 2019). The prevalence will continue to increase by around 10.9% in 2045 with a total increase of 51% from the data released in the previous year (WHO, 2021)(IDF, 2019) .

Southeast Asia has a prevalence of around 8.8% which is equivalent to 87.6 million people and 56.7% of cases were undiagnosed. This casean increase of 74% with a death rate of 1.2 million people in 2019. This figure will increase by 115 million in 2030 and will reach 153 million in 2045 (IDF, 2017). Countries in Southeast Asia that have the highest number of diabetes mellitus patients include Laos, Cambodia, Myanmar and Indonesia (Kemenkes RI, 2018b). According to the Ministry of Health of the Republic of Indonesia, which comes from the Basic Health Research (Riskesdas) in 2018, it states that diabetes mellitus is one of the non-communicable diseases (PTM), the number four cause of death in Indonesia. There is an increase in the prevalence of the population of diabetes patients in Indonesia compared to 2013 (Kemenkes RI, 2018a).

Makassar City is one of the most populous cities in Indonesia. Makassar ranks second as the area with the highest prevalence of diabetes mellitus based on symptoms. The diabetes mellitus rate based on a doctor's diagnosis in the Makassar region is 5.3%, higher among several other areas in the province of South Sulawesi. The death rate due to diabetes mellitus is 811 cases (Dinkes Sulsel, 2015). The latest data that has been reported by the Eradication of Non-Communicable Diseases from the Health Office of South Sulawesi Province which comes from surveillance results, found 27,252 new cases of diabetes mellitus. The incidence rate in 2018 was found in 46 puskesmas. This disease ranks fifth as the most common disease found in all age groups in Makassar City. The total incidence rate in 2018 was 31,284 cases with varying hospitalization rates in each hospital throughout Makassar City (Dinkes Sulsel, 2018).

Diabetes mellitus is a metabolic disorder characterized by an increase in blood glucose due to impaired insulin production or the body's resistance to this hormone. Increased blood glucose levels over a long period of time lead to chronic microvascular complications and neuropathic complications. If this disease is not treated further, it can lead to myocardial infarction, stroke, and peripheral artery disease (Mellisha, 2016). Peripheral circulation disorders can be suffered by people with diabetes mellitus with a 15% chance of experiencing the risk of ulcers throughout their life, in line with sufferers whose prevalence continues to increase every year (Lee et al., 2013). With data on the increasing prevalence

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of diabetes mellitus cases and increasing cases of lower limb peripheral circulation disorders, further treatment is needed. There are several actions that can be taken in the management of diabetic feet, namely by taking preventive measures and rehabilitative measures (Hasnah & Sau, 2018).

Rehabilitative measures are usually performed on patients who have suffered diabetic foot wounds. Actions that can be done in the treatment of diabetic foot are evaluation of ulcers, metabolic control, debriment of wounds, use of appropriate antibiotics, germ culture, and surgery. Meanwhile, preventive measures that can be taken with one of the goals are to accelerate the lower extremity peripheral circulation of diabetes mellitus patients, including health education about foot care, use of diabetic foot shoes, diabetic foot exercises, foot mobility exercises, and the Buerger Allen Exercise (Hasnah & Sau, 2018).

Buerger Allen Exercise is an exercise that can be done for diabetes mellitus patients to improve peripheral circulation of the lower extremities and prevent the occurrence of diabetic foot injuries for patients who have not experienced injuries to the extremities or for patients who have poor extremity circulation levels (Hasnah & Sau, 2018). Buerger allen exercise is important to do, because it can improve circulation and blood circulation to the peripheral areas of the extremities which is very effective in preventing obstruction of blood vessels, preventing foot wounds and accelerating the healing process of diabetic foot wounds so that amputation and death rates from diabetes mellitus can decrease. In addition, the Buerger Allen training is also easy to do in a relatively short amount of time (Hasan et al., 2016).

