Comparative Effects of Self-Foot Massage Using Wooden Stick Versus Using hand on Sensation, Balance, and Quality of Life in Individuals with Type 2 Diabetes Peripheral Neuropathy: A pilot study

ผลเปรียบเทียบการนวดเท้าด้วยตนเองระหว่างการใช้ไม้นวดและการใช้มือต่อการรับความรู้สึก การทรงตัว และคุณภาพชีวิตในผู้ที่มีภาวะปลายประสาทเสื่อมจากเบาหวานประเภทที่ 2: การศึกษานำร่อง

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Abstract

This study aimed to investigate the impact of self-foot massage using Thai massage sticks versus using hands on sensation, balance, and quality of life in individuals with type 2 diabetes and foot neuropathy. Seventeen participants aged 58.18 (±7.68) years were randomly assigned to two groups using wooden massage sticks (n=8) and the other using hand massages (n=9). Participants performed three sessions per week, with each session consisting of 30-minute foot massages and 30-second calf stretches, over the period of four weeks. The foot sensation was evaluated using the Semmes–Weinstein Monofilament Test, while balance was tested with the Time Up and Go Test and One Leg Stand Test. Quality of life was tested by the WHOQOL-BREF-THAI. The results showed that there were significant improvements in sensation and dynamic balance post-intervention ($p < 0.05$), but not quality of life for both groups. Nevertheless, the significant difference between groups was not found ($p > 0.05$). This study suggests that both methods may be effective in improving sensation and dynamic balance in individuals with diabetic neuropathy. However, no significant difference was found between the effectiveness of both self-foot massage techniques.

Keywords: *Self-Thai foot massage; Diabetic foot neuropathy; Type 2 diabetes mellitus; Sensation; Balance; Quality of life*

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาผลของการนวดฝ่าเท้าด้วยตนเองโดยใช้ไม้กดจุดเปรียบเทียบกับการนวดด้วยมือต่อการรับความรู้สึก การทรงตัว และคุณภาพชีวิตในผู้ที่มีภาวะเบาหวานชนิดที่ 2 ที่มีภาวะปลายประสาทเสื่อมร่วมด้วย ทำการศึกษาในอาสาสมัครจำนวน 17 คน ซึ่งมีอายุระหว่าง 58.18 (±7.68) ปี อาสาสมัครได้รับการสุ่มออกเป็น 2 กลุ่ม ได้แก่ กลุ่มที่นวดด้วยไม้กดจุด (n=8) และกลุ่มที่นวดด้วยมือ (n=9) อาสาสมัครทุกคนทำการนวดฝ่าเท้าเป็นเวลา 30 นาที และยืดกล้ามเนื้อน่องเป็นเวลา 30 วินาทีอย่างน้อยสัปดาห์ละ

3 ครั้ง เป็นระยะเวลา 4 สัปดาห์ ในการศึกษานี้ประเมินการรับความรู้สึกของฝ่าเท้าด้วย Semmes–Weinstein Monofilament Test ประเมินการทรงตัวด้วยการทดสอบ Time Up and Go Test และ One Leg Stand Test และประเมินคุณภาพชีวิตด้วยแบบสอบถาม WHOQOL-BREF-THAI ผลการศึกษาพบว่า ทั้งสองกลุ่มมีการรับความรู้สึกและการทรงตัวพัฒนาดีขึ้นอย่างมีนัยสำคัญทางสถิติภายหลังการนวด 4 สัปดาห์ ($p < 0.05$) แต่ไม่พบการเปลี่ยนแปลงในตัวแปรคุณภาพชีวิต อนึ่งไม่พบความแตกต่างอย่างมีนัยสำคัญระหว่างทั้งสองกลุ่ม ($p > 0.05$) ผลการศึกษานี้แสดงให้เห็นว่า การนวดทั้งสองวิธีมีประสิทธิภาพในการช่วยให้การรับความรู้สึกและการทรงตัวดีขึ้นในผู้ป่วยเบาหวานที่มีภาวะปลายประสาทเสื่อม อย่างไรก็ตาม ไม่พบความแตกต่างอย่างมีนัยสำคัญระหว่างประสิทธิภาพของเทคนิคการนวดฝ่าเท้าด้วยตนเองทั้งสองวิธี

คำสำคัญ: *การนวดฝ่าเท้าด้วยตนเองแบบไทย ปลายประสาทเท้าเสื่อมจากเบาหวาน เบาหวานชนิดที่ 2 การรับความรู้สึก การทรงตัว คุณภาพชีวิต*

Introduction

Diabetes mellitus is a chronic disease with rising incidence and prevalence globally, including Thailand. A review by the Health System Research Institute indicates increasing incidence among the Thai population across all age groups. Furthermore, Thailand was the 4th highest number of diabetes patients in the Western Pacific region (Diabetes Association of Thailand, The Endocrine Society of Thailand, Department of Medical Services, Ministry of Public Health, & National Health Security Office, 2017). Managing diabetes requires controlling high sugar levels and mitigating complications, which can lead to long-term effects for the patient.

