

Literature Review: Neuromuscular Taping and Exercise for Diabetes Mellitus

Nora Eny Zulikha^{1*}, Umi Budi Rahayu², Nadyastama Faisal Haqi³

^{1,2}Program Studi Fisioterapi, Fakultas Ilmu Kesehantan, Universitas Muhammadiyah Surakarta, Indonesia

³Praktik Mandiri, Kinnefisio, Indonesia

Email: Nez895@ums.ac.id

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ABSTRACT

Introduction: This literature review study was motivated by global health challenges such as diabetes mellitus (DM), which has become a significant global health issue, particularly in Indonesia, which ranks seventh in the world. Complications from DM, such as diabetic neuropathy, drastically affect patients' quality of life. Non-pharmacological approaches, such as neuromuscular taping therapy (NMT) and physical exercise, can reduce the risk of complications and thus be an effective additional solution in DM management. **Methods:** The literature review method was applied to five articles obtained from several databases, namely ResearchGate and Google Scholar. The search keywords for articles included NMT, Exercise, and Diabetes Mellitus. The researchers used "AND" as the Boolean Operator. **Results:** The findings of the literature review indicate that the application of NMT significantly improves microcirculation, balance, and proprioception, as well as reducing neuropathic pain in patients. In addition, the combination of NMT with non-pharmacological interventions such as Progressive Muscle Relaxation (PMR) and foot exercises can also reduce swelling and diabetic neuropathic pain. NMT with exercise shows greater improvement in Ankle Brachial Index (ABI) values and patient quality of life. **Conclusion:** NMT combined with exercise has been proven effective. NMT provides an effective and safe alternative for improving the quality of life of diabetic patients.

Keywords: *Diabetes Mellitus, Exercise, Neuromuscular Taping, Pain, Proprioception*

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INTRODUCTION

Diabetes mellitus (DM) has emerged as a critical public health issue on a global scale, characterised by its continuously increasing incidence and severe long-term complications without proper management (Abdullah et al., 2025). The prevalence of DM has increased by approximately 50% in the last 10 years (Halim et al., 2025). Indonesia has shown a significant increase in prevalence, making it one of the non-communicable diseases with the seventh highest incidence rate nationally (Ahmed et al., 2020). Data shows that 536.6 million cases have been reported globally, and Indonesia faces a major challenge in managing this chronic condition due to its serious complications if not properly treated (Naki et al., 2025). Indonesia ranked seventh in the world in 2019 with 10.7 million sufferers, and

this is projected to increase to 16.6 million by 2045, placing it in eighth position (Yuniartika et al., 2021).

Diabetes mellitus is a chronic metabolic condition caused by the ineffectiveness of the hormone insulin, which triggers damage to the beta cells of the pancreas and causes high blood sugar levels (Wulandari et al., 2025). This chronic hyperglycaemic condition can trigger various macrovascular and microvascular complications, such as heart disease, stroke, nephropathy, and neuropathy, which significantly affect patients' quality of life (Helmi et al., 2024; Wulandari et al., 2025). The high prevalence and impact of complications make DM the seventh leading cause of death globally, with approximately 536.6 million diagnosed cases worldwide (Ahmed et al., 2020; Naki et al.,

2025). A robust therapeutic approach that addresses all consequences is essential for regulating blood glucose concentrations and mitigating further complications (Wulandari et al., 2025).

Diabetic neuropathy is a type of nerve disorder that often arises as a consequence of chronically elevated blood glucose concentrations (Yulita et al., 2019). These high glucose levels cause disturbances in blood flow to the lower extremities, leading to a decrease in microvascular circulation. This reduction causes motor and sensory dysfunction, which affects balance and mobility. In addition, diabetic patients often experience impaired blood flow and immune response, which hinders tissue repair and increases susceptibility to pathogen invasion, especially in the lower extremities (Halim et al., 2025). There are two approaches to treating DM: pharmacological and non-pharmacological. Long-term pharmacological effects can affect immune function, as demonstrated by metformin, which affects the number and function of T cells and lymphocytes, thereby impairing the immune response of diabetic patients to interventions such as vaccination (Widiastutik et al., 2025). Therefore, it is important to explore non-pharmacological interventions, such as neuromuscular tapping and physical exercise, which have the potential to improve neuromuscular and peripheral circulation in DM patients and enhance their overall quality of life.

