



## THE EFFECT OF FOOT EXERCISE ON THE STATUS OF LOWER EXTREMITY SENSORY NEUROPATHY IN PATIENTS WITH TYPE 2 DIABETES MELLITUS AT THE TANJUNGANOM HEALTH CENTER, NGANJUK REGENCY

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### ABSTRACT

**Introduction:** The increasing prevalence of type 2 Diabetes Mellitus in both developed and developing countries so that it becomes a health problem or a global disease in society. Therefore type 2 Diabetes Mellitus can be prevented by regular exercise, healthy and regular living. The purpose of this study was to determine the effect of foot exercise on the status of lower limb sensory neuropathy in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency.

**Method:** The design in this study was pre-experimental with a one-group pre-posttest design approach. This research looked for the effect of foot exercise on lower limb sensory neuropathy status in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, in this study involved 30 respondents using a purposive sampling technique. This research was conducted on 14 – 21 October 2022.

**Results:** From the results of the Wilcoxon test, the results obtained after foot exercise were the status of lower limb sensory neuropathy in the right limb,  $\rho$  value =  $0.000 \leq \alpha$  0.05, this indicated that there was an effect of foot exercise on lower limb sensory neuropathy status in patients with type 2 diabetes mellitus at the Puskesmas. Tanjunganom, Nganjuk Regency.

**Conclusion:** In this study it was found that there was an effect of foot exercise on the status of lower extremity sensory neuropathy in patients with type 2 diabetes mellitus.

**Keywords:** foot exercise; lower extremity sensory neuropathy; diabetes mellitus

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## INTRODUCTION

The incidence of diabetes mellitus is very large, as stated by the International Diabetic Federation (IDF, 2015) explaining that the global prevalence rate of DM sufferers in 2014 was 8.3% of the total population in the world, so this diabetes mellitus requires attention. especially because in the long term it will lead to complications, one of which is neuropathy. Neuropathy is the most common complication experienced by people with Diabetes Mellitus (DM). Neuropathy refers to a group of diseases that attack

all types of nerves in the body, including sensory, motor and autonomic nerves and are often found in the peripheral parts of the body or are called Diabetic Peripheral Neuropathy (DPN). (Parkeni, 2011; Suzanne C. Smeltzer & Brenda G. Bare, 2015). Neuropathy occurs based on risk factors including age, complications of diabetes mellitus with neuropathy can attack the elderly which can be caused by degenerative factors, namely the decline in the function of the human body, especially the ability of pancreatic  $\beta$  cells to produce insulin. (Smeltzer and

Bare, 2002). Complications of neuropathy can result in foot disorders in people with diabetes mellitus, ranging from the occurrence of foot or leg injuries to the possibility of foot or leg amputation. Sensory (peripheral) neuropathy with initial symptoms are paresthesias (stabs, tingling), burning sensation, numbness in the legs (patience) (Suzanne C. Smeltzer & Brenda G. Bare, 2015). The longer a person has diabetes mellitus, the greater the incidence of diabetic neuropathy is found. (Katulanda, P., Priyanga, R., Ranil, J., Gidwin, R.C., Rezvis, S., David, 2012). Lack of sports activities such as physical activity in daily activities can also worsen the situation and cause complications because fat in the body blocks the passage of insulin, thereby increasing the likelihood of diabetic neuropathy complications. (Retno Novitasari, 2012). Years of elevated glucose levels have implications for the etiology of neuropathy. The average diabetic neuropathy has been suffering from diabetes mellitus for 10 years. Soewondo et al (2010) in Purwanti (2013). Foot self-care or foot care has a positive and important role for DM sufferers as a support for controlling the causes of NPS (Neurophatic Pain Scale) through DM progression, foot care can also prevent DM complications from getting worse such as peripheral neuropathy (Sutejo, 2018). Peripheral neuropathy can cause foot deformities and angiopathy, this occurs due to decreased blood circulation to peripheral perfusion (Wahyuni Aria, 2016). Peripheral neuropathy can be treated with several treatments that can be carried out by DM sufferers such as foot care or foot self-care (cleansing feet, selecting footwear for DM sufferers, dietary adjustments, pharmacological therapy) and foot exercises (Wahyuni Aria, 2016). Other treatment for peripheral neuropathy can be done by implementing foot self care with foot exercises which can improve blood circulation in the feet and improve the strength of the small leg muscles to reduce the

occurrence of abnormal foot shape, reduce pain, reduce nerve damage and control blood sugar (Taylor, 2010; Black & Hawks, 2009). Foot exercise can be applied to DM sufferers because it is easier for people with diabetes to do it independently, foot exercise does not require money and foot exercise can be an activity during free time (Damayanti, 2015). Foot care in DM sufferers needs to be improved and carried out. The purpose of this study was to determine the effect of foot exercise on the status of lower limb sensory neuropathy in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency.

