

Foot Exercise on Foot Sensitivity in Diabetic Peripheral Neuropathy: A Systematic Review

Muzaroah Ermawati Ulkhasanah^{1*}, Hani Risnawati¹, Mustain¹, Natalino Vasco da Silva²

¹Departement of Nursing Study, Faculty of Health Science, Universitas Duta Bangsa Surakarta, Indonesia

²Faculty Of Medicine And Science Of Health, Universidade Nacional Timor Lorosa'e

Email: muzaroah_ermawati@udb.ac.id

ABSTRACT

Background: Diabetic Peripheral Neuropathy (DPN) is one of the most common chronic complications of diabetes mellitus, characterized by decreased foot sensitivity, numbness, tingling, pain, and an increased risk of foot ulcers and amputation. Various non-pharmacological interventions have been developed to improve peripheral circulation and nerve function, including foot exercise. However, evidence regarding the effectiveness of foot exercise in improving foot sensitivity among patients with DPN remains scattered across studies. **Objective:** This systematic review aimed to evaluate the effectiveness of foot exercise interventions on foot sensitivity in patients with Diabetic Peripheral Neuropathy. **Methods:** A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Electronic databases including PubMed, Scopus, ScienceDirect, ProQuest, and Google Scholar were searched for relevant studies published between 2015 and 2025. The inclusion criteria comprised experimental and quasi-experimental studies involving adult patients with diabetes mellitus and Diabetic Peripheral Neuropathy who received foot exercise interventions. Data extraction and quality appraisal were performed independently by reviewers, and findings were synthesized narratively. **Results:** A total of 10 studies met the inclusion criteria. The reviewed studies consistently demonstrated that foot exercise significantly improved foot sensitivity, peripheral blood circulation, balance, and lower-extremity function among patients with DPN. Several studies reported significant improvements in monofilament test scores, vibration perception, and sensory function following regular foot exercise programs performed for 1-2 weeks. **Conclusion:** The positive effects were associated with increased blood flow, enhanced muscle activity, and stimulation of peripheral nerve function.

Keywords Diabetes Mellitus, Diabetic Peripheral Neuropathy, Foot Exercise, Foot Sensitivity, Diabetic Foot, Systematic Review.

This is an Open Access article licensed under the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are properly cited

INTRODUCTION

Diabetes mellitus is a growing global health problem, with an estimated prevalence of 463 million people in 2019 and predicted to increase to 700 million by 2045. Diabetes mellitus is a metabolic disorder characterized by hyperglycemia due to insulin deficiency or insulin resistance. The causes of diabetes mellitus are complex and involve various factors, including genetics, environment, and lifestyle. Symptoms of diabetes mellitus are classified into four categories: type 1 diabetes mellitus, which is caused by damage to pancreatic beta cells, resulting in absolute insulin deficiency. Type 2 diabetes mellitus results from progressive insulin secretion disorders associated with insulin resistance. Specific types of diabetes mellitus result from genetic disorders of beta cells, genetic disorders of insulin action, and diseases of the exocrine pancreas. Diabetes mellitus occurs during pregnancy.

The American Diabetes Association and the World Health Organization (WHO) use random blood sugar (CBG) and fasting blood sugar (FBG) tests to diagnose diabetes mellitus, as well as hemoglobin A1c (HbA1c), which are crucial indicators for determining the diagnosis of diabetes mellitus. The HbA1c test can provide an overview of average glucose levels over the past 2-3 months and correlates well with the risk of long-term diabetes complications. Diabetes mellitus can be managed through lifestyle changes, such as dietary adjustments and increased physical activity, as a non-drug therapy. People with diabetes receive pharmacological therapy to control blood glucose levels and prevent potential complications. Various types of diabetes medications are available, including oral medications, such as metformin, which aim to increase insulin sensitivity and reduce glucose production by the liver. Insulin, prescribed for patients with type 1 diabetes and some cases of type 2 diabetes, works by increasing glucose uptake by the body's cells.

Complications of diabetes mellitus, particularly peripheral neuropathy, are a major concern because they can significantly reduce a patient's quality of life. Diabetic peripheral neuropathy is a complication caused by nerve damage caused by long-term high blood glucose levels, which can cause symptoms such as tingling, pain, and loss of sensation in the extremities.

Diabetic peripheral neuropathy can lead to mobility difficulties, an increased risk of injury, and infection, significantly impacting a patient's quality of life. Diabetic peripheral neuropathy is a major challenge in diabetes management due to its impact on patients' quality of life. The management of diabetic peripheral neuropathy involves diabetic foot exercise therapy, which is believed to improve blood circulation and stimulate nerve fibers, thereby helping restore sensory function in the feet. Treatment: Interventional methods have been studied to improve sensitivity in patients with diabetic peripheral neuropathy, including physical exercise, electrical stimulation, and manual therapy.