The work area of the health center which is the location of the study shows some patient handling and diabetic foot care, which includes education on the management of diabetes mellitus management independently and administering drugs regularly. The phenomenon found by researchers at the research location is quite concerning. Based on interviews conducted by researchers with posyandu cadres and type 2 diabetes mellitus patients in the work area of the Samata Community Health Center for non-pharmacological treatment, in the form of exercises to improve peripheral circulation to reduce the risk of ulcers or other problems in the legs, none of these have been given to patients. In addition, the number of type 2 diabetes mellitus patients in this area is quite high compared to several other districts in Gowa Regency.

This phenomenon is one of the causes and the urgency of being able to do leg exercises to smooth the circulation of the extremities, namely the buerger allen exercise. It is intended that the long-term adverse effects, in the form of the possibility of limb injury, disability, amputation, and mortality, can be minimized in patients with diabetes mellitus. If preventive measures are not carried out, then the threat of diabetic foot injuries caused by lower extremity peripheral circulation disorders, even to the point of death will increase as well. In addition, the Buerger Allen Exercise is also not yet popular in the community, so it is a very strong reason for this problem, to be used as research material.

Based on the various data that have been described, related problems, and previous studies, the aim of this study was to examine the effect of the Buerger Allen Exercise on the lower extremity peripheral circulation of patients with type 2 diabetes mellitus.

Background provides the state of the art of the study and consists of an adequate background, the previous researches and significance of the study to show the scientific merit or novelties of the paper. Avoid the use of literature review or a summary of the results. Objective states the major aim of the study.

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METHODS

1. Design and samples
   The research method used is a quantitative method with a pre-experimental research design using the prepost test approach without control group. This research was conducted to see the effect of the Buerger Allen Exercise on respondents who had type 2 diabetes mellitus. This research was conducted at the Samata Health Center, Romang Polong Village, Somba Opu District, Gowa Regency. This research was conducted during August 2020. The population in this study were individuals with type 2 diabetes mellitus who were recorded in the Samata Public Health Center. The sampling technique used in this study is non-probability sampling with an accidental sampling approach based on the number of patients who visited the study site at the health center. The sample in this study were 5 respondents.
   a. Inclusion criteria
      1) Patients with type 2 diabetes mellitus for 1-10 years
      2) Have a family who can accompany you during training.
      3) 35-69 years old
      4) Do not have diabetic foot wounds.
      5) Do not have dangerous complications of acute or chronic diseases.
      6) Active in physical movement
      7) Communicative and understand the research flow
   b. Exclusion criteria
      1) Refusing to participate is the object of research.
      2) Experiencing a situation that interferes with the ability to carry out exercises such as diabetic foot injuries and limited movement.
      3) Have a smoking habit.
      4) Currently undergoing a treatment program for type 2 diabetes mellitus.
      5) Has minor complications and major complications, such as Diabetic Kidney Disease
      6) Are depressed, worried, or anxious.
2. Research instrument and data collection
   The types of instruments used are aneroid Sphignomanometer or tension meter and the Vasculer Dopler Ultrasound probe. The research data were obtained through the measurement results of the ankel brachial index before being given the Buerger Allen Exercise treatment and the measurement results of the ankel brachial index after being given the Buerger Allen Exercise treatment.
3. Data analysis
   This study used the Spearman statistical test formula to determine whether there is a difference or relationship between variables with a numerical scale.

RESULTS

1. Characteristics of Respondents

Based on table 1 on the characteristics of the respondents below, it can be seen that the respondents aged 41-50 years were 2 people (40%), respondents aged 51-60 years were 2 people (40%). Based on gender characteristics, it can be seen that the majority of respondents are female as many as 4 people (80%). Based on the characteristics of education, it can be seen that the respondents are dominated elementary school by 2 people (40%). Based on the characteristics of the job, it can be seen that the respondents are dominated by housewives as many as 3 people (60%). Finally, the characteristics of

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the length of time diagnosed with DM from the most respondents who were diagnosed for 1-5 years (80%) were 4 people.