## METHOD

The design in this study was pre-experimental with a one group pre-posttest design approach, which is a research design used to reveal causal relationships by involving one group of research subjects. Subjects were observed before the intervention was carried out, then the intervention was carried out and observed again after the intervention. In this study, we tried to explore how the effect of foot exercise on the status of lower limb sensory neuropathy in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, in this study involved 30 respondents using a purposive sampling technique. This research was conducted on 14 - 21 October 2022 in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency. The independent variable or independent variable in this study was foot exercise, while the dependent variable or dependent variable in this study was lower extremity sensory neuropathy in patients with type 2 DM. Statistical test using Wilcoxon with  $\alpha=0.05$  Output significance  $p = 0.005 \leq \alpha 0.05$  and correlation coefficient of -2.81.

## RESULTS

### Lower Extremity Sensory Neuropathy Status Value in Type 2 Diabetes Mellitus Patients at the Tanjunganom Health Center, Nganjuk Regency, before doing foot exercises.

Table 1. Frequency Distribution of Lower Extremity Sensory Neuropathy Status in Patients with Type 2 Diabetes Mellitus at the Tanjunganom Health Center, Nganjuk Regency Before Foot Exercises Performed on 14-21 October 2022.

Neuropathy Score	Pre Right		Pre Left	
	F	%	F	%
1/10	0	0	0	0
2/10	1	3	1	3
3/10	2	7	2	7

4/10	1	3	0	0
5/10	10	33	11	37
6/10	11	37	10	33
7/10	4	13	5	17
8/10	1	3	1	3
9/10	0	0	0	0
10/10	0	0	0	0
<b>Total</b>	30	100	30	100

Based on the results of the study in table 1, the value of lower limb sensory neuropathy status in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, before doing foot exercises on the right extremity, out of 10 points

examined for neuropathy status, almost half were 11 respondents (37%) with a score 6/10, whereas in the left lower extremity it is almost half, namely 11 respondents (37%) with a value of 5/10.

**Status Value of Lower Extremity Sensory Neuropathy in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, after doing foot exercises.**

Table 2. Frequency Distribution of Lower Extremity Sensory Neuropathy Status Values in Patients with Type 2 Diabetes Mellitus at the Tanjunganom Health Center, Nganjuk Regency After Foot Exercise on 14-21 October

Neuropathy Score	Right Post		Left Post	
	F	%	F	%
1/10	0	0	0	0
2/10	0	0	0	0
3/10	0	0	0	0
4/10	0	0	0	0
5/10	0	0	0	0
6/10	0	0	0	0
7/10	2	7	0	0
8/10	6	20	1	3
9/10	14	47	18	60
10/10	8	27	11	37
<b>Total</b>	30	100	30	100

Based on table 2, the value of lower limb sensory neuropathy status in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, after doing foot exercises on the right limb, out of 10 points examined, almost half of neuropathy

status was examined, namely 14 respondents (47%) with a score of 9/10 , while in the left lower extremity the majority were 18 respondents (60%) with a score of 9/10.

**The effect of foot exercise on the status of lower limb sensory neuropathy in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency.**

Table 3. Analysis of the Effect of Foot Exercise on the Status of Lower Extremity Sensory Neuropathy in Patients with Type 2 Diabetes Mellitus at the Tanjunganom Health Center, Nganjuk Regency After Foot Exercise was

Neuropathy Score	Pre Right		Right Post		Pre Left		Left Post	
	F	%	F	%	F	%	F	%
1/10	0	0	0	0	0	0	0	0
2/10	1	3	0	0	1	3	0	0
3/10	2	7	0	0	2	7	0	0
4/10	1	3	0	0	0	0	0	0
5/10	10	33	0	0	11	37	0	0
6/10	11	37	0	0	10	33	0	0
7/10	4	13	2	7	5	17	0	0
8/10	1	3	6	20	1	3	1	3

<b>9/10</b>	0	0	14	47	0	0	18	60
<b>10/10</b>	0	0	8	27	0	0	11	37
<b>Total</b>	30	100	30	100	30	100	30	100

Based on table 3, it shows that the Wilcoxon statistical test results obtained after foot exercise, the status of sensory neuropathy in the lower limb in the right limb obtained  $p$  value =  $0.000 \leq \alpha 0.05$  so that  $H_0$  was rejected and  $8/10$  6 20 1 3 9/10 14 47 18 60 10/10 8 27 11 37 Total 30 100 30 100  $H_a$  was accepted, while in the left limb obtained  $p$  value =  $0.000 \leq \alpha 0.05$  so that  $H_0$  is rejected and  $H_a$  is accepted.