Seventy-two percent of individuals with diabetes are afflicted by diabetic neuropathy (Williams, Van Gaal, & Lucioni, 2002). This prevalent complication results from the pathological processes of both small and large blood vessels, causing insufficient blood flow to lower extremities nerves due to high blood sugar. Peripheral neuropathy ensues, leading to sensory alteration such as numbness, tingling, and diminished sensation, thereby compromising the patients' capacity to safeguard themselves against foot injuries. Existing literature indicates that neuropathy is presented in 12% of newly diagnosed cases, with incidence escalating over time. Therefore, individuals with diabetes face an increased risk of 8% to 18% of developing foot ulcers and 2% to 15% for undergoing amputations when compared to those without neuropathic complications. (American Diabetes Association 2016; Fowler, 2011)

Foot massage is an effective and recommended method for individuals with diabetes, as it enhances blood circulation and stimulates nerve endings. (Agustini, Wulansari, Yusniawati, & Ni, 2019; Bayat et al., 2020; Chatchawan, Eungpinichpong, Plandee, & Yamauchi, 2015; Diabetes Association of Thailand, The Endocrine Society of Thailand, Department of Medical Services, Ministry of Public Health, & National Health Security Office, 2017)

Despite its potential to reduce complications, foot massage requires assistance, posing limitations in convenience and cost. Furthermore, self-massage enhances safety by enabling the individual to control the applied pressure, minimizing injury risk in neuropathic areas. Various studies in the past have investigated innovative self-massage approaches, such as utilizing coconut shell carpet (Rattanachompu et al., 2019), kernel shell (Bootsri & Singban, 2025), and halved bamboo (Pungpotong, Nunla-ong, & Nunla-ong, 2014), resulting in a notable decrease in complications. However, these innovations require users to be in a standing position and cannot be securely fixed, thus increasing the risk of falls. Hence, a device that allows patients to independently perform foot massage while maintaining a stable, seated posture would prove advantageous. As a result, the primary objective of this research was to examine the effect of self-foot massage using hands versus wooden massage sticks (WMS), known as Mai Nuad Thai, intending to demonstrate the positive effects of massage therapy that can be conveniently performed in a seated position.

Research Methodology

1. Study design

This study was a randomized controlled trial conducted between April 2021 and June 2022, which was approved by the Ethics Committee for Human Research at Mae Fah Luang University (EC 21006-25) following the Helsinki Declaration, and the clinical trial registration number is TCTR20220209006. All participants provided written informed consent before taking part in the study.

2. Participants

The participants with type 2 diabetes mellitus, aged between 40 and 70 years, were recruited from Tambon Health Promoting Hospital in Chiang Rai, Thailand, via poster advertisement. The inclusion criteria for the study were 1) diabetes duration of 5 years or more, 2) consistent blood sugar level monitoring, 3) loss of sensation in the soles of both feet sensation at 3 or more points as determined by the Semmes-Weinstein Monofilament Test (SWMT), 4) independently walking without gait aid, and 5) a score on the Mental State Examination E10 greater than the dementia cutoff point. The exclusion criteria included 1) pregnancy, 2) deformities of leg and foot, 3) diabetic-related wounds on the feet and legs, 4) visual impairments not correctable with glasses, 5) fever with a temperature exceeding 38.5 degrees Celsius, 6) hypertension with blood pressure over 160/100 mmHg, 7) lower limb fracture within the past 6 months, 8) a history of chronic alcoholism, 9) a history of vestibular abnormalities, 10) peripheral neuropathy due to musculoskeletal issues, 11) neurological conditions affecting balance, and 12) skin disease that may spread to other areas. The withdrawal criteria were 1) developing a foot wound during participation, 2) choosing to withdraw, 3) developing an exclusion criteria-related condition after joining the study, and 4) being unable to follow the study protocol consciously.

