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Nursing-Based Diabetes Self-Management Education for Controlling Peripheral Artery Disease in Type 2 Diabetes: A Quasi-Experimental Study

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ABSTRACT

Background: Peripheral Artery Disease (PAD) is a significant complication of type 2 Diabetes Mellitus (DM). PAD is an obstructive atherosclerotic vascular disease that interferes with the arteries, causing problems or changes in the circulation of the legs. Adherence to the four pillars of diabetes management—including diet, physical activity, medication adherence, and monitoring. **Objectives:** To analyze the effect of Diabetes Self-Management Education (DSME) on controlling PAD in Type 2 Diabetes. **Methods:** This research employs a quasi-experimental method and was conducted over 16 weeks, from August to November 2024, at the Gajahan and Pucang Sawit Community Health Centers in Surakarta. The selected respondents were 79, with the criteria of suffering from diabetes for 2 years and not having diabetic foot ulcers. Respondents were divided into two groups: the intervention group, with 40 participants, and the control group, with 39 participants. **Results:** The analysis revealed a significant difference in ankle-brachial index (ABI) values ($p = 0.001$) and foot sensitivity ($p = 0.001$) between the intervention group and the control group after the intervention. The mean ABI of the intervention group (0.99) was lower than that of the control group (1.16). In contrast, the mean sensitivity of the intervention group (9.74) was higher than the mean of the control group (8.36). **Conclusion:** DSME can control PAD by improving foot sensitivity, but 3 months is not enough time to improve the Ankle-Brachial Index (ABI).

Keywords: Ankle-Brachial Index; Diabetes Mellitus; Foot Sensitivity; Self-Management Education

INTRODUCTION

The prevalence of diabetes mellitus is increasing worldwide. The global number of adults living with diabetes is projected to reach 589 million by 2025, representing 11.1% of all adults. The number of cases is expected to rise to more than 850 million by 2050 (Duncan *et al*., 2025). The increase in diabetes is due to population growth, aging, unhealthy diets, obesity, and sedentary lifestyles. Diabetes patients can implement alternative management and treatment strategies through self-care health education approaches. Self-care health education management can help type 2 diabetes patients by teaching them how to apply the Diabetes Self-Management Education (DSME) method (Bakara & Kurniyati, 2022).

Diabetes Mellitus type 2 (DM Type 2) can result in a wide variety of complications. WHO data shows that type 2 diabetes (type 2 diabetes) can cause many complications that are harmful to the health of sufferers. The number of cases of type 2 diabetes that have complications has increased in recent years (Niu *et al*., 2024). Thus, people with type 2 diabetes have a two- to three-fold risk of death from various causes of death (Peimani *et al.*, 2024). This disease increases every year and causes many complications, one of which is peripheral vasculopathy.

The main complication of type 2 diabetes mellitus is diabetic foot ulcers, which occur in 15% of people (van Netten *et al*., 2024). Local complications of DM disease include damage to the arteries, which causes patients to be unable to walk far or close due to insufficient oxygen flow to the leg muscles, causing numbness or numbness (Staniszewska *et al*., 2024). Peripheral neuropathy and secondary ischemia caused by peripheral

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vascular disease are the leading causes of ulcers – . Peripheral neuropathy can occur due to repeated damage to sensory nerve fibers. In addition, skin surface damage and ulcers are caused by the deposition of glucose metabolism products, such as advanced glycosylation end products, in the blood vessels of the lower limbs (Rodrigues *et al*., 2022).

Peripheral Artery Disease (PAD) is an obstructive atherosclerotic vascular disease that interferes with the arteries, causing problems or changes in the circulation of the legs (Zúnica-García *et al.*, 2024). Increased risk of cardiovascular disease and amputation is associated with PAD (Staniszewska *et al*., 2024). The risk of PAD will increase with age, the duration of diabetes, and the presence of primary neuropathy (Perks *et al*., 2023). Therefore, early detection is necessary to reduce the risk of amputation (Jalilian *et al*., 2020). Occurrences of PAD, such as lower limb infections, diabetic foot ulcers, peripheral artery disease, and gangrene, are the most common medical conditions that cause amputation (Davidson *et al*., 2023). More than 85 percent of people with diabetes require lower limb amputation because of diabetic foot ulcers that are generally difficult to cure (Serban *et al*., 2021).

