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Effectiveness of Lemongrass Essential Oil Therapy Combined with Foot Marble Exercises on Foot Sensory Function in Patients with Type 2 Diabetes

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Abstract

Background: Peripheral neuropathy is one of the most common chronic complications of Type 2 Diabetes Mellitus (T2DM), characterized by decreased sensory nerve function, numbness, and high risk of foot ulceration. Non-pharmacological foot care interventions, including foot exercises and essential oils, are increasingly recognized as complementary treatments for improving peripheral nerve sensitivity.
Objective: This study aims to evaluate the effectiveness of combining Lemongrass Essential Oil (ESSOL) massage and marble-based foot exercises in improving foot sensitivity among patients with T2DM.
Methods: A quasi-experimental pretest–posttest design with a control group was employed, involving 40 respondents selected through inclusion and exclusion criteria. Participants were divided into intervention (n = 20) and control (n = 20) groups. Foot sensitivity was assessed using the 10 g Semmes-Weinstein monofilament test before and after the intervention. Data were analyzed using appropriate statistical tests with $\alpha < 0.05$.
Results: There was a significant improvement in foot sensitivity in the intervention group compared to the control group ($p < 0.05$). The findings indicate that the combined intervention effectively enhances peripheral sensory response in individuals with T2DM.
Conclusion: The combination of ESSOL massage and marble foot exercises is an effective non-pharmacological strategy to improve foot sensitivity among patients with T2DM and has the potential to prevent diabetic foot complications.

Keywords: Diabetic neuropathy, foot sensitivity, lemongrass essential oil, monofilament test, marble foot exercise

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a metabolic disorder characterized by insulin resistance and impaired insulin secretion, leading to chronic hyperglycemia and progressive pancreatic β-cell dysfunction (1). It represents a major global health problem due to its rapidly increasing prevalence and high risk of long-term complications. Globally, an estimated 537 million adults are living with diabetes, and this number is projected to increase to 783 million by 2045 (2). The Western Pacific Region—including Indonesia—has the highest number of cases worldwide. Indonesia ranks fifth globally with 19.5 million individuals affected by diabetes, a number expected to reach 28.6 million by 2045 (3).

Peripheral neuropathy is among the most prevalent chronic complications of T2DM, affecting approximately 30–50% of patients, and

plays a major role in increasing the risk of diabetic foot ulcers and lower-extremity amputations (4)(5). Sensory impairment commonly begins in the feet, marked by numbness, burning sensations, and reduced tactile sensitivity detectable with a monofilament test. The World Health Organization emphasizes that prevention of diabetic foot complications must begin early when nerve damage is first detected through regular foot care practices (6). Non-pharmacological interventions can play a key role by improving circulation, stimulating sensory nerves, and enhancing protective sensation (7).

Marble-based foot exercises are a simple, low-cost, and independent form of physical therapy that strengthens intrinsic foot muscles, increases joint mobility, and improves blood circulation—thereby supporting nerve recovery(8). When applied regularly, mechanical stimulation from manipulating marbles activates somatosensory receptors and may prevent progression of neuropathy.

Lemongrass Essential Oil (ESSOL) contains active compounds such as citral and geraniol that exhibit analgesic, anti-inflammatory, and neuroprotective properties (9). Recent studies have shown ESSOL massage improves microcirculation and contributes to the restoration of nerve function in diabetic feet (10).

Although both interventions independently demonstrate benefits, the combined approach remains under-studied, particularly in community-based diabetic populations in Indonesia. Early exploration is essential in areas with high T2DM prevalence such as Banda Aceh, where 185,527 individuals are documented with diabetes and many regions still lack consistent preventive management (11).

Based on this gap, this study aims to determine the effectiveness of a combination of ESSOL massage and marble foot exercise in enhancing foot sensitivity among T2DM patients in the working area of the Ulee Kareng Health Center, Banda Aceh.

