## SYSTEMATIC REVIEW

# The Effect of Foot Massage on Peripheral Neuropathy in Patients With Diabetic Mellitus: A Systematic Review

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#### ABSTRACT

**Introduction:** Diabetic peripheral neuropathy (DNP) is significant comorbidity affecting diabetic patients globally. Massage can assist diabetic neuropathy patients to experience minor discomfort and enhance their impaired sensitivity by improving blood flow, skin sensation, and joint movement. Given the growing population and impact on the quality of life of individuals suffering from DNP, an overview of potential treatments is needed. Objectives, the purpose of this systematic review was to offer an overview of foot massage for DNP. **Methods:** Search was conducted using Embase, PubMed, MEDLINE, and Cochrane Library and was done until March 2020. The search used three types of English keywords: (1) diabetic peripheral neuropathy, foot massage, or foot reflexology. **Results:** Of 8 included studies, four were conducted using randomized control trials and the other four used queasy experimental design. Only one study reported a reduction in pain intensity after the intervention. **Conclusion:** Massage therapy could be a potential alternative therapy in enhancing peripheral sensitivity of the feet in patients with DNP. A large-scale study to further assess the effect of foot massage on DNP with long term follow-up time should be done.

Keywords: Diabetic peripheral neuropathy, Foot massage, Reflexology, Systematic review

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#### **INTRODUCTION**

Diabetic peripheral neuropathy (DNP) is significant comorbidity, affecting 30% of diabetic patients globally (Sun, 2020). Neuropathy begins with a loss of sensation in the foot and spreads symmetrically and gradually upwards (1). Unfortunately, the early symptoms of this pernicious disease are frequently overlooked until the condition has progressed to the point where it appears irreversible (1). DPN is a cause of impairment, resulting in pain, foot ulcers, and amputations, as well as high healthcare expenditures (2). In the United States, DPN costs \$10 billion every year five and increases healthcare costs annually by at least 20 per cent to 30 per cent. (3)

The pathophysiology of DNP is still not well understood (4). Some research concluded that maintaining near

normoglycemia appears to be the optimal strategy for preventing or delaying DNP (4,5). In contrast, others assert that maintaining standard glycemic control is insufficient to prevent, stop, or reverse impaired nerve function (6). Many pain medicines are available for DNP (5,7), but adherence is limited due to adverse effects (8). It is necessary to investigate therapeutic options to alleviate neuropathic symptoms and enhance patients suffering from DNP.

The application of integrative and complementary therapies provides a means of promoting health and preventing and recovering from disease, potentially influencing the development of disease. The thumb, finger, palm, or elbow can be used in acupressure massage for diabetic feet.. In individuals with type 2 diabetes, massage is an effective means of achieving mediated vasodilation (9), which helps to increase blood circulation while also decreasing metabolic demands. (9–14) Massage can assist diabetic neuropathy patients to experience minor discomfort and enhance their impaired sensitivity by improving blood flow, skin sensation, and joint movement. (9,15,16) An evaluation of possible treatments for DNP is needed because of the increasing population and the negative impact on the quality of life of those affected. Thus, the purpose of this systematic review was to offer an overview of foot massage for DNP.

#### MATERIALS AND METHODS

#### Search strategy

The search strategy was determined following the PRISMA agreement's guidelines. 16 Search was conducted using Embase, PubMed, MEDLINE, and Cochrane Library until March 2020. The keywords were a combination of "diabetic peripheral neuropathy" OR "DNP" "OR" "diabetes" "AND "foot massage" OR "foot reflexology," "OR" "massage" OR "acupressure". All research was completed separately by two reviewers in electro-databases and was limited to human trials. We also searched for relevant studies in Bahasa Indonesia, manually checked the reference of the original and review publications, and sought to find grey literature through other sources.

#### Inclusion criteria and study selection

We sought and included studies in this review that had the following criteria: 1) individuals identified with DPN using specific recommendations; 2) An experimental study examining the effect of foot massage, and 3) the outcome was either foot pain or sensitivity. English language restriction was utilized.

At first, two different reviewers individually selected titles and abstracts, which were then assessed collectively to include all the required information. It was up to a third reviewer to make the ultimate decision if there wasn't enough agreement.

#### Data extraction and synthesis

To obtain information on participants, the intervention procedure, and outcome measures. Discrepancies have been resolved by discussion or by the third reviewers.

#### **Risk of bias assessment**

Two reviewers who used the Critical Appraisal Skills Program independently assessed the quality assessment of all the included studies. Any discrepancies were resolved through consultation with a third reviewer.