Although not all diabetics are at risk of developing foot ulcers, it is still important for people with diabetes who have risk factors to take precautions (van Netten *et al*., 2024). To avoid complications of diabetes, effective DM management is essential (Tanamas *et al*., 2025). The main concepts of diabetes self-management include dietary adherence, physical activity, blood glucose monitoring, medication adherence, and risk-reduction behaviors (Molla *et al*., 2025). Poor foot care management can lead to cuts, infections, or decreased physiological function of the foot, leading to various complications (Sirait *et al*., 2024). To reduce the risk of diabetic foot ulcers, diabetics should adhere to a diabetes treatment program consisting of doctor therapy, diet, and exercise. However, medication compliance in diabetes sufferers is still not optimal, so DM sufferers need to be given DSME (Jalilian *et al*., 2020). DSME has been shown to improve health promotion to prevent diabetic foot ulcers (Kartika *et al*., 2021).

Education is important for people with DM. Education in DM patients can prevent complications of diabetic foot ulcers, improving Quality of Life (Ghasemi *et al*., 2021), increases dietary or nutritional adherence (Medhat *et al*., 2020; Lee *et al*., 2022), increase knowledge (Sarmadikia *et al*., 2022), as well as increasing compliance in activities (Medhat *et al*., 2020). Certified diabetes nurses and certified diabetes educators can play an important role in teaching people with diabetes about reducing their risk of diabetic foot disease (Abdelaziz et al., 2022). A team consisting of an endocrinologist or diabetes specialist, a physician trained to care for people with diabetes, a diabetes specialist nurse or diabetes educator, and a dietitian should provide education (Olinder *et al*., 2022). The novelty of this research is to carry out a DSME approach with four pillars of diabetes management, namely nutrition/nutrition, physical activity, treatment, and education to prevent diabetic foot ulcers effectively. However, evidence on the direct impact of DSME on PAD parameters remains limited. This study aims to analyze the effect of DSME on the control of PAD in Type 2 Diabetes.

METHODOLOGY

Study Design

This quasi-experimental research was conducted in Pucang Sawit and Gajahan Community Health Centers Surakarta, Indonesia, from August to November 2024. The intervention group received treatment through the Diabetes Self-Management Education (DSME) method, which included material on diet, physical activity, and medication. The DSME applied in this study is a behavioral nursing intervention that aims to empower patients to improve their health status. The control group received a book compiled by the researchers as a self-management guide to improve adherence to diet, physical activity, and medication.

Samples/Participants

The study involved two groups of people diagnosed with type 2 DM. The intervention group had 40 respondents, while the control group had 39 respondents. Cluster random sampling was used initially to select study areas, followed by simple random sampling to recruit participants, and simple random sampling is used in the second stage to take samples from a predetermined population. Respondents met the inclusion criteria: they were registered as type 2 diabetics at the Health Center, had been diagnosed with type 2 diabetes for at least two

years, did not have diabetic foot ulcers, and were willing to be respondents. However, people with type 2 DM with complications who are unable to communicate are criteria that are not included in this study.

Data Collection

In this study, the measurement used was the Diabetes Self-Management Education (DSME) method, which consisted of three instruments: DM diet, physical activity, and medication (Lai *et al*., 2024). The research instrument has been tested for validity and reliability with a Cronbach's alpha value of 0.975. Noninvasive tests to detect PAD include the ankle-brachial index (ABI) test and the plantar sensitivity test, which is assessed using 10g of Semmes-Weinstein monofilament (Cerqueira *et al.*, 2024). ABI and foot sensitivity examinations were performed in both groups before and after the intervention to identify PAD.

Data Analysis

Data analysis was carried out to examine the differences in respondent characteristics, ABI values, and foot sensitivity before and after the intervention. Categorical variables can be described by frequency and percentage, continuous variables can be described by mean and standard deviation. The Mann–Whitney U test and independent t-test were used to test differences between continuous data. In contrast, the chi-square test was used to examine differences in categorical variables with a significance level of $p < 0.05$.