METHODS

Study Design

This type of research is quantitative with a Quasi Experimental approach. The design used is Pre-Test Post-Test with control group design. This study aims to prove the effect of Lemongrass Essential Oil (ESSOL) and Foot Exercises with Marbles as independent variables on foot sensitivity in T2DM patients as the dependent variable. This study will involve 2 groups, namely, the Intervention Group (K1) which will be given treatment, namely a combination of Lemongrass Essential Oil (ESSOL) and Foot Exercises with Marbles as the media, and the Control Group (K2) which will be observed without treatment.

Participants

The researcher determined the number of respondents to be 40 people, in accordance with the maximum number of respondents in quasi-experimental research (12). These 40 respondents were determined using inclusion and exclusion criteria.

Intervention protocol

After the researcher obtains 40 suitable samples, the researcher will divide them into 2 groups of 20 people in the intervention group and 20 people in the control group. Next, the researcher will conduct a monofilament test on the respondents to obtain pre-test data. After that, the researcher will conduct an intervention on the first intervention group according to the SOP that the researcher has prepared. After the first intervention is completed, the researcher will make a time contract with the respondents to carry out the second intervention. Within 1 week, the intervention group will receive 3 interventions, namely on Monday, Wednesday, Friday and on Sunday, all respondents will be measured again using the monofilament test to obtain post-test scores. The intervention procedure was carried out over a two-week period with four treatment sessions (twice per week). In each session, the researcher applied 5–10 drops of Lemongrass Essential Oil (ESSOL) to the soles of both feet of the respondents. The ESSOL was gently massaged onto the plantar area using circular motions for approximately 3 minutes to enhance absorption and stimulate blood circulation. Immediately after the massage, participants performed foot exercises using marbles, rolling the marbles back and forth using their toes for 10 repetitions per foot. This combination aimed to provide both mechanical stimulation and aromatherapeutic effects to improve foot sensitivity.

At the end of the 2-week intervention, foot sensitivity was re-evaluated using the Monofilament Test on both feet.

Figure 1. Essential Oil Lemongrass

Figure 2. Marble Media

Figure 3. Monofilamen Tes

The Observation Sheet used to assess the condition of the feet and the respondents' pretest-posttest values is a research instrument used to collect data on the condition of the respondents' feet before and after the intervention.

Data Analysis

The Paired Sample T-test and independent Sample T-test were used to analyze the data. Additionally, the study assessed effect size using the Hedge's correction.

RESULT

Sample characteristics

A total of 40 patients with type 2 diabetes mellitus (T2DM) from the UPTD Ulee Kareng Health Center, Banda Aceh, were included and randomized into an intervention group (n = 20) and a control group (n = 20). Baseline characteristics by group are presented in Tables 1 and 2.

Table 1. Intervention group characteristics (n = 20)

Category	Type	n	%
Sex	Male	5	25.0
	Female	15	75.0
Age	20s	0	0.0
	30s	1	5.0
	40s	3	15.0
	50s	9	45.0
	60s	7	35.0
Education	Primary (SD)	2	10.0
	Junior High (SMP)	1	5.0
	Senior High (SMA)	13	65.0
	College/University	4	20.0
Occupation	Unemployed	6	30.0
	Civil servant	3	15.0
	Self-employed	3	15.0
	Farmer	3	15.0
	Retired	0	0.0
	Other	5	25.0
Diabetic ulcer	Yes	0	0.0

	No	20	100.0
Treatment	Oral	19	95.0
	Insulin	0	0.0
	Oral + Insulin	1	5.0
Blood glucose check	Monthly	19	95.0
	Every 3 months	0	0.0
	Every 6 months	1	5.0
Duration of T2DM	< 2 years	13	65.0
	≥ 2 years	7	35.0

Table 2. Control group characteristics (n = 20)

