



THE EFFECT OF KINESIOTAPING THERAPY ON ANKLE-BRACHIAL INDEX (ABI) AND FOOT PAIN IN PATIENTS WITH DIABETES MELLITUS

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ABSTRACT

Diabetes mellitus (DM) is a chronic metabolic disorder associated with vascular complications, including peripheral artery disease (PAD), which can impair peripheral circulation, reduce the ankle-brachial index (ABI), and exacerbate foot pain. Kinesiotaping has been proposed as a complementary intervention to improve peripheral perfusion and alleviate pain. This study aimed to evaluate the effects of kinesiotaping on ABI and foot pain in patients with DM. A quasi-experimental pretest–posttest control group design was employed involving 104 patients with DM at Bululawang Primary Health Center, Malang Regency, Indonesia. Participants were selected using simple random sampling. Data were analyzed using paired-samples and independent-samples t-tests. In the intervention group, the mean ABI increased significantly from 0.8955 to 0.9828 ($p < 0.001$), while the mean foot pain score decreased from 4.8833 to 1.2833 ($p < 0.001$). Compared with the control group, the intervention group exhibited significantly higher ABI values and lower foot pain scores ($p < 0.001$). These findings suggest that kinesiotaping may be a beneficial complementary intervention for improving peripheral circulation and reducing foot pain in patients with DM.

Keywords: ankle-brachial index; diabetes mellitus; kinesiotaping; peripheral arterial disease

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INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder caused by impaired insulin secretion, impaired insulin action, or both, resulting in elevated blood glucose levels. Insulin plays a crucial role in facilitating glucose uptake into muscle and other body tissues for energy production while maintaining the homeostasis of carbohydrate, lipid, and protein metabolism. Under normal physiological conditions, insulin regulates blood glucose and lipid levels by promoting glucose transport into cells through glucose transporters (GLUTs). When this process is impaired, glucose cannot be efficiently utilized by body cells, leading to persistent hyperglycemia and systemic metabolic disturbances (Huether et al., 2019; Ignavaticius & Workman, 2016; LeMone et al., 2017; Setiati et al., 2017).

The global prevalence of diabetes mellitus reached approximately 589 million people in 2024. Current evidence highlights the growing global burden of diabetes on individuals, families, and healthcare systems. The latest International Diabetes Federation (IDF) Diabetes Atlas (2025) reported that 11.1%, or approximately 1 in 9 adults aged 20–79 years, are living with diabetes, with more than 40% remaining undiagnosed. By 2050, the IDF projects that approximately 1 in 8 adults, equivalent to 853 million people, will be living with diabetes, representing a 46% increase compared with current estimates (International Diabetes Federation, 2025). Indonesia is one of the 38 countries and territories in the International Diabetes Federation (IDF) Western Pacific Region. Of the 589 million people living with diabetes worldwide, approximately 215 million reside in the Western Pacific Region, and this number is projected to increase to 254 million by 2050. In

Indonesia, the prevalence of diabetes is estimated at 11.3% among the adult population of 185,217,400, corresponding to approximately 20.4 million individuals living with diabetes mellitus. (International Diabetes Federation, 2025).

Patients with diabetes mellitus are at high risk of developing Peripheral Arterial Disease (PAD), which is characterized by narrowing of the peripheral arteries and reduced blood flow to the lower extremities. The hallmark symptom of PAD is intermittent claudication, characterized by leg pain during walking that is relieved by rest (PERKENI, 2021). As Peripheral Arterial Disease (PAD) progresses, pain may occur even at rest, often presenting as a burning sensation or severe pain in the soles of the feet. The Indonesian Society of Endocrinology (PERKENI) clinical guidelines also identify activity-induced leg pain accompanied by ischemic foot ulcers as common manifestations of PAD in patients with diabetes mellitus (Akkus & Sert, 2022; PERKENI, 2021).

Peripheral Arterial Disease (PAD) in patients with diabetes mellitus can progress to diabetic foot ulcers, which may subsequently precipitate acute hyperglycemic conditions, increase hospitalization rates, reduce quality of life, and contribute to higher mortality. Therefore, early detection and appropriate management of peripheral circulatory disorders are essential to prevent the progression of severe diabetes-related complications (Soyoye et al., 2021; Veves et al., 2018). Non-pharmacological interventions aimed at improving peripheral circulation, particularly complementary therapies, remain underutilized in clinical practice. One emerging non-pharmacological approach is kinesiotaping therapy. However, its application in patients with diabetes mellitus, especially for improving the Ankle-Brachial Index (ABI) and reducing foot pain, is still uncommon in primary healthcare settings such as community health centers. Furthermore, empirical evidence regarding the effectiveness of kinesiotaping in community-based patients with diabetes mellitus remains limited.

