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Correlation Between Activity of Doing Foot Exercises and Peripheral Perfusion Status in Patients with Diabetes Mellitus

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Abstract

Background: Diabetes mellitus is a chronic metabolic disease that can cause complications in the form of peripheral perfusion disorders due to damage to blood vessels. One of the nonpharmacological efforts to improve blood circulation of the lower extremities is through diabetic foot gymnastics. The patient's activeness in doing foot exercises is suspected to be closely related to the status of peripheral perfusion.
Aims: This study aims to determine the correlation between the activity of doing foot exercises and the status of peripheral perfusion in patients with diabetes mellitus.
Methods: This study uses a *correlational descriptive* design with *a cross sectional* approach. The study sample was people with diabetes mellitus who met the inclusion criteria, with a total of 42 respondents, who were taken by *total sampling technique*. Activeness in doing foot gymnastics was measured using an activity level questionnaire, while peripheral perfusion status was assessed using the Neuropathy System Score (NSS) questionnaire. Data analysis was carried out using *the Spearman Rank* test with a significance level of $p < 0.05$.
Results: The results showed that there was no significant relationship between foot exercise activity and peripheral perfusion status in patients with diabetes mellitus with a Spearman Correlation value of -0.117 with a significance level of 0.263.
Conclusion: These findings suggest that foot exercises alone may not be enough to improve peripheral perfusion and need to be combined with comprehensive diabetes management and other lifestyle interventions.

Keywords: blood circulation; diabetes mellitus; foot exercises; peripheral perfusion

INTRODUCTION

Comorbidities that have an impact on people with diabetes mellitus are the onset of diabetic ulcers as well as atherosclerosis, and peripheral perfusion disorders (Supriatin et al., 2025). If not treated immediately, it can cause stroke, peripheral diseases and myocardial infarction (Lukitaningtyas et al., 2024). The cause of nerve death in the legs when not treated will begin to disappear and the sensation of taste in the legs will decrease. Atherosclerosis, which is a condition of narrowing and hardening of blood vessels, if not treated properly, can cause blockages in the arteries and veins in the lower extremities. This obstruction interferes with the smooth flow of blood to the legs, so it can trigger peripheral perfusion disorders (Arifahyuni & Retnaningsih, 2024).

Regarding the impact of diabetes mellitus, there are two main approaches in handling it, namely pharmacological and non-pharmacological therapy. Pharmacological therapy is carried out by administering drugs such as insulin and blood glucose-lowering agents (Yudiernawati et al., 2025). Meanwhile, non-pharmacological therapies include weight management, physical activity, and dietary regulation (diet) (Putra et al., 2023). However, most people with diabetes tend to focus more on medication consumption and dietary arrangements, while the exercise aspect is often overlooked. In fact, light physical activities such as walking, leisurely cycling, swimming, and gymnastics including diabetic foot gymnastics have an important role in disease management (Parada Flores et al., 2023). Diabetic foot exercises are

especially recommended because they are able to increase peripheral perfusion and prevent the onset of complications, especially in the feet of diabetics (Embuai et al., 2019).

Based on previous research in 2022 in Indonesia, out of 1785 people with diabetes mellitus in Indonesia, 63% of people with diabetes mellitus experienced neuropathic complications (Balgis et al., 2022). The number of people with type 2 diabetes in Jember Regency in 2023 is 35,951 people. Data from the Puger Health Center in 2023 shows approximately 150 people with diabetes mellitus of various ages, who experience damage to circulation and peripheral perfusion of approximately 20% of the total patients with diabetes mellitus in the legs, while 30% of patients experience neuropathic nerves. The average neuropathic nerve sufferer consists of the pre-elderly (age 40-60 years) and the elderly. Some things that can be done to manage type 2 diabetes include: Doing diabetic foot exercises, to increase peripheral perfusion in the body of diabetics. Foot gymnastics at the Puger Health Center has carried out foot gymnastics for diabetics in prolanis and health counseling activities.

