



Original Article

The Importance of Exercise: Effectiveness of Buerger Allen Exercise in Improving Lower Extremity Peripheral Circulation and Perfusion in Patients with Type II Diabetes Mellitus

¹Nani Asna Dewi, ¹Hayyu Naafi Hidayanti, ¹Nur Endah Rakhmawati, ¹Sri Agustin Tabara, ¹Lisnadyanti, ²Yani Kurniawan, ³Deni Heriyanto

¹ Nursing Program Study, Institut Kesehatan Hermina, Indonesia

² Internal Medicine Department, Hermina Hospital, Depok, Indonesia

³ Emergency Department, Hermina Hospital, Jatinegara, Depok

E-mail Corresponding: naniasnadewi@gmail.com

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ABSTRACT

Background: Type 2 diabetes mellitus can cause venous and arterial blood circulation disorders. Buerger Allen Exercise (BAE) is a modality therapy that uses active posture movements. This study aimed to assess the effect of BAE on increasing the Ankle Brachial Index (ABI) value.

Methods: This study used a pre-experimental, pretest and posttest design. Sampling was carried out using consecutive sampling techniques of 54 respondents with type 2 DM. The Wilcoxon test was performed to analyze the data. Measurement of ABI values was carried out to assess increased blood circulation in the legs. BAE exercises were carried out 2 times a day with a duration of 10 to 15 minutes for 3 days. In the intervention group and the control group.

Results: The results showed that there was a significant difference between before and after the intervention with a p value of 0.001 ($p < 0.005$). BAE is effective in improving blood circulation, peripheral perfusion and ABI values. Based on the results of the statistical test, it is known that $p \text{ value} = 0.067 > 0.05$ so it can be concluded that H_0 : is rejected, thus it can be said that there is no difference in ABI scores in the control group. In contrast to the 10-minute BAE intervention, the test results look different with a p value = 0.0005 so it can be concluded that there is a difference between 3-minute exercise (control group) and 10-minute exercise (intervention group).

Conclusion: BAE had an effect on the ABI score and had the effect of reducing peripheral vascular disease in the extremities of the legs and improving blood circulation in the legs.

INTRODUCTION

Diabetes mellitus (DM) is a group of chronic metabolic disorders characterized by increased blood sugar levels (hyperglycemia) in the body¹ and the occurrence of insulin insufficiency², WHO stated that there is an

increase in the prevalence of DM every year, based on data from the International Diabetes Federation (IDF). Currently there are 537 million DM sufferers in the world, an increase of 40.6% from 2013 and is estimated to increase by 45.8% in 2045³. Indonesia is

ranked 7th out of 10 countries with 10.7 million DM sufferers, so it requires good and appropriate management for DM sufferers⁴. A person can be diagnosed with DM if they have classic symptoms of DM, namely: polydipsia, polyuria and polyphagia and have instant blood sugar levels (FBS) > 200 mg/dl and fasting blood sugar (FBS) > 126 mg/dl⁵. Various complications can arise due to uncontrolled blood sugar levels, one of which is often complained about is microvascular complications which result in inadequate peripheral circulation and perfusion in the lower leg area of DM sufferers⁶.

Based on preliminary study data at Hermina Hospital Jakarta in early February 2024, DM patients who experience microvascular complications such as neuropathy, nephropathy and gangrenous wounds in the lower extremities require good and appropriate care and management, one of which is by using the BAE⁴. Previous research results reported that Burger Allen exercises can improve local circulation in peripheral arterial occlusive disease, post-orthopedic surgery, and gynecological problems⁷. BAE can increase the Ankle Brachial Index (ABI) value in patients with type 2 diabetes mellitus⁸. However, we have not been able to see more specifically the effectiveness of BAE on blood circulation and peripheral blood perfusion in the lower extremities of patients with type 2 diabetes mellitus⁹.

