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The Relationship Between Foot Exercise and Neuropathy Scores Among Diabetic Neuropathy Patients in Indonesia: A Scoping Review

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Abstrak: Neuropati diabetik (DN) merupakan salah satu komplikasi paling umum pada pasien dengan diabetes mellitus tipe 2. Prevalensinya telah meningkat di Indonesia seiring dengan meningkatnya prevalensi diabetes mellitus tipe 2 secara nasional. Senam kaki direkomendasikan sebagai intervensi nonfarmakologis sederhana untuk neuropati diabetik (DN); namun, bukti yang ada masih terfragmentasi. Penelitian ini bertujuan untuk memetakan efektivitas senam kaki dalam mengurangi skor neuropati pada pasien dengan neuropati diabetik di Indonesia. Tinjauan cakupan dilakukan pada artikel yang diterbitkan antara tahun 2016 dan 2026 dari basis data Garuda, Google Scholar, PubMed, dan EBSCO. Pemilihan studi mengikuti kerangka kerja PRISMA dengan kriteria inklusi dan eksklusi yang ketat. Sebanyak 7 studi dianalisis menggunakan pendekatan naratif deskriptif. Semua penelitian menunjukkan penurunan skor neuropati yang signifikan ($p<0,05$) setelah intervensi senam kaki, yang dinilai menggunakan instrumen subjektif (DNS) dan objektif (DNE, MNSI, TCSS). Durasi intervensi berkisar antara 1 hingga 24 minggu, dengan frekuensi bervariasi dari 3 kali seminggu hingga 5 kali sehari. Hasil yang lebih optimal diamati pada durasi intervensi yang lebih lama atau frekuensi yang lebih tinggi. Senam kaki efektif dalam mengurangi skor neuropati pada pasien dengan neuropati diabetes dengan meningkatkan sirkulasi darah, oksigenasi jaringan, dan sensitivitas insulin. Pelaksanaan secara teratur dengan durasi dan frekuensi yang memadai memberikan hasil yang optimal dan direkomendasikan sebagai terapi non-farmakologis yang aman dan sederhana.

Kata kunci: neuropati diabetik, senam kaki, indonesia, tinjauan cakupan

Abstract: *Diabetic neuropathy (DN) is one of the most common complications in patients with type 2 diabetes mellitus. Its prevalence has increased in Indonesia in parallel with the rising national prevalence of type 2 diabetes mellitus. Foot exercise is recommended as a simple non-pharmacological intervention for Diabetic neuropathy (DN); however, existing evidence remains fragmented. This study aimed to map the effectiveness of foot exercise in reducing neuropathy scores among patients with diabetic neuropathy in Indonesia. A scoping review was conducted on articles published between 2016 and 2026 retrieved from Garuda, Google Scholar, PubMed, and EBSCO databases. Study selection followed the PRISMA framework with strict inclusion and exclusion criteria. A total of 7 studies were analyzed using a descriptive narrative approach. All studies demonstrated a significant reduction in neuropathy scores ($p<0.05$) following foot exercise interventions, assessed using both subjective (DNS) and objective instruments (DNE, MNSI, TCSS). Intervention duration ranged from 1 to 24 weeks, with frequencies varying from 3 times per week to 5 times per day. More optimal outcomes were observed with longer durations or higher frequencies of intervention. Foot exercise is effective in reducing neuropathy scores in patients with diabetic neuropathy by improving blood circulation, tissue oxygenation, and insulin sensitivity. Regular implementation with adequate duration and frequency yields optimal outcomes and is recommended as a safe and simple non-pharmacological therapy.*

Keywords: *diabetic neuropathy, foot exercise, Indonesia, scoping review*

Pendahuluan

Diabetic neuropathy (DN) is one of the most common complications in patients with type 2 diabetes mellitus. Its prevalence has increased in Indonesia in parallel with the rising national prevalence of type 2 diabetes mellitus, with the lowest rates reported in Bali and West Java. In contrast, the highest prevalence of DPN has been reported in South Sulawesi and North Sumatra, which is presumed to be associated with suboptimal healthcare facilities and service programs in these regions (Susanti et al., 2025). The most common symptom experienced by patients is symmetrical numbness in the distal extremities. Additional complaints include burning sensations, sharp pain, and electric shock-like sensations. Other uncomfortable symptoms such as pruritus and hyperalgesia may increase the risk of non-traumatic limb amputation (Zhu et al., 2024).