3. Sample size calculation

The sample size was calculated as 47

participants, based on the pooled variance by Chatchawan et al. (2015) for the SWMT values, with a test power of 90%, a significance level of 5%, and a dropout rate of 20%. Despite the calculated target, the study was terminated prematurely due to the unforeseen operational and safety constraints imposed by the COVID-19 pandemic. These constraints, primarily limited participant access and heightened safety concerns for elderly volunteers, resulted in an early cessation of recruitment with the final sample size of 17 participants (8 in the wooden massage stick group, and 9 in the hand group)

4. Intervention

A research assistant blinded to the intervention and outcome assessment randomly divided participants into 2 groups using stratified random sampling, with stratification based on gender and age. The first group performed self-foot massage utilized wooden massage sticks (WMS), while the second group performed self-foot massage using hand (SHM).

The wooden massage sticks consisted of four pieces: two about 40 cm handles connected by 60 cm main axis. A central 8 cm massage axis features a tapered and rounded tip. This innovative design, previously validated for reducing back pain and increasing flexibility (citation needed, though mentioned in original text), allows for effective self-application.

Both groups of participants received training in self-foot care and were provided with a notebook to record their foot care activity. The researcher demonstrated the massage technique (as illustrated in Figure 2) (Chanumklang, Peungsuwan, Donrapunha, Chatchawan, & Sriboonreung, 2019) and instructed the participants to apply the pressure (Buttagat, Techakhot, Wiriya, Mueller, & Areeudomwong, 2020). The participants were instructed to perform the self-massage a minimum of three sessions per week, though daily performance was encouraged. Pressure was adjusted to comfortable tension without pain and was maintained for 5 seconds at each point. The entire massage program lasted for 30 minutes, followed by 30 seconds of calf muscle stretching.

After the practice session, the participants performed self-massage according to their assigned group's program diary for 4 weeks. The participant in WMS used wooden massage sticks, applying pressure to the sole by pulling the handle of the stick toward their body, and stretched their calf muscles by placing their foot in the space of the wooden stick's point and pulling the handle (as illustrated in Figure 3). The participant in SHM performed the massage using their own hand and actively stretched their calf muscle by dorsiflexing the ankle until a maximally tolerated stretch was felt.

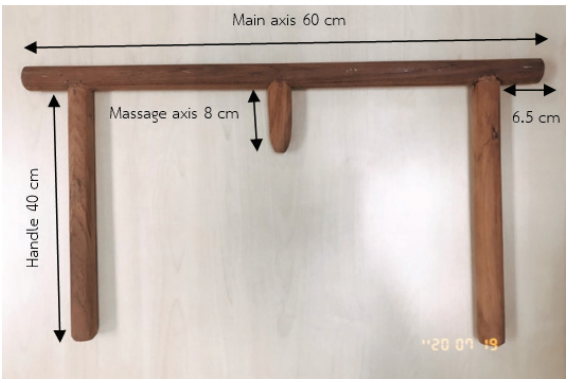

Figure 1 shows a wooden massage stick

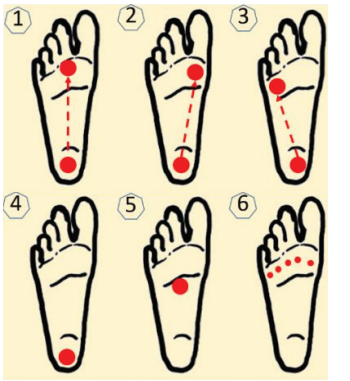

Figure 2 shows the massage techniques

Figure 3A-B shows the self-calf stretching techniques for the WMS

5. Data collection and outcome measures

Following the screening, baseline outcome assessments were conducted. Measurement included the Semmes-Weinstein monofilament test (SWMT) (Kamei et al., 2005), Timed up and go (TUG), One leg stands (OLS) with both eyes open and closed, and WHOQOL - BREF - THAI. The post-intervention assessments were performed at 4 weeks. An additional evaluation was conducted after 6 weeks (after a 2-week cessation period) to determine long-term effects. All assessments were conducted by the research assistant, who was blinded to group allocation.

Before data collection, the intra-rater reliability of the research assistant was established. The Intraclass Correlation Coefficient (ICC) values indicated excellent reliability for the following measures: the SWMT (ICC=1.00), the TUG test (ICC=0.97), and the OLS test with eyes open (ICC=0.97). Reliability was also acceptable for the OLS test with eyes closed (ICC=0.80).

6. Mental State Examination E10 (MSET10)

The MSET10, a tool employed to assess dementia, was utilized during the screening process. This instrument comprises 10 questions, with a maximum score of 29. The dementia cut-off scores are stratified based on the individual's education level: 14 points and below for those without formal education or literacy, 17 points

for individuals with primary school education, and 22 points for those with education beyond primary school (Zaudig, 1992).