Studies have shown varying results with diabetic foot exercise management on increasing sensitivity in diabetic peripheral neuropathy. Therefore, a systematic review is needed to provide scientifically sound evidence regarding the effectiveness of diabetic foot exercise on sensitivity in diabetic peripheral neuropathy.

METHODS

This study uses a systematic literature review method that aims to identify, assess and synthesize all relevant empirical evidence regarding the effect of diabetic foot exercise therapy in preventing the severity of diabetic peripheral neuropathy as a complication of diabetes mellitus. The research process was carried out systematically, explicitly and reproducibly to minimize bias and produce evidence-based conclusions. The research data

sources used came from Google Scholar, Pubmed, ScienceDirect, Researchgate, EBSCO. The article search used keywords: diabetic foot exercise AND sensitivity AND diabetic peripheral neuropathy. The study found 8 scientific works in the form of international journals from 2022 to 2026. The analysis of the journal results was carried out by examining similarities and differences, comparing the time, dosage of implementation of diabetic foot exercise on the sensitivity of diabetic peripheral neuropathy.

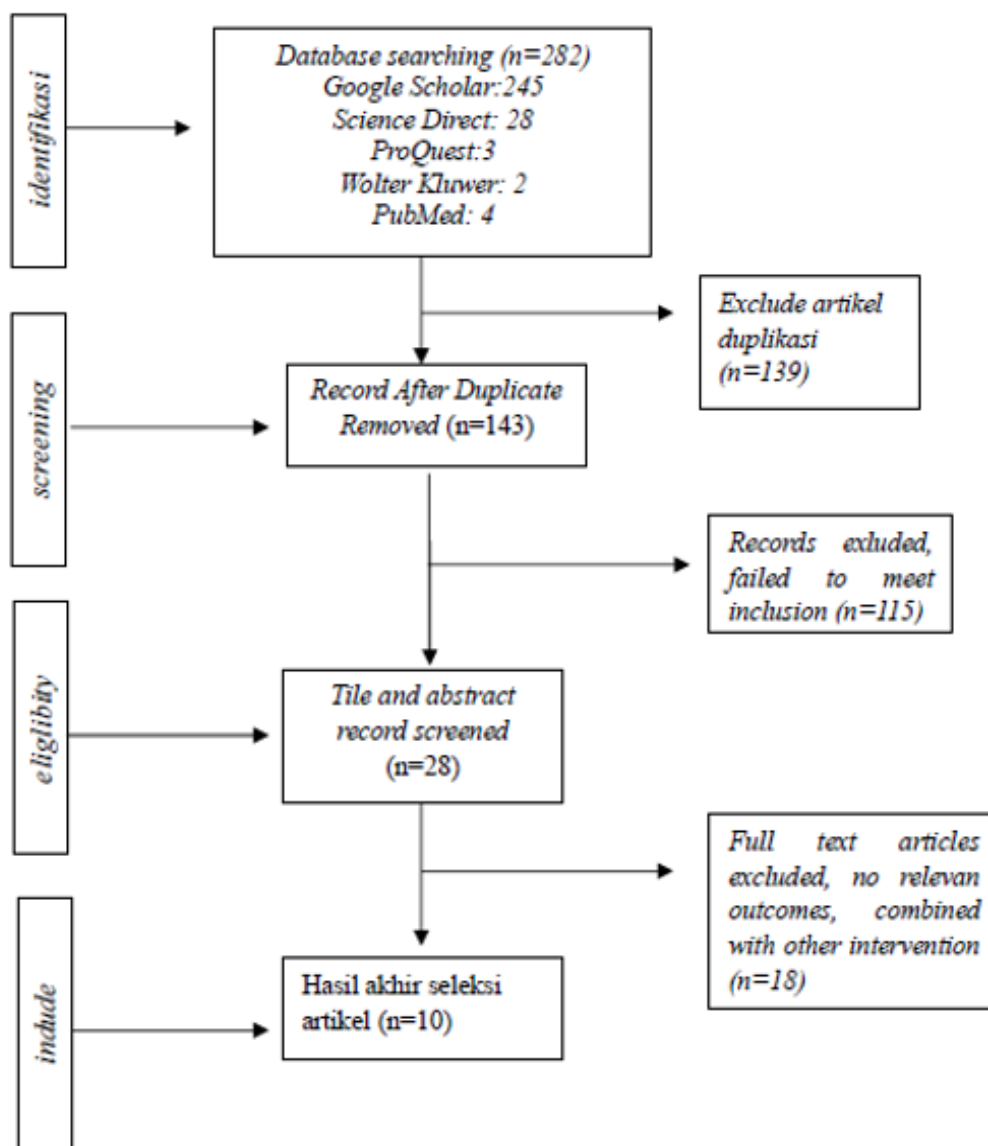


Figure 1. Research Stages Flowchart

RESULTS

Diabetes mellitus, especially type 2 diabetes, often leads to serious complications such as peripheral neuropathy, which can significantly reduce sensation in the feet. Various interventions have been studied to improve foot sensitivity in patients with this condition,

including foot exercise techniques. Several studies have shown that foot exercises, such as the Buerger Allen Exercise and other techniques, can have a positive effect on foot sensitivity. The Buerger Allen Exercise is one effective method for improving perfusion and sensitivity in patients with type 2 diabetes. Recent research has shown that consistent application of this exercise can improve patients' ability to sense stimuli in their feet, which is an important indicator in preventing wounds and infections.

Table 2. Summary of Previous Studies on the Effect of Diabetic Foot Exercises on Foot Sensitivity and Peripheral Neuropathy in Patients with Diabetes Mellitus

No.	Author and Year	Research Objective	Intervention Duration	Results / p-value	Interpretation
1	Uba, N. A., Mubarrok, A. S., & Kurdi, F. (2025)	To examine the effect of diabetic foot gymnastics on injury prevention, blood circulation, and foot sensitivity in patients with diabetes mellitus.	5 days	$p < 0.001$	Diabetic foot gymnastics had a highly statistically significant effect on the measured outcomes. The intervention was associated with improved foot condition, circulation, or sensitivity among patients with diabetes mellitus.
