Diabetic ulcers prevention in the elderly for improving blood circulation of lower extremities with combination foot exercise therapy and electrophysical therapy

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ABSTRACT

Background: Diabetic foot ulcer is one of the complications of diabetes. The intervention for diabetic foot examination is the Ankle Brachial Index (ABI). Decreased ABI scores indicate decreased peripheral blood circulation in the extremities. An increase in ABI can be done by combining foot exercise therapy with electrophysical therapy. This study aims to analyze ABI scores in patients with type II diabetes performing a foot exercise combined with electrophysical therapy.

Method: The research design is quasi-experimental, with a pre-test-posttest comparison group used. The sampling method used was purposive sampling. A total of 120 respondents were divided into 2 groups: intervention and control. The intervention group was given diabetic foot exercises with a combination of electrophysical therapy, while the control group was given a standard intervention. The diabetic foot exercise was conducted daily in the morning for 4 weeks and lasted 20-30 minutes. Subsequently, the ABI score was assessed. Prior to the intervention, respondents’ ABI scores were measured. Data were analyzed using SPSS version 26.0 for Windows.

Result: We found that an increase in the ABI score by 0.113 was statistically significant at a p-value <0.05. After a month of the initial state, the ABI score by 0.758, and the p-value shows significance at <0.05. In comparison, an increased ABI score was observed after a month of the first intervention. There was an increase in the ABI score by 0.654 (p<0.05).

Conclusion: Foot exercise therapy combined with electrophysical therapy was shown significantly increased repetitive muscle contractions and improve blood circulation, thus increasing the ABI score, which was higher than the control group.

INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by high blood glucose levels (hyperglycemia).1 The World Health Organization (WHO) classified diabetes into four types: type 1 diabetes mellitus, type 2 diabetes mellitus, gestational diabetes mellitus, and other types of diabetes. In type 2 Diabetes Mellitus or Non-Insulin Dependent Diabetes (NIDDM), the amount of insulin produced by the pancreas is usually sufficient to prevent ketoacidosis but not enough to meet the needs of the total body.2

WHO predicts an increase in the number of people with Diabetes Mellitus in Indonesia from 8.4 million in 2000 to around 21.3 million in 2030. This high number makes Indonesia fourth in the world after the United States, India, and China.3 Based on the 2018 Riskesdas data, the prevalence of Diabetes Mellitus in Indonesia at 1.5% and in Central Kalimantan at 1.1%.4 It is also stated that 15% of people with diabetes will experience at least one diabetic foot ulcer in their lifetime.5 Diabetic foot ulcers are the main cause of 85% of all lower extremity amputations.6,7 These data are reinforced by data from WHO in 2008, which states that limb amputations occur 10 times more in people with diabetes than in non-diabetics. In Indonesia alone, according to data from the Indonesian Endocrine Association (PERKENI) in 2009 at Cipto Mangunkusumo Hospital (RSCM), nearly 70% of Diabetes Mellitus patients are treated with a diagnosis of diabetic foot ulcers.8

Based on the classification of diabetes mellitus complications into 2 major groups. There are acute complications and chronic complications.9 Chronic complications consist of macrovascular, microvascular, and neuropathic complications. The most common macrovascular complications are coronary artery disease, cerebrovascular disease, and peripheral vascular disease.10 Microvascular complications in the retina, causing diabetic retinopathy, and the kidneys cause diabetic nephropathy.11 Meanwhile, complications of neuropathy, a complication of peripheral and autonomic neuropathy, cause problems in the feet in the form of diabetic foot ulcers.12

The causes of diabetic ulcers are multifactorial and can be categorized into three groups, namely due to pathophysiological changes, anatomical deformities, and environmental factors. The risk factors for ulcers and infections
are peripheral neuropathy, neuro-osteartopathy deformity, vascular insufficiency, hyperglycemia and other metabolic disorders, patient limitations, maladaptive behavior, and failure of health services. Peripheral vascular disorders due to both macrovascular (atherosclerosis) and microvascular disorders cause leg ischemia, especially in the elderly.13