#### RESULTS

A total of 330 studies were recorded at first searched in database searches, and none of the studies was found from the reference or other grey literature. Following the deletion of duplicate records, the total number of records was reduced to 112. A total of 91 papers were excluded based on their titles and abstracts, as they were either animal studies or reviews. The remaining 21 papers have been downloaded. Finally, eight studies

were included in the analysis. The study selection flow diagram is presented in Figure 1.



Figure 1 : PRISMA Flow Chart.

## Characteristics of included studies

(17) conducted a randomized crossover study to 25 with DNP as measured by MNSI score higher than 2.5 out of 10 in the physical assessment section. Self-Thai foot massages (STFMs) included 5 min of stretching the lower back and leg muscles. Nine forms of Thai foot massages were performed on the meridian lines and pressure points of the dominant foot and lower leg for a total of 25 minutes. (17) conducted a randomized parallel-controlled trial with a total sample of 60. The Thai foot massage group received a modified Thai traditional foot massage for 30 min, three days per week for two weeks, for sensitivity was assessed using Semmes Weinstein monofilaments test (SWMT). (18) conducted a gueasy experiment with a nonequivalent control group design. A total of 30 Respondents (15 treatment and 15 control group) were recruited and given reflexology therapy three days a week for 30 minutes. Measurement of the feet sensitivity using monofilament. (19) conducted a study using randomized, controlled and blind clinical trials with a treated group (n = 21) and control groups (n = 24). Each participant has received guidelines on foot selfcare and 12 sessions of foot reflexology. Diabetes Neuropathy Symptom Score and the monofilament 10-g test were used to assess the occurrence of neuropathic symptoms.

(20) conducted a queasy experiment with a nonequivalent control group design on 20 respondents

Author	Country	Study design	Sample	Intervention	Measure	Outcome
(year)						
Laksmi (2012)	Indonesia	Queasy experiment with Pre- Posttest design.	<ul> <li>N=28 Respondents (14 Treatments, 14 Controls).</li> <li>Patients with type 2 diabetes who have decreased Ankle Brachial Index (ABI).</li> </ul>	The foot massage treatment was given twice a day in the morning and evening for 10 days.	Ankle Brachial Index (ABI).	There was a significant difference in the difference in pressure of ABI before and after foot massage in the intervention group compared to control group (p < 0.05)
Harmaya (2014)	Indonesia	Queasy experiment with nonequivalent control group design.	<ul> <li>N= 20 Respondents (10 Treatments, 10 Controls)</li> <li>Patients with type 2 diabetes who experience decreased sensitivity in the feet with a score of (-) 1-20 out of 20 areas assessed using monofilament 10g.</li> </ul>	Foot massage was performed twice a week for four weeks with a duration of ± 15 minutes.	Monofilament 10g	The mean foot sensitivity score in the treatment group was 4.3, but decreased to 1.4 after receiving foot massage twice a week for four weeks.
Darmilis (2014)	Indonesia	Queasy experiment with nonequivalent control group design.	<ul> <li>30 Respondents <ul> <li>(15 Treatment, 15 Control)</li> </ul> </li> <li>Patients with type 2 diabetes who experience decreased sensitivity in the feet.</li> </ul>	Given acupressure therapy three times a week	Monofilament 10g	• The mean of foot sensitivity level before intervention was 5.93, while the mean after receiving acupressure therapy three times a week was 5.93.
						• There was a significant improvement in foot sensitivity in individuals with type 2 diabetes post-intervention (p < 0.05).

## Table I : Summary of included studies

### Continue....

Dalal et al (2014)	India	A Randomized Controlled Clinical Trial	<ul> <li>reflexology group (n = 29) and control group (n = 29).</li> <li>Patients, with documented peripheral diabetic neuropathy</li> </ul>	<ul> <li>A foot reflexology therapy</li> <li>Each reflexology area was stimulated (average)</li> <li>15 times of ~20 seconds duration per session with the understanding that stimulations on a particular RA &lt; 10 times did not produce any therapeutical effect and a RA would be overstimulated with continuous stimulations &gt;20 times. One therapy session took ~1/2-hour duration and there were 2 therapy sessions per</li> </ul>	<ul> <li>Neuropathic pain using VAS score</li> <li>Thermal and vibration sensitivities were measured by using Vibrotherm analyzer (Vibrotherm Dx, Diabetic Footcare, India)</li> </ul>	<ul> <li>Pain intensity was reduced from 7.8 ± 1.4 to 3.0 ± 1.8 at the end of follow-up period with highly statistical significance (<i>P</i> value &lt; 0.001) for reflexology group patients.</li> <li>The maximum response was obtained in improving cold sensitivity with 100% response among reflexology group subjects. Each of the responses was found to be statistically significant</li> </ul>
Resi L. (2015)	Indonesia	Queasy experiment with nonequivalent control group design.	<ul> <li>30 Respondents <ul> <li>(15 Treatments, 15 Controls).</li> </ul> </li> <li>Patients with type 2 diabetes who experienced decreased sensitivity in the feet.</li> </ul>	Reflexology therapy is given three consecutive days a week for 30 minutes.	Foot sensitivity measurement using monofilament	The level of sensitivity of the feet increased in the experimental group (p < 0.05), and in the control group there was no significant increase.

