

The Difference in Average Ankle-Brachial Index (ABI) Before and After Diabetic Foot Exercise in the Working Area of Simpang Kawat Public Health Center Jambi City

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ABSTRACT

Peripheral artery disease (PAD) is one of the chronic complications of type 2 diabetes mellitus that can be identified through the Ankle-Brachial Index (ABI). A low ABI score indicates impaired blood flow in the lower extremities. Diabetic foot exercise is a non-pharmacological intervention that can improve peripheral circulation. This study aimed to determine the difference in average ABI before and after the implementation of diabetic foot exercise in type 2 diabetes patients at the Simpang Kawat Public Health Center in Jambi City. This quantitative research used a quasi-experimental one-group pretest-posttest design. A total of 35 respondents were selected through purposive sampling based on specific inclusion and exclusion criteria. The intervention involved diabetic foot exercises performed twice a week for one week, each session lasting 20-30 minutes per person. ABI values were measured using a vascular Doppler device before and after the intervention, and data were analyzed using the paired sample t-test. The results showed a significant increase in mean ABI scores from 0.89 to 0.94 in both lower limbs. Statistical analysis revealed a significant difference ($p < 0.001$), and the effect size was large ($d = 1.39$ for the right extremity, $d = 1.28$ for the left), indicating the strong effectiveness of the intervention. In conclusion, diabetic foot exercise significantly improves peripheral blood circulation in patients with type 2 diabetes mellitus and can be recommended as part of routine diabetes self-care management.

Keywords: Ankle-Brachial Index, Diabetic Foot Exercise, Peripheral Artery Disease, Type 2 Diabetes Mellitus

INTRODUCTION

Diabetes mellitus is one of the leading non-communicable diseases with a rapidly increasing prevalence in Indonesia (Kemenkes, 2019). This chronic condition is not only characterized by elevated blood glucose levels but also by its potential to cause long-term complications affecting various organ systems (WHO, 2020). One of the most common vascular complications of type 2 diabetes mellitus is Peripheral Artery Disease (PAD), a condition in which narrowed blood vessels reduce blood flow to the lower extremities. A simple, non-invasive method to assess the presence and severity of PAD is through the Ankle-Brachial Index (ABI), which compares the systolic blood pressure in the ankle to that in the arm. A lower ABI score is often associated with impaired circulation and an increased risk of chronic wounds, infections, and even limb amputation (Widia, 2020).

In primary health care settings, especially in communities with limited access to advanced vascular care, early identification and preventive interventions are critical. One of the recommended non-pharmacological strategies to improve peripheral blood flow in diabetic patients is diabetic foot exercise. This form of physical activity involves a series of light, structured movements designed to enhance circulation in the feet, strengthen lower limb muscles, reduce the risk of foot deformities, and support overall vascular health (Kurnia, 2023). Despite its benefits, diabetic foot exercise remains underutilized in clinical practice, particularly in community health centers like Puskesmas Simpang Kawat, Jambi City, where many diabetic patients have never been introduced to or practiced this intervention.

This study was conducted to determine whether there is a significant difference in the Ankle-Brachial Index (ABI) values before and after the implementation of diabetic foot exercise in type 2 diabetes mellitus patients. The goal is to provide evidence for integrating diabetic foot exercise into regular nursing interventions at the primary care level to support vascular health and prevent complications related to poor circulation in diabetic individuals.

METHODS

This research uses a quantitative quasi-experimental study with a one-group pretest-posttest design to determine the difference in Ankle-Brachial Index (ABI) values before and after diabetic foot exercise. The study was conducted at the Simpang Kawat Public Health Center, Jambi City, in March–April 2025. The sample consisted of 35 respondents selected using purposive sampling based on inclusion and exclusion criteria. The intervention was diabetic foot exercise performed twice per week for one week. ABI measurements were taken using a vascular Doppler before and after the intervention. Data were analyzed using paired sample t-test.

RESULTS

Based on the data collected from 35 diverse respondents, the characteristics of the respondents are as follows.

1. Respondent Characteristics

a. Respondent Characteristics Based on Age

Table 1. Frequency Distribution of Respondents by Age

No	Age group (years)	Frequency (f)	Percentage (%)
1	40-49	3	8,57
2	50-59	9	25,71
3	60-69	17	48,57
4	≥70	6	17,14
Total		35	100

Based on Table 1, the majority of respondents in this study were in the 60–69 years age group, totaling 17 individuals or 48.57%. The second largest group was aged 50–59 years with 9 respondents (25.71%), followed by the ≥70 years group with 6 respondents (17.14%), and the 40–49 years group with 3 respondents (8.57%). This indicates that most respondents were in the early elderly category, which is considered a vulnerable group for complications of diabetes mellitus, particularly peripheral blood circulation disorders.