The circulatory system acts as a transport system in the body that has the main function of circulating oxygen and nutrients throughout the body's tissues, returning carbon dioxide (CO_2) to the lungs, as well as transporting metabolic residue to the kidneys for excretion (Dilworth et al., 2021). In addition, this system is also responsible for the distribution of hormones that are essential for maintaining the function and survival of the body's cells (Palacios-Abril et al., 2025). When there is a disturbance in this system, especially at the capillary level, a condition called ineffective peripheral perfusion can appear, which is a decrease in blood flow to peripheral tissues that has an impact on disrupting the body's metabolic processes (Pang et al., 2025).

Diabetic foot gymnastics is a form of physical exercise with a focus on variations of movements involving the muscles and joints of the legs. This exercise has many benefits, one of which is to improve and improve blood circulation in the leg area (Megawati et al., 2020). With increased blood flow, more capillaries open up so that the oxygen supply to the tissues of the legs becomes optimal. In addition, foot exercises help strengthen the leg muscles, prevent deformities or deformities that can increase the risk of diabetic wounds, and stimulate the production and utilization of insulin to help the process of glucose transport into cells, thereby reducing blood glucose levels (Mustofa et al., 2021). This exercise also provides a relaxing effect and increases the distribution of nutrients and oxygen throughout the body. Smooth blood circulation due to active movement also helps the detoxification process through the transport of metabolic waste substances out of the body. Diabetic foot exercises should be done regularly 3 to 5 times per week, with a duration of exercise of about 30 to 60 minutes (Megawati et al., 2020).

Foot exercises provide significant benefits in improving blood circulation and peripheral perfusion, especially for people with diabetes mellitus. However, diabetic foot gymnastics is still not widely known among the public, including in the Prolanis gymnastics group at the UPTD Puger Health Center. Therefore, the introduction of specific gymnastic movements in the leg area is very important, as it not only helps reduce the symptoms of diabetes mellitus, but also plays a role in lowering the risk of complications. The purpose of this study was to determine the relationship between the activity of six legs and the status of peripheral perfusion in patients with diabetes mellitus.

METHOD

Design

This study uses a quantitative design with a cross-sectional approach. To measure the activeness of foot gymnastics in this study, a questionnaire of activity in doing foot gymnastics was developed by the researcher to assess how active the respondents were in doing foot gymnastics as part of their self-care routine in patients with diabetes mellitus, which were then categorized as active and inactive. Meanwhile, to assess peripheral perfusion using the Neuropathy System Score (NSS) instrument, because this instrument has a relatively high sensitivity to detect symptoms of diabetic neuropathy and has been used in various epidemiological and clinical studies as an initial screening tool.

Sample

The population in this study is all participants of the Chronic Disease Management Program (Prolanis) who suffer from diabetes mellitus at the UPTD Puger Health Center, with a total of 42 people. The sampling technique used is total sampling. The inclusion criteria in this study include: respondents who have been diagnosed with type 2 diabetes mellitus, patients who are willing to be respondents, and are over 40 years old. Meanwhile, the exclusion criteria include patients with physical, mental, or cognitive limitations that have the potential to interfere with the smooth running of the study, such as blindness, deafness, or mental developmental disorders. In addition, patients with complications or comorbidities such as chronic kidney failure, heart failure, and vision impairment were also excluded from the study.

Data analysis

Univariate analysis was used to describe the characteristics of respondents and research variables, which was performed using frequency distribution tests. Furthermore, bivariate analysis was carried out using the Spearman correlation statistical test to determine the relationship between the variables of diabetic foot gymnastics activity and peripheral perfusion in patients with diabetes mellitus.

RESULTS

Table 1. Characteristics of respondents

Variable	Frequency (n=42)	Percentage (%)
Education		
Primary	6	14,3
Middle school	9	21,4
Higher school	15	35,7
Graduation	12	28,5
Age		
45-60 Years old	24	57,1
>60 Years old	18	42,9
Sex		
Female	32	76,2
Male	10	23,2
Occupation		
Unemployed	21	50
Employed	21	50
Duration of Diabetes		
<5 years	25	59,5
>6 years	17	40,5

Table 1 appears the dissemination of statistic characteristics of the study respondents. Among the 42 respondents, 76,2% were women, aged 45-60 years (57,1%), with a higher school education level (35,7%). The duration of diabetes mellitus was more than five years among 59,5% of respondents.