7. Semmes-Weinstein Monofilament Test (SWMT)

SWMT assessed the foot sensation using a 10-g monofilament applied with sufficient pressure to buckle for about a second on 10 points of each foot (Kamei et al., 2005). The participants were instructed to keep their eyes closed during the examination and verbally respond with "Yes" when they felt the monofilament touch their foot (Raymond et al., 2019). The number of lost sense points was recorded by the examiner.

8. Timed up and go Test (TUG)

The dynamic balance was evaluated using the TUG test, which began recording the time when participants rose from the chair, walked for 3 meters, and concluded by returning to a seated position. The average duration of two trials was recorded for analysis.

9. One Leg Stand Test (OLS)

The static balance was evaluated using the OLS test under 2 conditions: eyes opened and eyes closed, on both sides of the leg. Participants were instructed to place their hands on their waist and lift one leg off the ground, at which point the time began. They were required to maintain their balance for as long as possible without assistance or for 60 seconds, either with eyes open or closed, depending on the test condition. The time was stopped when the stance foot shifted on the ground or the raised foot touched the ground. The performance times from 2 trials were recorded and averaged Park, Yang, Yoo, & Kim, 2020).

10. World Health Organization Quality of Life Brief - Thai (WHOQOL - BREF - THAI)

The WHOQOL - BREF - THAI was utilized to assess the quality of life across 4 domains: physical health, psychological, social relationships, and environment. The questionnaire consists of 26 items, with a total score of 130. The results are categorized into 3 levels: a score of 26-60 indicates poor quality of life, 61-95 signifies moderate quality of life, and 96-130 reflects good quality of life.

11. Statistical analysis

This study aimed to examine the effect of using a wooden massage stick or self-hand massage at different points of time (before the massage, after 4 weeks of massage, and 2 weeks after stopping the massage to assess long-lasting effects. Within-group differences for normally distributed data were analyzed using a paired t-test, while those with abnormal distributions were assessed using the Wilcoxon Signed Ranks test. Between-group differences for normally distributed data were analyzed using ANCOVA, with the baseline (pre-intervention) values of the respective dependent variable serving as the covariate, whereas those with abnormal distribution were analyzed using the Mann-Whitney U test. Data normality was assessed using the Shapiro-Wilk test. All data analyses were conducted using SPSS version 20.0. The analysis was conducted using a Per-Protocol approach, including only participants who completed the entire intervention and follow-up as specified in the study protocol.

Results

The publicity of this study was disseminated to the Tambon Health Promoting Hospitals in Nang-lae, Patung, Pra Ratchathan, Maekaotom, and Thasud. Following the screening process, 45 participants met the inclusion and exclusion criteria; however, only 17 participants were eligible to proceed with the study. These 17 participants were randomly assigned into two groups: 8 participants in the WMS and 9 participants in the SHM. The baseline characteristics of both groups of participants were relatively similar which are presented (Shown in Table1)

Table 1 Participant characteristics

Characteristics	WMS (N = 8) Mean ± SD	SHM (N = 9) Mean ± SD
Gender; number of male (%)	5 (62.50%)	4 (44.40%)
Age (years), Mean (sd)	60.11 ± 7.15	59.13 ± 8.94
BMI (kg/m^2)	24.81 ± 4.14	23.67 ± 4.57
Duration of diabetes (years)	8 ± 3.38	9 ± 4.83
Number of lost sense points of SWMT (out of 20) (points)	5 ± 2.14	4.11 ± 1.45
Rt. One Leg Stand (Closed Eye) (sec.)	4.71 ± 4.42	4.4 ± 4.17
Time Up and Go Test (sec.)	9.19 ± 1.55	9.27 ± 2.07
Rt. One Leg Stand (Open Eye) (sec.)	19.21 ± 12.37	17.15 ± 10.94
Lt. One Leg Stand (Open Eye) (sec.)	20.63 ± 19.06	15.96 ± 14.92
Lt. One Leg Stand (Closed Eye) (sec.)	6.33 ± 5.32	3.98 ± 1.89
WHOQOL-BREF-THAI (score)	99.87 ± 7.69	98 ± 16.73

1. Intervention effects

After a 4-week intervention, the number of lost sense points (SWMT) showed a significant improvement within both the WMS and SHM groups (as detailed in Table 2). In the WMS group, the number of points significantly decreased from a pre-test to post-test at 4 weeks (p-value <.001). This improvement persisted two weeks after the cessation of the massage, maintaining a statistically significant reduction (p-value<.05) compared to the baseline (as shown in Table 2). A similar reduction was observed in the SHM group; significant improvements were seen at the 4-week post-test, and these effects continued to persist at the 6-week follow-up (p<.01).