Neuromuscular taping is the application of elastic tape designed to support muscles and joints without restricting range of motion, which can be applied in various conditions such as DM and diabetic neuropathy. This approach has the potential to improve local circulation, reduce pain, and improve neuromuscular function in people with diabetes, particularly in areas prone to neuropathy complications (Bassi Dibai et al., 2022). Additionally, NMT can stimulate the lymphatic system and reduce oedema, which often accompanies diabetic neuropathy and worsens circulation (Halim et al., 2025). This mechanism allows NMT to facilitate tissue recovery and improve proprioception, which is crucial for patients with sensory deficits due to

diabetic neuropathy (Smith et al., 2022). Physical exercise for diabetic patients is a key pillar in self-management of DM, as it has been proven to improve glycaemic control through enhanced glucose uptake by skeletal muscles and increased insulin sensitivity (Lestari and Mundriyasutik., 2023). The incorporation of physical exercise regimens, including podiatric gymnastics, has been shown to improve haemodynamics and strengthen lower limb muscles, thereby reducing the risk of complications associated with peripheral neuropathy and promoting rapid wound healing (Abbas et al., 2024). Foot exercises involve flexion, extension, rotation, and circumduction of the ankle and toes, specifically targeting the intrinsic and extrinsic muscles of the foot (Putri et al., 2025). These exercises serve to improve balance and mobility, which are crucial for patients with peripheral diabetic neuropathy who often experience sensory and motor impairments (Khurshid et al., 2025; Orlando et al., 2021). Through increased local blood flow and nerve stimulation, foot exercises can also contribute to the prevention of diabetic foot ulcers, a serious complication that can lead to amputation (Silva et al., 2021).

The combination of NMT with structured physical exercise is expected to provide positive synergy in improving glycaemic control, increasing muscle strength, and reducing the risk of vascular complications in diabetic patients (Halim et al., 2025; Mukti and Novendy, 2025). Thus, the integration of neuromuscular taping and foot exercises can offer a complementary holistic approach to improving the quality of life of diabetes mellitus patients, especially in mitigating diabetic neuropathy complications (Monteiro et al., 2020). Research on NMT and diabetic foot exercises is growing, but there are still limitations in understanding the mechanisms/protocols and combined benefits of these two therapies in managing diabetes complications. Consequently, this comprehensive literature review aims to explore the advantages of Neuromuscular Therapy (NMT) in treating microvascular complications in individuals with diabetes, as well as investigating its impact on the



Ankle-Brachial Index (ABI), proprioceptive function, and overall patient quality of life. With a better understanding of the mechanisms and benefits of this therapy, it is hoped that NMT can be more widely adopted as part of a safe and effective non-pharmacological treatment approach for diabetes patients.

METHODS

The objective of a literature review is to furnish a thorough synthesis of prior research endeavours undertaken within a specific academic discipline. The methodology employed in the literature review entails a systematic framework for the analysis of data, utilising an organised approach. This quasi-research design article delineates the outcomes of experimental investigations conducted in the English language. The selected articles concentrate on original empirical research papers or scholarly articles that present the findings derived from authentic observations or experiments, wherein the structure encompasses abstracts, introductions, methodologies, results, and discussions.

Article Search Strategy

The systematic approach to article retrieval utilises databases accessible via the electronic resources of the National Library of the Republic of Indonesia, encompassing platforms such as Google Scholar, PubMed, ScienceDirect, and ResearchGate. The specific keywords utilised in the search for relevant articles include neuromuscular taping, exercise, and diabetic mellitus, with researchers employing "AND" as a Boolean operator. The application of the Boolean operator "AND" is intended to amalgamate distinct concepts and dimensions as search keywords to refine the corpus of documents retrieved (Ramdhani et al., 2014).

The inclusion criteria established for the literature review encompass: 1) Quasi-experimental designs, 2) Original articles derived from primary sources, 3) Research articles disseminated between 2015 and 2025. Conversely, the exclusion criteria consist of: 1) Articles published within the preceding decade, specifically prior to 2015, 3) Articles that contain solely the abstract or partial content, and 4) Literature review articles.