Table 2. Correlation of foot exercise activity with peripheral perfusion in people with diabetes mellitus

Variable	peripheral perfusion				
Foot exercise activity	mild	moderate	severe	Sig	Koefisien Korelasi
Active	3	7	8	0,263	-0,117
Not active	20	12	0		
Jumlah	23	19	8		

Based on table 2, the results of the study analyzed the relationship between foot exercise activities and perfusion conditions showed statistically insignificant results. Based on the results of the Spearman correlation analysis, a correlation coefficient value of -0.177 with a significance value (p-value) of 0.263 was obtained. These results showed that there was a very weak negative association between foot exercises and perfusion, but the association was not statistically significant ($p > 0.05$).

DISCUSSION

These results show that although participation in Prolanis is quite high, not all participants are involved in physical activities such as foot gymnastics. From the results of the study in prolanis participants with diabetes, there were as many as 24 respondents (57.1 percent) who did not actively participate in foot exercises, while 18 respondents (42.9 percent) actively participated in these activities. From these findings, the majority of respondents have a secondary education level, with the following details: 15 Higher School graduates (35.7 percent). This distribution shows that most respondents have an adequate level of secondary education to understand basic health materials. But in reality, many prolanis participants with diabetes mellitus do not know the benefits of foot exercises. This is because many respondents showed that 18 respondents (42.9 percent) > 60 years old age. Thus, the study population is predominantly made up of elderly groups who are prone to chronic diseases and peripheral circulation disorders.

The management of diabetes mellitus is generally carried out through two approaches, namely pharmacological and non-pharmacological therapy. Pharmacological therapy involves administering medications, both insulin and oral hypoglycemic agents, which aim to lower blood glucose levels. Meanwhile, non-pharmacological therapies include weight management, the application of a healthy diet (diet), and physical activity. Unfortunately, most people with diabetes focus more on dietary arrangements and medication consumption, while the exercise aspect is still often overlooked (Faizah et al., 2021). In fact, light sports such as walking, leisurely cycling, swimming, and gymnastics are highly recommended, one of which is diabetic foot gymnastics. Participation in foot gymnastics to perform foot exercises regularly and correctly, both by diabetics and non-sufferers, to maintain foot health, improve blood circulation and prevent foot problems (Parada Flores et al., 2023).

From the results of the research at the UPTD Puger Health Center with 42 respondents whose perfusion data is available, as many as 23 people (54.8 percent) experienced mild perfusion and 19 people (45.2 percent) experienced moderate perfusion. No respondents with heavy perfusion were found. These findings suggest that most respondents are from formal non-worker groups, who are likely to have more flexible time to join health programs such as Prolanis. This shows that the majority of respondents have mild to moderate blood circulation disorders.

Attendance in the prolanis program is the active participation of participants in activities organized by the program such as medical consultation, health education,

health monitoring and prolanis gymnastics. The chronic disease management program (Prolanis) organized by BPJS Kesehatan aims to improve the quality of patients with chronic diseases such as diabetes mellitus and hypertension through a proactive approach and integrated health services. This is related to the level of attendance at Prolanis there are as many as 36 respondents (85.7 percent) recorded actively participating in the Prolanis program, This high level of participation shows good acceptance of the chronic disease management program organized by health facilities. This data shows that most of the respondents are chronic sufferers with medium to long disease duration. The duration of suffering from the disease among respondents varied, with the highest number being 9 people (21.4 percent) for a duration of 3 years and 9 people (21.4 percent) for a duration of 6 years. So that peripheral perfusion in people with diabetes mellitus experiences mild peripheral perfusion on average.

