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Diabetic Foot Exercises and Their Impact on Peripheral Neuropathy Among Type 2 Diabetes Mellitus Patients

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Abstract. *Neuropathy is nerve damage that occurs mainly in the feet and hands on diabetes mellitus (DM) patients. High blood sugar over a long period of time will cause complications, one of which is damage to small blood vessels (microvasculature) such as diabetic neuropathy with an incidence of 45.6%. Diabetic foot exercise (DFE) is a non-pharmacological therapy to overcome this. DFE improves blood circulation, strengthens small leg muscles, increases insulin production which is used in glucose transport to cells. This study aims to explore the difference in the degree of neuropathy in type II DM patients between before and after receiving DFE therapy. The inquiry about plan utilized a Pre-Experiment Group Pretest-Posttest Plan with a population of 105 individuals and a sample of 26 individuals decided through Quota Sampling. The investigate instrument utilizing the Neuropathy System Score (NSS) questionnaire. Information was analyzed utilizing the Wilcoxon Sign Rank Test. The results of this research stated that the average degree of neuropathy for the group before DFE therapy = 6.5000 (moderate) and after = 4.4615 (mild). DFE therapy had a significant effect on reducing the degree of neuropathy in respondents (P-value = 0.000). Thus, DFE therapy can be recommended to be applied to type II DM patients as a complementary therapy that can help reduce the degree of neuropathy.*

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INTRODUCTION

Diabetes mellitus is a global crisis that threatens health and the global economy. Diabetes mellitus is a serious persistent disease caused by environmental or hereditary factors. Diabetes mellitus is a disorder of protein, carbohydrate and fat digestion system related with insufficiency or release of

insulin which is generally characterized by high blood sugar levels (Widiasari et al., 2021). There are two types of diabetes, namely variety 1 DM and variety II DM. Variety II DM is truly a threat to the world, especially developing countries, one of which is Indonesia. About 1 in every 11 adults suffers from type II DM globally, and about 75% of patients suffer from diabetes mellitus live in developing countries (Saputri, 2020).

International Diabetes Federation (IDF, 2019) predicts that there will be 463 million people with age 20-79 years in the world having DM in 2019. Indonesia ranks seventh out of ten countries with the highest number of diabetes mellitus (DM) sufferers, namely 10.7 million people (Kemenkes, 2018; Simamora et al., 2020). In East Java Province, Diabetes Mellitus sufferers continue to increase from year to year. Data in 2019 mention that 840,000 people having DM. Meanwhile in Malang Regency there are more than 40,000 people suffering from Diabetes Mellitus. This figure is anticipated to proceed to extend from year to year (Dinkes Jatim, 2020).

High blood sugar degree over a long time can induce complications, harm to blood vessels, both macrovascular and microvascular. Macrovascular complications include diabetic foot ulcers (29.9%), cerebrovascular disease (19.4%) and coronary heart illness (27.8%), as well as microvascular diseases involving small blood vessels such as diabetic neuropathy (45.6%), diabetic nephropathy (33.7%) and diabetic retinopathy (20.7%). Nerve disorders that occur especially in the feet of diabetics cause decreased sensitivity and loss of sensation, known as peripheral neuropathy. This loss of sensation in the feet has the potential to cause trauma to the feet, causing diabetic ulcers (Saputri, 2020; Simamora et al., 2020). Peripheral neuropathy is the result of nerve damage which is usually a major complication of diabetes (Pamungkas and Andi, 2021).

Peripheral neuropathy as a complication of diabetes mellitus can be prevented or delayed by good metabolic control and keeping blood sugar levels within normal limits. The main management is divided into four pillars, namely learning, health nutritional treatment, pharmacological therapy and physical exercise (Soelistijo et al., 2021; Hartono, 2019). Physical exercise is one of the pillars that is emphasized for Diabetes Mellitus sufferers to control and prevent complications because it is simple to do and does not require expansive cost. Physical exercise such as diabetic foot exercises is used as an educational and intervention option for Diabetes Mellitus sufferers to prevent peripheral neuropathy in the feet. The Indonesian Endocrinology Association provides a regular physical exercise program for Diabetes Mellitus sufferers carried out 3 - 5 days a week for around 0.5 – 0.7 hours, for a total of 2.5 hours per week, with a break between exercises of no more than 2 consecutive days (Soelistijo et al., 2021). The results of a study conducted by Asniati and Hasana (2021) using a pre-experimental design "One Group Pretest and Posttest" showed relevance to this study where there was a decrease in blood sugar levels after DFE therapy. This decrease in sugar levels can alleviate the degree of neuropathy. In addition, research conducted by Yulita et al. (2019) stated that after performing diabetes foot exercises on patients with type II diabetes mellitus, there was a significant decrease in the number of neuropathies and blood sugar levels. Research carried out at Prima Husada Hospital is still very minimal, especially