The elderly experience aging, which causes a decrease in overall body function. Entering old age means experiencing a decline in physical, psychosocial, and spiritual and will also experience a loss of resistance to infection and the risk of experiencing degenerative diseases such as DM. The condition of the elderly will decrease, causing the elderly to be unproductive, especially with complications of DM (ulcer) wounds caused by lack of foot care. The elderly experience a decline in their ability to self-care, so the elderly are less able to carry out treatments that can help them solve their health problems. Nurses have a role in helping meet the need for therapeutic self-care for the elderly with DM through prevention and control of DM.8

Various efforts can be made to prevent and control DM complications through DM management. One of the efforts is to do foot care. Regular foot care can reduce diabetic foot disease by 50-60%. Diet management, monitoring blood sugar levels, and pharmacological therapy manages diabetes mellitus in addition to physical exercise. To carry out foot care vascularization, it can also be done with foot movements known as diabetic foot exercises.8 Diabetes gymnastics is a low-impact and rhythmic aerobic exercise with fun movements, not boring. It can be followed by all age groups, thereby attracting the group’s enthusiasm in diabetes clubs. Diabetes gymnastics can increase physical fitness and optimal aerobic value.3 Leg gymnastics is an exercise performed by patients with diabetes mellitus to prevent injuries and help improve blood circulation in the legs. In patients with impaired leg blood circulation, lower leg blood pressure will be lower than arm blood pressure.15 Furthermore, electrophysical therapy is one of the therapies for managing diabetic foot ulcers. That therapy can improve blood circulation and prevent potential injuries to the feet.16 These therapies help increase the ABI score, which measures the ratio of systolic blood pressure in the arm to systolic blood pressure at the ankle.17

In a preliminary study conducted by researchers in the Kayon Health Center working area, patients with diabetes had never been given or taught about DM foot exercises and electrophysical therapy. These two therapies can improve peripheral blood circulation in diabetic patients. This study aimed to analyze an increase in ABI scores in type II diabetic patients with foot exercises combined with electrophysical therapy.

METHODS

We conducted a quasi-experiment with a comparison group design employed in this study. The population in this study was all elderly patients with Type II Diabetes Mellitus living in Palangka Raya City, and samples were recruited at two PHCs (Kayon Primary Health Care and Menteng Primary Health Care, Palangka Raya City). The sampling technique in this study was consecutive. The sample size was 52 for each intervention and control group. However, to prevent the dropout rate of 10%, 60 respondents were selected for each group, with a total sample of 120 respondents. Some inclusion criteria applied are as follows: ready to be a respondent; age 60-75 years old; Diagnosed with type II DM (more than 6 months); GDS (200-400 mg/dL); no foot ulcer; and get anti-diabetic drugs (NIDDM); and exclusion criteria are as follow: elderly who were suddenly absent and refused to be respondent. The instrument used in this study to measure the ABI score was the Module of Effects of Electronic Foot Therapy Combination Diabetic Exercises on the Ankle-Brachial Index (ABI) in the Elderly with Type II Diabetes Mellitus, which was created with expert reviews. In the meantime, a sphygmomanometer and stethoscope were used to measure blood pressure.

Application of foot exercises combined with electrophysical therapy

In the control group, patients were given only diabetic foot exercise therapy. Diabetes exercises aim to improve physical fitness or optimal aerobic value for diabetics, with exercise tailored to the needs of people with diabetes without severe complications. Foot exercises are also believed to manage patients with Diabetes Mellitus. Diabetes Mellitus patients, after foot exercises, feel comfortable, reduce pain, reduce damage to nerves, control blood sugar, and improve blood circulation in the legs. Meanwhile, it stated that diabetic foot exercises create a sense of pleasure in members and can also motivate other members to continue to exercise regularly. So diabetic foot exercises are a low-impact and rhythmic aerobic exercise with fun movements and can improve physical fitness and facilitate blood circulation.

