



Effect of Diabetic Foot Exercises on Foot Sensitivity in Elderly People with Diabetes Mellitus in Magelang Regency

Sigit Priyanto^{1*}, Agus Kristiyanto², Kusnandar³, Anik Lestari⁴, Sinu Andhi Jusup⁵

^{1,2,3,4,5}: Sebelas Maret of University, Indonesia

Corresponding author: sigitpriyanto@unimma.ac.id

Abstract. The increasing population of people with diabetes mellitus has an impact on increasing the incidence of diabetic foot ulcers as a chronic complication of diabetes mellitus, as many as 15-25% of people with diabetes mellitus will experience diabetic foot ulcers (Riskesdas, 2023). Diabetic foot exercises are activities or exercises performed by people with diabetes mellitus to prevent wounds and help improve blood circulation in the feet. Objective: to determine the effect of diabetic foot exercises on foot sensitivity in elderly with diabetes mellitus in Magelang Regency. Method: quasi-experimental pre and post-test with control group. The sample was 62 respondents in the intervention group and 62 respondents in the control group, with a proportional random sampling technique. Results: the difference in the level of foot sensitivity, before and after being given foot exercises, in the intervention group p-value = 0.00, while in the control group p-value = 0.083; the difference in foot sensitivity after being given diabetic foot exercises between the intervention group and the control group p-value = 0.02. Conclusion: there is an effect of diabetic foot exercises on foot sensitivity. Suggestion: it is necessary to develop an effective health promotion model to manage diabetes mellitus.

Keywords: Diabetes Mellitus; Diabetic Foot Exercises; Foot Sensitivity

INTRODUCTION

According to the International Federation of Diabetes [10] in 2023 diabetes mellitus in the world is expected to triple from the previous year which is 463 million. The lowest prevalence is in the age range of 20-24 years old is 1.4% in 2023 and in the age range of 75-79 years, the prevalence of diabetes is 19.9% in 2023 so it is predicted to increase to 20.4% and 20.5% in 2030 and 2045. IDF estimates that DM patients in Indonesia in 2030 will be 13.7 million and in 2045 will be 16.6 million.

The 2023 Riskesdas results state that the prevalence of diabetes in Indonesia based on a doctor's diagnosis among those aged ≥ 15 years is 2.3%, an increase compared to the 2018 Riskesdas results of 1.5%. The prevalence of diabetes mellitus cases in Central Java province in 2023 was 20.8%, an increase compared to cases in 2018. DM cases in Magelang district in 2023 amounted to 1.53%. The proportion of Diabetes Mellitus (DM) treatment types diagnosed by doctors in Magelang District at all ages was Anti Diabetes Drugs (OAD) from medical personnel by 73.04%, insulin injection by 5.98%, OAD from medical personnel and insulin injection by 12.38%, and untreated by 8.61% [3,14]. Based on the age category, diabetics are dominated in the age range of 55-64 years and 65-74 years. The risk of vascular complications can increase if a person has DM. A total of 15% of people with

DM will experience DM wounds and 24% of people with foot ulcers will require amputation [2]. A total of 54.74% do exercise, 7.87% are not compliant according to doctor's advice [14]. Foot care is an effort to primary prevention of diabetic foot wounds and early symptoms of tingling or numbness that will cause a decrease in foot sensitivity. One of the actions that must be taken in foot care to determine the presence of foot abnormalities early is to massage the veins as well as diabetic foot exercises, in addition to cutting nails properly, wearing good footwear, and maintaining foot hygiene [11].

The basic treatment that can be done when complications occur is only by controlling blood sugar levels as much as possible to prevent worse conditions, because neuropathy will continue along with the course of diabetes mellitus suffered. Handling neuropathy can be done through three things, namely (1) counseling or giving advice; (2) pain treatment; and (3) foot care [19]. Foot care is an effort to primary prevention of diabetic foot wounds and early symptoms of tingling or numbness that will cause a decrease in foot sensitivity. One of the actions that must be taken in foot care to find out the presence of foot abnormalities early is to do a venous massage as well as diabetic foot exercises, in addition to cutting nails properly, wearing good footwear, and maintaining foot hygiene [15]. Diabetes mellitus can be overcome by managing several things that affect glucose reduction, namely activity, insulin levels, diet, education and therapy [8,11]. The right exercise is measured, regular, controlled and sustainable. The recommended frequency is several times per week for 30 minutes or more regularly and not excessively [15]. One type of exercise that is recommended especially in elderly patients is foot exercise [4].

