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FOOT EXERCISES CAN MORE EFFECTIVELY IMPROVE FOOT SENSITIVITY IN ELDERLY PATIENTS WITH TYPE 2 DIABETES

Asmawati[1]✉, Puji Rahayu[2], Dahrizal[3]

[1]Department of Nursing, Health Ministry Polytechnic of Banten, asmawati@poltekkesbanten.ac.id
[2]Bachelor of Nursing, Health Ministry Polytechnic of Banten, pujir8148@gmail.com
[3]Departement of Nursing, Health Ministry Polytechnic of Banten, dahrizal@poltekkesbanten.ac.id
**Corresponding author: asmawati@poltekkesbanten ac.id*

ABSTRACT

One of the complications of diabetes mellitus (DM) is peripheral neuropathy, which can lead to decreased foot sensitivity and increase the risk of diabetic foot problems. Peripheral neuropathy is one of the most common complications of DM, affecting approximately 50% of people with diabetes. This study aimed to determine the effect of leg exercises on foot sensitivity in patients with type 2 diabetes mellitus. This study employed a quasi-experimental design using a pretest–posttest control group design. Samples were DM patients who suffered decreased sensitivity without mobility impairment. The total sample consisted of 40 respondents, with 20 participants in each group. The intervention group received leg exercises three times a week, while the control group received range-of-motion (ROM) exercises. Foot sensitivity was assessed before and after the intervention and reassessed after two weeks using a 10-g Semmes-Weinstein monofilament test. The Mann–Whitney U test showed a significant difference in foot sensitivity between the two groups was 1,05 ($p = 0.008$; $\alpha < 0.05$). The leg exercise intervention was more effective in improving mean foot sensitivity than a ROM exercise in patients with type 2 diabetes mellitus.

Keywords: Diabetes mellitus; Foot sensitivity; Leg exercise; ROM

INTRODUCTION

Developed countries and developing countries currently face three burden health problems at a time: infectious diseases, non-infectious diseases, and mental health diseases or diseases of risky social behavior (triple burden of diseases). It can cause a high number of deaths, especially in the case of NCDs (non-communicable diseases) or non-infectious diseases; it is estimated to continue to increase worldwide. More of two- thirds or (70%) of 265 million soul global population will die consequence disease No infectious like disease heart, stroke and Diabetes Mellitus (DM)(Meripal, 2018). Diabetes mellitus (DM) is endemic in Asia, including Indonesia. Currently, DM occurs not only among the elderly but also among young people. DM is known as the mother of diseases, or the parent of various diseases, such as hypertension, heart and blood vessel disease, stroke, kidney failure, and blindness (Rahman *et al.*, 2021).

The high morbidity rate due to diabetes worldwide leads to various complications that are often experienced by DM sufferers and can be life-threatening. Common complications include lower-extremity peripheral vascular disease, which results in changes in the peripheral nervous system or peripheral neuropathy (somatic neuropathy). The prevalence of neuropathic complications in DM sufferers reaches more than 90%, meaning almost all DM sufferers experience neuropathic complications. Peripheral neuropathy is the most common complication, accounting for 50% of global neuropathy cases. Symptoms of peripheral neuropathy complications include weakness, numbness in the feet and hands, pain in the feet, and decreased foot sensitivity, which increases the risk of diabetic foot problems. Neuropathic complications can cause very slow wound healing and even lead to amputation (Rahman *et al* ., 2021).

Treating diabetic foot sensitivity involves maintaining blood glucose balance through the five pillars of diabetes management: diet, pharmacological therapy (insulin and antidiabetic drugs), physical exercise, and education. Physical exercises that can prevent diabetes complications include leg exercises, jogging, aerobics,

cycling, yoga, weight training, and swimming. Physical exercise can improve blood circulation, thereby preventing complications from diabetes (Rahmasari, 2019). Leg exercises are recommended for improving blood flow to the legs. It can improve blood circulation in the feet, so it is hoped that nutrient distribution in the tissues will be smooth. It can strengthen the muscles of the calves and soles of the feet so that when walking, the feet become more stable, increase joint flexibility, and prevent the risk of stiff joints and maintain nerve function(Rahmasari, 2019).

One nursing measure to manage diabetes mellitus (DM) complications through non-pharmacological intervention is physical exercise that can be performed independently at home—specifically, leg exercises. These exercises improve blood circulation in the legs, thereby facilitating nutrient delivery to the tissues; they strengthen calf and foot muscles (enhancing stability while walking), increase joint flexibility, prevent joint stiffness, and maintain nerve function (Rahmasari, 2019). To date, however, the leg exercise program at the Sawah Lebar Community Health Center (Puskesmas) has not been implemented intensively or consistently by nurses; DM patients are merely advised to exercise at home without any subsequent evaluation of the results.