The American Diabetes Association (ADA) recommends foot exercise as a preventive strategy for diabetic neuropathy. Foot exercise is a simple, low-cost, and safe intervention. The recommended movements are continuous, rhythmic, interval-based, and progressive. These exercises are expected to improve blood circulation, strengthen foot muscles, and enhance insulin production (Putri et al., 2025). Furthermore, foot exercise can increase foot sensitivity by improving blood flow, thereby ensuring adequate distribution of oxygen and nutrients to distal extremities (Putri et al., 2025).

Although numerous studies have investigated the effectiveness of foot exercise in patients with diabetes mellitus, most are still individual studies with small sample sizes. In addition, variations in the use of instruments to measure diabetic neuropathy have resulted in fragmented study findings. Therefore, a review is needed to identify these inconsistencies.

Based on this gap, this study aims to map evidence from the last 10 years regarding the effect of foot exercise on reducing neuropathy scores in patients with diabetic neuropathy through a scoping review approach. This study is expected to provide new insights into the benefits of foot exercise in reducing neuropathic complications and to serve as a basis for developing more effective clinical interventions and health policies.

Metode

This scoping review was conducted in March 2026 and in accordance with the Joanna Brigs Institute (JBI) methodological guidance. This review was guided by the PCC framework, which consists of Population (patients with diabetic neuropathy), Concept (foot exercise interventions), and Context (studies conducted in Indonesia) Literature searches were performed across four databases: Garuda, Google Scholar, PubMed, and EBSCO. The search strategy used keywords combined with Boolean operators. On Google Scholar we use the keyword: (senam kaki OR senam

kaki diabetes) AND ("skor neuropati" OR "DNS" OR "DNE" OR "MNSI") AND (Indonesia). On Garuda we use the keyword: (senam kaki) AND (skor neuropati). On PubMed and Ebsco we use the keyword: ("foot exercise" OR "diabetic foot gymnastic" OR "foot gymnastics" OR "ankle exercise") AND ("diabetic neuropathy" OR "peripheral neuropathy" OR "neuropathy score" OR "DNS" OR "MNSI" OR "DNE") AND ("Indonesia" OR "Indonesian").

A rigorous selection process was applied using the following inclusion criteria: (1) articles published within the last 10 years (2016–2026); (2) studies examining foot exercise interventions in patients with diabetic neuropathy in Indonesia; (3) studies reporting neuropathy scores; and (4) articles published in English or Indonesian. The exclusion criteria included grey literature, conference abstracts, letters to the editor, articles with no full-text access, non-human studies, and review articles.

The study selection process was reported in accordance with the PRISMA-ScR framework with the assistance of Rayyan AI. First, all articles obtained from Google Scholar, PubMed, EBSCO, and Garuda were compiled. This stage successfully yielded 204 articles. Next, 3 duplicate articles were removed. This stage left 201 articles. Second, the remaining 201 articles were then screened based on the relevance of their titles and abstracts to the research topic. This stage left 10 articles. Third, articles were assessed based on the availability of their full text, and those that could not be accessed were excluded. At this stage, all 10 articles were accessible, so none were excluded. Fourth, the full texts of the remaining articles were reviewed, and those that did not meet the inclusion criteria were excluded. This step excluded 3 articles because they were review articles, were unrelated to foot exercises, or involved clinical scores, leaving 7 articles. These 7 articles will be analyzed in the scoping review.