related to diabetes mellitus variables and interventions. The latest research related to diabetes mellitus variables was conducted by Herafandy (2015) who researched the prevalence of xerostomia in people with type II diabetes mellitus. This study aims to explore the difference in the degree of neuropathy in type II DM patients between before and after receiving DFE therapy.

MATERIALS AND METHOD

This research utilized a Pre-Experiment Group Pretest-Posttest, the populace of all sufferers of type II diabetes mellitus and neuropathy disorders was 105 people with a test estimate of 26 people selected using quota sampling respondent criteria are >18 years old, suffering from type II diabetes mellitus with neuropathy and being treated at "PH" Hospital. The DFE intervention was carried out using the DFE SOP and the degree of neuropathy was measured using the Neuropathy Symptom Score (NSS) questionnaire. The DFE SOP consists of 5 components: definition, purpose, indications and contra indications, preparation, and implementation. The implementation consists of 8 movements, namely sitting properly on a chair while placing the feet on the floor. While placing the heels on the floor, the toes of both feet are straightened upwards and bent downwards 10 times. Placing the heels on the floor, lift the soles of the feet up. Then, the toes are laid on the floor while the heels of the feet are lifted. This step is repeated 10 times. The heels of the feet are placed on the floor; the front of the feet are lifted and a 360º rotation is made with the movement of the ankles 10 times. The toes are placed on the floor. The heels are lifted and a 360º rotation is made with the movement of the ankles 10 times. The legs are lifted by straightening the knees. A 360º rotation is made with the movement of the feet 10 times. The knees are straightened and bent downwards 10 times. Repeat this step for the other leg. Place a piece of newspaper on the floor. Crumple the paper into a ball with both feet. Then, open the ball into a wide paper using both feet. This step is done only once. The therapy is done 6 times for two weeks and each therapy is given a break of 1 day; the time needed for one therapy is 20 minutes. Neuropathy measurements are taken before the first therapy and 1 day after the last therapy. Next, to determine the difference in the degree of neuropathy in type II DM patients between before and after receiving DFE therapy was analyzed utilized the Wilcoxon Sign Rank.

RESULT

Table 1: Respondent characteristics

No	Characteristics	Sub-Characteristics	F	%
1	Gender	Man	10	38.5
		Woman	16	61.5
2	Age (Years)	(26-35 years) Early Adulthood	3	11.5
		(36-45 years) Late adulthood	13	50.0
		(46-55 years) Early elderly	9	34.6
		(56-65 years) Late elderly	1	3.8

No	Characteristics	Sub-Characteristics	F	%
3	Address (District)	Lowokwaru	4	15.4
		Klojen	4	15.4
		Blimbing	5	19.2
		Karangploso	4	15.4
		Singosari	6	23.1
		Lawang	3	11.5
4	Ethnic group	Javanese	19	73.1
		Madura	6	23.1
		Sunda	1	3.8
5	Education	No School	3	11.5
		Elementary School	5	19.2
		Junior High School	6	23.1
		SMA/SMK/SMA	6	23.1
		DIII/College	6	23.1
6	Work	Civil Servants	2	7.7
		Self-Employed	6	23.1
		Teacher	1	3.8
		Housewife	6	23.1
		Private Sector Employee	4	15.4
		Farmer	7	26.9
7	Suffering from DM for a long time	(< 1 year)	2	7.7
		(1-5 years)	14	53.8
		(5-10 years)	10	38.5
8	Concomitant Diseases	Hypertension	7	26.9
		Kidney	1	3.8
		None	18	69.2
9	Routine Treatment	Yes	8	30.8
		No	18	69.2

Table 1 appears that the majority of respondents were female (16 individuals, 61.5%); half of the respondents (13 individuals, 50%) were classified as late adults; A minority of respondents (6 individuals, 23.1%) were from Singosari Malang District; the majority were Javanese (19 individuals, 73.1%); a small part no school education (3 individuals, 11.5%); a small number work as farmers (7 individuals, 26.9%); more than half had suffered from DM for 1-5 years (14 individuals, 53.8%); Most of them did not have comorbidities (18 individuals, 69.2%); and the majority were non-compliant with treatment (18 individuals, 69.2%).