This research is considered important to be studied considering that diabetes mellitus is a chronic disease and requires lifelong treatment because it can cause complications in various body systems including circulatory disorders and peripheral blood perfusion in the lower extremities of DM sufferers which are often the main complaints and have quite bad impacts for patients such as peripheral nephropathy¹⁰, gangrene and diabetic ulcers¹¹. Poor and inappropriate management will result in amputation (cutting off part of the body) later in the wound area that does not have good circulation and peripheral blood perfusion¹².

Diabetes Mellitus (DM) is a chronic disease that can be seen from an increase in blood glucose levels above normal, namely an increase in random blood sugar levels (GDS) > 200 mg/dl, and fasting blood sugar levels > 126 mg/dl¹³. DM is also known as a silent killer. Often sufferers are not aware of it and when it is discovered, complications have occurred¹⁴. DM can disrupt almost all human body-systems, DM has complications that are quite damaging to organs and systems, the International Diabetes Federation (IDF) states that the incidence of diabetes mellitus in the world is 1.9% and is the seventh leading cause of death in the world³. Uncontrolled DM has complications that can affect quality of life. DM can also affect the economy because the health of DM patients is significantly affected¹². In 2013, Indonesia had a prevalence of 2.1% for DM, this is higher than in 2007 (1.1%) and in 2023 it will increase to 11.7%¹⁵.

Although previous studies have demonstrated the potential effectiveness of Burger Allen Exercise (BAE) in improving local circulation among patients with peripheral arterial disease and diabetes mellitus (DM), specific empirical evidence detailing its impact on peripheral blood circulation and perfusion, particularly through measurable changes in the Ankle Brachial Index (ABI), remains limited, especially within the Indonesian context. This gap is crucial to address given the increasing prevalence of DM globally and nationally, accompanied by severe complications such as diabetic ulcers, gangrene, and amputations, significantly reducing patient quality of life and increasing healthcare economic burdens. According to the Indonesian Endocrinology Association (PERKENI) consensus, effective diabetes management involves several key components, including physical exercise, medical nutrition therapy, pharmacological intervention, and patient education. Additionally, effective DM control relies heavily on patient adherence to dietary management, encompassing meal scheduling, types, and quantities of food

consumed, particularly for patients on glucose-lowering medication or insulin therapy¹⁶. Therefore, systematically evaluating the effectiveness and optimal duration of Buerger Allen Exercise as part of physical exercise interventions is critically urgent, aiming to provide practical and accessible therapeutic solutions for DM patients, thereby minimizing the risk of severe peripheral vascular complications and enhancing overall clinical outcomes and healthcare quality.

METHOD

The research design used was a quasi-experimental with a purposive sampling technique and the data will be processed using SPSS 26. The population of this study was type II diabetes mellitus patients. The sample was calculated using the G power formula so that 54 respondents or subjects were obtained in this study. Consecutive Sampling was chosen as the technique used in this study.

The consecutive sampling technique is carried out by selecting all individuals who meet the research criteria until the desired number of samples is reached¹⁷. The inclusion criteria for the study were: 1) clients who were medically diagnosed with DM with diabetic wounds; 2) aged between 35–75 years; 3) type 2 DM patients and undergoing treatment; 4) able to communicate well; 5) patients with an ABI score <0.9 mmHg. This study has received a research permit letter No. 4362/DepKKL/MLM/VIII?2024 and a research ethics approval letter from the National Health Research Ethics Commission with No.165/KEPK-J/VIII/2024. After obtaining a research permit, the researcher conducted the study at Hermina Hospital.

This study differentiates the brachial ankle index values in the lower extremities of patients performed before and after BAE intervention in one group of research subjects. Researchers identified the subject-respondents based on predetermined criteria. The next stage, the researcher explained the stages of the procedures in the research

process, namely at the first meeting with all samples, followed by filling out the demographic data questionnaire of the respondent subjects, measuring ABI values and BAE exercises for 10-15 minutes. This BAE exercise was carried out 2 x 1 day with an interval of 6 hours for 3 weeks. This Action Procedure consists of three stages, namely: 1) the patient's lower extremities or lower legs can be lifted to a position of 450-900 with the legs supported by pillows, then the legs are flexed followed by extension for 2-3 minutes or until the skin looks pale. 2) The patient then sits in a relaxed position with his legs hanging under the bed or chair, then the DM patient's legs perform flexion and extension movements, then continued with prone and supine movements or leg movements inward and outward, this movement is done for five to ten minutes until the skin looks reddish again; 3) the patient lies in bed quietly.

