

Original Research Article

NEUROMUSCULAR TAPING IMPROVES MICROVASCULAR CIRCULATION IN TYPE 2 DIABETES MELLITUS PATIENTS

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Article Info:

Received: October, 4th, 2023

Revised: April, 18th, 2024

Accepted: April, 25th, 2024

DOI:

<https://doi.org/10.36720/nhjk.v13i1.585>

Abstract

Background: The most common complications in Diabetes Mellitus patients are foot problems and high risk for amputation. Factors that trigger problems in diabetic feet in the form of neuropathy factors, namely loss of sensory nerve function and circulatory disorders. One of the non-pharmacological therapies to prevent these problems is safe Neuromuscular Taping (NMT) which is applied to the skin with elastic plaster through a decompression method to prevent a decrease in peripheral blood circulation and improve blood circulation.

Objectives: The purpose of this study was to determine the comparison of the effectiveness of Neuromuscular Taping (NMT) intervention on microvascular circulation which was assessed by Ankle Brachial Pressure Index (ABPI) measurement in type 2 Diabetes Mellitus patients.

Methods: This study used a quasi-experimental research design with a pretest-posttest control group approach. The number of respondents to this study was 60 type 2 DM patients divided into treatment group respondents and control group respondents. The intervention group was given NMT intervention for 2 weeks with daily plaster changes while the control group was given standard foot care education. The data collected is an ABPI score that describes microvascular circulation using a sphygmomanometer. Analysis was carried out using paired sample t-tests which were used to determine the effectiveness of the intervention.

Results: Based on the results of the study, significant changes were obtained in the microvascular circulation of the treatment group ($p = 0.000$) $\alpha 0.05$ which is the category of normal microvascular circulation or no disturbance. Increased microvascular circulation is caused by the application of NMT for 2 weeks.

Conclusion: There was an increase in microvascular circulation seen through changes in Ankle Brachial Pressure Index (ABPI) values before and after Neuromuscular Taping (NMT) intervention. There were significant differences between the intervention and control groups in changes in ABPI scores.

Keywords: *Ankle Brachial Pressure Index, Diabetes Mellitus, Microvascular Circulation, Neuromuscular Taping*

INTRODUCTION

Diabetes mellitus (DM) is one of the fastest growing health challenges with the number of adults suffering from diabetes has more than tripled over the past 20 years and is projected to be one of the seven leading causes of death by 2030 (WHO, 2016). DM sufferers worldwide number 537 million people and the prevalence of DM in Indonesia's adult population is 19.5 million (International Diabetes Federation, 2021). Such is the case with the Aceh Region where DM sufferers currently have 138,291 patients and West Aceh Regency is one of the Aceh districts that has the most DM patients with 2,463 patients (Dinas Kesehatan Kabupaten Aceh Barat, 2021).

The highest prevalence in this type of DM is type 2 diabetes mellitus (T2DM) (American Diabetes Association, 2020) which if it continues for a long time then the patient can experience complications. The most common complication is foot injury where as many as 87% of DM patients have problems in the lower extremities/feet and as many as 35% have a high risk for limb amputation (IDF, 2019; Shaw KM, 2012). Factors that trigger problems in diabetic feet are neuropathy, namely loss of sensory nerve function (40%-70%) and circulatory disorders in the form of atherosclerosis (15%-45%) & vascular disease (15%-24%) (White & McIntosh, 2008).

Proper management is needed, one of which is through non-pharmacological therapy, namely Neuromuscular Taping (NMT) which is used to prevent a decrease in peripheral blood circulation, improve blood circulation and reduce edema in the

lower extremities. In addition, it also provides stimulation to the muscles and skin in reducing pain, and can reduce symptoms arising from vascular nervous system disorders (Kristianto et al., 2021). NMT is a safe technique without causing side effects that is applied to the skin with elastic plaster through a decompression method that can provide an eccentric effect on the muscles so as to reduce pressure on the tissue under the skin (Blow, 2012).

Peripheral circulation assessment is performed through Ankle Brachial Pressure Index (ABPI) measurements. ABI measurements are performed to measure blood circulation in the lower extremities of the ankles / legs and extremities in the brachial or hand (Alves-Cabrato et al., 2020). ABPI is a simple non-invasive examination that serves to detect signs and symptoms of peripheral blood vessel disorders such as ischemia (Ndraha, 2014). A quasi-experimental study of T2DM patients showed that ABI can measure blood circulation in the lower extremities with accurate results so that diabetic foot events can be avoided (Qaribi et al., 2021).