The TUG test results showed significant

improvements in both groups at the post-test and follow-up (as shown in Table 2). The WSM group showed a statistically significant reduction in time from pre-test to post-test (*p*-value = .02). This reduction was maintained at the 2-week cessation follow up (*p*-value = .01). Similarly, the SHM group also achieved significant improvements from pre-test to post-test (*p*-value = .008), and these improvements remained significant at the 6-week follow-up (*p*-value = .001) (as shown in Table 2).

Meanwhile, the significant differences in SWMT and TUG between the groups were not found. Additionally, other variables, including right and left OLS (both open and closed eyes) and WHOQOL BREF-THAI, did not show significant changes for post-intervention within group and between groups (shown in Table 2).

Table 2 Comparison between the pre-test and post 4 weeks, pre-test and post 6 weeks, and comparison between groups

Variables	Group	N	Pre-test Mean ± SD	Post 4 weeks Mean ± SD	Post 6 weeks Mean ± SD	Within group		Between groups	
						p-value (pre-and post-4 weeks)	*p*-value (pre-and post-6 weeks)	p-value (pre-and post-4 weeks)	*p*-value (pre-and post-6 weeks)
SWMT	WSM	8	5.00 ± 2.14	1.25 ± 1.39	0.5 ± 1.06	.001[p]*	.012[w]*	.96[m]	.298[m]
	SHM	9	4.11 ± 1.45	1.11 ± 0.93	0.78 ± 0.97	.007[w]*	.007[w]*		
TUG	WSM	8	9.19 ± 1.55	7.92 ± 1.55	7.78 ± 1.9	.02 [p]*	.01[p]*	.773[m]	.057
	SHM	9	9.27 ± 2.07	7.85 ± 1.67	7.61 ± 1.71	.008[w]*	.001[p]*		
Rt. OLS (OE)	WSM	8	19.21 ± 12.37	28.1 ± 22.54	21.7 ± 22.33	0.123[w]	.05[w]	.673[a]	.665[m]
	SHM	9	17.15 ± 10.94	22.39 ± 18.75	18.76 ± 16.05	0.282[p]	.767[w]		
Lt. OLS (OE)	WSM	8	20.63 ±19.06	22.88 ± 20.51	18.34 ± 21.67	0.575[w]	.674[w]	.7[m]	.531[m]
	SHM	9	15.96 ± 14.92	20.93 ± 12.46	16.75 ± 16.9	0.173[w]	.26[w]		
Rt. OLS (CE)	WSM	8	4.71 ± 4.42	6.83 ± 5.8	4.77 ± 4.18	0.408[p]	.979[p]	.178[m]	.441[m]
	SHM	9	4.4 ± 4.17	3.33 ± 1.47	5.77 ± 3.73	0.767[w]	.236[w]		
Lt. OLS (CE)	WSM	8	6.33± 5.32	7.07 ± 9.86	3.93 ± 4.17	1.00[w]	.575[w]	.63[m]	.102[m]
	SHM	9	3.98 ± 1.89	3.8 ± 2.39	5.74 ± 4.42	0.767[w]	.314[w]		
WHOQOL	WSM	8	99.87 ± 7.69	97.37 ± 11.34	96.62± 15.87	0.646[p]	.623[p]	.384[a]	.857[a]
	SHM	9	98 ± 16.73	92 ± 11.32	97.11 ± 12.33	0.239[p]	.841[p]		

*WSM; wooden self-massage group, SHM; self-hand massage group, SEMT; Semmes-Weinstein monofilament test (point), TUG; Time Up and Go test (sec.), Rt. OLS (OE) (sec.); Right One Leg Stand (Open Eye) (sec.), Lt. OLS (OE); Left One Leg Stand (Open Eye) (sec.), Rt. OLS (CE) (sec.); Rt. One Leg Stand (Closed Eye), Lt. OLS (CE) (sec.); Lt. One Leg Stand (Closed Eye) (sec.), WHOQOL; WHOQOL-BREF-THAI (score), [p]paired ttest, [w]Wikcoxon Signed Ranks test, [m]Mann Whitney U test, [a]ANCOVA, *p-value <0.05 statistical significant difference*

Discussion

This study aimed to assess the effects of a 4-week self-massage regimen, comparing the effectiveness of a wooden massage stick (WMS) and self-hand massage (SHM) on sensation, balance, and quality of life.