Diabetic foot exercises are activities or exercises carried out by patients with diabetes mellitus to prevent wounds and help improve blood circulation in the legs [15], diabetic foot exercises are one of the therapies provided by a nurse or health worker. This diabetic foot exercise aims to improve blood circulation so that nutrients to the tissues are smoother, strengthen small muscles, calf muscles, and thigh muscles, and overcome joint motion limitations that are often experienced by people with diabetes mellitus [4]. Diabetic foot exercises can be given to all patients with diabetes mellitus type 1 or 2. However, it should be given since the patient is diagnosed with diabetes mellitus as an early preventive measure for diabetic ulcers. This foot exercise has the effect of improving blood circulation. If not done, it can lead to ulcers, further increase the risk of disability or morbidity and ultimately increase the burden on individuals, families, communities and governments.

METHODS

This study aims to determine the effect of diabetic foot exercises on increasing the sensitivity of the feet of elderly people with diabetes mellitus in Magelang Regency in 2024. Data were collected directly from 124 respondents, including 62 respondents in the intervention group who were given foot exercises, and 62 respondents in a control group. The data was processed using SPSS for ease of quantitative analysis.

1. RESULTS AND DISCUSSION

1. Table 1. Differences in the level of sensitivity of sensitivity before and after being given foot exercises in the intervention group

Foot Sensitivity	Mean	Mean Different	Sd	<i>p-value</i>
Before	1.661	0,5	0.939	0.000
After	2.161		0.944	

* Wilcoxon test

Based on table 1. shows that 62 respondents experienced an increase in the level of foot sensitivity before and after being given foot exercises. The average result of foot sensitivity level before being given foot exercise therapy is 1.661 with a standard deviation of 0.939 and after being given foot exercise therapy the average result of foot sensitivity level is 2.161 with a standard deviation of 0.944. The difference between before and after being given foot exercise therapy is 0.5 with $p=0.000$. This means that the p value <0.05 which shows that there is a significant increase between before and after being given foot exercise therapy. From the table, it is known that there is an effect of foot exercise therapy to increase foot sensitivity.

2. Table 2. Differences in the level of sensitivity of sensitivity before and after being given foot exercises in the control group

Foot Sensitivity	Mean	Mean Different	Sd	p-value
Before	1.693	0,48	0.951	0,083
After	1.645		1.009	

* Wilcoxon test

Based on table 2. shows that there are 62 respondents in the control group. The average result of foot sensitivity level before is 1.693 with a standard deviation of 0.951 and after the average foot sensitivity level is 1.645 with a standard of 1.009. The difference between the initial and final measurements was 0.48 with $p = 0.083$. This means that the p value > 0.05 which indicates that there is no significant increase between the initial and final measurements in the control group. Based on the table above, it can be seen that there is no significant effect between the initial measurement and the final measurement of the control group.

3. Table 3. Effect of Foot Gymnastics After Action in the Intervention Group and Control Group

Intervention	Mean	Mean Different	p-value
Intervention group	2.161	0.516	0.002
Control group	1.645		

* Mann Withney test

Based on table 3. shows that there were 62 respondents in the intervention group and 62 respondents in the control group who experienced an increase in the average level of foot sensitivity before and after being given action in the intervention group 2.161, while in the control group 1.645, the difference before and after being given action was 0.516 with p -value = 0.002. This means that the p -value <0.05 , which shows that there is a significant difference between giving foot exercise therapy and not giving foot exercises to the level of foot sensitivity in respondents. From the table above, it can be seen that there is a significant effect between foot exercise therapy to increase the level of foot sensitivity in respondents. (p -value = 0.002).