MATERIALS AND METHODS

This study employed a quantitative approach with a quasi-experimental design using a pretest–posttest control group design. The study was conducted in the working area of the Sawah Lebar Community Health Center, Bengkulu City, from February to April 2022. The sample size for this study was determined based on the formula for the difference between two means, referencing previous research. The total sample consisted of 40 patients with type 2 diabetes mellitus (DM) who experienced decreased foot sensitivity without mobility impairment, with 20 participants in each group. Participants were selected using systematic random sampling. The inclusion criteria were patients with type 2 DM who had decreased foot sensitivity and no difficulty with lower-extremity movement. The intervention group received leg exercises, while the control group received range-of-motion (ROM) exercises for two weeks. The exercises were performed for 30 minutes once daily. Foot sensitivity was assessed before and after the intervention. Blood glucose levels were measured before the intervention. Foot sensitivity was assessed on the plantar surfaces of the feet using a 10-g Semmes-Weinstein monofilament. In addition, sensitivity was assessed using a sterile needle (pin) at 10 nerve-point locations on the plantar surfaces of the feet. Participants were considered sensitive if they could perceive the pinprick sensation at the tested sites. Measurements were performed before the intervention and after two weeks of intervention. The leg exercise program consisted of seven movements focusing on lower-extremity movements, such as bending and swinging the legs. The exercises were performed in a comfortable seated position on a chair. Statistical analysis was performed using the Mann–Whitney U test to determine differences in foot sensitivity between the intervention and control groups. This study received ethical approval from the review team of the Ethics Committee of Poltekkes Kemenkes Bengkulu on March 22, 2022 (Reference No. KEPK.M/101/03/2022).

RESULTS AND DISCUSSION

Table 5.1 Characteristics Overview and Homogeneity Test (N= 40)

Variables	Group		P value
	Intervention (N=20)	Control (N=20)	
Age			
< 59 years	5(25.0%)	3(15.0%)	
60-70 years	14(70.0%)	16(80.0%)	0.494*
71-80 years	1(5.0%)	1(5.0%)	
Sex			
Male	5 (25.0 %)	5 (25.0 %)	0.748*
Female	15 (75.0 %)	15 (75.0%)	
Body Mass Index			
24-28: Overweight	4 (3.3%)	4 (20, 0 %)	
18-24: Normal	21 (70.0%)8	1 1 (55, 0 %)	0.772*
<18: Thin	(26.7%)	5 (25, 0 %)	
Duration of DM			
< 1 year	3 (10%)	14 (70, 0 %)	
1-2 years	18 (60.0%)9	5 (25, 0 %)	0, 000
> 2 years	(30.0)	1 (5.0 %)	
Work			
No Work	12 (60.0%)	12 (60.0%)	0.577 *
Work	8 (40.0%)	8 (4 0.0%)	
Random glucose blood levels	12(60.0%)	14(70.0%)	0, 330*
Normal 100-200g/dl	8(40.0%)	6 (30.0%)	

Hyperglycemia >200g/dl	

SD, Standard Deviation , *sig p value > 0.05 * *Chi square*

The data normality test was carried out using the Chi-square test. Homogeneity test results showed there is no difference in all variables (homogeneous) with *p-value > 0.05* α ≥ 0.05, including age, gender, body weight, occupation, and blood glucose level, except length of DM. The characteristics of age of participants were 60-70 years old; there were 14 people (70%) in the intervention group and 16 people (80%) in the control group. According to Milita *et al.* (2021), the majority of DM sufferers are aged >60 years because the elderly's body organs experience a decrease in function, one of which is insulin, so that they cannot use insulin effectively, and complications of Neuropathy appear more quickly in the elderly. The most of woman, as much as 75 %. It states that DM sufferers are mostly women; 70% of the risk is due to a lack of physical activity and women's preference for sweet foods. Men generally engage in more physical activity than women, so they are less likely to suffer from diabetes. Most of them are unemployed, with a percentage of 75%. According to Jannah *et al*. (2017), that in the range of over 60 years old do not have jobs due to age factors and declining productivity. Age is seen as an age where people no longer work and can't do heavy activities like adults.

The majority of respondents had a normal body weight, with a BMI of 18-24, with a percentage of 60%-70% in both groups. This is in line with research conducted Adnan, Mulyati *et al* ., (2016) informing that the body mass index of DM sufferers can be normal, influenced by lifestyle and physical activities undertaken. The blood sugar levels in this study were mostly normal, with 60% in the range of 100-200 g/ dl. This is also described in research Yurida & Huzaifah, (2019) which informs that the study found that diabetes patients who regularly take blood sugar medication and have a normal body mass index (BMI) can maintain better control of their blood sugar levels. The respondents in this study regularly attended the elderly integrated service center and regular health checks, so even with diabetes, their blood sugar levels remained controlled and within normal limits. The duration of diabetes among each respondent varied, but most had suffered from it for 1-2 years in both groups (60-70%). This is also in line with the results of research conducted Yurida & Huzaifah (2019) stated that DM sufferers who have been diagnosed with DM for less than 2 years need early detection of complications that may have already occurred, one of which is decreased foot sensitivity. Decreased foot sensitivity due to DM requires interventional management to increase foot sensitivity and prevent diabetic ulcers.