The results revealed that both WSM and SHM group experienced a significant reduction in SWMT score from pre-test to post-test after 4 weeks, with this improvement persisting even after a 2-week cessation period. This finding suggests that both self-massage methods may be effective for improving sensation, which is important for the diabetic neuropathy patient. This aligns with the previous studies showing significant improvement in foot sensation after 2 and 4-week of massage, regardless of the technique (Chanumklang et al., 2019; Chatchawan et al., 2015; Gok Metin et al., 2017). The enhancements were attributed to improving local blood flow, stimulating the somatosensory system, activating multiple receptors, leading to changes in the pressure distribution, proprioceptive systems, muscle tension, joint angle, and muscle length. The various massage techniques have been reported as effective for diabetic neuropathy, including using a Thai massage technique for 30 minutes combined with a 5-minute stretching massage, administered by Thai massage therapists, 3 sessions per week for 2 weeks (Chatchawan et al., 2015), using a self-hand massage for 15 minutes twice a week for 4 weeks (Agustini et al. 2019), using an electric massage machine for 15 minutes twice a week for 4 weeks (Gok Metin et al., 2017), using a massage wood device for 30 minutes every day for 4 weeks (Chanumklang et al., 2019), using a bamboo rail for 15 minutes, 3 times a week for 4 weeks (Thuma, Khosinglang, & Ongruksa, 2020), and using a coconut shell carpet for 15 minutes, 3 times a week for 4 weeks (Rattanachompu et al. 2019).

The results of the TUG test paralleled those of the SWMT, with both groups demonstrating improved mobility and balance at the 4 weeks of massage, and continued improvement at 6 weeks. This indicates a 4-week self-massage regimen is effective for enhancing dynamic balance. These results align with the prior studies that reported improvements in TUG performance after just 2 weeks of massage in Type 2 Diabetes patients (Chatchawan et al., 2015; Tütün Yümin, Şimşek, Sertel, Ankaralı, & Yumin, 2017). The mechanisms behind the improvements from Thai massage were explained through 3 primary pathways. Firstly, the deep pressure and stretching techniques used in Thai foot massage enhance local blood pressure and stimulate the somatosensory system, which includes multiple receptors crucial for postural control. Secondly, the direct deep pressure applied to the plantar region may arouse joint mechanoreceptors, subsequently improving the neuromuscular function of joint-stabilizing muscle by increasing the extensibility of non-contractile capsule and ligamentous tissue, thus enhancing mobility and dynamic balance. Finally, the pressure applied to the plantar region activates plantar cutaneous receptors, supporting functional plasticity within the central nervous system and leading to a recalibration of somesthetic cues, thereby directly

enhancing balance (Tütün Yümin et al. 2017). Although the progression of SWME and TUG was observed, this study found no significant changes in other variables, including the OLS test and WHOQOL-BREF-THAI scores. The lack of change in the WHOQOL-BREF-THAI score may be due to uncontrolled external stressors and anxieties related to the COVID-19 pandemic during the study period. This factor likely impacted participants' overall quality of life, masking any subtle intervention effects from the massage itself. For the OLS test (an indicator of static balance and proprioception), the lack of significant improvement contrasts with some previous findings (Chatchawan et al., 2015; Tütün Yümin et al. 2017). While balance can improve through proprioceptive system activation, which some massage techniques (e.g., those combined with gentle traction) can stimulate, a significant factor for sustained OLS performance is lower limb muscle strength, which massage alone does not enhance. This inherent limitation may restrict the clear improvement observed. (Chatchawan et al., 2015; Chanumklang et al., 2019). However, OLS improvements were noted in other studies that used a longer, 6-week intervention period (Tütün Yümin et al. 2017), suggesting duration may be the key. Conversely, another previous study also failed to demonstrate an immediate massage effect on the OLS test (Chatchawan et al., 2015).

In alignment with the OLS test results, no significant changes were demonstrated in the quality of life scores as measured by the WHOQOL-BREF-THAI, with no notable difference between the pre-test and post-test. Research on massage effects suggests that the duration needed to achieve different outcomes varies significantly. For example, improvements in ankle and thumb range of motion and sleep performance have been observed after just a single massage session (Chatchawan et al., 2015; Wardani, Wijayanti, & Ainiyah 2019), and immediate effects on blood circulation were seen after three consecutive days of intervention (Puryanti, Subiyanto, & Amigo, 2023). However, improvements in sensory response typically require 4 weeks (Abiddin & Anam, 2024; Lapanantasin, Jedtanaprakrit, Assarach, Inklum, & Jamnongphon, 2014). Given this variance, the lack of quality of life improvement in this study may be due to the short 4-week intervention period, which was likely insufficient to impact overall quality of life. Furthermore, despite extensive studies on plantar massage, few have directly assessed its effect on quality of life.