In order to uphold the integrity of the literature review, the author invokes ethical principles delineated by Wager & Wiffen (2011), specifically pertaining to the avoidance of duplicate publication, the prevention of plagiarism, the promotion of transparency, and the assurance of accuracy. The article retrieval process employed a multitude of resources from databases accessible through the library and e-resources of the National Library of the Republic of Indonesia, which included eight articles from Research Gate and three thousand six hundred and ten articles from Google Scholar. The aggregate number of articles acquired at the initiation of the search, in accordance with the designated keywords, amounted to three thousand six hundred and eighteen articles. Among the entirety of the articles procured, there existed research articles that did not utilise randomised controlled trials (RCTs) and were categorised as experimental studies. The analytical framework employed in this literature review is distinguished by a methodical and efficient strategy. This efficient strategy involves the organised aggregation of each article sourced, subsequently succeeded by the synthesis of each individual finding (Aveyard, 2014).

The methodological stages employed in the analysis through a simplified approach encompass the systematic summarisation of each individual piece of literature. Concurrently, a rigorous critical appraisal or review is conducted to ascertain the relative strengths and weaknesses inherent in the literature, as well as to elucidate the interconnections among various literary works, thereby identifying recurring themes derived from the findings of each research endeavour within the literature. These themes ought to correspond to the research questions articulated in the literature review, whereby thematic development is achieved through the synthesis of all identified themes, along with a discourse on the robustness of the findings by evaluating the research outcomes based on the quality of evidence, whether it is substantiated by stronger or weaker empirical support, facilitated by the initial critical appraisal. Each theme is designated a name that reflects its essence, achieved through a comprehensive understanding



of the literature, ensuring that the nomenclature of the theme is congruent with the research results. The examination of literature entails the comparative analysis and review of each theme by verifying two principal criteria: the accuracy of the thematic nomenclature and the consolidation of themes into a singular, cohesive overarching theme, while meticulously observing the similarities and divergences present among the themes, followed by an in-depth analysis that considers the interrelations among the themes. Additionally, a review of the critical appraisal of each piece of literature is conducted to evaluate the extent to which the existing themes can adequately address each research question posed.

The critical appraisal process employs the JBI Critical Appraisal for Experimental Studies instrument to execute the evaluation and analytical procedures pertaining to the articles under review, particularly in order to assess the outcomes, validity, and pertinence of these articles in relation to the quasi-experimental research design and other forms of experimental inquiry.

RESULTS

Data Analysis

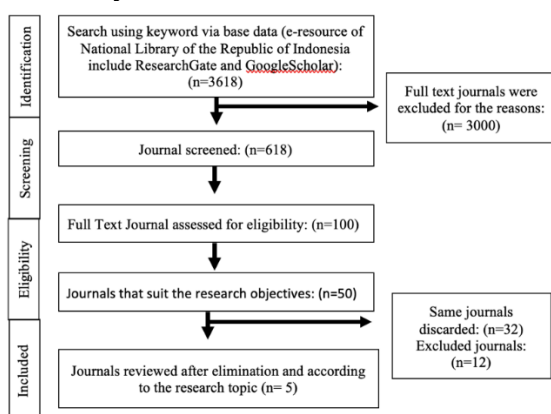


Figure 1. Prism study flow diagram

Data analysis was conducted in a structured manner employing a straightforward methodology. The search results for scholarly articles pertaining to neuromuscular taping, physical exercise, and diabetes mellitus yielded a total of eight articles from ResearchGate and 3,610 articles from Google Scholar. The cumulative number of articles retrieved at the

outset of the search process, based on the predetermined keywords, amounted to 3,618 articles. The relevant keywords used in the article search were neuromuscular taping and diabetes. The researchers implemented the Boolean operator "AND" to refine their search. The use of the Boolean operator "AND" serves to integrate diverse concepts and dimensions into the search terminology, thereby refining the breadth of documents eligible for retrieval. An exemplary illustration of the study flow prism is presented in Figure 1 (Gradin & Björklund, 2021). The rigorous appraisal and assessment of the study, executed utilising the JBI Critical Appraisal tool for Experimental Studies, encompassed five articles that fulfilled the inclusion criteria. The detailed examination of each individual article is illustrated in FIGURE 1 (Gradin and Bjorklund, 2021).

Summary

Neuromuscular Taping (NMT), either alone or in combination with other therapies such as Transcutaneous Electrical Nerve Stimulation (TENS), foot exercises, and Progressive Muscle Relaxation (PMR), provides significant benefits for patients with diabetes mellitus, particularly in addressing issues related to blood circulation, balance, proprioception, and neuropathic pain. NMT has been shown to improve peripheral and microvascular blood flow, which is crucial in reducing swelling, enhancing skin elasticity, and improving vascular function in the lower extremities. Additionally, these interventions also contribute to improved body balance, nerve conduction velocity, and reduction of neuropathic symptoms commonly experienced by patients with Diabetic Peripheral Neuropathy (DPN) (Fajriyah and Trisnawuri., 2022).