b. Respondent Characteristics Based on Gender

Table 2 Frequency Distribution of Respondents by Gender

No	Gender	Frequency (f)	Percentage (%)
1	Male	18	51,43
2	Female	17	48,57
Total		35	100

Based on Table 2, the majority of respondents in this study were male, totaling 18 individuals or 51.43%, while female respondents accounted for 17 individuals or 48.57%. This indicates that the gender distribution of respondents was relatively balanced between males and females.

c. Respondent Characteristics Based on Educational Background

Table 3. Frequency Distribution of Respondents by Educational Background

No	Education Level	Frequency (f)	Percentage (%)
1	No formal education	1	2,86
2	Elementary School	1	2,86
3	Junior High School	10	28,57
4	Senior High School	9	25,71
5	Higher Education	14	40
Total		35	100

Based on Table 3, which presents the characteristics of respondents by education level, most respondents had completed higher education, accounting for 40% of the total. This was followed by junior high school graduates at 28.57%, and senior high school graduates at 25.71%. Meanwhile, respondents who had only completed elementary school and those with no formal education each made up 2.86%. These data indicate that the majority of respondents had a relatively high level of educational background.

d. Respondent Characteristics Based on Occupational Background

Table 4. Frequency Distribution of Respondents by Occupation

No	Occupation	Frequency (f)	Percentage (%)
1	Daily laborer	4	11,43
2	Entrepreneur	5	14,29
3	Driver	1	2,86
4	Farm laborer	1	2,86
5	Retired civil servant	12	34,29
6	Civil servant	3	8,57
7	Housewife	9	25,71
Total		35	100

Based on Table 4 regarding occupational history, respondents in this study came from diverse professional backgrounds. The majority were retired civil servants, accounting for 34.29%, followed by housewives at 25.71%, and entrepreneurs at 14.29%. In addition, there were respondents who worked as daily laborers (11.43%), active civil servants (8.57%), as well as drivers and farm laborers, each comprising 2.86%. This occupational diversity reflects the varied socioeconomic backgrounds among the respondents.

e. Respondent Characteristics Based on Duration of Diabetes Mellitus

Table 5. Frequency Distribution of Respondents by Duration of Diabetes Mellitus

No	Duration of DM	Frequency (f)	Percentage (%)
1	<2 years	1	2,86
2	>2 years	34	97,14
Total		35	100

Table 5 shows that the majority of respondents in this study, accounting for 97.14%, had been living with diabetes mellitus for more than two years. Only one respondent (2.86%) had experienced diabetes for less than two years. These findings indicate that most respondents had a relatively long history of diabetes, which may influence vascular conditions and increase the risk of complications such as peripheral circulation disorders.

f. Respondent Characteristics Based on Smoking Status

Table 6. Frequency Distribution of Respondents by Smoking Status

No	Smoking Status	Frequency (f)	Percentage (%)
1	Active smoker	4	11,43
2	Non-smoker	31	88,57
Total		35	100

Based on Table 6, the majority of respondents in this study were non-smokers, totaling 88.57%. Meanwhile, only 11.43% of respondents were identified as active smokers. This condition indicates that most respondents had a relatively healthier lifestyle regarding smoking habits, which may contribute to better vascular health and peripheral circulation.

g. Respondent Characteristics Based on Hypertension History

Table 7 Frequency Distribution of Respondents by History of Hypertension

No	History of Hypertension	Frequency (f)	Percentage (%)
1	Yes	17	48,57
2	No	18	51,43
Total		35	100

As shown in Table 7, the respondents in this study were almost evenly divided, with 51.43% having no history of hypertension and 48.57% having a history of hypertension. This balanced distribution suggests that nearly half of the respondents may have an additional cardiovascular risk factor that could affect peripheral circulation.

2. Bivariate Analysis

Table 8. Results of Paired Sample t-Test on the Right Extremity

	ABI Pre Right	ABI Post Right
Mean	0,89	0,94
Std. Deviation	0,06	0,05

Minimum	0,79	0,86
Maximum	1	1
95% Confidence interval of mean	0,87-0,91	0,92 - 0,96
Mean ± Std.	0,89 ± 0,06	0,94 ± 0,05
P	<0,001	
D	1,39	

The analysis results showed that the mean Ankle-Brachial Index (ABI) value before the intervention on the right extremity was 0.89 with a standard deviation (SD) of 0.06, ranging from 0.79 to 1.00. After the diabetic foot exercise intervention, the mean ABI increased to 0.94 with an SD of 0.05 and a range between 0.86 and 1.00. The paired t-test indicated that this increase was statistically significant, with a p-value of < 0.001. Additionally, the effect size was calculated at 1.39, indicating that the intervention had a strong effect on improving the ABI of the respondents' right lower extremities.