The goal obtained after doing this foot exercise is to improve blood circulation in the feet of diabetic patients so that nutrition flows smoothly into the network. In addition, it also strengthens small muscles, prevents foot deformities, overcomes joint motion limitations, and prevents injuries. The tools that must be prepared are the chair (if the action is carried out in a sitting position) and the procedure for carrying out exercises. While preparing for the client is an agreement with the patient on the foot exercise's time, place, and purpose. Also, pay attention to a supportive environment, such as a comfortable environment for patients, and maintain patient privacy. Steps for performing foot exercises:

a. Nurse wash hands
b. If performed in a sitting position, position the patient sitting upright on a bench with feet touching the floor. It can also be done in a lying position by straightening the legs.

By placing the heel of one foot on the floor, lift the sole up. On the other foot, the toes are placed on the floor with the heel raised. Performed on the left and right legs alternately and repeated 10 times. In the sleeping position, move the fingers and the heel of the foot alternately between the left and right feet 10 times.

d. With your heels on the floor, the toes of both feet are straightened up and then bent back down like chicken claws 10 times. In the sleeping position, the toes of both feet are straightened up and...
then bent back down like chicken claws 10 times.

e. The heel of the foot is placed on the floor. Lift the toe and make a circular motion by moving the ankle 10 times. In the sleeping position, the legs are straight up and make a circular motion 22 by moving the ankles 10 times.

f. The toes are placed on the floor. Lift your heels and make a circular motion by moving your ankles 10 times. In the sleeping position, the legs must be raised slightly to make circular movements at the ankles 10 times.

g. Straighten one leg and lift it, rotate the leg at the ankle, and write in the air with the foot from the numbers 0 to 10 do it alternately. This movement is the same as the sleeping position.

h. Put a piece of newspaper on the floor. Shape the paper into a ball with both feet. Then, unfold the ball into a sheet as before using both feet. This method is done only once, then tear the newspaper into 2 parts, and separate the two parts of the newspaper. Some of the newspapers were torn into small pieces with both feet. Transfer the pieces of paper with both feet, then place the pieces of paper on the intact piece of paper. Wrap everything with both feet into a ball shape.

The intervention group will receive electrophysical therapy and diabetic foot exercises. This therapy can stimulate sensory nerve coordination that can increase self-care agency in the form of an ABI score. The objectives are to introduce a therapy program to increase the value of the ABI in the form of simple, easy and inexpensive exercises using technology that can be done at home. Second, increasing the knowledge of nurses and physiotherapists in health services, clients, and families about non-pharmacological therapies that can be applied to clients with diabetes mellitus. Third, increase the knowledge of nurses and physiotherapists in health services, clients, and families about diabetic foot exercises combined with foot-soaking electrophysical therapy.

While in health services, this intervention is recommended to be carried out for a minimum of 4 weeks with a dose of 2 sessions in the morning, for 15 minutes for each session with a 5 minutes rest span. During 1 week, this therapy was given 3 times. Based on references, this technique was done routinely and regularly to increase blood circulation in the legs. However, when this intervention is carried out by the client assisted by the family at home, then this intervention is best carried out every day in the morning, for 20-30 minutes for each session with a 5 minutes rest span. Indications for this intervention are the client is conscious and cooperative; the client does not experience gangrene injuries on the body, health workers and family accompany the client, and vital signs are within the normal range (blood pressure 110/70 mmHg-150/90 mmHg, respiration rate 16-20 x/m, heart rate 60-100 x/m, and axilla temperature 36.5-37.50C). Contraindications to this intervention are the client has cognitive impairment (delirium, dementia, and amnestic disorders), the client has hearing loss, the client has visual field impairment, and the client’s disability, injury, or acute joint complications. The stages of this combination intervention are:

1. If performed in a sitting position, position the patient sitting upright on a bench with feet touching the floor. It can also be done in a lying position by straightening the legs.

2. With the heel of one foot on the floor, lift the sole up. On the other foot, the toes are placed on the floor with the heel raised. Performed on the left and right legs alternately and repeated 10 times. In the sleeping position, move the fingers and the heel of the foot alternately between the left and right feet 10 times.