Continue....

da Silva et al (2015) Chatchawan et al (2015)	Brazil	Randomized, controlled and blind clinical trial	<ul> <li>Treated group (n = 21) and Control group (n = 24).</li> <li>People diagnosed with type 2 diabetes mellitus, for at least five years, aged 18 years or more.</li> <li>N=60 (30 for each group)</li> <li>Type II diabetic patients aged 40–70 years and with peripheral neuropathy.</li> </ul>	Received guidelines on foot self-care and 12 sessions of foot reflexology The Thai foot massage group received a modified Thai traditional foot massage for 30 min, 3 days per week for 2 weeks	The Diabetic Neuropathy Symptom Score was applied to investigate the presence of neuropathic symptoms, followed by the 10-g monofilament test.	• The effect of foot reflexology insensitivity, both treated and control group had an average score of "3" at the beginning of the research, and feet were qualified with moderate impairment.
						<ul> <li>Participants showed a score increases throughout the study; there were no significant differences between participants of treated and control group.</li> <li>The Thai foot massage group also showed significant</li> </ul>
						significant improvements in foot sensation after the 2-week treatment

Continue....

Chatchawan Thailand et al (2020) A randomized crossover

study

• n: 25

• Inclusion criteria were as follows: (1) an MNSI score higher than 2.5 out of 10 in the physical assessment section of the hospital medical records, (2 diagnosis of type 2 diabetes with well-controlled blood glucose based on three follow-up instances of medical assessments, and (3) ability to sit on the floor for 1 h without pain or discomfort in the lower extremities

Self-Thai foot massages (STFMs): – 5 min of stretching of the lower back and leg muscles. - Nine forms of TFM were performed on the meridian lines and pressure points of the dominant foot and lower leg for a total of 25 minutes. – Thumb pressure was gently applied along the meridian lines and pressure points and repeated 3-5 times. – 5-min stretching of the calf and foot muscles was performed after a 25-min TFM. Washout

Neuropathy Screening Instrument (MNSI)

Michigan

 Self-Thai foot massages could improve foot skin blood flow and ROM of the foot and ankle in diabetic patients with peripheral neuropathy

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period of at least 1 week divided into two groups, ten as the treatment group and ten as the control group. Respondents were type 2 DM patients who experience decreased sensitivity in the feet with a score of (-) 1-20 out of 20 areas assessed using Homemade monofilament 10g. Foot massage was performed twice a week for four weeks with a duration of  $\pm$  15 minutes. Furthermore, Darmilis et al. (2014) conducted a queasy experiment with a nonequivalent control group design on 30 respondents with decreased sensitivity in the feet (15 respondents in the treatment group and 15 respondents in the control group). The intervention was given acupressure therapy three times a week.

(21) conducted a study using a randomized controlled clinical trial. Participants in this study were divided into reflexology groups (n = 29) and control groups (n = 29). In each session, a foot reflexology therapy was performed 15 times for a total of 20 seconds. Therapy sessions lasted approximately half an hour, with two sessions every day. Laksmi et al. (2012) conducted a study using a queasy experimental pre-posttest design. The intervention was conducted on 28 (14 treatments and 14 control group) patients with type 2 diabetes who experienced a decrease in the Ankle Brachial Index (ABI). The foot massage treatment was given twice a day in the morning and evening for ten days.