## DISCUSSION

### Lower Extremity Sensory Neuropathy Status Value in Type 2 Diabetes Mellitus Patients at the Tanjunganom Health Center, Nganjuk Regency, before doing foot exercises.

Based on the results of the study in table 1, the value of lower limb sensory neuropathy status in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, before doing foot exercises on the right extremity, out of 10 points examined for neuropathy status, almost half were 11 respondents (37%) with a score 6/10, whereas in the left lower extremity it is almost half, namely 11 respondents (37%) with a value of 5/10.

Lower limb neuropathy is a common consequence of Type 1 and Type 2 diabetes mellitus and chronic hyperglycemia involving vascular pathways or metabolic disorders. There are three main ways in which diabetes is thought to damage peripheral nerves. First, neural tissue does not require insulin for glucose transport and instead uses alternative metabolic polyol pathways for glucose metabolism. Glucose is converted to sorbitol, and sorbitol in turn is very slowly converted to fructose. Glucose buildup from chronic hyperglycemia combined with a very slow conversion rate of sorbitol to fructose results in sorbitol accumulation in the peripheral nerves. The increase in sorbitol causes interference with the ion pump by generating osmotic pressure by drawing in the fluid. This reduces nitric oxide and causes an increase in molecular reactive oxygen and an increase in oxidative stress. This element damages Schwann cells and causes disruption of nerve conduction. Second, protein C kinase is inappropriately activated as a result of hyperglycemia, which may also contribute to neurologic complications. Protein C kinase is an

intracellular signaling molecule that regulates many vascular functions; The level is increased in diabetes. Activation of this protein C kinase in vascular nerves can cause vascular damage and decrease nerve conduction. Third, advanced glycosylation end products (AGEs) are the result of the attachment of glucose metabolites to proteins. Although it is a normal component of protein, the basement membrane in smaller blood vessels, uncontrolled blood glucose levels favor over-production of AGEs. The increase in AGEs causes a thickening of the basement membrane, contributing to a reduced oxygen supply. Because neuronal dysfunction is closely related to vascular abnormalities and nerve damage due to AGE. Additional microvascular damage includes protein trapping (including LDL), nitric oxide inactivation, and loss of vasodilatation due to deposition of sorbitol and polyol pathways, activation of protein C kinase, and excess accumulation of AGEs all contribute to neuronal damage via myelin degeneration, causing nerves to lose their ability to transmit blood vessels. signal.

Lower extremity neuropathy occurs when nerves are damaged enough to cause decreased or absent nerve transmission causing a number of possible symptoms including numbness, pain, or tingling. The presence of lower extremity neuropathy will cause a loss or decrease in the sensation of pain in the feet so that they will experience trauma without being felt which results in ulcers on the feet. The clinical manifestations of diabetic neuropathy depend on the type of nerve fibers that are affected. Considering that the nerve fibers affected by the lesion can be small or large, proximal or distal, focal or diffuse, motor or sensory or autonomic, the clinical manifestations vary, including: tingling, numbness, numbness, burning sensation as if torn. (Smeltzer & Bare, 2017).

Based on the description above, the researchers argue that there is an incidence of lower extremity sensory neuropathy in patients with type 2 diabetes mellitus, diabetic neuropathy is associated with problems with blood supply to the feet which can cause foot ulcers and slow wound healing. This infection can cause amputation wounds, all lower limb amputations are caused by diabetes mellitus. Management of diabetes mellitus consists of the first pharmacological therapy which includes administration of oral anti-diabetic drugs and insulin

injections. The second is non-pharmacological therapy which includes lifestyle changes by making dietary adjustments known as medical nutrition therapy, increasing physical activity, and continuously educating various problems related to diabetes mellitus.

According to the researchers, they obtained information about foot exercise and education having a role in the incidence of diabetic neuropathy in patients with Type 2 DM at the Tanjunganom Health Center, Nganjuk Regency. Education is a factor which can affect the level of knowledge of respondents about self-care management and how to capture any information conveyed by the media and other people. This is in accordance with the results of research conducted by (Widyasari, 2017) showing that there is a relationship between recent education and a person's diabetes status. Lack of knowledge about foot exercise, if foot exercise is not carried out routinely it can cause diabetic neuropathy problems.

#### **Status Value of Lower Extremity Sensory Neuropathy in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, after doing foot exercises.**

Based on table 2, the value of lower limb sensory neuropathy status in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, after doing foot exercises on the right limb, out of 10 points examined, almost half of neuropathy status was examined, namely 14 respondents (47%) with a score of 9/10, while in the left lower extremity the majority were 18 respondents (60%) with a score of 9/10.