2	Wijayanti, D. R., & Warsono, W. (2022)	To analyze the application of the Buerger-Allen exercise and its effect on foot sensitivity in patients with diabetes mellitus.	1 week	$p = 0.001$	The Buerger-Allen exercise had a statistically significant effect on foot sensitivity. This result indicates that the intervention may help improve peripheral circulation and sensory function in diabetic patients.
3	Lestari, D. Y., Rondhianto, R., Kushariyadi, K., & Sujarwanto. (2024)	To explore the effect of leg exercises on blood circulation and diabetic peripheral neuropathy.	3 days	$p < 0.001$	Leg exercises had a highly statistically significant effect on blood circulation and diabetic peripheral neuropathy. The intervention may support better peripheral blood flow and reduce neuropathy-related problems.
4	Sumarni, T., & Hartanto, Y. D. (2023)	To determine the use of diabetic foot exercises in preventing and managing neuropathy.	2 weeks	$p < 0.001$	Diabetic foot exercises had a highly statistically significant effect on neuropathy prevention and management. The findings support the use of regular foot exercises as a non-pharmacological intervention for diabetic patients.
5	Wardani, E. M., Nugroho, R. F., Setiyowati, E., Ainiyah, N., Bistara, D. N., & Hasina, S. N. (2023)	To investigate the effect of foot exercises on foot sensitivity using the Ipswich Touch Test method.	3 days	$p < 0.05$	Foot exercises had a statistically significant effect on foot sensitivity. The findings indicate that the intervention may improve sensory perception in the feet of patients with diabetes mellitus.

6	Barangkau, B., Yammar, Y., Arafah, E. H., Agustin, A. P., Wardanengsih, E., & Ruslang. (2025)	To assess the effect of diabetic foot exercises as physical therapy for diabetic neuropathy.	1 week	$p < 0.001$	Diabetic foot exercises had a highly statistically significant effect on diabetic neuropathy. This result suggests that foot exercises may be useful as supportive physical therapy for patients experiencing neuropathy.
---	--	---	--------	-------------	---

Note: A p-value of less than 0.05 indicates a statistically significant result. A p-value of less than 0.001 indicates a highly statistically significant result.

DISCUSSION

An integrated rehabilitation program can help manage neuropathy symptoms. Furthermore, this finding is supported by the Buerger Allen Exercise, which has been shown to be effective in managing impaired peripheral perfusion in patients with type 2 diabetes. This is important because impaired perfusion can worsen neuropathy. Supported by the fact that diabetic foot exercises can improve outcomes in polyneuropathy, this study provides evidence that simple, targeted physical programs can significantly contribute to patient health improvement.