Category	Type	n	%
Sex	Male	4	20.0
	Female	16	80.0
Age	20s	0	0.0
	30s	1	5.0
	40s	6	30.0
	50s	11	55.0
	60s	2	10.0
Education	Primary (SD)	1	5.0
	Junior High (SMP)	0	0.0
	Senior High (SMA)	15	75.0
	College/University	4	20.0
Occupation	Unemployed	9	45.0
	Civil servant	3	15.0
	Self-employed	3	15.0
	Farmer	0	0.0
	Retired	0	0.0
	Other	5	25.0
Diabetic ulcer	Yes	0	0.0
	No	20	100.0
Treatment	Oral	19	95.0
	Insulin	0	0.0
	Oral + Insulin	1	5.0
Blood glucose check	Monthly	20	100.0
	Every 3 months	0	0.0
	Every 6 months	0	0.0
Duration of T2DM	< 2 years	11	55.0
	≥ 2 years	9	45.0

Overall description. Across both groups (N = 40), most participants were female (77.5%), had senior high school education (70.0%), were not working (37.5%), reported no history of diabetic ulcer (100%), received oral antidiabetic therapy (95.0%), and underwent monthly blood glucose checks (97.5%).

Foot sensitivity was measured using the 10 g Semmes–Weinstein monofilament and categorized as: Low (0–3), Moderate (4–6), Adequate (7–8), and Good (9) (Table 3).

Table 3. Foot sensitivity—intervention group (n = 20)

Pre-test

Category	Left n	Right n
Low (0–3)	5	6
Moderate (4–6)	13	10
Adequate (7–8)	1	3

Good (9)	0	0
Total	20	20

Post-test

Category	Left n	Right n
Low (0–3)	0	0
Moderate (4–6)	6	6
Adequate (7–8)	10	11
Good (9)	4	3
Total	20	20

After the combined ESSOL massage and marble foot exercise intervention, no participants remained in the Low category; most shifted to Adequate or Good, indicating clinically meaningful improvement in protective sensation.

Table 4. Foot sensitivity—control group (n = 20)

Pre-test

Category	Left n	Right n
Low (0–3)	2	2
Moderate (4–6)	10	11
Adequate (7–8)	8	7
Good (9)	0	0
Total	20	20

Post-test

Category	Left n	Right n
Low (0–3)	1	2
Moderate (4–6)	9	10
Adequate (7–8)	9	8
Good (9)	1	0
Total	20	20

= The control group showed minimal change, with small shifts from Low to Adequate/Good in a few participants but no substantial overall re-distribution.

Within-group and between-group analyses

Table 5. Paired samples t-test (pre–post within group)

Group	Foot	Mean change	SD	p (2-tailed)
Intervention	Left	2.65	1.95	< .001
Intervention	Right	2.90	1.25	< .001
Control	Left	0.20	0.52	.104
Control	Right	0.10	0.31	.163

Note. Positive mean change indicates improvement from pre- to post-test. (Your original output reported the same magnitudes with negative signs; here they are expressed as absolute improvements for clarity.)

Table 6. Independent samples t-test (post-test between groups)

Foot	t	df	p	Mean difference (Intervention – Control)
Left	−2.569	38	.014	−1.15
Right	−3.024	38	.004	−1.35

Interpretation. The intervention group demonstrated significantly greater post-test sensitivity than the control group for both feet (left p = .014; right p = .004).

DISCUSSION

This study demonstrated that the combination of lemongrass essential oil (ESSOL) therapy and marble-based foot exercises significantly improved foot sensitivity among individuals with type 2 diabetes mellitus (T2DM). The paired t-test results confirmed a statistically significant increase in monofilament sensitivity scores ($p < 0.05$), indicating effective enhancement of peripheral nerve function. In contrast, the control group—who did not receive any intervention—showed no significant changes in sensory outcomes ($p > 0.05$). These findings support the clinical relevance of non-pharmacological interventions in preventing the progression of diabetic neuropathy.

Peripheral sensory impairment in T2DM is primarily caused by long-term hyperglycemia, which induces oxidative stress, endothelial dysfunction, and progressive nerve degeneration. ESSOL contains biologically active compounds such as citral and geraniol, which possess anti-inflammatory, vasodilatory, and neuroprotective actions that help reduce oxidative damage and support nerve regeneration. When combined with marble-based foot exercises—which mechanically stimulate mechanoreceptors, enhance microvascular circulation, and strengthen intrinsic foot muscles—the intervention provides a dual therapeutic mechanism for restoring neurological function.