Table 9. Results of Paired Sample t-Test on the Left Extremity

	ABI Pre Left	ABI Post Left
Mean	0,89	0,94
Std. Deviation	0,05	0,05
Minimum	0,79	0,86
Maximum	1	1
95% Confidence interval of mean	0,87 - 0,91	0,92 - 0,95
Mean ± Std.	0,89 ± 0,05	0,94 ± 0,05
P	<0,001	
D	1,28	

On the left extremity, the mean Ankle-Brachial Index (ABI) value before the intervention was 0.89 with a standard deviation of 0.05. After the diabetic foot exercise intervention, the mean ABI increased to 0.94, with the same standard deviation of 0.05. The paired t-test results indicated that this improvement was statistically significant, with a p-value of < 0.001. Furthermore, the effect size of 1.28 suggests that the intervention had a strong impact on increasing the ABI in the respondents' left lower extremities. These findings demonstrate that diabetic foot exercise is effective in improving peripheral blood circulation in the left extremity.

DISCUSSION

The present study demonstrates that diabetic foot exercise has a significant impact on improving peripheral circulation in patients with type 2 diabetes mellitus, as indicated by increased Ankle-Brachial Index (ABI) values. Prior to the intervention, the mean ABI in both lower extremities was 0.89, a value slightly below the normal range (>0.90), suggesting the presence of mild peripheral arterial disease (PAD). This aligns with the American Heart Association's definition, which classifies ABI values below 0.90 as an indicator of arterial narrowing. Patients with diabetes are at higher risk for PAD due to chronic hyperglycemia, which contributes to endothelial dysfunction, arterial stiffness, and atherosclerosis. The low ABI values observed in this study reflect early signs of vascular impairment, even in the absence of clinical symptoms such as claudication.

Following one weeks of diabetic foot exercise performed twice per week, the mean ABI value increased to 0.94 ± 0.05 in both extremities. This post-intervention value falls within the normal range, indicating improved peripheral perfusion. Diabetic foot exercise, as a low-intensity physical activity, activates the calf muscles, stimulates venous return, and promotes arterial elasticity. This physiological mechanism enhances peripheral circulation and supports tissue oxygenation. The improvement in ABI was not only statistically significant (p < 0.001) but also clinically meaningful, as shown by large effect sizes (d = 1.39 for the right leg and d = 1.28 for the left leg). These findings are consistent with previous studies by Wahyuni et al. (2021), Siregar and Nurhayati (2023), and Fitriana (2022), all of which support the effectiveness of diabetic foot exercises in increasing ABI and improving vascular function.

Furthermore, this study reinforces the value of ABI as a non-invasive and practical tool for early detection of macrovascular complications in diabetic patients. The significant post-intervention increase in ABI values suggests that regular foot exercise may help reverse early-stage PAD. The physiological improvements observed can be attributed to repeated muscle contractions, which promote venous return and stimulate vasodilation. This improves capillary perfusion, blood pressure regulation, and vascular tone.

An interesting observation in this study was the variation in ABI improvement relative to exercise frequency. While the standard program recommended exercise twice per week, some respondents, such as Mrs. E (57 years old), practiced more frequently at home and experienced a more substantial ABI increase—from 0.91 to 1.00 in both legs. In contrast, Mrs. S (65 years old), who followed the prescribed schedule, experienced a more modest increase. This suggests that frequency and adherence may influence the magnitude of physiological response, and future studies could explore this relationship further.

In conclusion, diabetic foot exercise is an effective non-pharmacological intervention for improving peripheral blood flow in patients with type 2 diabetes mellitus. The intervention significantly increases ABI values, reflecting enhanced peripheral circulation and potentially lowering the risk of severe vascular complications such as foot ulcers and amputation. These findings highlight the importance of integrating structured exercise programs into diabetes self-management, particularly at the primary health care level.

CONCLUSIONS

Based on the results of research on the difference in average Ankle-Brachial Index (ABI) before and after diabetic foot exercise among type 2 diabetes mellitus patients at the Simpang Kawat Public Health Center, Jambi City, in 2025, it can be concluded that: From 35 respondents, the average ABI value before the intervention was 0.89 on both lower limbs, which was below the normal range. After undergoing diabetic foot exercise twice a week for four weeks, the average ABI increased to 0.94, which is within the normal range. Statistical analysis showed a significant difference with a p-value of < 0.001 . The effect size was 1.39 on the right leg and 1.28 on the left leg, indicating a strong impact of the intervention. Diabetic foot exercise is proven to be effective in improving peripheral blood circulation in type 2 diabetes mellitus patients.

It is expected that the Simpang Kawat Public Health Center can implement regular diabetic foot exercise classes as part of diabetes self-management programs. Healthcare workers should be trained to deliver the exercises correctly, and community health cadres can be empowered to help educate patients. Diabetic patients are also encouraged to perform the exercises independently at home at least twice a week as part of their routine to prevent diabetic foot complications.

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