There are not many references related to how NMT can affect microvascular circulation in diabetic patients so further research is needed on this matter.

Objective(s): The purpose of this study was to determine the effectiveness of Neuromuscular Taping (NMT) intervention on microvascular circulation which was assessed through Ankle Brachial Pressure Index (ABPI) measurements.

METHODS

Study Design

This study used a quasi-experimental research design with a pretest-posttest control group approach.

Setting

This research was conducted at a public health center in West Aceh which has the most diabetics among other health centers in Meulaboh City in 2023.

Research Subject

The population in this study was all puskesmas visitors suffering from DMT2. The respondents of this study were patients diagnosed with T2DM for more than three years and were willing to be respondents, had diabetic foot complaints characterized by pain and tingling in the legs, did not have diabetic ulcer complications, paralysis and could follow research instructions.

Determination of sample size using Gpower analysis calculations from Cunningham and McCrum-Gardner (Cunningham & McCrum-Gardner, 2007) where the number of samples is 60 people where each group amounts to 30 respondents who have been determined according to criteria by researchers.

Instruments

The data collected is an ABPI score that describes microvascular circulation. The ABPI examination is a non-invasive tool for assessing vascular status which looks at the ratio between systolic blood pressure in the legs (dorsalis pedis and posterior tibial) and in the arms (brachial). The ABPI examination is calculated by recording systolic blood pressure in the supine position starting from the right arm, right leg, left leg and left arm using a digital tensimeter that applies the Oscillo metric method in its functionalization (Khan et al.,

2019). ABPI is calculated by dividing the highest value obtained on each ankle by the highest value on the arm. The normal cut-off value for ABI is between 0.9 and 1.4 (Aboyans et al., 2012). An abnormal ankle-brachial index below 0.9 is a strong marker of cardiovascular risk including problem in microvascular circulation. In this study, the research team was assisted by a research assistant, a nurse at the Puskesmas who had been given an explanation on how to measure ABPI by researchers. Before the intervention, a pre-test was carried out by measuring ABPI. Then, after the series of interventions were completed in two weeks, post-test data measurements were carried out.

Intervention

The intervention given to the intervention group was the installation of Neuromuscular Taping (NMT), which is the installation of plaster on the skin using elastic plaster Kinesiology Tape which is installed to form a fan using the decompression method (without any tension of plaster and stretched skin) on both legs along the posterior tibial to ankle, then continued to be installed in the dorsalis pedis and plantar of the foot. NMT installation is carried out for 2 weeks, this taking into consideration the varying intervention times carried out by previous studies and there were no specific standards in determining the length of intervention so the researchers took an average of 2 weeks of intervention duration. The plaster changes every day following the respondent's prayer schedule because the NMT used must not be wet and dirty. The control group after the exercise was given standard treatment in the form of foot exercise education through audiovisual media for two weeks following their activities.

Data Analysis

After the data was collected, analysis was carried out using paired sample t-tests which were used to determine the effectiveness of the intervention

Ethical Consideration

The research has received ethical approval from the Health Research Ethics Commission, Universitas ‘Aisyiyah Bandung, based on ethical certificate 787/KEP.01/UNISA-BANDUNG/IX/2023.

Respondents who are willing to participate in this study sign informed consent of their own volition without coercion from any party. This research did not bring harm to respondents. Respondents could withdraw from the study when they felt insecure during the study process.

RESULTS

The respondents (60 diabetes mellitus type 2 patients) completed this study. The characteristics of respondents from the two groups are presented in Table 1.

Table 1. Demographic Characteristics of Respondents

Characteristics	Group	
	Treatment	Control
	f (%)	f (%)
Age (years)		
≤ 45	5 (16.6)	12 (40.0)
> 45	25 (83.4)	18 (60.0)
Sex		
Male	8 (26.6)	12 (40.0)
Female	22 (73.4)	18 (60.0)
Education		
No School	4 (13.4)	7 (23.4)
Primary School	9 (30.0)	13 (43.4)
Middle & High School	11 (36.7)	8 (26.7)
Bachelor	6 (19.9)	2 (6.5)
Employment		
Employed	6 (20.0)	16 (53.4)
Unemployed	24 (80.0)	14 (46.6)

Duration of Diabetes		
< 10 years	7 (23.30)	12 (40.0)
> 10 years	23 (76.7)	18 (60.0)
Total	30 (100)	30 (100)

Based on the table, the research data that has been tested for normality using the Shapiro Wilk test where the sample is normally distributed with a significance level of >0.05. It can be seen that there is no significant difference between the two groups regarding age, gender and duration of suffering from diabetes. The education of the majority of respondents in the treatment group (36.7%) was middle & high school and the majority of education in the control group (43.4%) was primary school.