Several studies have demonstrated that the application of kinesiotaping, also known as neuromuscular taping (NMT), to the lower extremities can improve peripheral circulation and reduce pain in patients with diabetes mellitus. For example, a study by Ulkhasanah & Widiastuti (2024) reported that the combination of diabetic foot exercises and neuromuscular taping (kinesiotaping) significantly improved the Ankle-Brachial Index (ABI) in patients with type 2 diabetes mellitus. Similarly, Fajriyah & Trisnawuri (2023) reported that the combination of Neuromuscular Taping (NMT) and Progressive Muscle Relaxation (PMR) significantly increased the Ankle-Brachial Index (ABI), indicating improved peripheral blood circulation in patients with diabetes mellitus.

Physiologically, kinesiotaping is proposed to produce a localized vasodilatory effect by lifting the skin and creating convolutions that increase the interstitial space, thereby enhancing vascularization and tissue perfusion. Laboratory-based investigations have confirmed that the local application of elastic tape can improve blood flow and peripheral circulation. In addition, kinesiotaping has been shown to significantly increase muscle blood flow during and after exercise, indicating enhanced peripheral perfusion. Collectively, these findings suggest that the application of kinesiotaping to the lower extremities facilitates local circulation, including improvements in the Ankle-Brachial Index (ABI), in patients with diabetes mellitus, as supported by both experimental evidence and underlying physiological mechanisms. (Aktifah et al., 2025; Ilgu & Kwangjae, 2014).

In addition, kinesiotaping has been reported to be effective in reducing pain in patients with diabetes mellitus, particularly neuropathic and diabetes-related musculoskeletal pain. The literature indicates that Neuromuscular Taping (NMT) is widely used as an adjunctive therapy for both acute and chronic pain (Kristianto et al., 2021). Specifically, the concept of kinesiotaping suggests that the application of elastic tape reduces pressure on peripheral nerves and capillaries, thereby decreasing pain perception (Ilgu & Kwangjae, 2014). Furthermore, NMT has been shown to

enhance lymphatic drainage, improve vascularization, and alleviate pain associated with diabetic neuropathy (Kristianto et al., 2021). Therefore, through its combined mechanical and neurosensory effects, kinesiotope applied to the lower extremities may indirectly reduce foot pain and neuropathic symptoms in patients with diabetes mellitus.

Kinesiotope, as a complementary therapeutic intervention, has been shown to improve microcirculation, enhance neuromuscular function, and reduce pressure on tissues and pain receptors. Previous studies have demonstrated that the application of kinesiotope to the lower extremities may improve peripheral blood flow, as reflected by increased Ankle-Brachial Index (ABI) values, while simultaneously reducing pain intensity in patients with diabetes mellitus. Moreover, this intervention is considered safe, non-invasive, cost-effective, and easy to implement in nursing practice. Based on these considerations, this study aimed to evaluate the effects of kinesiotope on the ankle-brachial index (ABI) and foot pain in patients with diabetes mellitus (DM). The findings are expected to provide evidence to support the use of kinesiotope as a complementary nursing intervention to improve peripheral circulation, reduce foot pain, prevent peripheral vascular complications, and enhance patients' functional outcomes and quality of life.

METHOD

This study employed a quasi-experimental pretest-posttest control group design to evaluate the effect of kinesiotope (KT) on the Ankle-Brachial Index (ABI) and foot pain in patients with diabetes mellitus (DM). A longitudinal approach was used, with data collected before the intervention (pretest) and one week after the intervention (posttest) to assess the therapeutic effects of KT. The study was conducted at five Prolanis (Chronic Disease Management Program) groups within the service area of the Bululawang Primary Health Center, Malang Regency, Indonesia, namely Bululawang, Pringu, Kasri, Bakalan, and Sempalwadak villages. The study population consisted of 140 patients with diabetes mellitus. Using the Slovin formula and simple random sampling, 104 eligible participants meeting the predefined inclusion and exclusion criteria were recruited and allocated into intervention and control groups. Data collection was carried out in June 2026.