Respondent's foot sensitivity before and after intervention

Variable	Group		P-value
	Intervention (N=20)	Control (N=20)	
Foot Sensitivity **(*Baseline*)**			
Mean	7,90	8,25	
Min-Max	6-9	6-9	0,065*
SD	0,968	0,851	
CI 95%	7,45;8,35	7,85;8,65	
Foot Sensitivity **(Post)**			
Mean	8,95	8,4	
Min-Max	7-10	7-9	0,008**
SD	0,698	0,681	
CI 95%	8,13;8,77	8,08;8,72	
P Value	0,000*	0,000*	

SD, Standar Deviasi, *p value* sig ≤ 0,05 α 95%, **M*ann Whitney,* *Wilcoxon

Research results show the mean of foot sensitivity before the intervention, in the intervention group 7,90 and in the control group 8.25, that the level was moderate to mild. This condition was also influenced by the body mass index; most of the participants were normal and had not suffered from diabetes for long, and took medications regularly so that their blood glucose was controlled. In line with the study Rahman *et al* ., (2021) in diabetes mellitus sufferers with decreased foot sensitivity inform that the sensitivity of the feet of diabetics will decrease by as much as 20 % or more each year, depending on the individual. Other research stated that the part of the foot that is prone to losing sensitivity is the middle of the sole of the foot.

Research results all exercises can increase the mean of foot sensitivity. In the intervention group, there

was an increase in foot sensitivity after the leg exercises intervention. The average increase in foot sensitivity was 1.05 from the initial foot sensitivity 7,9 (moderate) to 8.95 (mild). This study is in line with research conducted by Trisnawati *et al.* (2020) which stated that leg exercises can improve blood circulation in the feet, thereby increasing foot sensitivity. Leg exercises were carried out 6 times for 2 weeks and were found to increase the average foot sensitivity. Another study from Rahman *et al* ., (2021) stated that the part of the foot that experiences the fastest increase in foot sensitivity is the toes because the nerves in the toes have a fairly large nervous system compared to other parts of the foot, so that after being given physical exercise, blood flow in the nervous system in the toes will improve, which then results in an increase in foot sensitivity faster than other parts of the foot.

Meanwhile, in the control group that was given *ROM exercises,* there was also an increase in foot sensitivity. The mean difference in foot sensitivity was 0.15, from 8.25 (moderate) to 8.40 (moderate). This research is in line with research conducted by Yurida & Huzaifah, (2019), which stated that *ROM* exercises. Regular exercises can improve foot sensitivity in people with diabetes. ROM exercises were performed six times over two weeks and were found to increase the average foot sensitivity only by 0.15.

The mean difference in foot sensitivity between the groups was 0,90. The results of the *Mann-Whitney test* showed a *p-value of* 0.008; there was a significant difference in the average increase in foot sensitivity between groups. The leg exercise is more effective in improving foot sensitivity compare than ROM exercise. It is in line with research conducted by Widiawati et al., (2020), leg exercises in patients with type 2 diabetes mellitus can improve foot sensitivity. Research result of Trisnawati *et al.*, (2020) in diabetes sufferers who experience decreased foot sensitivity, inform that *leg exercises* can increase foot sensitivity, with mean results of initial foot sensitivity with a mean increase of 1.00 %. Research conducted by Sutarti et *al* ., (2018) mentioned that *leg exercises* carried out for 2 weeks are able to increase the mean foot sensitivity from 6.47 to 7.31 (1,16). *Leg exercises* can increase leg sensitivity better than *ROM exercises* because leg exercises involve many muscles that are actively moving compared to ROM exercises; in actively moving muscles, there is an increase in glucose needs, but insulin needs do not increase. Actively moving muscles improve blood circulation in the legs so that there can be an increase in leg sensitivity (Widiawati *et al* ., 2020) . Leg e*xercises* can be a physical exercise that is easy to do anytime and safe for people with diabetes, especially those aged 60 years and above. By regularly doing leg exercises, it can prevent diabetic foot complications that begin with loss of foot sensitivity to stimulation and the emergence of cramps. Leg exercises are more effective than physical exercise with ROM exercises. This can be seen from the mean increase in foot sensitivity in the intervention group, which is better than the control group (Dewi *et al* ., 2022) .

A weakness of this study is the small number of respondents, so the results cannot be generalized to the DM population in Bengkulu City. The lack of enthusiasm among DM patients to consistently perform leg exercises or ROM for 2 weeks and the elderly condition of the respondents affected their ability to perform the exercises. A multivariate analysis was not conducted to examine the influence of confounding variables affecting foot sensitivity. Further research with a larger sample size is needed, incorporating intensive leg training and a structured schedule of duration and timing, to maximize the accuracy of the results.

CONCLUSION

Respondents were classified as elderly with an average age of 60-70 years; most of gender was female, did not work; most of their body weight was normal; most of their blood sugar levels were in the normal range, and most had suffered from diabetes mellitus for 1-2 years. There was a difference in the mean increase in leg sensitivity after being given leg exercises and ROM exercises. The intervention affected the foot sensitivity which leg exercises being more effective in improving foot sensitivity compare than ROM exercises.

CONFLICT OF INTEREST

No conflict interest

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