Data extraction was performed using Microsoft Excel. The extracted variables included author, year of publication, study design, sample size, intervention protocol, measurement tools, and main findings. Data were analyzed using a descriptive narrative approach to map the effects of foot exercise on neuropathy scores.

Hasil dan Pembahasan

Tabel 1. Study characteristics

Author & Year	Study Design	Sample	Intervention Protocol	Measurement	Findings
(Fitrina et al., 2025)	Quasi-experimental	46 (23 intervention, 23 control)	1 week, 5 times/day, 20 minutes/session	DNS Score	Mean score decreased from 2.57 to 1.48 (p = 0.000)

(Mangemba et al., 2022)	Quasi-experimental	32	6 sessions over 2 weeks	MNSI & MDNS	Significant effect (p = 0.003); participants shifted from severe/moderate to mild/moderate neuropathy
(Yulita et al., 2019)	Quasi-experimental	32 (16 intervention, 16 control)	3 times/week for 2 weeks (6 sessions), 30 minutes/session	MNSI	Significant reduction in intervention group (p = 0.001); significant difference vs control (p = 0.003)
(Prasetiyo & Purwanti, 2026)	Quasi-experimental	68 (34 intervention, 34 control)	3 weeks, 3 times/week, ~30 minutes/session	TCSS	Mean score decreased from 10.56 to 7.21 (p = 0.001)
(Ratnawati & Insiyah, 2017)	Quasi-experimental	30	3 months	DNE	Mean score decreased from 7.67 to 5.37 (p = 0.000)
(Simamora et al., 2020)	Quasi-experimental	16	Not specified	DNS Score	Mean score decreased from 2.81 to 1.88 (p = 0.001)
(Setyoningrum & Setyani, 2024)	Pre-experimental	30	2 weeks, 2 days rest/week (10 effective days)	DNS	Significant effect (p = 0.000); DNS positive before intervention, negative after intervention

As shown in Table 1, all included studies consistently demonstrated that foot exercise reduces neuropathy scores in patients with diabetic neuropathy. Foot exercise improves peripheral sensory function by providing neural stimulation and strengthening foot muscles, thereby reducing symptoms such as tingling and pain (Setyoningrum & Setyani, 2024; Simamora et al., 2020). In addition, foot exercise may reduce neural hypoxia, enhance nerve conduction, and improve blood circulation by increasing nitric oxide levels through aldose reductase inhibition (Fitrina et al., 2025; Prasetiyo & Purwanti, 2026; Ratnawati & Insiyah, 2017; Setyoningrum & Setyani, 2024; Yulita et al., 2019).

These findings are consistent with (Furrer et al., 2023), who reported that foot exercise movements typically involving dorsiflexion, plantarflexion, and ankle rotation induce rhythmic skeletal muscle contractions, particularly in the gastrocnemius and soleus muscles, which function as a peripheral muscle pump. This mechanism increases intramuscular pressure, facilitating venous return to the central circulation and simultaneously enhancing arterial blood flow to peripheral tissues. In addition to these mechanical effects, vascular deformation during muscle contraction

triggers endothelial mechanotransduction, leading to vascular smooth muscle relaxation via the release of vasodilatory mediators such as nitric oxide (NO). (Marume et al., 2023) further reported that foot exercise directly improves muscle oxygenation, as reflected by increased muscle oxygen saturation (SmO_2), indicating a better balance between oxygen supply and demand in peripheral tissues.

Beyond its effects on circulation and muscle strength, foot exercise also enhances glucose utilization in skeletal muscle by activating insulin receptors, thereby improving glycemic control and preventing further nerve damage (Prasetiyo & Purwanti, 2026; Simamora et al., 2020). This is supported by (Syeda et al., 2023) who reported that physical activity increases insulin sensitivity.