Furthermore, the findings of this investigation indicate that the integration of NeuroMuscular Therapy (NMT) with additional interventions, such as podiatric exercises or Progressive Muscle Relaxation (PMR), can improve Ankle Brachial Index (ABI) values and overall quality of life for patients. Improved ABI indicates enhanced peripheral circulation, which is crucial for reducing the risk of chronic vascular complications, including diabetic foot ulcers and peripheral neuropathy (Ulkhassanah and



Widiastuti). Overall, non-pharmacological therapy involving NMT provides an effective and safe alternative for improving the quality of life

of diabetic patients, improving blood circulation, and reducing pain, with a greater impact than other therapies.

Table 1. Data analysis matrix in articles used in the literature review

Author, Title, Journal	Method Design	Result
Susanti and Arofiati., 2022, The Effectiveness of Neuromuscular Taping (NMT) and Foot Exercise in Improving Microcirculations in Diabetes Mellitus Patients, Jurnal Aisyah,	Quasi-experimental study	The study found significant changes: 1. ABI Scores - The NMT group showed a significant improvement with a mean difference of 12.14% and a p-value of 0.000 ($p < 0.05$). - The diabetic foot exercise group also showed significant improvement, with a mean difference of 9.87% and a p-value of 0.006 ($p < 0.05$). 2. Between-Group Comparisons The Mann-Whitney U test revealed that the NMT intervention group had a significantly higher post-test ABI value compared to both the control group (mean difference of 9.38%, $p = 0.010$) and the diabetic foot exercise group (mean difference of 7.68%, $p = 0.041$). The results indicate that both Neuromuscular Taping (NMT) and diabetic foot exercise can significantly improve ABI values in patients with diabetes mellitus, but NMT was more effective in enhancing peripheral circulation than foot exercises. The control group, which did not receive specific interventions, showed no significant improvement in ABI values.
Fajriyah and Trisnawuri., 2023, The Effectiveness of Progressive Muscle Relaxation and Neuromuscular Taping on Ankle Brachial Index Values and Quality of Life in People With Type 2 Diabetes Mellitus, Critical Medical and Surgical Nursing Journal	Quasi-experimental study	Based on the findings of this investigation, it can be inferred: 1. Improvement in ABI, with a mean change from 1.68 ± 0.48 to 1.32 ± 0.48 with a p-value of 0.034. 2. Improvement in quality of life (QoL), with a mean change from 1.38 ± 0.50 to 1.75 ± 0.45, with a p-value of 0.034. 3. The Mann-Whitney U test revealed a significant difference in ABI between the intervention group (27.40 ± 0.189) and the control group (18.02 ± 0.189), with a mean difference of 9.38 and a p-value of 0.010. 4. The Mann-Whitney U test also showed a significant difference in QoL, with the intervention group showing better improvement (75% had good QoL) compared to the control group (31.3%). Overall, the study found that the PMR and NMT combination was effective in improving ABI and QoL in Type 2 Diabetes Mellitus patients, with significant differences between the intervention and control groups
Illahude et al., 2024. The Effect of Combining Foot Exercises and Neuromuscular Taping on Diabetic Foot Neuropathic Pain, Journal of Nursing Science Update	Quasi-experimental study	In light of the findings derived from this investigation, it is permissible to deduce: 1. Intervention Group (Foot Exercises + Neuromuscular Taping): - The pain score decreased significantly to a median of 0.00 (range: 0-10), with a p-value of 0.000 2. Between-Group Comparison: The Mann-Whitney U test elucidated a statistically significant disparity in the diminution of neuropathic pain with the intervention group showing a median change of -7.50 compared to -2.00 in the control group ($p = 0.000$). These results confirm that the combination of foot exercises and neuromuscular taping (NMT) is more effective than foot exercises alone in reducing diabetic foot neuropathic pain.
Qaribi et al., 2024, Neuromuscular Taping Improves Microvascular Circulation in Type 2 Diabetes Mellitus Patients,	Quasi-experimental study	Based on the findings derived from this investigation, one may deduce: 1. Treatment Group (NMT Intervention): - Post-test ABPI: 20.20 ± 1.15, showing a significant improvement in microvascular circulation ($p = 0.000$). 2. Comparison Between Groups: - The Mann-Whitney test revealed a significant difference in post test ABPI values between the treatment group and the control group (mean difference of 9.38, $p = 0.000$). The treatment group showed a significant improvement in microvascular circulation
Ulhasanah and Widiastuti., 2024, The Effect of Diabetes Mellitus Exercises and Neuromuscular Taping (NMT) on Ankle Brachial Index (ABI) in Type 2 DM Patients	Quasi-experimental study	The study revealed that both diabetes foot exercises and neuromuscular taping: 1. Diabetes Foot Exercise Intervention (Group I): - Post-test ABI: 1.02 (normal circulation), with a p-value of 0.001, indicating significant improvement. 2. Neuromuscular Taping (NMT) Intervention (Group II): - Post-test ABI: 1.766 (normal circulation), with a p-value of 0.004, showing a significant improvement. The results showed that both foot exercises and NMT effectively increased ABI values, with NMT demonstrating a more substantial improvement compared to foot exercises.