Table 2. Microvascular Circulation Respondent

	Treatment		p value
	Pre Test	Post Test	
	mean ± SD	mean ± SD	
Microvascular Circulation	27.35 ± 0.65	20.20 ± 1.15	0.000
	Control		p value
	Pre Test	Post Test	
	mean ± SD	mean ± SD	0.535
	25.60 ± 0.75	23.60 ± 0.87	

Table 2 compares microvascular circulation scores assessed through ABPI measurements before and after intervention in the treatment and control groups via paired t-tests. The microvascular circulation score in the treatment group before NMT was 27.35 ± 0.65 (including the category of impaired microvascular circulation). After the respondents did NMT for two weeks, there was a significant improvement in microvascular circulation to 20.20 ± 1.15 (p = 0.000) which is the category of normal microvascular circulation or no disturbance. The mean microvascular circulation score in the control

group before the intervention was 25.60 ± 0.75 . At the end of the study, there was a slight improvement in microvascular circulation to 23.60 ± 0.87 (p value = 0.535) where microvascular circulation was still experiencing interference.

DISCUSSION

The results of the paired t-test showed that the variable p-value of ABPI in the treatment group after the NMT intervention (p-value 0.000) showed a significant value which means that there was a change in the ABPI value after the foot gymnastics intervention or NMT intervention. Ankle Brachial Pressure Index (ABPI) is one of the parameters that can be used to determine the health status of the feet (Alqahtani et al., 2018). ABPI is one way to assess the risk of circulatory disorders, especially in the legs. Under normal conditions, ABPI values are between 0.9 and 1.29 (Alves-Cabratos et al., 2020).

People with diabetes mellitus are often associated with foot problems, as their blood circulation is disrupted and results in decreased blood circulation (Alves-Cabratos et al., 2020). This decrease is caused by excess levels of glucose in the blood, so the blood in the body becomes more concentrated (Van Laake-Geelen et al., 2019). This condition can be overcome with nonpharmacological therapy, one of which is the installation of Neuromuscular Taping (NMT) (Kristianto et al., 2020). This study showed NMT intervention improved blood circulation as evidenced by improvements in ABPI values in the treatment group given NMT in the normal category.

This is in line with research conducted in randomized controlled trials by (Cristiningtyas, 2018) to 46 respondents and (Susanti & Arofiati, 2022) to 66

respondents indicated NMT provides change by improving and improving circulation in respondents. The improvement in the respondent's microvascular circulation was due to NMT plaster insertion performed along the posterior tibial to ankle and in the plantar and dorsal legs for 2 weeks with daily plaster changes. Changing plaster every day is due to following the respondent's worship schedule which requires respondents to be exposed to water so that if it is not replaced, the condition of the adhesive installed will not work properly. Respondents installed NMT for 14 days with the majority of tape installations for 13 hours a day. NMT installation must be done properly and correctly in order to get the effect of getting effects such as improving or improving blood vessel circulation for the better.

This change is in accordance with the theory put forward by (Blow, 2012) i.e. NMT intervention provides good results in stimulating skin tissue, muscle tissue, tendons, nerves, lymphatics and blood vessels, so as to improve tissue function. The NMT mechanism of action uses a decompression method that causes wrinkles in the plaster due to movement. Wrinkles in NMT plasters cause the skin to be stimulated by pressure facilitated by mechanoreceptors such as Puccini bodies, Meister bodies, Markel bodies, and Ruffini tips thereby prolonging the pressure stimulus on the skin and subcutaneous tissue. Ultimately, the NMT stimulus is able to increase elasticity in the skin and cause vasodilation of muscles and tendons. The condition results in increased muscle and skin extension time so that the skin is lifted, skin pressure and subcutaneous tissue decrease, tissue interstitial space increases, and blood vessels dilate.