3. By placing the heels on the floor, the toes of both feet are straightened up and then bent back down like chicken claws 10 times. In the sleeping position, the toes of both feet are straightened up and then bent back down like chicken claws 10 times.

4. The heel of the foot is placed on the floor. Lift the toe and make a circular motion by moving the ankle 10 times. In the sleeping position, the legs are straight up and make a circular motion 22 by moving the ankles 10 times.

5. The toes are placed on the floor. Lift your heels and make a circular motion by moving your ankles 10 times. In the sleeping position, the legs must be raised slightly to make circular movements at the ankles 10 times.

6. Straighten one leg and lift it, rotate the leg at the ankle, and write in the air with the foot from the numbers 0 to 10 do it alternately. This movement is the same as the sleeping position.

7. Put a piece of newspaper on the floor. Shape the paper into a ball with both feet. Then, unfold the ball into a sheet as before using both feet. This method is done only once, then tear the newspaper into 2 parts, and separate the two parts of the newspaper. Some of the newspapers were torn into small pieces with both feet. Transfer the pieces of paper with both feet, then place the pieces of paper on the intact piece of paper. Wrap everything with both feet into a ball shape.

8. Put salt into the container provided with warm water, place your feet on the salt, and turn on the electrophysical therapy set. Leave it for 20-30 minutes and wash it off.

Data Collection and analysis

Data were collected by the researchers from February to Mei 2022 at the Health Center Kayon and Health Center Menteng, Palangka Raya, Indonesia, which has a one-day care service. There were two research assistants. The normality test with Kolmogorov-Smirnov showed that the data were not normally distributed. The statistical test was used to determine the effectiveness of the variables using the General Linear Model Repeated Measures test. All data were analyzed using SPSS version 26.0 for Windows.

RESULTS

There were 120 respondents who participated in the study until it was completed, which were equally divided, namely 60 respondents in the control group and 60 respondents in the intervention group. The respondent’s characteristic data describes the respondent’s characteristics which include gender, age, and respondent’s congenital disease. Table 1 shows the significance value (Sig.) on the homogeneity test of respondents’ characteristics based on sex,
Table 1. Frequency distribution based on characteristics of respondents.

<table>
<thead>
<tr>
<th>Characteristics of Respondents</th>
<th>Control Group (n=60)</th>
<th>Intervention Group (n=60)</th>
<th>Homogeneity</th>
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<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Gender</td>
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<tr>
<td>Woman</td>
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<td>Man</td>
<td>23</td>
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<td>31</td>
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<tr>
<td>Age (Years)</td>
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<td></td>
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<td>60</td>
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<td>28.30</td>
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<td>11</td>
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<tr>
<td>65</td>
<td>10</td>
<td>16.70</td>
<td>6</td>
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<td>Congenital Diseases</td>
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<td></td>
<td></td>
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<tr>
<td>With Congenital Diseases</td>
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<td>51.70</td>
<td>30</td>
</tr>
<tr>
<td>Without Congenital Disease</td>
<td>29</td>
<td>48.30</td>
<td>30</td>
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Table 2. Normality test results.

<table>
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<tr>
<th>Data</th>
<th>p</th>
<th>Interpretation</th>
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<tr>
<td>Pretest</td>
<td></td>
<td></td>
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<tr>
<td>Post Test 1</td>
<td>0.000*</td>
<td>Not normally distributed</td>
</tr>
<tr>
<td>(After the first intervention, H+1)</td>
<td>0.000*</td>
<td>Not normally distributed</td>
</tr>
<tr>
<td>Post Test 2</td>
<td>0.000*</td>
<td>Not normally distributed</td>
</tr>
<tr>
<td>(After all interventions, H+30)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. GLM-RM prerequisite test results.