Literature Review Results

Based on the literature review in this article, the author found the effect of neuromuscular taping on diabetes. Each outcome yields three predominant themes, specifically: clinical physiology, enhancement, reduction, augmentation of balance, microcirculation, discomfort, and quality of life.

The findings in the first theme examined the effectiveness of NMT and foot exercises on the Ankle Brachial Index (ABI) values in patients with diabetes mellitus, with the following main findings: (1) An increase in ABI values with the application of NMT, with an average increase of 12.14%, which was statistically significant at $p < 0.05$, (2) An increase in ABI values with foot exercises of 9.87%, which was also statistically significant ($p = 0.006$), (3) When comparing NMT and foot exercises, NMT showed a greater effect on ABI values than foot exercises ($p = 0.041$). Neuromuscular Taping (NMT) plays an important role in improving microcirculation in patients with diabetes mellitus by improving peripheral blood flow and reducing oedema in the lower extremities. In diabetic patients, poor blood circulation often occurs due to peripheral vascular disorders, which can lead to diabetic foot ulcers and amputation. NMT involves applying elastic tape to the skin without tension, creating folds in the skin that stimulate blood vessels and subcutaneous tissue, improving blood flow and reducing pressure on irritated tissue. This technique helps increase oxygen and nutrient supply to lower extremity tissue, thereby reducing swelling and improving vascular health.

The findings in the second theme examined Progressive Muscle Relaxation (PMR) and Neuromuscular Taping (NMT) on Ankle Brachial Index (ABI) values and quality of life in patients with type 2 diabetes mellitus, with the following main findings: (1) The combination of PMR and NMT interventions showed a significant increase in ABI values in the intervention group ($p = 0.034$), (2) An improvement in quality of life in the intervention group ($p = 0.007$). These improvements indicate that both non-pharmacological interventions can improve blood flow and quality of life in diabetic patients. This

shows that NMT can improve peripheral blood circulation by improving blood flow to the lower extremities, which in turn increases ABI values. In addition, the decompression process that occurs when elastic tape is placed on the skin also helps reduce swelling and improve blood flow, which is very beneficial for patients with diabetic foot.

The findings in the third theme examined the Combination of Foot Exercises and Neuromuscular Taping on Diabetic Foot Neuropathy Pain, with the following main findings: (1) A reduction in neuropathy pain with a median change score of -7.5 with a p -value < 0.05 , (2) A more significant improvement in quality of life scores in the intervention group. NMT works by stimulating mechanoreceptors in the skin, which improves peripheral blood circulation and reduces pressure on irritated tissues. The application of elastic tape to the feet can improve vascular function and blood circulation, which is very beneficial for patients with microvascular disorders such as diabetes. The findings in the fourth theme examined neuromuscular taping to improve microvascular circulation in patients with type 2 diabetes mellitus, with the following main findings: (1) Improved microvascular circulation with an ABPI value of 20.20 ± 1.15 , showing a significant improvement in microvascular circulation ($p = 0.000$). The application of NMT in diabetic patients aims to increase peripheral blood flow using a decompression technique that causes folds in the skin. These folds help stimulate blood vessels and increase blood flow, which is very important for patients with microvascular disorders, as often occurs in diabetes. This improvement in microcirculation results from the application of NMT, which stimulates vasodilation and increases skin elasticity, which in turn reduces pressure on the tissues and improves blood circulation to the lower extremities. The findings in the fifth theme examined diabetes mellitus exercise and neuromuscular taping to improve microvascular circulation in type 2 diabetes mellitus patients, with the following main findings: (1) Improved



microvascular circulation in the diabetes mellitus exercise group with an ABI value of 1.02 and a p-value of 0.001, (2) Improved microvascular circulation in the neuromuscular taping group with an ABI value of 1.766 (normal circulation) and a p-value of 0.004. Diabetes mellitus exercise and neuromuscular taping both play an important role in improving peripheral blood flow and preventing complications in diabetic feet. These interventions help reduce the risk of circulatory disorders that often cause diabetic foot ulcers and peripheral neuropathy.