NMT therapy can dilate blood vessels so as to improve blood circulation and cause adequate blood circulation. People with diabetes mellitus have a risk of changes in the elasticity of capillary blood vessels, thickening of blood vessel walls, and plaque formation which can cause vascularization to the periphery to be inhibited. So, this results in people with diabetes mellitus tend to have abnormal ABI values (Monteiro et al., 2020)

NMT can be a complementary therapy that is useful in the treatment of diabetic foot as well as prevention of complications of blood vessel disorders in the lower extremities characterized by pain and pose a risk of diabetic ulcers in the feet due to nerve tissue ischemia (Kristianto et al., 2021). The change in ABPI values was not too significant in the control group because the group did not receive NMT therapy and was only given standard interventions about foot care. So that the changes in microvascular circulation seen through the ABPI value in the control group only experienced a slight change and were still in the category of impaired microvascular circulation.

The main limitation of this study is that the design of this study cannot explain causality. In addition, bias can occur because the participants of each group are not randomly drawn.

CONCLUSION

There was an increase in microvascular circulation seen through changes in Ankle Brachial Pressure Index (ABPI) values before and after Neuromuscular Taping (NMT) intervention. There were significant differences between the intervention and control groups in changes in ABPI scores.

SUGGESTIONS

NMT intervention can be one of the nursing interventions to be applied in health services as a preventive measure for microvascular complications, especially in patients with diabetes mellitus. It recommended subsequent studies using randomized controlled designs trials to look back favorably at the effect of NMT on microvascular circulation and eliminate bias.

ACKNOWLEDGMENT

We would like to thank to STIKes Medika Seramoe Barat, LPPM-STIKes Medika Seramoe Barat, and Cot Seumeureung Public Health Center, Aceh Barat who have facilitated the implementation and their valuable insights of this research.

DECLARATION OF CONFLICTING INTEREST

The authors declared that they have no conflict of interest.

FUNDING

This research was supported by a research grant from Ministry of Education and Culture Research and Technology of the Republic of Indonesia (KEMDIKBUDRISTEK), with Contract Number 189/E5/PG.02.00.PL/2023 dated June, 19, 2023 with derivative Contract Number 026/LL13/AL.04/LT/2023 dated June 26, 2023, and 29/LPPM/STIKes.MSB/VII/2023 July 12, 2023

AUTHOR CONTRIBUTION

Mahanta Qaribi: Arrange research implementation, conduct literature review, collect data, compile manuscripts.

Rizki Andriani: Analyzing data, compiling Manuscript and corresponding to journal.

Roofi Asma Putri: Analyzing data, compiling manuscripts.

Arif Fadhillah: Collect data and Analyzing data.

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REFERENCES

- Aboyans, V., Criqui, M. H., Abraham, P., Allison, M. A., Creager, M. A., Diehm, C., Fowkes, F. G. R., Hiatt, W. R., Jönsson, B., Lacroix, P., Marin, B., McDermott, M. M., Norgren, L., Pande, R. L., Preux, P. M., Stoffers, H. E., & Treat-Jacobson, D. (2012). Measurement and interpretation of the ankle-brachial index: a scientific statement from the American Heart Association. *Circulation*, *126*(24), 2890–2909. <https://doi.org/10.1161/CIR.0B013E318276FBCB>
- Alqahtani, K. M., Bhangoo, M., Vaida, F., Denenberg, J. O., Allison, M. A., & Criqui, M. H. (2018). Predictors of Change in the Ankle Brachial Index with Exercise. *European Journal of Vascular and Endovascular Surgery*, *55*(3), 399–404. <https://doi.org/10.1016/j.ejvs.2017.12.004>
- Alves-Cabratos, L., Comas-Cufí, M., Ponjoan, A., Garcia-Gil, M., Martí-Lluch, R., Blanch, J., Elosua-Bayes, M., Parramon, D., Camós, L., Guzmán, L., & Ramos, R. (2020). Levels of ankle-brachial index and the risk of diabetes mellitus complications. *BMJ Open Diabetes Research and Care*, *8*(1), 977. <https://doi.org/10.1136/bmjdr-2019-000977>
- American Diabetes Association. (2020). Standards of medical care in diabetes-2020. *Diabetes Care*, *43*(SUPPL.).
- Blow, D. (2012). *Neuromuscular Taping: From Theory to Practice*. Edi-Ermes Medical Publisher, Milan, ITALY.
- Cristiningtyas, I. (2018). *Pengaruh Penerapan Neuromuscular Taping Terhadap Status Sensori Kaki Diabetik Pada Pasien DM Tipe 2 Di Wilayah Kerja Puskesmas Kota Malang*. Universitas Brawijaya.
- Cunningham, J. B., & McCrum-Gardner, E. (2007). Power, effect and sample size using GPower: practical issues for researchers and members of research ethics committees. *Evidence-Based Midwifery*, *5*(4), 132–137.
- Dinas Kesehatan Kabupaten Aceh Barat. (2021). *Profil Kesehatan Kabupaten Aceh Barat 2020*.
- IDF. (2019). International Diabetes Federation: Diabetes Atlas. 9th ed. In *International Diabetes Federation*. [https://doi.org/10.1016/S0140-6736\(55\)92135-8](https://doi.org/10.1016/S0140-6736(55)92135-8)
- International Diabetes Federation. (2021). IDF Diabetes Atlas 10th edition. In *IDF*. <https://doi.org/10.1016/j.diabres.2013.10.013>