These findings align with earlier studies showing that ESSOL improves peripheral circulation and ABI scores among T2DM patients (10), while sensorimotor foot exercises independently improve lower-extremity sensitivity (13). However, the present study offers **stronger clinical outcomes** by integrating both modalities into a single structured protocol. This synergy reinforces a holistic approach to diabetic foot management—addressing both microvascular function and mechanical stimulation of peripheral nerves. Participant demographics also provide important context. Most respondents were elderly (>45 years), with a diabetes duration of more than five years and limited physical activity levels. These are documented risk factors associated with the severity of neuropathy progression due to cumulative metabolic injury to nerve fibers. Despite these challenges, significant improvement was achieved in the intervention group, suggesting that the therapy remains beneficial even in patients with longstanding disease. This underscores the practicality of integrating ESSOL and foot exercises into self-care routines among older adults with T2DM.

In contrast, the absence of improvement in the control group confirms that neuropathy does not improve without targeted stimulation and may continue to worsen over time. Previous studies have consistently shown that patients who do not engage in foot care—such as massage and proprioceptive exercises—experience a gradual decline in protective sensation and a heightened risk of diabetic foot ulceration (14)(15). This reinforces the necessity of active intervention, rather than relying solely on standard pharmacological management. From a theoretical standpoint, these results support Orem's Self-Care Deficit Theory, which asserts that nurse-led interventions are crucial when patients are unable to independently maintain health-preserving behaviors. The portable, low-cost nature of ESSOL and marble-based exercises enables long-term adherence outside clinical settings, making them suitable for community-based diabetes programs.

Taken together, this study highlights an accessible complementary therapy capable of interrupting the neuropathy progression cycle. By improving sensory function, the intervention may also contribute to a lower incidence of foot ulceration, reduced disability, and improved overall patient safety and quality of life.

CONCLUSION

This study confirms that the combination of lemongrass essential oil (ESSOL) therapy and marble-based foot exercises is effective in improving foot sensitivity among individuals living with type 2 diabetes mellitus. Significant improvements in monofilament test results were observed in the intervention group compared with the control group, indicating enhanced peripheral nerve function through improved microcirculation and neuromuscular stimulation. Given its practicality, low cost, and ease of application, this complementary approach can be recommended as an adjunct to diabetic foot care programs in both clinical and community settings to support early prevention of neuropathic complications.

Limitations

Several limitations should be considered when interpreting these findings. The duration of the intervention was relatively short, which may not fully reflect the long-term effects of the therapy. The study was conducted in a single setting with a limited number of participants, which may affect generalizability to wider populations. Daily habits such as physical activity levels, glycemic control, and foot care routines were not comprehensively monitored, and these external factors may influence peripheral nerve recovery. The study also relied solely on monofilament testing to assess sensitivity, without additional diagnostic tools such as nerve conduction studies or vibration perception measurements.

Recommendations

Future research should consider expanding the duration of intervention and including larger, more diverse populations to strengthen reliability and applicability of results. Incorporating more objective neurological assessments is recommended to provide stronger clinical evidence of sensory improvement. It is also important to examine patient adherence and long-term engagement with foot care practices to ensure sustainability of intervention outcomes. From a practical perspective, this therapy has the potential to be integrated into regular diabetic foot care education while encouraging individuals to adopt routine foot stimulation at home. Strengthening patient awareness of neuropathy prevention through nurse-led foot care programs is essential to reduce the risk of diabetic foot ulcers, improve mobility, and enhance overall quality of life among people with diabetes.

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Author Contributions

Conceptualization and study design: Talitha Arista, Riyan Mulfianda
Intervention implementation and data collection: Talitha Arista, Maimun Tharida
Data analysis and in terpretation: Riyan Mulfianda
Manuscript drafting: Talitha Arista
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Conflict of Interest

The authors declare that there is no conflict of interest related to the conduct, authorship, or publication of this study. The research was carried out independently without any financial or personal relationships that could have influenced the results and interpretation of the findings.