The intervention group received kinesiotope therapy for one week, while the control group received routine care without kinesiotope. Data analysis followed several stages, including data preparation, cleaning, preliminary assessment, principal analysis, and interpretation. Descriptive statistics were used to summarize participants' characteristics. Paired t-tests were performed to compare pre- and post-intervention outcomes within groups, independent t-tests were used to compare outcomes between groups. Statistical significance was set at $p < 0.05$. This study was approved by the Health Research Ethics Committee of Hafshawaty Zainul Hasan University (Approval No. 246/KEPK-UNHASA/V/2026) and was conducted with authorization from the Institute for Research and Community Service (LPPM), STIKes Panti Waluya Malang.

RESULT

Univariate analysis was performed to describe the characteristics of the study participants, including the Ankle-Brachial Index (ABI), foot pain score, age, sex, body mass index (BMI), duration of diabetes mellitus, smoking status, physical activity level, foot care status, history of diabetes-related complications, and blood glucose level (secondary data). The demographic and clinical characteristics of the participants are presented in the table below.

Bivariate analysis consisted of three statistical tests: (1) the comparison of Ankle-Brachial Index (ABI) and foot pain scores before and after the intervention within the intervention group using the paired t-test; and (2) the comparison of post-intervention ABI and foot pain scores between the intervention and control groups using the independent t-test.

Table 1
Demographic and Clinical Characteristics of the Study Participants

Variables	f	%
Gender		
Male	10	9.6
Female	94	90.4
Body Mass Index (BMI)		
Underweight (<18.5 kg/m ²)	9	8.7
Normal (18.5–24.9 kg/m ²)	38	36.5
Overweight (25.0–26.9 kg/m ²)	34	32.7
Obesity Class I (27.0–35.0 kg/m ²)	18	17.3
Obesity Class II (>35.0 kg/m ²)	5	4.8
Duration of Diabetes Mellitus		
<5 years	42	40.4
5-10 years	43	41.3
>10 years	19	18.3
Smoking Status		
Current smoker	5	4.8
Passive smoker	34	32.7
Non-smoker	65	62.5
Physical Activity Level		
Light	42	40.4
Moderate	62	59.6
Foot Care Status		
Good	35	33.7
Fair	34	32.7
Poor	24	23.1
Very Poor	11	10.6
History of Diabetes-Related Complications		
None	27	26
Microvascular	10	9.6
Macrovascular	61	58.7
Severe complications	6	5.8
Treatment Adherence		
High	42	40.4
Moderate	47	45.2
Low	14	13.5
	Mean	Std. Deviation (SD)
Age (years)	64.4	8.76315
Blood Glucose Level (mg/dL)	198.74	83.55708
Ankle-Brachial Index (ABI)	0.88	0.10949
Foot Pain Score	3.68	1.24841

Table 2
Comparison of Ankle-Brachial Index (ABI) and Foot Pain Scores Before and After the Intervention in the Kinesiotaping Group

Variables	Pre-intervention (Mean ±SD)	Post-intervention (Mean ±SD)	t-value	p-value
Ankle-Brachial Index (ABI)	0.8955 ± SD	0.9828 ± SD	-10.223	0.000
Foot Pain Score	4.8833 ± SD	1.2833 ± SD	19.204	0.000

Table 3
Comparison of Post-Intervention Ankle-Brachial Index (ABI) and Foot Pain Scores Between the Intervention and Control Groups

Variables	Intervention Group (Mean ± SD)	Control Group (Mean ± SD)	t-value	p-value
Ankle-Brachial Index (ABI)	0.9828 ± SD	0.8743 ± SD	6.025	0.000
Foot Pain Score	1.2333 ± SD	3.1833 ± SD	-14.312	0.000

DISCUSSION

Most participants were female (90.4%) with an older age profile (mean age: 64.4 years). The majority had a normal to overweight body mass index (69.2%) and had been living with diabetes