#### Main findings

(17) found that Self-Thai foot massages may help diabetic patients with peripheral neuropathy increase blood flow and range of motion in their feet and ankles. Resi et al. (2015) revealed a p-value of 0.000 (p < 0.05), which showed a difference in the ankle-brachial index pressure between the treatment group and the control group. This study demonstrates a substantial difference in ankle-brachial pressure index (ABPI) between the two groups before and after foot massage. While da Silva et al. (2015) found At the outset of the study, both the treatment and control groups ha an average score of "3," which indicated moderate deterioration of the feet. Despite the fact that research participants' scores rose with time, no differences existed between the treatment group and the control group.. (17) reported that the Thai foot massage group also showed significant improvements in foot sensation after the 2-week treatment.

(20) indicated that before receiving foot massage intervention, the mean foot sensitivity score in the treatment group was 4.3 but decreased to 1.4 after receiving foot massage twice a week for four weeks. The pre-test score for the control group was 4.6, whereas the post-test score was 5.3. A statistically significant difference was found between the foot sensation score changes in type 2 diabetes mellitus patients who received the intervention and those who received no intervention. Darmilis et al. (2014) discovered that the mean foot sensitivity level before intervention was 5.93, while the mean after receiving acupressure therapy three times a week was 5.93. There was a significant improvement in foot sensitivity in individuals with type 2 diabetes post-intervention (p < 0.05). This study indicates a substantial difference in the average level of foot sensitivity between the treatment group and the control group before and after acupressure therapy.

(21) found that pain intensity was reduced from 7.8  $\pm$  1.4 to 3.0  $\pm$  1.8 at the end of the follow-up period with high statistical significance (*P* value < 0.001) for reflexology group patients. When it came to enhancing cold sensitivity, reflexology group members showed the best results, with a 100 percent improvement. Our analysis revealed that all of the replies were significant statistically. Laksmi et al. (2012) found that the mean score of the ankle-brachial index is given foot massage therapy was 0.8971 and after being given a foot massage therapy increased to 0.9879. This study demonstrates a substantial difference in ankle-brachial pressure index (ABPI) between the two groups before and after foot massage (p < 0.05).

#### Risk of bias assessment

Of eight studies, four studies used randomized control trials, and four used a queasy experimental design. All studies have a small sample size.

#### DISCUSSION

diabetic peripheral neuropathy symptoms The improved with foot massage, but the results were not reported because of a lack of proof. Some studies used reflexology approaches, and some studies used massage techniques. Studies have shown that these treatments provide various benefits to patients, easing the symptoms of breast and lung cancer patients, as well as women experiencing menstrual cramps (1,22-25). The reflexology theory states that skin regions on the feet, hands, and ears correspond to the body's internal organs and deliver sensory information and data to these internal organs via the central nervous system or hormones (26). These impulses are intended to correct the mentioned ones' abnormal functional condition if any exists. The principles of reflexology therapy may resemble those of acupuncture procedures (27,28).

The authors of two research found that self-massage increased participants' feelings of competence and self-awareness. Diabetes self-management programs with long-term viability could be one of the potential outcomes of this research. (29,30) Because it raises the heart rate so much, self-therapy may be considered a light physical activity. The central command in the brain activates sympathetic activity and inhibits parasympathetic stimulation during physical exercise, resulting in an increase in heart rate.(31) For diabetic people, an STFM can be utilized in a practical way to regulate their blood sugar levels. (32,33) 30 minutes of TFM and stretching by an experienced massage therapist may be beneficial, though. In other words, it promotes rest and doesn't raise metabolic needs. There are several benefits to a home-based self-massage program for diabetic patients, including improved physical fitness and quality of life. The efficacy of self-massage in homebased treatment needs to be proven in future research. This systemic evaluation comprised eight intervention trials aimed at establishing viable therapy choices for neuropathic pain and indications of sensitivity arising from diabetic peripheral foot neuropathy. There was a broader viewpoint in this study and included a different form of foot massage. To our knowledge, it is unknown whether the pathophysiological variations between Type 1 and Type 2 diabetes determine the outcome and management of DNP. The studies included in our analysis varied considerably in terms of the characteristics of Type 2 diabetes patients. The short follow-up duration and limited sample size of the included trials imply that long-term therapy effects are unknown.

#### CONCLUSION

In conclusion, the current review demonstrates the effectiveness of massage therapy in enhancing the sensitivity of the feet of patients with diabetes mellitus. Massage therapy is a complementary therapy that stimulates the skin and subcutaneous tissues to improve blood circulation, reduce discomfort, and relax muscles. Interventions to improve foot sensitivity in people with diabetes mellitus and programs involving foot massage therapy must be devised. More research is needed to assess the effectiveness of nurse-provided foot massage and the experience of DM patients receiving therapy. A large-scale study to further assess the effect of foot massage on DNP with long term follow-up time should be done.

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