- Khan, S. Z., Zafar, A. Bin, Waris, N., Miyan, Z., Ulhaque, M. S., & Fawwad, A. (2019). Comparison of ankle-brachial index (ABI) measured by an automated oscillometric apparatus with that by standard hand-held doppler in patients with Type-2 diabetes. *Pakistan Journal of Medical Sciences*, 35(4), 1167. <https://doi.org/10.12669/PJMS.35.4.30>
- Kristianto, H., Waluyo, A., Gayatri, D., Yunir, E., & Blow, D. (2021). Neuromuscular taping treatment of diabetic foot: A concept analysis. *Clinica Terapeutica*, 72(3), 231–235. <https://doi.org/10.7417/CT.2021.2320>
- Kristianto, H., Waluyo, A., Yunir, E., Gayatri, D., & Blow, D. (2020). Neuromuscular taping application opportunities in nursing: a literature review. <Http://Cejnm.Osu.Cz/Doi/10.15452/Cejnm.2020.11.0018.Html>, 11(3), 143–151. <https://doi.org/10.15452/CEJNM.2020.11.0018>
- Monteiro, R. L., Ferreira, J. S. S. P., Silva, É. Q., Donini, A., Cruvinel-Júnior, R. H., Veríssimo, J. L., Bus, S. A., & Sacco, I. C. N. (2020). Feasibility and preliminary efficacy of a foot-ankle exercise program aiming to improve foot-ankle functionality and gait biomechanics in people with diabetic neuropathy: A randomized controlled trial. *Sensors (Switzerland)*, 20(18), 1–18. <https://doi.org/10.3390/s20185129>
- Ndraha, S. (2014). Diabetes Melitus Tipe 2 Dan Tatalaksana Terkini. *Medicinus*, 27(2), 9–16.
- Qaribi, M., Suza, D. E., & Tarigan, R. (2021). Effect of education in preventing diabetic foot ulcers to compliance and quality of life the diabetic patients. *European Journal of Molecular and Clinical Medicine*, 8(3), 3225–3237.
- Shaw KM, C. M. (2012). *Diabetes chronic complications*. Wiley.
- Susanti, I., & Arofiati, F. (2022). The Effectiveness of Neuromuscular Taping (NMT) And Foot Exercise in Improving Microcirculations in Diabetes Mellitus Patients. *Jurnal Aisyah : Jurnal Ilmu Kesehatan*, 7(S2), 71–78. <https://doi.org/10.30604/jika.v7is2.1408>
- Van Laake-Geelen, C. C. M., Smeets, R. J. E. M., Quadflieg, S. P. A. B., Kleijnen, J., & Verbunt, J. A. (2019). The effect of exercise therapy combined with psychological therapy on physical activity and quality of life in patients with painful diabetic neuropathy: A systematic review. In *Scandinavian Journal of Pain* (Vol. 19, Issue 3, pp. 433–439). Scand J Pain. <https://doi.org/10.1515/sjpain-2019-0001>
- White, R., & McIntosh, C. (2008). Topical therapies for diabetic foot ulcers: standard treatments. In *Journal of wound care* (Vol. 17, Issue 10). J Wound Care. <https://doi.org/10.12968/jowc.2008.17.10.31305>
- WHO. (2016). *Global report on Diabetes*. <http://www.who.int/diabetes/global-report/en/>.

Cite this article as: Qaribi, M., et al. (2024). Neuromuscular Taping Improves Microvascular Circulation in Type 2 Diabetes Mellitus Patients. *Nurse and Health: Jurnal Keperawatan*, 13 (1), 39-46. <https://doi.org/10.36720/nhjk.v13i1.585>