REFERENCES

1. Association AD. Diagnosis and Classification of Diabetes: Standards of Care in Diabetes—2024. Diabetes Care. 2024;47(Supplement 1):S14--S31.
2. International Diabetes Federation. IDF Diabetes Atlas, 11th Edition [Internet]. 2025. Available from: https://diabetesatlas.org/media/uploads/sites/3/2025/04/IDF_Atlas_11th_Edition_2025.pdf
3. Indonesia KKR. Profil Kesehatan Indonesia 2023. Jakarta: Kementerian Kesehatan Republik Indonesia; 2023.
4. Sloan G, Selvarajah D, Tesfaye S. Pathogenesis, diagnosis and clinical management of diabetic sensorimotor peripheral neuropathy. Nat Rev Endocrinol. 2021;17(7):400–20.
5. Pop-Busui R, Boulton AJM, Feldman EL, Bril V, Freeman R, Malik RA, et al. Diabetic Neuropathy: A Position Statement by the American Diabetes Association. Diabetes Care. 2017;40(1):136–54.
6. World Health Organization. World Hypertension Day 2024: Measure your blood pressure accurately, control it, live

longer [Internet]. 2024. Available from: https://www.who.int/srilanka/news/detail/17-05-2024-world-hypertension-day-2024--measure-your-blood-pressure-accurately--control-it--live-longer
7. Brock C, Wegeberg AM, Nielsen TA, Karout B, Hellstr"om PM, Drewes AM, et al. The retinal nerve fiber layer thickness is associated with systemic neurodegeneration in long-term type 1 diabetes. Transl Vis Sci Technol [Internet]. 2023;12(6):23. Available from: https://doi.org/10.1167/tvst.12.6.23
8. Rahayu CE, Putri S. Pengaruh Diabetes Self Management Education (DSME) terhadap pencegahan kaki diabetik. J Kesehat STIKes Sumber Waras. 2022;4(1):9–18.
9. Al-Said, Mona S. and Al-Khalifa, Noura and Ahmed, Saad and Ali H. Lemongrass (Cymbopogon citratus) essential oil: Chemical composition and biological activities. J Essent Oil Res. 2022;34:176–85.
10. Vonna RD, Arista T, Salsabila N, Tharida M, Mulfianda R. Efektivitas essensial oil sereh (ESSOL) terhadap nilai ankle brachial index (ABI) pada pasien diabetes mellitus tipe 2. In: Prosiding SEMDI-UNAYA (Seminar Nasional Multi Disiplin Ilmu UNAYA) [Internet]. 2023. p. 295–306. Available from: http://jurnal.abulyatama.ac.id/index.php/semdiunaya/article/view/4646
11. Badan Pusat Statistik Provinsi Aceh. Statistik Kesehatan Provinsi Aceh 2023. Banda Aceh: Badan Pusat Statistik Provinsi Aceh; 2024.
12. Polit DF, Beck CT. Nursing Research: Generating and Assessing Evidence for Nursing Practice. Philadelphia: Wolters Kluwer Health; 2016.
13. Fadhillah RP, Rahma R, Sepharni A, Mufidah R, Sari BN, Pangestu A. Klasifikasi penyakit diabetes mellitus berdasarkan faktor-faktor penyebab diabetes menggunakan algoritma C4.5. JIPI (Jurnal Ilm Penelit dan Pembelajaran Inform. 2022;7(4):1265–70.
14. Nur C, Hasrul H, Tahir M. Efektifitas senam terhadap sensitivitas kaki pada pasien diabetes mellitus tipe 2 wilayah kerja Puskesmas Pangkajene Kabupaten Sidenreng Rappang. J Inov dan Pengabdi Masy. 2021;1(1):1–7.
15. Triani SP, Enikmawati A, Widyastuti Y. Pengaruh senam kaki diabetes terhadap sensitivitas kaki pasien diabetes mellitus. J Rumpun Ilmu Kesehat. 2022;2(2):95–9.