Ethical Consideration

This research received ethical approval from the Research Ethics Commission, Universitas Aisyiyah Surakarta, Indonesia with reference number 198/VII/AUEC/2024 on 4th July, 2024.

RESULTS

Table 1: Distribution of Respondent Characteristics of the Intervention and Control Groups

Variable	Intervention Groups (n = 40)	Control Groups (n = 39)	*p*
Gender			
Female	24 (60%)	28 (71.79%)	0.206
Male	16 (40%)	11 (28.2%)	
Employment Status			
Working	17 (42.5%)	15 (34.46%)	1.000
Not working	23 (57.5%)	24 (61.54%)	
Education Level			
Higher education	5 (12.5%)	2 (5.13%)	0.014*
Secondary education	20 (50%)	10 (25.64%)	
Primary education	15 (37.5%)	27 (69.23%)	
Smoking History			
Do not smoke	33 (82.5%)	35 (89.7%)	0.866
Smoke	7 (17.5%)	4 (10,3%)	
Age	62.55 (9.25%)	60.67 (8.95%)	0.361
Duration of Diabetes	7.43 (7.56%)	5.49 (7.02%)	0.242

**Significant at p < 0.05 when comparing intervention and control groups*

Analysis results Table 1 showed no significant differences between the intervention and control groups in terms of gender (p=0.206), occupation (p=1.000), smoking history (p=0.866), age (p=0.361), and duration of illness (p=0.242). However, there were differences between the two groups in terms of education level (p=0.014).

Table 2: Differences in ABI and Pre and Post-intervention Sensitivity in the Intervention and Control Groups

Variable	N	Pre-intervention		Post-intervention	
		Mean (SD)	*p*	Mean (SD)	*p*
ABI					
Intervention groups	40	1.15 (0.21)	0.001*	0.99 (0.20)	<0.001*
Control groups	39	0.98 (0.20)		1.16 (0.21)	
Sensitivity					
Intervention groups	40	7.48 (3.84)	0.495	9.74 (0.59)	0.001*
Control groups	39	6.92 (3.94)		8.36 (1.98)	

**Significant at p < 0.05 when comparing intervention and control groups*

Based on Table 2, there was no significant difference in the initial foot sensitivity values (p=0.495), but there was a difference in the ABI (p=0.001). The ABI values (p<0.001) and foot sensitivity (p=0.001) after the intervention showed significant differences. The post-intervention measurement results showed that the average ABI in the intervention group (0.99) was lower than in the control group (1.16). These results indicate a decrease in the ABI value in the intervention group. Meanwhile, the average foot sensitivity value in the intervention group (9.74) was higher than that in the control group (8.36), indicating an increase in foot sensitivity in the intervention group.

DISCUSSION

Diabetes Self-Management Education (DSME) is an educational method that nurses can implement to improve the knowledge and self-management skills of people with diabetes. The education level influences the success of DSME. This study showed a difference in education level between the intervention and control groups, which could influence DSME outcomes. The majority of respondents in this study had a high school education. Diabetes patients with lower education levels had poorer glycemic control and a lower risk of death (Liao *et al*., 2023). Therefore, various behavioral, psychosocial, and psychological interventions are needed, along with empowering, didactic, interactive, and collaborative educational methods (Camargo-Plazas *et al*., 2023) to increase understanding and improve self-care skills.

DSME conducted by nurses in carrying out their roles as educators and facilitators has proven effective in improving knowledge (Harahap *et al*., 2025) and glycemic control behaviors of diabetes patients (Sun *et al*., 2025; Osei *et al*., 2025). Better knowledge can help diabetes patients manage diet, medication, activity, and stress (Kusnanto *et al*., 2020). Therefore, to improve the quality of life for patients with diabetes, education is necessary (Medhat *et al*., 2020; Lee *et al*., 2022). The main goal of education for patients with diabetes is to achieve metabolic control, preventing complications from developing. To optimize metabolic control, a multidisciplinary approach is needed that combines diet, physical activity, and therapy or medication (Acosta *et al*., 2025; Sarmadikia *et al*., 2022).