mellitus for 5–10 years. Only a small proportion were current smokers (4.8%), while most were non-smokers. Moderate physical activity was reported by the majority of participants (59.6%). Foot care practices were generally classified as good or fair, although 28.7% of participants demonstrated poor or very poor foot care. Most participants (64.5%) had a history of macrovascular diabetes-related complications, and 85.6% exhibited moderate to high treatment adherence. These findings suggest that comprehensive diabetes management, particularly through improving treatment adherence, optimizing glycemic control, promoting smoking cessation, and implementing appropriate foot care practices, may help preserve peripheral perfusion and reduce the risk of Peripheral Arterial Disease (PAD) in patients with diabetes mellitus. The study further demonstrated that Ankle-Brachial Index (ABI) values were significantly associated with several clinical factors, including duration of diabetes mellitus ($p = 0.000$), smoking status ($p = 0.029$), foot care status ($p = 0.000$), history of diabetes-related complications ($p = 0.000$), adherence to diabetes therapy ($p = 0.000$), and blood glucose level ($p = 0.000$). These findings indicate that effective management of these modifiable factors plays a crucial role in maintaining peripheral arterial circulation in patients with diabetes mellitus (Syukkur & Sutiarsih, 2026).

In the intervention group ($n = 52$), the paired t-test demonstrated a significant increase in the mean Ankle-Brachial Index (ABI) from 0.8955 to 0.9828 ($\Delta = +0.0873$; $t = -10.223$; $p < 0.05$), along with a significant reduction in the mean foot pain score from 4.8833 to 1.2833 ($\Delta = -3.6000$; $t = 19.204$; $p < 0.05$). These findings indicate that kinesiotaping therapy significantly improved peripheral perfusion while reducing foot pain in patients with diabetes mellitus. The observed effects are consistent with the proposed physiological mechanism of kinesiotaping, whereby lifting the skin increases the subcutaneous space, thereby enhancing blood and lymphatic circulation. Kristianto et al., (2021) reported similar findings, demonstrating a significant improvement in the Ankle-Brachial Index (ABI) following Neuromuscular Taping (NMT) in patients with diabetes mellitus, indicating enhanced peripheral circulation. In contrast, an experimental study by Banerjee et al., (2020) found no significant increase in cutaneous blood flow after kinesiotaping in healthy individuals, with a slight decline in blood flow observed instead. These findings suggest that the therapeutic effects of kinesiotaping are more pronounced in individuals with impaired peripheral circulation, such as patients with diabetes mellitus, whereas the effects are minimal in healthy populations. From a physiological perspective, the skin-lifting effect produced by elastic tape is believed to increase capillary permeability and facilitate microcirculatory pumping. The resulting improvement in blood flow enhances tissue oxygenation and reduces the accumulation of local inflammatory mediators, thereby alleviating peripheral nerve ischemia, a major contributor to neuropathic pain (Ilgu & Kwangjae, 2014; Syukkur et al., 2020; Syukkur & Handini, 2022).

The observed reduction in pain is also consistent with previous evidence indicating that Neuromuscular Taping (NMT) stimulates cutaneous mechanoreceptors and modulates pain transmission through the Gate Control Theory. For example, in patients with multiple sclerosis, NMT has been reported to reduce neuropathic pain by approximately 4–5 points on the Visual Analog Scale (VAS) compared with the control group (Ulhasanah & Widiastuti, 2024). Therefore, the combined effects of improved peripheral perfusion and neurosensory modulation provide a plausible physiological explanation for the significant reduction in foot pain observed in patients with diabetes mellitus (Ilgu & Kwangjae, 2014; Molle, 2018).

The independent t-test compared post-intervention outcomes between the kinesiotaping (KT) intervention group and the control group. The results demonstrated that the mean Ankle-Brachial Index (ABI) was significantly higher in the intervention group (0.9828) than in the control group (0.8743) ($t = 6.025$, $p < 0.05$). Likewise, the mean foot pain score was significantly lower in the intervention group (1.2333) than in the control group (3.1833) ($t = -14.312$, $p < 0.05$). These findings confirm that the addition of kinesiotaping provides clinically significant benefits beyond those achieved with conventional therapy alone. The results are consistent with the within-group

pre-post analysis and support evidence from recent randomized controlled trials. From a clinical perspective, these findings suggest that kinesiotaping may serve as an effective adjunctive therapy for patients with diabetes mellitus. Given that pharmacological treatment for diabetic neuropathic pain is often insufficient, non-pharmacological interventions such as kinesiotaping may help reduce pain severity, potentially decreasing the need for analgesic medications while simultaneously improving peripheral perfusion and supporting wound healing.