DISCUSSION

Improved Balance

Neuromuscular Taping (NMT) has been proven to have significant potential in improving body balance, especially in patients with balance disorders due to injury or neurological conditions. This technique works by stimulating the body's proprioception, increasing stabiliser muscle activity, reducing pain, and improving neuromuscular function. By applying elastic tape to the skin, NMT helps improve coordination between muscles and joints, which is crucial for maintaining body balance (Thakur and Goyal., 2023). The improved balance resulting from NMT can reduce the risk of falls, increase mobility, and support recovery in patients with musculoskeletal disorders or after injury. Therefore, NMT can be an effective non-pharmacological intervention in balance rehabilitation, providing support to patients who need post-injury recovery or those with neurological problems (Marcolin et al., 2017).

Improved microcirculation

Neuromuscular Taping (NMT) has a significant effect on improving microcirculation, particularly in patients with peripheral circulation disorders, such as those with diabetes mellitus (Andrianti et al., 2024). NMT works by increasing blood flow through a decompression effect that reduces pressure on blood vessels and tissues, as well as stimulating mechanoreceptors in the skin that contribute to improved blood vessel and muscle function. This technique is also effective in reducing oedema, improving lymphatic drainage, and relieving pain caused by microcirculation disorders (Susanti and Arofati.,

2022). In patients with diabetes mellitus, who often experience microcirculatory disorders and circulatory problems in the lower extremities, NMT can help improve blood circulation, improve Ankle Brachial Index (ABI) values, and prevent further complications such as diabetic foot ulcers and peripheral neuropathy. Thus, NMT can serve as an effective non-pharmacological therapy in the rehabilitation of microvascular circulation and the prevention of vascular complications in patients with circulatory disorders (Ulkhassanah and Widiastutu., 2024).

Pain reduction

Neuromuscular Taping (NMT) has been proven effective in reducing neuropathic pain and muscle tension in diabetic patients, particularly in the lower extremities. NMT works by improving blood circulation, reducing inflammation, and enhancing muscle tissue elasticity (Thakur and Goyal., 2023). By increasing blood flow, NMT helps reduce swelling and tension in tight or painful muscles, as well as stimulate the nervous system to divert pain. Additionally, NMT also helps relieve neuropathic pain by increasing oxygen supply to affected tissues and improving neuromuscular function (Sadiyah and Prasajo, 2022). Through these effects, NMT enables patients to move more freely, improve mobility, and reduce dependence on analgesic medications. Thus, NMT not only provides benefits in pain management but also improves the quality of life for diabetic patients by allowing them to engage in physical activities and daily life more comfortably.

Improved Quality of Life

NMT has been proven effective in reducing swelling (oedema) and pain in diabetic patients, which in turn improves their mobility and quality of life. By improving blood circulation, lymphatic drainage, and reducing muscle tension, NMT helps patients move more freely and comfortably (Kristianto et al., 2021). This allows them to continue physical activities and go about their daily lives without pain or mobility restrictions. Thus, NMT not only plays a role in managing the physical condition of diabetic patients, but also enhances their emotional and social well-being,



contributing significantly to an overall improvement in quality of life.

CONCLUSION

Neuromuscular Taping (NMT) is effective in improving the quality of life of diabetes mellitus patients by improving balance, microcirculation, neuropathic pain, and neuromuscular function. The application of NMT, either independently or in combination with exercise, helps improve peripheral blood flow, reduce swelling, and improve body balance, proprioception, and mobility in patients experiencing sensory and motor impairments due to diabetic neuropathy. Overall, NMT is a safe and effective non-pharmacological therapy for managing microvascular complications, reducing neuropathic pain symptoms, and preventing further complications, such as diabetic foot ulcers, thereby significantly improving the quality of life of diabetes patients.

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