Table 1
Characteristics of Respondents, n = 5 Respondents

Variable	Frequency (n)	Percentage (n)
Age		
41-50 years	2	40.0
51-60 years	2	40.0
> 60 years	1	20.0
Gender		
Man	1	20.0
Women	4	80.0
Education		
SD	2	40.0
Junior High	1	20.0
High school	1	20.0
Diploma	1	20.0
Profession		
entrepreneur	2	40.0
Housewife	3	60.0
Long diagnosed with DM		
1-5 years	4	80.0
> 5 years	1	20.0

2. The Effect of the Buerger Allen Exercise on Peripheral Circulation

Bivariate analysis was used to determine the effect of independent variables on the dependent variable or the effect of Buerger Allen Exercise on lower limb peripheral circulation in patients with type 2 diabetes mellitus as indicated by a p value <0.05. The normality test using the Shapiro Wilk Test shows an abnormal distribution of data on the pre and post measurement results of the right limb ABI value so that the Wilcoxon Test is used and shows normal data distribution on the pre and post measurement results of the left limb ABI value, so the Paired T test is used -Test. The following shows the effect of the Buerger Allen Exercise on the peripheral circulation of the right extremities in patients with type 2 diabetes mellitus.

Based on the Wilcoxon Signed Rank Test on the ABI value of the right extremity pre and post test on 5 respondents, the p value is 0.043 <0.05. This shows a significant difference in the peripheral circulation of the right lower limb which is indicated by an increase in the ABI value in patients with type 2 diabetes mellitus before and after the intervention. Intervention on the left lower limb, which was then carried out by the T-Paired Test on the ABI value of 5 respondents, the p value was 0.025 <0.05. This shows that there is a significant difference in the peripheral circulation of the left lower limb which is indicated by an increase in the ABI value of type 2 diabetes mellitus patients before and after the intervention.

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Table 2
Distribution of the Effect of Buerger Allen Exercise on Dextra (Right / Right) and Sinistra (Left / Left) Peripheral Circulation in Type 2 Diabetes Mellitus Patients in the Working Area of the Samata Health Center

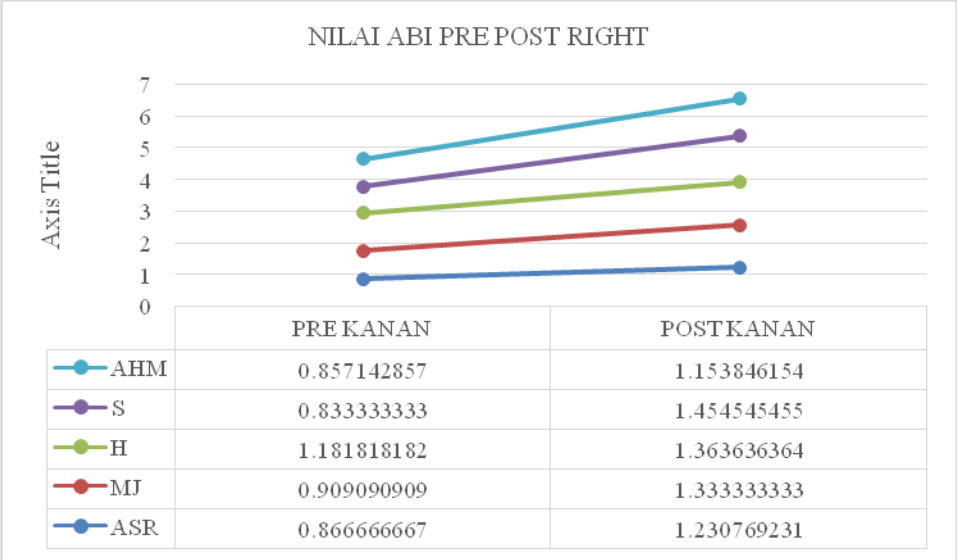
ABI value	*Pre Test*		*Post Test*		Difference in Mean	P
	Mean	SD	Mean	SD		
Dextra Peripheral Circulation	0.9296	0.14362	1,3072	0.11719	-0.3776	0.043
Sinistra Peripheral Circulation	0.8768	0.25367	1,2478	0.10922	-0.371	0.025

Source: Primary Data 2020

Based on the research results that have been presented in table 2 above, it can be seen that there are different results in the mean value of the pre-test and post-test results of the measurement of the peripheral circulation of the right and left limbs after giving the Buerger Alllen exercise. The treatment given for 6 times to the respondent, by conducting a pre-test measuring the ABI value in the first intervention and post-test at the 6th time at the end of the intervention, the resulting mean difference in the results of both. It can be seen that the mean ABI value on the right limb pre-test is 0.9296. Whereas the average ABI value on the right limb post test was 1.3072 with an average difference of -0.3776.