Thakur & Goyal (2023) reported that patients receiving Neuromuscular Taping (NMT) combined with Transcutaneous Electrical Nerve Stimulation (TENS) experienced significantly greater improvements in neuropathic pain, balance, proprioception, and nerve conduction parameters than those receiving sham taping with TENS. Most outcome measures demonstrated moderate to large effect sizes ($d = 0.66-0.97$), indicating that the addition of NMT provided clinically meaningful benefits beyond those of TENS alone. Although Thakur & Goyal (2023) did not evaluate the Ankle-Brachial Index (ABI), their findings demonstrated that NMT significantly improved neuropathic pain and sensorimotor function compared with sham taping. Similarly, Ulkhasanah & Widiastuti (2024) reported significant improvements in ABI following the combination of diabetic foot exercises and Neuromuscular Taping. Collectively, these findings support the hypothesis that NMT enhances peripheral perfusion while simultaneously alleviating neuropathic symptoms in patients with diabetes mellitus.

Our study demonstrated a significant improvement in the Ankle-Brachial Index (ABI) in the intervention group, increasing from 0.90 to 0.98 following kinesiotaping therapy. An ABI within the normal range (0.90–1.40) indicates adequate arterial perfusion, whereas an ABI below 0.90 is suggestive of Peripheral Arterial Disease (PAD). Thus, kinesiotaping successfully increased participants' ABI to the normal threshold, potentially reducing the risk of lower-limb ischemia. The proposed physiological mechanism involves the skin-lifting effect of the elastic tape, which enhances microcirculation and facilitates edema reduction. During movement, the elastic recoil of the tape provides a gentle "micro-massage" effect, stimulating somatosensory receptors and reducing resistance to blood flow. In addition, sensory stimulation from the tape may increase muscle activation in the calf and plantar regions, thereby enhancing the calf muscle pump during walking. These findings are consistent with the concept analysis by Kristianto et al., (2021) which identified enhanced vascularization through skin decompression as one of the primary mechanisms of Neuromuscular Taping (NMT). Improved vascular perfusion is accompanied by reduced edema, attenuation of inflammatory responses, and enhanced neuromusculoskeletal function, including increased muscle strength, range of motion, joint stability, proprioception, and walking ability. Clinically, these vascular and neuromuscular improvements may enhance lower-extremity perfusion, as reflected by increased ABI values, while contributing to the prevention of diabetic foot complications and promoting tissue healing.

Physiologically, kinesiotaping provides continuous sensory stimulation that modulates pain transmission through the Gate Control Theory, whereby non-nociceptive sensory input suppresses nociceptive signals reaching the central nervous system. Furthermore, the mechanical decompression produced by the tape may reduce pressure on peripheral nerves and inflamed tissues, thereby decreasing the release of pain mediators (Ilgu & Kwangjae, 2014; Molle, 2018). These mechanisms support the present findings that Neuromuscular Taping (NMT) alleviates diabetic neuropathic pain by improving peripheral microcirculation, reducing edema and tissue compression, enhancing lymphatic drainage, and stimulating cutaneous mechanoreceptors. Improved tissue perfusion also increases oxygen and nutrient delivery to peripheral nerves, thereby reducing nerve ischemia, a key contributor to diabetic neuropathic pain. These mechanisms are supported by the concept analysis of Kristianto et al., (2021) which demonstrated that NMT enhances vascularization, reduces inflammation, improves neuromusculoskeletal function, and facilitates tissue repair. Our findings are further supported by Thakur & Goyal (2023), who reported

significant analgesic effects of NMT in patients with diabetic painful distal symmetrical polyneuropathy. Their study demonstrated significant reductions in pain intensity following kinesiotaping based on paired t-test analysis ($p < 0.05$), as well as significant differences between the intervention and control groups based on independent t-test analysis ($p < 0.05$), indicating that the addition of kinesiotaping provides greater therapeutic benefits than conventional treatment alone (Syukkur & Handini, 2022).

CONCLUSION

The paired t-test demonstrated that kinesiotaping therapy significantly improved the Ankle-Brachial Index (ABI) and reduced foot pain scores in patients with diabetes mellitus ($p < 0.001$). The independent t-test further revealed significant differences between the intervention and control groups, with participants receiving kinesiotaping exhibiting significantly higher ABI values and lower foot pain scores than those in the control group ($p < 0.001$). These findings indicate that kinesiotaping is an effective non-pharmacological intervention for improving peripheral arterial perfusion and alleviating foot pain in patients with diabetes mellitus. Therefore, kinesiotaping has considerable potential as an evidence-based complementary nursing intervention to support the prevention of peripheral vascular complications and improve patients' functional outcomes and quality of life.

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