Variations in intervention duration and frequency across studies may influence outcomes. For instance, (Ratnawati & Insiyah, 2017) implemented a longer intervention period of three months, aligning with recommendations that optimal neuropathy risk assessment should be conducted over 3–6 months. In contrast, (Fitrina et al., 2025) applied a short intervention duration of one week with a high daily frequency (five times per day), based on the premise that although foot exercise is effective when performed three to four times per week, daily practice may yield more optimal results. According to (American Diabetes Association, 2025), evaluation of peripheral neuropathy risk in certain patient groups is recommended every 3–6 months, supporting the relevance of longer intervention periods, while daily exercise is also considered beneficial for maximizing outcomes.

Differences in measurement instruments, such as DNS (Diabetic Neuropathy Symptom), DNE (Diabetic Neuropathy Examination), and MNSI (Michigan Neuropathy Screening Instrument), reflect variations in the focus of assessment between subjective symptoms and objective clinical findings. DNS serves as a rapid screening tool with high predictive value for detecting subjective symptoms such as pain, tingling, and numbness. Studies using DNS, such as (Fitrina et al., 2025) and (Simamora et al., 2020), consistently reported reductions in mean scores from approximately 2.5–2.8 to 1.4–1.8 following intervention.

In contrast, instruments such as DNE and TCSS (Toronto Clinical Scoring System) are considered more comprehensive for clinical validity, as they incorporate objective physical examinations, including Achilles reflexes, motor strength, and sensory testing. For example, (Ratnawati & Insiyah, 2017) reported a reduction in mean DNE scores from 7.67 to 5.37 over three months. Meanwhile, MNSI, which combines symptom questionnaires with simple physical assessments, has proven effective in monitoring changes in severity categories. (Mangemba et al., 2022) reported a shift from predominantly severe neuropathy to mostly mild (34.3%) and moderate (40.6%) categories. A key limitation of purely subjective instruments such as DNS is the higher risk

of response bias; therefore, combined instruments such as MNSI or TCSS are considered more reliable for accurate and clinically stable evaluation.

Furthermore, (Oper et al., 2024) reported that the Michigan Neuropathy Screening Instrument (MNSI), particularly MNSI-B, demonstrates superior diagnostic performance compared to DNS and DNE in detecting peripheral neuropathy in patients with type 2 diabetes mellitus. MNSI-B showed the highest accuracy (92.8%), closely approximating the gold standard biothesiometer. It also demonstrated high sensitivity (85.4%) and specificity (97.6%), indicating strong ability to correctly identify both affected and non-affected patients. The high positive and negative predictive values further support its reliability in clinical practice. Additionally, the combined subjective (MNSI-A) and objective (MNSI-B) approach provides a more comprehensive assessment compared to DNS, which is purely symptom-based, or DNE, which focuses primarily on physical examination.

Kesimpulan

Foot exercise is effective in reducing neuropathy scores in patients with diabetic neuropathy across various intervention durations and frequencies, as measured by both subjective and objective assessments. The effects tend to be more optimal with longer duration or higher frequency of exercise. These benefits are supported by improvements in blood circulation, tissue oxygenation, and insulin sensitivity, indicating that foot exercise is a safe and simple non-pharmacological intervention worth recommending.

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Referensi

American Diabetes Association. (2025). Retinopathy, neuropathy, and foot care: Standards of care in diabetes 2025. *Diabetes Care*, *48*(suppl 1), S252-S265. https://doi.org/10.2337/dc25-S012

Fitrina, Y., Chaidir, R., & Fadhila, N. (2025). Senam kaki diabetik terhadap penurunan neuropati sensorik pada penderita diabetes melitus. *Jurnal Kesehatan Perintis*, *12*(2). https://doi.org/10.33653/cx13cn38

Furrer, R., Hawley, J. A., & Handschin, C. (2023). The molecular athlete: exercise physiology from mechanisms to medals. *Physiological Reviews*, *103*(3), 1693–1787. https://doi.org/10.1152/physrev.00017.2022

Mangemba, D., Abdullah,A., Ra'bung, A. S., & Admasari, Y. (2022). Pengaruh senam kaki terhadap penurunan neuropatik pada pasien diabetes melitus tipe II di RSUD Labuang Baji Makassar. *Jurnal Berita Kesehatan*, *15*(1), 34-38.