<table>
<thead>
<tr>
<th>Times</th>
<th>Factor Variables</th>
<th>Mauchy’s Test of Sphericity &amp; Test of Within-Subject Effects</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Before Intervention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 After the first intervention, H+1</td>
<td></td>
<td></td>
<td>0.000*</td>
</tr>
<tr>
<td>3 After all interventions, H+30</td>
<td></td>
<td></td>
<td>0.000*</td>
</tr>
</tbody>
</table>

Table 4. GLM-RM ANOVA test results between subjects.

<table>
<thead>
<tr>
<th>Times</th>
<th>Mean Difference</th>
<th>Standard Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.113</td>
<td>0.009</td>
<td>0.000*</td>
</tr>
<tr>
<td>2</td>
<td>0.758</td>
<td>0.022</td>
<td>0.000*</td>
</tr>
<tr>
<td>3</td>
<td>0.113</td>
<td>0.009</td>
<td>0.000*</td>
</tr>
<tr>
<td>2</td>
<td>0.654</td>
<td>0.016</td>
<td>0.000*</td>
</tr>
<tr>
<td>3</td>
<td>0.758</td>
<td>0.022</td>
<td>0.000*</td>
</tr>
<tr>
<td>3</td>
<td>0.645</td>
<td>0.016</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

age, and congenital disease > 0.05, so it can be concluded that the data variance in each group in each group is the same or homogeneous. All respondents in this study were included in the elderly category, with the respondent’s ages ranging from 60 to 65 years. In the control and intervention groups, the majority had and did not have congenital diseases; namely, 31 respondents in the control group did not have congenital diseases (51.70%) and 30 respondents in the intervention group had and did not have congenital diseases as many as 30 respondents (50.00%). The type of gender of the respondents between men and women was almost the same, with 37 female respondents (37.00%) in the control group and 31 male respondents in the intervention group (51.70%).

The normality test was carried out to determine the distribution level of the research data; then, the test results were used to determine the different test methods. The result is that if the probability value (P value) for each variable is greater than the significance level of 5% (0.05), it can be concluded that the distribution of this research data is normal.

The results of the data normality test using Kolmogorov-Smirnov showed that the control and intervention groups’ pretest, posttest 1, and posttest 2 data were not normally distributed.

The results of the GLM-RM (General Linear Model-Repeated Measure) ANOVA prerequisite test are shown in Table 3. Table 3 explains three variables for the three different timing of ABI measurements in each control and intervention group. In the estimation test or the underlying requirements (not absolute requirements), the repeated measures ANOVA test is that the research data has the same variance through the Sphericity value. Based on the table above, it is known that the significance value (Sig.) or p-value is 0.000 <0.05, so it is concluded that the data of this study do not meet the estimated variance similarity. Thus, the repeated measures ANOVA test refers to the Greenhouse-Geisser value in the Tests of Within-Subjects Effects table.

In the Greenhouse-Geisser value, the p-value is 0.000 <0.05; in other words, there is a factual (significant) difference in the average increase in the ABI. So, it can be concluded that the intervention given to the control group (diabetic foot exercise) and the intervention group (diabetic foot exercise combined with electronic foot soaking therapy) can increase the value of the ABI, which is an indicator to assess the severity of peripheral artery occlusion which is a picture of blockage arteries in general in diabetic patients.
The results of the GLM-RM (General Linear Model-Repeated Measure) ANOVA between-subject saliva volume between the control and intervention groups are shown in Table 3.

Table 4 describes the average increase in ABI scores for each measurement over time (before the intervention, after the first intervention, H+1, and after the first intervention, H+30). Number 1 shows the time of ABI measurement before the intervention. Number 2 shows the time of ABI measurement after the first intervention, and number 3 shows the time of ABI measurement after a month of routine intervention.