Based on the results of picture 1 below, it can be seen that the trend of changes in the ABI value of the right limb in respondents is compared between the first measurement as a pre test and the last measurement as a post test. There was a significant change, in which all respondents experienced a significant change in the value or ABI score which showed an increase in the peripheral circulation of the right limb in patients with type 2 diabetes mellitus.

Picture 1
I. Trend of Change in Right Extremity ABI Value in Measurements 1 and 6



Based on the results of picture 2 below, it can be seen that the trend of changes in the ABI value of the left limb in respondents is compared between the first measurement as a pre test and the last measurement as a post test. There was a significant change, in which all respondents experienced a significant change in the ABI score or score which showed an increase in left limb peripheral circulation in patients with type 2 diabetes mellitus.

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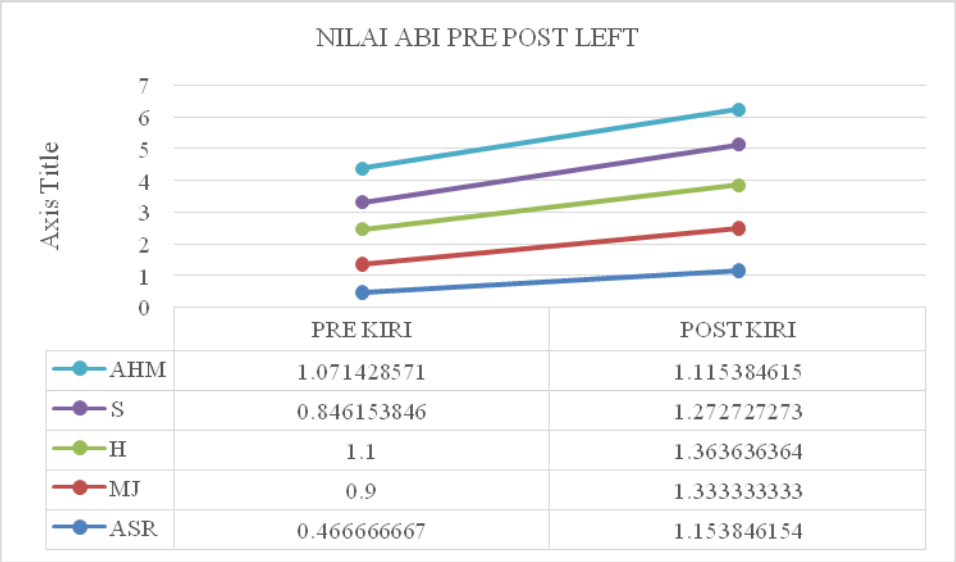
Picture 2
Trend of Change in Left Extremity ABI Value in Measurements 1 and 6



	PRE KIRI	POST KIRI
AHM	1.071428571	1.115384615
S	0.846153846	1.272727273
H	1.1	1.363636364
MJ	0.9	1.333333333
ASR	0.466666667	1.153846154

DISCUSSION

Based on picture 1 and picture 2 regarding the trend of changes in the ABI value of the right and left limbs in measurements 1 and 6 (pre and post test), it can be seen that there is an increasing trend in ABI values from pre test to post test. The results showed a positive value, both on the ABI value of the left limb and the ABI value of the right limb.This is also in accordance with research which has been done by Supriyadi et al., (2018) who provided BAE intervention for 15 days by pre-test by measuring before the 1st day of training and the post-test on the 15th day with the results of the study in the form of a significant increase in ABI values as a positive effect of BAE training.