Instrument: This study used the Ankle-Brachial Index (ABI) Worksheet, measured by dividing the previously measured blood pressure at the ankle, namely the lower leg, by the upper leg, namely the arm⁸. The ABI is calculated by dividing the highest systolic pressure from the ankle artery by the highest systolic pressure from the arm artery¹⁸. ABI measurements are performed with the patient resting in the supine position¹⁹. The examiner should perform all arm and leg blood pressure measurements with an appropriately sized blood pressure cuff and Doppler device^{20,21}. Systolic blood pressure is determined in both arms, and ankle systolic blood pressure is determined for the right and left posterior tibial (PT) arteries and the dorsalis pedis (DP) artery²⁰. The ABI for each leg was determined using the highest of the two arterial PT or DP readings, and the highest of the two brachial artery readings²². The lower ABI of the two is used for diagnostic purposes²¹. ABI measurements can usually be performed in less than 10 minutes²³.

RESULTS AND DISCUSSION

The results of the analysis using the analysis test are univariate and bivariate data. Table 1 shows that the number of male and female respondents is almost the same, male

51.9% and female 48.1%, dominated by Javanese ethnicity at 33%, with an education level of 48.14% elementary school. History of DM 75.9% and non-DM 24.1

Table 1. Patient Demographic Data

Variable	Frequency (f)	Persentase (%)
Gender		
Male	28	51.9
Female	26	48.1
Ethnic		
Jawa	33	61.12
Sumatra	5	9.26
Kalimantan	7	12.96
Sulawesi	4	7.4
Papua	5	9.26
Education		
Elementary	26	48.14
Junior High School	13	24.08
Senior High School	11	20.37
College	4	7.41
Health History		
DM	41	75.9
Non-DM	13	24.1
Smoking History		
Smoking	38	70.37
No-Smoking Hist	16	29.62
Total	54	100

Table 2 shows that before being given Buerger Allen exercises, 14.8% of patients had ABI values in the normal range (0.9-1.2 mmHg), 37.11% of patients were at risk of developing gastric disorders (0.8-0.9 mmHg) and 48.1% of patients were at risk of developing arterial ulcers (0.5-0.7 mmHg). After being given Buerger Allen exercises, 38.9% of patients had ABI values in the normal range (0.9-1.2 mmHg), 20.4% of patients were at risk of developing gastric disorders (0.8-0.9 mmHg) and 40.7% of

patients were at risk of developing gastric disorders (0.8-0.9 mmHg) were at risk of developing arterial ulcers (0.5-0.7 mmHg).

Table 3 shows the results of statistical tests on patients before being given Buerger Allen exercise treatment for 3 minutes, the average value is 0.74 and 0.75 after being given Buerger Allen exercise treatment, the p-value is 0.67 > 0.005. These results show that within 3 minutes there are no significant results.

Table 2. Buerger Allen Workout Values Before and After

ABI	Buerger Allen Exercise			
	Before		After	
	f	%	f	%
Normal (0,91–1,2 mmHg)	8	14.8	21	38.9
Risk of ulcer disorders (0,8–0,9 mmHg)	20	37.1	11	20.4
Risk of arterial ulcer disorders (0,5–0,7 mmHg)	26	48.1	22	40.7
Total	54	100	54	100

Table 3. Effect of Buerger Allen Test on ABI Before and After BAE Intervention for 3 minutes (control group)

Buerger Allen Exercise	N	Mean	Median	Min-Max	p
Before	27	0.74	0.74	0.50-0.90	0.67
After	27	0.75	0.74	0.62-1.00	

Source: primary data, 2024

Table 4 shows the results of statistical tests on patients before being given Buerger Allen exercise treatment for 3 minutes with an average value of 0.82 and after being given Buerger Allen exercise treatment for 3 minutes with a p-value of 0.0005 <0.005. These results indicate that

within 10 minutes it showed significant results.