**DISCUSSION**

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. These conditions make DM sufferers must be able to control their blood sugar.1 The results show that many older women suffer from DM. These results align with research by Wahyuni S and Alkaff RN, which stated that 3.6% of women of reproductive age suffer from DM. Risk factors for DM in women are 29.6% due to obesity, 52.7% due to low physical activity, 26.9% due to smoking, 16.7% due to consuming fatty foods, and 97.4% due to low consumption of fruits and vegetables. If, during the productive age, a woman already suffers from DM, it is likely that she will continue to the condition of the elderly, especially if women cannot control her risk factors.20

The study also showed that older adults aged 60-65 had DM, and some had congenital diseases. These results are in line with research conducted by Hijriana I and Sahara T. Conditions of aging and congenital diseases in the elderly with DM are risk factors for decreased ABI, so the elderly require treatment efforts to improve blood circulation, especially in the lower to prevent potential foot injuries.21 Efforts to increase ABI were carried out with foot exercises foot the control group, then a combination of foot exercise and electrophysical therapy for the intervention groups.6,23

At time 1 (before intervention) compared to number 2 (after the first intervention was carried out), there was an average increase in the ABI score of 0.113, and the difference in the increase in the ABI score was factual with a p-value of 0.000 <0.05. Time 1 (before intervention) compared to number 3 (after a month of intervention), there was an average increase in the ABI score of 0.758, and the difference in the increase in the ABI score was factual, with a p-value of 0.000 <0.05. Time 2 (after the first intervention was carried out) compared to number 3 (after a month of intervention), there was an average increase in the ABI score of 0.654, and the difference in the increase in the ABI score was factual with a p-value of 0.000 <0.05.

So it can be concluded that by routinely giving diabetic foot exercises in the control group and diabetic foot exercises in combination with electron soaking foot therapy in the intervention group, both can increase a person’s ABI score by 0.113 in one intervention and 0.758 within a month. The GLM-RM (General Linear Model-Repeated Measure) ANOVA between subjects between the control group and the intervention group showed a difference in the increase in ABI scores between groups on the first day of measurement to the 30 days of measurement (a month).

Type 2 diabetes has become a prominent health problem affecting a large proportion of the population over 50.23 Both men and women are equally susceptible to metabolic disorders.24 However, regarding symptoms and complications (congenital diseases), gender plays an important role. Regarding gender, men are twice as likely to develop Type 2 Diabetes Mellitus as women. As per research, the common reason behind it is the difference in fat distribution in the body. Males accumulate more fat in the middle (visceral fat), making them more prone to developing conditions of elevated glucose.25 Women store most of the fat in the legs and hips, known as subcutaneous fat.26 Visceral fat is more harmful to health and metabolically active than subcutaneous fat. That increases the risk of developing type 2 diabetes mellitus and other metabolic conditions in men.27 It also implies that even if women are obese, they are metabolically healthier than men.28 Even if men and women have the same body mass index (BMI), men are more likely to develop Diabetes Mellitus than women. Other factors that make men more likely to develop diabetes include alcohol consumption and smoking habits.20

In this study, it was successful to prove an increase in ABI scores in both groups despite receiving 2 different therapies. In the control group, the intervention was routine diabetic foot exercises from health workers at the Primary Health Center (Puskesmas). In contrast, the intervention group was given diabetic foot exercises with a combination of foot-soaking electrophysical therapy. The intervention was given for 30 consecutive days with a span of 20 minutes of daily administration. ABI evaluation was carried out before the intervention, immediately after the first intervention, and a month after the 30th intervention was given to the respondent.

In this study, before being given intervention in the control group (diabetic foot exercise) and the intervention group (diabetic foot exercise combined with foot soaking electrophysical therapy), the ABI was first measured using a non-mercury type sphygmomanometer and then recorded on the observation sheet. The results obtained from 120 respondents before foot exercise was that most of the ABI were at a mean value of 0.4 mmHg (heavy PAD). This shows that the value of the ABI in some respondents can be interpreted as claudication.9 Claudication is pain due to blood circulation that is not smooth in the body part that is actively used.20