Decreased sensory neuropathy of the lower extremities after doing leg exercises occurs because foot exercises can improve the nerves in the legs aiming to smoothen blood flow to the periphery and train the leg muscles of Type 2 DM sufferers so that lower extremity neuropathy problems do not occur which are not immediately treated will lead to problems such as amputation. According to Samendawai, (2013) explained that foot exercise can show the development of good effectiveness in lower limb sensory neuropathy in patients with Type 2 DM before and after giving foot exercise.

Foot exercise can reduce the value of neuropathy disorders because it can improve blood flow to the periphery, increase the strength of the leg muscles, and improve sensory, motor and autonomic functions. Foot exercise has 10 movements that aim to improve blood circulation in the legs, strengthen the leg muscles, prevent foot deformities, increase

the calf and leg muscles, increase joint motion and prevent injuries. The leg exercise movement is very easy and doesn't take a long time, it can be done sitting down. Foot exercise can improve the vascularization of the feet more smoothly to prevent complications of neuropathy in the feet, which can prevent amputation and diabetic foot in type 2 diabetes mellitus. And in accordance with the opinion of (The Centers for Disease Control And Prevention, 2010) that foot exercise regularly can reduce foot disorders in type 2 diabetes mellitus sufferers by 50-60% which can affect quality of life. (Annalia Wardhani, 2020).

Based on this description, the researchers believe that there is a change between before doing leg exercises and after doing leg exercises because in diabetics, elevated blood sugar over a long period of time will cause neurological disorders called neuropathy and vascular disorders. This situation causes a decrease in the feeling of pain stimuli, changes in motor strength resulting in changes in the pressure on the soles of the feet. One of the goals of doing diabetic foot exercises is to improve blood circulation, especially peripheral blood circulation, so that by doing foot exercises, blood circulation to the periphery will run smoothly and reduce the risk of neuropathy.

#### **The effect of foot exercise on the status of lower limb sensory neuropathy in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency.**

Based on the results of research conducted at the Tanjunganom Health Center, Nganjuk Regency, by providing foot exercise therapy in 2 meetings for 2 weeks, it was found that almost all respondents experienced a decrease in lower limb sensory neuropathy.

Based on table 3, it shows that the Wilcoxon statistical test results obtained after foot exercise, the status of sensory neuropathy in the lower limb in the right limb obtained  $p$  value =  $0.000 \leq \alpha 0.05$  so that  $H_0$  was rejected and  $H_a$  was accepted, while in the left limb obtained  $p$  value =  $0.000 \leq \alpha 0.05$  so that  $H_0$  is rejected and  $H_a$  is accepted.

The theory presented by Guyton & Hall, (2008) leg exercise exercises occur in the movement of the legs which results in stretching the leg muscles and compressing the veins around the muscles, this will push blood towards the heart and venous pressure will decrease, this mechanism is known with a "venous pump". This mechanism will help improve blood circulation in the legs, improve blood circulation, strengthen small muscles, prevent foot

deformities, increase calf and thigh muscle strength, and overcome joint limitations. Smooth blood circulation will inhibit the process of demyelination or the process of tearing the myelin sheaths in neurons which will damage the axons, if the neuron cells are in good condition then the process of transmitting impulses to sensory, motor and autonomic receptor cells will be adequate.

Foot exercise is included in the management of foot care, where based on the information and evidence above, it can be concluded that foot exercise can reduce the condition of lower limb sensory neuropathy in Type 2 DM sufferers. The above theory is in accordance with the reality in the field of lower limb sensory neuropathy in Patients with Type 2 DM can be prevented by doing regular foot exercises. Foot exercises that are not done routinely will be at risk of experiencing lower extremity sensory neuropathy which can cause problems in the feet of people with Type 2 DM, namely dry skin, tingling, unable to feel sensitivity when the soles of the feet are touched and muscle stiffness which is at risk for diabetic foot problems.

## CONCLUSION

From the research that was conducted on 14 - 21 October 2022 in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency, it can be concluded that the lower limb sensory neuropathy status values were obtained in patients with type 2 diabetes mellitus at the Tanjunganom Health Center, Nganjuk Regency before doing foot exercises on the extremities Nearly half of the 10 points examined for neuropathy status, namely 11 respondents (37%) with a score of 6/10, besides that after doing leg exercises on the right extremity, out of 10 points examined for neuropathy status, almost half were 14 respondents (47%) with a value of 9/10, while in the left lower extremity the majority were 18 respondents (60%) with a 9/10 value while in the left lower extremity almost half were 11 respondents (37%) with a 5/10 value

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