Peripheral perfusion is the process of blood flow to all parts of the body, especially in extremity areas such as the hands and feet, to ensure that the tissues get enough oxygen and nutrients and remove limb products. Adequate peripheral perfusion is essential for healthy function and overall organ health (Soyoye et al., 2021). Ineffective peripheral perfusion can lead to serious problems, including wounds that are difficult to heal, infections and in severe cases amputations (Hasina et al, 2022). Monitoring and treatment of ineffective peripheral perfusion is essential to maintain limb health and prevent further complications. Peripheral tissue perfusion disorders that are not treated immediately can lead to nerve damage or peripheral neuropathy, which is characterized by a decrease to loss of tactile sensation in the legs (Arifahyuni & Retnaningsih, 2024). One of the causes of this perfusion disorder is atherosclerosis, which is a condition in which plaque accumulates on the walls of blood vessels. If you don't get the right treatment or treatment, atherosclerosis can cause obstructions in the arteries and veins in the lower extremities, thereby blocking blood flow to the tissues of the legs (Palacios-Abril et al., 2025).

Based on the results of the Spearman correlation analysis between foot exercises and perfusion in 42 respondents, a correlation coefficient value of -0.177 with a significance value (p-value) of 0.263 was obtained. The value of the correlation coefficient is in the range of -0.10 to -0.29, which according to the correlation interpretation guidelines is included in the category of very weak negative relationships. That is, statistically there is a tendency that the more often a person does foot exercises, the more perfusion decreases slightly, but this relationship is very weak and clinically meaningless. Furthermore, the significance value ($p = 0.263$) was greater than the commonly used significant limit of 0.05 ($p > 0.05$), which means that the association between foot gymnastics and perfusion is not statistically significant. In other words, there is not enough evidence to suggest that there is a real relationship between the two variables in the population based on the sample data used.

Based on the results of previous researchers, ineffective peripherals include food control, blood sugar control, environment and foot care for people with diabetes mellitus with foot gymnastics therapy. This foot exercise can increase peripheral perfusion is not effective for people with diabetes mellitus (de Faria et al., 2025). In people with diabetes mellitus, performing foot exercises routinely is an independent non-pharmacological therapy to treat the feet, so it is concluded that the relationship between diabetic foot exercises and peripheral perfusion is very strong. Diabetic foot exercises are one of the efforts

to increase peripheral perfusion (Soyoye et al., 2021). Increased peripheral perfusion can prevent the onset of diabetic ulcers. One of the five pillars of diabetes management that aims to increase peripheral perfusion is foot gymnastics. Diabetic foot exercises increase peripheral perfusion in people with diabetes mellitus because it can control blood sugar levels (Mustofa et al., 2021).

This insignificant difference in results can be explained by several methodological factors. First, the relatively limited sample size is likely to reduce statistical power, so that statistical tests are less able to detect small but likely associations in larger populations. Second, variability in perfusion measurements and participants' non-adherence to exercise protocols can result in measurement errors that weaken the actual association between foot exercises and perfusion. Third, the presence of confounding factors such as differences in initial vascular status, comorbidities or other uncontrolled levels of physical activity may obscure the direct relationship between leg exercise and peripheral perfusion. Therefore, although physiologically physical activity in the lower extremities is thought to affect blood circulation, the findings of these two studies suggest that the association may not be strong or require a more sensitive study design to be significantly detected.
These findings are in line with the results of previous studies reporting that although foot exercise and foot care interventions showed improvements in some clinical parameters, there was no significant difference in Ankle-Brachial Index (ABI) values between the intervention and control groups ($p = 0.26$), which also reflects that foot exercise is not necessarily directly associated with an increase in peripheral perfusion measured via ABI in patients with diabetes mellitus (Embuai et al., 2019).

CONCLUSION

The results showed that foot exercise activity was not significantly related to peripheral perfusion status in patients with diabetes mellitus. Health workers, especially nurses, are expected to provide continuous education and motivation so that patients routinely do foot exercises as part of daily self-care to maintain optimal peripheral circulation function.

Ethics Approval

This research passed the ethical test and met the ethical requirements with number: 1242/KEPK/UDS/VII/2025 dated July 07, 2025 by KEPK dr. Soebandi University.

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