Epidemiologically, diabetes mellitus is often not detected, and it is said that the onset or onset of diabetes mellitus is 5 years before the diagnosis is made, so early morbidity and mortality occur in undetected cases.29 Researchers assume that people with diabetes mellitus who rarely control blood sugar will be more susceptible to a decrease in ABI scores.30 This is because patients do not know the development of blood sugar levels that can affect the occurrence of atherosclerosis, especially in the legs, likewise, with activities/sports.31 Progressive muscle relaxation can activate the parasympathetic system, one of which is the dilation of blood vessels. Dilation of blood vessels
will increase blood circulation throughout the body. In DM patients, this situation will improve blood flow in the legs so that the ABI score will increase.\textsuperscript{32} Researchers assume that respondents with decreased ABI have complaints of tingling, pain, and stiffness in the legs. The symptoms of tingling are caused by poor blood circulation in the legs. Blood circulation disorders can also be affected by blood viscosity.\textsuperscript{39} Other factors that influence blood viscosity include cholesterol, HDL, LDL, uric acid, amount of water consumption, examination with monofilament, etc. Physiologically, the above elements will affect the viscosity or blood viscosity which can affect the lower ABI score.\textsuperscript{32} The ABI measurement compares the systolic ankle value with the systolic brachial value, where the ankle is in the furthest position from the heart or the peripheral position as an indicator of blood circulation in the lower extremities.\textsuperscript{6}

This study wanted to analyze the effect of the intervention in the control group (diabetic foot exercise) and the intervention group (diabetic foot exercise combined with foot soaking electrophysical therapy) to increase the ABI score. After analyzing using the GLM-RM, it was found that the two interpretations had a significant effect on the ABI. So diabetic foot exercises and combinations with foot soaking electrophysical therapy are equally beneficial for improving the respondent’s blood circulation.\textsuperscript{31} In the intervention group, the increase was much greater than in the control group.\textsuperscript{33} This is because the use of foot soaking electrophysical therapy can directly open the arterial circulation of the lower extremities due to the flow of warm water and negative ions coupled with foot exercises.\textsuperscript{34}

Electrophysical therapy with foot soaking electrophysical therapy provides electrical therapy through a device to increase blood flow and endogenous blood vessel growth factor (VEGF). VEGF has an important function in forming new blood vessel cells, which begins with the formation of angiogenic blood vessels, namely arterial/ venous capillaries in vascular endothelial cells and smooth muscle cells.\textsuperscript{35} Increased blood vessel circulation is related to vasodilation due to electrical stimulation, which releases nitric oxide (NO), which plays a role in dilating blood vessels. In people who are given therapy with an electric current in the low voltage category, it can release no, thereby increasing blood flow to the tissues.\textsuperscript{36,37}

With the finding of this study, diabetic foot exercise or a combination with foot soaking electrophysical therapy is one type of combination exercise that is recommended especially for patients or diabetics.\textsuperscript{38} This diabetic foot exercise should be carried out in a measured, regular, controlled, and continuous manner.\textsuperscript{39,40} Complications of DM in the elderly occur throughout the life of DM patients, so it can affect their quality of life. Elderly care in the prevention and control of DM requires the support of others. The closest people are family. Diabetic foot exercise or a combination with foot soaking electron therapy helps the elderly increase their ABI. With great motivational support from the family in the treatment, the elderly will have a high quality of life with minimal risk of complications.\textsuperscript{39-41}

This limitation of this study is that it still does not assess confounding factors such as respondents’ diet and physical activity.

CONCLUSION

Giving diabetic foot exercises or in combination with foot soaking electrophysical therapy is one type of combination exercise that is recommended, especially for patients or diabetics. This combination therapy can increase the ABI score from 0.4 mmHg or severe PAD (claudication) to 0.5 mmHg or moderate PAD on the first day of intervention and continued to increase from day 30 to 1.2 mmHg, which was included in the normal category. This diabetic foot exercise should be done in a measurable, regular, controlled, and continuous manner.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest concerning this article’s research, authorship, and publication.

ETHICAL CONSIDERATION

This research has received research ethics approval from the Health Research Ethics Commission of the Ministry of Health, Palangka Raya, Number: 016/III/KE.PE/2022. The study’s aim and procedure were explained to the respondents prior to data collection. Each respondent was asked to sign an informed consent, and they could withdraw without penalty.