Table 5 shows the results of the Mann Whitney U statistical test. The pre-test results obtained a p-value of 0.67 > 0.005, after carrying out the Buerger Allen test exercise, the post-test results were obtained with a p-value of 0.0005 < 0.005.

Table 4. Effect of Buerger Allen Exercise on ABI Before and After BAE Intervention for 10 minutes (intervention group)

Buerger Allen Exercise	N	Mean	Median	Min-Max	p
Before	27	0.82	0.80	0.70-1.00	0.0005
After	27	0.94	0.98	0.78-1.00	

Source: primary data, 2024

Table 5. ABI values before and after the test

	Mann Whitney U	Z	Asymp.sig 2 tailed	Information
Pre Test	340.000	-.427	.670	No Significant
Post Test	110.000	-4.495	.0005	Significant

Source: primary data, 2024

DISCUSSION

Based on the statistical test output, it is known that the asymp sig (2-tailed) is 0.067 > 0.05 so it can be concluded that Ho: is rejected, thus it can be said that there is no difference in ABI scores in the control group. In contrast to the 10-minute BAE intervention, the test results look different so it can be concluded that there is a difference between 3-minute exercise (control group) and 10-minute exercise (intervention group). In this study, the Burger Allen Test exercise had an effect on the ABI score and had the effect of reducing arterial disease, improving blood circulation in the legs and improving blood circulation. The results of the Mann-Whitney U Z Asymp Test Calculation (2-tailed)

showed a significant difference with a p-value = 0.0005.

The Mann-Whitney test analysis showed a difference in the increase in BAE training results between the two groups, namely control and intervention. Ho is accepted if the probability value (sig) is >0.05, while Ho will be rejected if the probability value is (sig). From the pre-test results, it is known that in the control case that was given BAE training for 3 minutes, there was an increase in ABI results with a p-value of 0.67¹⁸. 10 minutes exercise p value = 0.0005. In this study, physical examination and supporting examination were previously carried out on the subjects in each of the cases above, the risk of ineffective peripheral perfusion related to the clinical condition of

diabetes mellitus accompanied by risk factors for a sedentary lifestyle, The client's sedentary lifestyle means rarely doing exercise.¹¹.

The length of time a person has diabetes mellitus can increase the risk of complications, one of which is the inhibition of peripheral vascularization which can reduce the ABI value²⁴. Increased blood sugar levels over a long period of time can cause damage to the lumen of blood vessels². Long-term hyperglycemia will cause glucose levels to build up in certain cells and tissues, which will then be converted into sorbitol, which will cause damage and changes in cell function²⁵. Sorbitol is metabolized slowly, then added to form Advanced Glycation End Products (AGEs)²⁶. AGEs are substances that cannot be further metabolized by the body, so if they accumulate on the walls of blood-vessels they will cause atherosclerosis²⁷. DM patients who have a history of the disease for more than five years have a greater risk of complications, namely atherosclerosis³. The most common complications of atherosclerosis occur in the legs (macrovascular). If atherosclerosis is not treated properly, it will cause blockages in the

arteries and/or veins in the legs, which will disrupt blood flow to the legs²⁸. Prolonged peripheral perfusion disorders cause nerve death (neuropathy) in the feet of people with Diabetes Mellitus, resulting in reduced and/or lost sensation of touch⁴. Most people with diabetes who experience decreased or even loss of touch sensation do not realize that their feet have been injured and caused ulcers²⁹. There is a fairly strong relationship between the length of time a person suffers from DM and the level of risk of DM complications, including impaired peripheral tissue perfusion in the feet or lower legs which can cause diabetic ulcers and this should be avoided²².

CONCLUSIONS

Based on blood circulation or peripheral blood circulation and perfusion, lower extremity health is an important thing to maintain. Before the Buerger Allen exercise, most respondents adhered to the ABI value. In this study, the Burger Allen Test exercise affected the ABI score and affected the decrease in arterial disease, smooth blood circulation in the legs and smooth blood circulation..

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