No significant differences were observed in any of the measured outcomes between the WSM and SHM group, suggesting that both massage interventions may be improving the assessed parameters. Nonetheless, variations in participant satisfaction were noted. Some participants in the WMS found the wooden massage stick comfortable for seated use and provided satisfactory pressure. In contrast, participants in the SHM group experienced discomfort with deep pressure and reported back and knee pain during the massage. Conversely, some participants preferred manual hand massage due to its greater control over pressure and placement compared to the wooden massage stick.

The study could be constrained by limitations that affected its capacity to detect subtle differences in results, including the short duration of intervention and limited sample size. Additionally, the investigation was carried out during the COVID-19 pandemic, presenting obstacles in enrolling and collecting the data of the participants, particularly the elderly, and restricted access to vaccinations among the Thai population, leading to potential distress and necessitating ending the study before it finishes. Given these limitations of this study, further research should include a larger sample size and a longer intervention period. This study explored applying the innovation for approaching plantar massage, offering a viable option for foot care in individuals with type 2 diabetes mellitus. The conclusion of this study suggests that a 4-week plantar massage program, whether using a manual technique or a wooden stick, may be effective in improving neuropathy and balance.

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Reference

Abiddin, A. H., & Anam, A. K. (2024). Efektifitas Senam Kaki Diabetes Menggunakan Alat Pijat Plantar Manual pada Klien Diabetes Mellitus. *Malahayati Nursing Journal, 6*(6), 2406-2414. doi: 10.33024/mnj.v6i6.13450

Agustini, N. L. P. I. B., Wulansari, N. T., Yusniawati, Y. N. P., & Ni, W. S. (2019). The effect of foot massage on decreasing peripheral neuropathy diabetic complaints in the patients with type 2 diabetes mellitus. *Jurnal Ners, 14*(3), 305-309. doi:10.20473/jn.v14i3.17152

American Diabetes Association. (2016). 9. Microvascular complications and foot care. *Diabetes care, 39*(Supplement_1), S72-S80. doi: 10.2337/dc16-S012

Bayat, D., Mohammadbeigi, A., Parham, M., Mehrandasht, A., Hashemi, M., Mahlooji, K., & Asghari, M. (2020). The Effect of Massage on Diabetes and its Complications: A Systematic Review. *Crescent Journal of Medical & Biological Sciences, 7*(1), 2148-2696.

Bootsri, W., & Singban, C. (2025). Effects of Black Rose Wood Carpet on Relieving Foot Numbness in Type 2 Diabetic Patients at Nong Kainok Health Promoting Hospital, Muangsamsib District, Ubon Ratchathani. *Regional Health Promotion Center 9 Journal, 19*(3), 1139-1151.

Buttagat, V., Techakhot, P., Wiriya, W., Mueller, M., & Areeudomwong, P. (2020). Effectiveness of traditional Thai self-massage combined with stretching exercises for the treatment of patients with chronic non-specific low back pain: A single-blinded randomized controlled trial. *Journal of Bodywork and Movement Therapies, 24*(1), 19-24. doi: 10.1016/j.jbmt.2019.03.017

Chanumklang, K., Peungsuwan, P., Donrapunha, W., Chatchawan, U., & Sriboonreung, T. (2019). The Effectiveness of Home Self-Foot Massage Using a Massage Wood Device on Foot Sensation and Balance Performance in Patients with Diabetes Mellitus. *Archives of Allied Health Sciences, 31*(2), 175-185.