DSME is a process that facilitates the development of knowledge, attitudes, and self-management skills (Ernawati *et al*., 2021) to control PAD, as evidenced by foot sensitivity measurements. Diabetes mellitus is a chronic disease that requires lifelong lifestyle interventions and pharmacological therapy (Bekele *et al*., 2020). Consequently, individuals with diabetes must make numerous self-management decisions and engage in complex daily care activities (Bakara & Kurniyati, 2022). DSME can influence daily care behaviors in people with diabetes (Lai *et al*., 2024). Education, meal planning, lifestyle changes, physical activity, and healthy habits are key components of diabetes mellitus (DM) management. DSME helps people with diabetes make lifestyle changes and improve their health outcomes.

DSME can improve a person's ability to live a healthy life with diabetes and reduce the risk of diabetes-related complications (Olson *et al*., 2022). Lifestyle changes such as regular exercise, weight management, and adopting a healthy diet can improve peripheral perfusion and lower blood sugar levels, thereby preventing diabetes complications (Hartanto *et al*., 2025). Therefore, dietary education programs appear crucial for preventing and reducing the complications of type 2 diabetes (Sarmadikia *et al*., 2022).

Nurses play a key role in educating diabetes patients about self-management within the healthcare system (Zhuang & Bo, 2025). This reinforces the importance of DSME for the ongoing care of people with diabetes (Camargo-Plazas *et al*., 2023). Lifestyle and dietary changes can improve outcomes for patients with diabetes. Adherence to a diet is the first step in managing diabetes. However, dietary changes and adherence to dietary recommendations are the most difficult parts of diabetes management (Molavynejad *et al.*, 2022).

DSME can improve foot care behavior and awareness by assessing foot conditions, helping patients avoid DM-related foot problems. One way to perform a foot examination is to check foot sensitivity and the Ankle-Brachial Index (ABI) (Frisca, 2021). An increase or decrease in the ABI can lead to complications in people with type 2 diabetes. Type 2 DM patients with high ABI values are at higher risk of developing foot ulcers and neuropathy compared to DM patients with normal ABI values (Sartore *et al.*, 2023). However, the DSME program needs to be implemented continuously for at least 1 year to be effective in improving glycemic control (Lai *et al.*, 2024) and, thus, ABI values.

DSME addresses all the elements of clinical, educational, psychosocial, and behavioral care necessary for day-to-day self-management and provides a foundation to help all people with diabetes go through daily care confidently and with better outcomes (Powers *et al.*, 2020). So that DMSE can increase compliance in diabetics, one of which is by exercising regularly. Exercise is an important part of the lifestyle of diabetics. Exercise can increase vasodilation and tissue blood flow (Tran & Haley, 2021). Exercise can also improve myelin and axon nerve function and improve nerve conduction and sensitivity, thereby reducing peripheral sensory neuropathy. In addition, exercise also plays an important role in improving the sensory sensitivity of the feet, improving blood circulation, reducing neuropathy, and lowering blood glucose levels in patients with diabetes mellitus (Sirait *et al.*, 2024).

Limitations

Limitations of this study include its focus on education about medication, diet, and activity, as well as differences in educational background, which may influence the study's findings.

CONCLUSION

This study demonstrates the importance of structured DSME in managing PAD in patients with diabetes, encouraging nurses and other healthcare professionals to enhance their role in educating patients with diabetes. DSME can control PAD by improving foot sensitivity, but three months is not enough time to improve ABI values. The study also suggests that DSME can improve patients' self-care skills, thereby helping them better manage and detect PAD risk. Given the limitations of this study, including the small sample size and the 3-month DSME implementation period, these results should be considered preliminary. Future studies should include larger sample sizes and longer follow-up periods to yield more accurate results. Researchers are also encouraged to explore multiple methods for aggregating PAD.

Recommendation

This study demonstrates that Diabetes Self-Management Education (DSME) can be implemented for all people with diabetes. DSME should also be implemented over a longer period. The use of digital tools for continuing education programs can also complement the material provided to people with diabetes.

Conflict of Interest

No potential conflicts of interest relevant to this article have been reported.

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