Marume, K., Mugele, H., Ueno, R., Amin, S. B., Lesmana, H. S., Possnig, C., Hansen, A. B., Simpson, L. L., & Lawley, J. S. (2023). The impact of leg position on muscle blood flow and oxygenation during low-intensity rhythmic plantarflexion exercise. *European Journal of Applied Physiology*, *123*(5), 1091–1099. https://doi.org/10.1007/s00421-022-05117-9

Oper, N. K. N., Kristianto, H., & Yuliatun, L. (2024). *Uji diagnostik Michigan Neuropathy Screening Instrument (MNSI), Diabetic Neuropathy Symptom Score (DNS) dan Diabetic Neuropathy Examination (DNE) dalam mendeteksi neuropati perifer pada kaki diabetik di Rumah Sakit Lavalette Kota Malang.* [Tesis: Universitas Brawijaya].

Prasetiyo, A. R., & Purwanti, O. S. (2026). Pengaruh senam kaki terhadap neuropati pada lansia diabetes melitus tipe 2 Puskesmas Colomadu II dan Colomadu I. *JUMANTIK*, *10*(2), 315-327.

Putri, Y. E., Sari, S. P., & Witdiawati. (2025). The Effect of Diabetic Foot Exercise on Peripheral Perfusion and Fall Risk in Elderly with Diabetes Mellitus: Case Report. *Journal of Nursing Care*, *8*(2).

Ratnawati, D. I., & Insiyah. (2017). Pengaruh senam kaki terhadap penurunan resiko neuropati perifer dengan skor Diabetic Neuropathy Examination pada pasien diabetes melitus tipe 2 di Puskesmas Sibela Kota Surakarta. *Jurnal Keperawatan Global*, *2*(2), 86-90.

Setyoningrum, U., & Setyani, D. (2024). Perbedaan tanda neuropati perifer diabetik sebelum dan sesudah dilakukan senam kaki diabetik pada penderita DM tipe 2 di Desa Nglorog. *Indonesian Journal of Nursing Research*, *7*(1), 2-7.

Simamora, F. A., Siregar, H. R., & Hidayah, A. (2020). Pengaruh senam kaki diabetik terhadap penurunan neuropati pada penderita diabetes melitus tipe 2. *Journal Education and Development*, *8*(4), 431-434.

Susanti, I., Seraph, N. M., Edward, M. N., & Burhan, A. (2025). National Trends in the Prevalence of Diabetic Peripheral Neuropathy Among Diabetes Mellitus Patients in Indonesia (2010–2024): A Pooled Meta-Analysis of 46 Studies with 2,808 Participants. *Java Nursing Journal*, *3*(2), 124–146. https://doi.org/10.61716/jnj.v3i2.103

Syeda, U. S. A., Battillo, D., Visaria, A., & Malin, S. K. (2023). The importance of exercise for glycemic control in type 2 diabetes. *American Journal of Medicine Open*, *9*, 100031. https://doi.org/10.1016/j.ajmo.2023.100031

Yulita, R. F., Waluyo, A., & Azzam, R. (2019). Pengaruh senam kaki terhadap penurunan skor neuropati dan kadar gula darah pada pasien DM tipe 2 di Persadia RS. TK. II. Dustira Cimahi. *Journal of Telenursing (JOTING)*, *1*(1), 80–95. https://doi.org/10.31539/joting.v1i1.498

Zhu, J., Hu, Z., Luo, Y., Liu, Y., Luo, W., Du, X., Luo, Z., Hu, J., & Peng, S. (2024). Diabetic peripheral neuropathy: pathogenetic mechanisms and treatment. *Frontiers in Endocrinology*, *14*. https://doi.org/10.3389/fendo.2023.1265372