Chatchawan, U., Eungpinichpong, W., Plandee, P., & Yamauchi, J. (2015). Effects of Thai Foot Massage on Balance Performance in Diabetic Patients with Peripheral Neuropathy: A Randomized Parallel-Controlled Trial. *Medical Science Monitor Basic Research, 21*, 68-75. doi: 10.12659/MSMBR.894163

Diabetes Association of Thailand, The Endocrine Society of Thailand, Department of Medical Services, Ministry of Public Health, & National Health Security Office. (2017). *Clinical practice guideline for diabetes 2017*. Retrieved from https://drive.google.com/file/d/18Ay6FHnW0gToDSDVNOXh6tsqNMT2yr4N/view

Fowler, M. J. (2011). Microvascular and macrovascular complications of diabetes. *Clin diabetes, 29*(3), 116-122. doi: 10.2337/diaclin.29.3.116

Kamei, N., Yamane, K., Nakanishi, S., Yamashita, Y., Tamura, T., Ohshita, K., ... & Kohno, N. (2005). Effectiveness of Semmes–Weinstein monofilament examination for diabetic peripheral neuropathy screening. *Journal of Diabetes and its Complications, 19*(1), 47-53. doi: 10.1016/j.jdiacomp.2003.12.006

Lapanantasin, S., Jedtanaprakrit, S., Assarach, R., Inklum, W., & Jamnongphon, S. (2014). Effect of Massage with Peripheral Vascular Circulation Exercise on Neuropathic Symptoms of Lower Legs in Type 2 Diabetic Patients: A Pilot Study. *Thai Journal of Physical Therapy, 36*(3), 97-105.

Gok Metin, Z., Arikan Donmez, A., Izgu, N., Ozdemir, L., & Arslan, I. E. (2017). Aromatherapy massage for neuropathic pain and quality of life in diabetic patients. *Journal of Nursing Scholarship, 49*(4), 379-388. doi: 10.1111/jnu.12300

Park, K. N., Yang, M., Yoo, T. G., & Kim, S. H. (2020). One-leg standing and Y-balance test performance in elderly fallers and nonfallers. *Topics in Geriatric Rehabilitation, 36*(2), 92-96. doi: 10.1097/TGR.0000000000000262

Pungpotong, S., Nunla-ong, O., & Nunla-ong, Y. (2014). Effects of Traditional Bamboo Foot Care on Reducing Foot Numbness in Elderly Diabetic Patients. *KKU Journal for Public Health Research,* 7(2), 75-80.

Puryanti, C., Subiyanto, P., & Amigo, T. A. E. (2023). Integration of Foot Massage and Diabetic Foot Gymnastic on Peripheral Perfusion in Patients with Diabetes Mellitus 2. *Jurnal Kebidanan Dan Keperawatan Aisyiyah, 19*(1), 40-50. doi: 10.31101/jkk.3041

Rattanachompu, P., Boonthong, M., Tongthong, K., Thiraphatthanavong, P., Wansutha, S., & Yuenyaow, L. (2019). Effectiveness of Coconut Seed Carpet for Foot Massage on Peripheral Neuropathy Mitigation of Feet of Diabetic in Patients Wang Yang Subdistrict, Phanna Nikhom District, Sakon Nakkhon Province. *Udon Thani Rajabhat University Journal of Sciences and Technology, 7*(2), 159-177.

Raymond, B., Steriovski, J., Gillyard, K., Yang, C., Wu, S. C., & Crews, R. T. (2020). Choosing a vibratory test to pair with Semmes Weinstein monofilament testing for evaluating lower extremity sensation in patients with diabetes: A comparison of three vibratory methodologies. *Journal of diabetes science and technology, 14*(1), 8-15. doi: 10.1177/1932296819849478

Thuma, K., Khosinglang, S., & Ongruksa, S. (2020). The Effect of Foot Massage by Stepping on Bamboo Rails in Combination with Foot Bath with Warm Water on the Symptoms Foot Numbness in Patients with Type 2 Diabetes. *Health Science, Science and Technology Reviews, 13*(2), 31-35.

Tütün Yümin, E., Şimşek, T. T., Sertel, M., Ankaralı, H., & Yumin, M. (2017). The effect of foot plantar massage on balance and functional reach in patients with type II diabetes. *Physiotherapy Theory and Practice, 33*(2), 115-123. doi: 10.1080/09593985.2016.1271849

Wardani, E. M., Wijayanti, L., & Ainiyah, N. (2019). *The Effect of Diabetic Feet Spa Therapy to Blood Glucose Level and Sleep Quality of Diabetes Mellitus Patient.* Indonesia: International Conference of Kerta Cendekia Nursing Academy

Williams, R., Van Gaal, L., & Lucioni, C. (2002). Assessing the impact of complications on the costs of Type II diabetes. *Diabetologia, 45*(Suppl 1), S13-S17.

Zaudig, M. (1992). A new systematic method of measurement and diagnosis of “mild cognitive impairment” and dementia according to ICD-10 and DSM-III-R criteria. *International psychogeriatrics, 4*(4), 203-219. doi: 10.1007/s00125-002-0859-9