The results of the analysis of several references gave birth to facts which are supported by several research results that have been investigated by researchers. Research that has been carried out by Chang et al., (2015) states that Buerger exercise can improve ABI values, improve health, and symptoms of discomfort in the lower extremities. In line with research conducted by John & Rathiga, (2015) which aims to see the level of perfusion of the lower extremities of patients with diabetes mellitus and the effect of Buerger Allen Exercise in improving the low peripheral perfusion. The results of his research showed that after the intervention was carried out, the intervention group experienced a significant change in the ABI value after leg exercises, compared to before the intervention was given.

The theory put forward by Rosales-Velderrain et al., (2013) mentioned that BAE therapy can be done to improve peripheral circulation in the vascular vessels. This is supported by research published by C. C. Chang et al., (2016) that the Buerger Allen Exercise significantly increases the level of peripheral perfusion pressure in diabetes mellitus patients who experience ischemia in the blood vessels of the extremities which causes interference with the peripheral circulation of the lower extremities, both in patients with diabetic foot injuries and those without diabetic foot injuries.

Looking at the research results obtained through the description above, the researchers saw that the Buerger Allen Exercise has been shown to significantly improve lower limb peripheral circulation with an indicator of an improved ABI value. The results obtained from the study as a whole show that BAE exercise is evidence-based practice

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proven to improve and improve lower limb peripheral circulation through good results from measurement of the ABI indicator. The Buerger Allen Exercise stimulates increased peripheral circulation through regular, continuous movements of the foot of dorsiflexion and plantarflexion. Dorsiflexion is carried out by moving the soles of the feet upward.

The increase in tissue perfusion through BAE exercises is caused by postural changes, with the modulation of the force of gravity and the application of muscle contraction can increase the perfusion of the lower extremities and help in the circulation mechanism and dilation of blood vessels, causing smooth blood circulation to the lower limb area. BAE exercises modulate muscle pump performance. Muscle pump is a pumping mechanism to the muscles, which functions to increase blood circulation through a process in the form of moving the areas and blood vessels that flow especially in the extremities to become smooth, so that blood flow to the heart and to the rest of the body also increases (Jannaim, 2018).

Furthermore, in the results of C. C. Chang et al., (2016) stated that in the first stage of BAE training, gravity causes the emptying of the veins and increases the flow of the right atrium, which in turn causes an increase in cardiac output. The second stage, gravity still plays an important role in increasing blood flow in the arterioles. Changes in leg movement also strengthen distal circulation due to increased muscle contraction. Flexion of the dorsaplantar also helps the patient to train the Achilles tendon to avoid the name contracture or joint stiffness that causes deformity of the leg. And the final stage of the exercise is lying in a supine position which can improve blood flow or reperfusion from the leg as the effects of gravity begin to wear off.

The movement of blood caused by this form of leg movement can help run the pumping mechanism of the limb muscles, increase peripheral circulation, which manifests as an increase in the ABI value measured by the Doppler device, an increase in HbO2 and HbT concentrations through NIRS measurements and a shortening of the CRT time. In addition, this smooth pumping of blood will help in curing diabetic ulcers, reducing the degree of edema, due to the effect of smooth circulation, oxygenation and nutrition towards the periphery (increased vascularization (Jannaim, 2018).

Limitations

The limitation in this study is the lack of respondents who are involved in the study of Buerger Ellen exercise, due to the COVID-19 pandemic conditions. Researchers find it difficult to find potential respondents at the Samata Health Center. Only a small proportion of type 2 diabetes mellitus patients in the working area of the Samata Community Health Center were able to participate in the study.

CONCLUSION

The study concluded that there was an effect of Buerger Allen Exercise on the peripheral circulation of the lower extremities in patients with type 2 diabetes mellitus using the Wilcoxon Signed Rank Test and Paired T-Test where the p value was obtained, 0.05, which means that there was a significant effect. The results of this study can be used as a reference in providing intervention and nursing care for diabetes mellitus patients who have problems with lower limb peripheral circulation, namely by applying the Buerger Allen Exercise as a non-pharmacological intervention with evidence based practice.

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CONFLICTS OF INTEREST
There is no conflicts of interest in this study

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