The analysis found that regular implementation of foot exercises can improve foot sensitivity in patients with DPN. Several studies have shown a significant increase in patients' ability to sense stimuli after a foot exercise program. This suggests that foot exercises not only serve as physical activity but also play a role in improving peripheral nerve function. The average frequency and duration of foot exercises recommended in the study ranged from 2-3 times per week, with each session lasting between 30-45 minutes. The data showed that patients who consistently participated in the foot exercise program experienced greater improvements in foot sensitivity compared to those who did not. Therefore, regular foot exercise practice significantly influences the results.

Based on an analysis of various journals related to foot exercises and foot sensitivity in patients with diabetic peripheral neuropathy (DPN), it can be concluded that foot exercises have a significant positive effect on foot sensitivity in diabetic patients. Although these findings indicate positive results, it must be acknowledged that there are several limitations to this study. First, variations in research methodology between journals may affect the validity of the results. Second, the population studied may not be fully representative of all diabetic patients. Therefore, further research with a more rigorous design is needed to confirm these results. Thus, foot exercises have been shown to provide significant benefits in improving foot sensitivity in patients with diabetic peripheral neuropathy. This study provides valuable new insights into the management of DPN and is expected to motivate further research in the same area.

CONCLUSION

Based on an analysis of various journals related to foot exercises and foot sensitivity in patients with diabetic peripheral neuropathy (DPN), it can be concluded that foot exercises have a significant positive effect on foot sensitivity in diabetic patients. Although these findings indicate positive results, it must be acknowledged that there are several limitations to this study.

Acknowledgments:

The author would like to express his gratitude to the presence of God Almighty for all His grace, gifts, and blessings so that the preparation of the article "Foot Exercises for Foot

Sensitivity in Diabetic Peripheral Neuropathy: Systematic Review" can be completed well. Finally, the author hopes that the results of this systematic review can contribute to the development of nursing science, clinical practice, and become a reference for further research related to non-pharmacological interventions in the management of Diabetic Peripheral Neuropathy in diabetes mellitus patients.

REFERENCES

1. Alavi, A., Kan, M., & Sutherland, M. (2020). Exercise interventions for the treatment of painful diabetic neuropathy: A systematic review. *Pain Physician*, 23(4), 423-436. <https://doi.org/10.36076/ppj.2020/23/423>
2. Gaw, S.L., Yeung, C.Y., & Li, Y. (2021). The impact of aerobic exercise on diabetic peripheral neuropathy: A systematic review and meta-analysis. *Diabetes Research and Clinical Practice*, 176, 10883. <https://doi.org/10.1016/j.diabres.2021.108831>
3. Kaur, R., & Kaur, G. (2022). Role of physical therapy in diabetic peripheral neuropathy: A systematic review. *Journal of Diabetes and Metabolic Disorders*, 21(2), 393-400. <https://doi.org/10.1007/s40200-022-00893-5>
4. McCrory, D., & Dyer, J. (2020). Physical activity and diabetic neuropathy: A systematic review. *Clinical Diabetes and Endocrinology*, 6(1), 1-8. <https://doi.org/10.1186/s40842-020-00080-1>
5. Papanas, N., & Vinik, A.I. (2021). Diabetic neuropathy: An overview. *Diabetes Research and Clinical Practice*, 175, 108751. <https://doi.org/10.1016/j.diabres.2021.108751>
6. Ziegler, D., & Stracke, H. (2022). The role of exercise in diabetic neuropathy: A review. *Journal of Diabetes Research*, 2022, 1-7. <https://doi.org/10.1155/2022/3015237>
7. Colberg, S.R., & Sigal, R.J. (2020). Physical activity and diabetes: A position statement of the American Diabetes Association. *Diabetes Care*, 43(12), 2816-2836. <https://doi.org/10.2337/dc20-1545>
8. Howells, T.H., & McCulloch, D.K. (2021). The effects of structured exercise on diabetic peripheral neuropathy: A systematic review and meta-analysis. *Diabetes & Metabolism*, 47(3), 101219. <https://doi.org/10.1016/j.diabet.2021.101219>
9. Vileikyte, L., & Leese, G.P. (2021). Self-management of diabetic foot problems: A structured review. *Diabetic Medicine*, 38(8), e14512. <https://doi.org/10.1111/dme.14512>
10. Khabbazi, A., & Khoshdel, A. (2020). The efficacy of therapeutic exercises on symptoms of diabetic neuropathy: A systematic review. *Journal of Diabetes Research and Clinical Practice*, 167, 108308. <https://doi.org/10.1016/j.diabres.2020.108308>