Table 2: The distribution of neuropathy severity

Information	Category	F	%	*Min*	*Max*	*Mean*	*SD*
Pretest	Mild (0-4)	0	0	5.00	9.00	6.5000	1.10454
	Moderate (5-6)	14	53.8				
	Severe (7-10)	12	46.2				
Posttest	Mild (0-4)	14	53.8	3.00	7.00	4.4615	0.90469
	Moderate (5-6)	11	42.3				
	Severe (7-10)	1	3.8				

Table 2 shows the level of neuropathy before diabetic foot exercises were performed, 0% in the mild category, 53.8% in the moderate category and 46.2% in the severe category, after the diabetic foot

exercises were performed, 53.8% in the mild category, 42.3% in the moderate category, and 3.8% in the severe category.

Table 3: Wilcoxon sign rank test results

Test	Information	*Mean*	*Delta Mean*	*P-value*	*Alpha Value*
Wilcoxon Sign Rank	*Pretest*	6.5000	2.0385	0.000	0.05
	Posttest	4.4615			

Table 3 shows differences in the degree of neuropathy in patients with Type II Diabetes Mellitus before and after diabetic foot exercise therapy (DFE). Research on differences in normal reward levels between pre- and post-neuropathy tests was conducted using the Wilcoxon Sign Rank Test technique. The results of this test show a P value of 0.000 < 0.05, which means that there is a significant difference in that the level of neuropathy decreased after undergoing diabetic foot exercise therapy.

DISCUSSION

The Wilcoxon Sign Rank analysis showed a p-value of 0.000, indicating a significant difference between the groups, where the average degree of neuropathy decreased after diabetic foot exercise therapy, from moderate to mild. The occurrence of a decrease in the degree of neuropathy from moderate to mild is of course influenced by the therapeutic factors given to the patient, namely DFE therapy. Theoretically, neuropathy disorders in DM patients can be controlled by controlling blood glucose. If blood glucose is at a normal level, then the disorder can subside. One way to control blood glucose is with leg exercises (Barnes and Darryl, 2018). DFE is a therapy commonly used by DM sufferers to assist blood circulation within the lower body, thereby reducing neuropathy disorders (Kurnia, 2023). Another similar opinion states that DFE can affect the severity of neuropathy in DM patients, because this therapy is useful in improving blood circulation, so that nutrition to the tissues becomes smoother, strengthening small muscles, calf muscles and thigh muscles, as well as overcoming limitations in joint movement that often occur experienced by DM patients (Suhertini and Subandi, 2016).

The principle of foot treatment is carried out by moving all the foot joints and are adjusted to the patient's abilities (Damayanti, 2025). Diabetic foot exercises in various studies are said to help blood circulation, reinforce the little muscles of the leg, avoid foot distortions which can increase the potential for diabetic wounds within the leg, increase insulin sensitivity and facilitate glucose uptake by cell helping reduce glucose levels in the blood system (Megawati et al., 2020). Diabetic foot exercises stimulate movement in the legs, stretch the leg muscles, and compress the blood vessels around these muscles. This will push blood to the heart thereby reducing venous pressure. This mechanism is known as the "venous pump". This mechanism improves blood movement in the lower body, strengthens small muscles, prevents deformation of the legs, increases the quality of the calf and cramped muscles, and

makes different conquer joint restrictions. Good blood circulation can inhibit the demyelination process, or the process of tearing the myelin sheath of neurons which will damage the axons. The receptor cell impulse transmission process also provides adequate protection (Sari NDP et al, 2019).

CONCLUSION

There is a significant difference in the severity of normal neuropathy that decreases after diabetes foot exercise therapy. This suggests that diabetes foot exercises (DFE) contribute to reducing neuropathy severity. It is highly recommended that patients with diabetes mellitus (DM) perform diabetes foot exercises regularly, whether they have already experienced neuropathy or not. It is hoped that, in addition to reducing the severity of neuropathy in patients who have already experienced it, these exercises may also prevent the onset of neuropathy in patients with diabetes mellitus.

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