Based on the results of the study, respondents after being given health promotion were 59.7 in the intervention group and 37.1% in the control group, thus showing there was an effect of compliance with diabetic foot exercises on foot sensitivity with $p = 0.000$. Based on Riskesdas data in 2023, elderly people with diabetes mellitus who do sports or activities to overcome peripheral blood circulation disorders are only 48.1%. This data shows the lack of people who make efforts to deal with the impact of diabetes mellitus with activities including diabetic foot exercises.

Blood circulation is the flow of blood pumped by the heart into blood vessels and flowed by arteries to all organs of the body, one of which is the organ of the foot [1,5]. Sensitivity measurements are made by comparing the results of sensitivity measurements or sensitivity between those using needles, and brushes with cotton. The criteria for sensitivity at the tip of the sole are value 0 is no sensitivity, value 1 is less sensitivity, value 2 is moderate sensitivity and value 3 is good / normal

sensitivity [9].

The causes of wounds or abnormalities in the feet of diabetic patients are a nerve disorder, a blood vessel disorder and then an infection. Of these three things, the most instrumental is nerve disorders, while blood vessel disorders play a more real role in wound healing it determines the fate of the foot. Nerve abnormalities can affect sensory nerves, motor nerves and autonomic nerves [10, 12]. Sensory nerves become numb, which causes them to be unable to feel pain stimuli, resulting in a loss of vigilance to protect the foot from external stimuli. As a result, the feet are more susceptible to injury even with minor impacts. When a wound occurs, it makes it easier for germs to enter, causing infection. If this infection is not treated properly, it will progress to decay (gangrene) and can even be amputated [13,18].

Disruption of motor nerve fibers (nerve fibers that go to the muscles) can result in atrophic wasting of the interosseous muscles in the foot. As a further result of this situation there is an imbalance of the foot muscles, and there is a change in the shape of the deformity in the foot such as bending the cock up toes, shifting the luxation joints in the metatarsophalangeal forefoot joints and thinning of the fat pad under the base of the metatarsal caput toe area. This leads to an expansion of the stressed area, especially under the caput metatarsal [6,7].

Power changes enlarge or shrink the vasodilated blood vessels in the lower leg area, resulting in stiff joints. A further condition is a change in the shape of the charcot foot, which causes changes in the new foot pressure area and the risk of injury [13]. Vascular abnormalities result in blockage of blood vessels that inhibit blood flow, disrupting the supply of oxygen, foodstuffs or antibiotics that can interfere with the wound healing process. Incomplete treatment of this infection can lead to gangrenous decay. Extensive gangrene can also occur due to extensive blockage of blood vessels so that the possibility of amputation of the leg above the knee [20].

Diabetic foot gymnastics is a physical exercise that is selected and created in a planned manner, arranged systematically to form and develop a harmonious person [15]. Based on its definition, gymnastics is a type of aerobic exercise that uses movements of some of the body's muscles, where oxygen needs can still be met by the body [16]. Physical exercise is one of the principles in the management of diabetes mellitus. Daily physical activity and regular physical exercise (3-4 times a week for approximately 30 minutes) are one of the pillars of diabetes management. Physical exercises include walking, leisurely cycling, jogging, gymnastics, and swimming. These physical exercises should be adjusted according to age and physical fitness status [11].

Diabetic foot exercises are activities or exercises performed by patients with diabetes mellitus to prevent wounds and help improve blood circulation in the feet [15]. Foot exercises can help improve blood circulation strengthen the small muscles of the foot and prevent foot deformities. In addition, it can increase the strength of the calf muscles, and thigh muscles, and also overcome limitations in joint movement [19]. Physical activity is the movement of the body that substantially increases energy use and can be in the form of daily activities (walking, doing homework, gardening) or sports activities such as swimming, cycling, gymnastics, and fitness [16].

According to Skelton, 2001 his activity theory states that successful aging depends on how the elderly feel satisfaction in doing and maintaining activities. This is related to social interaction and the involvement of the elderly in their environment so that the loss of role will eliminate the satisfaction of an elderly person. This is reinforced by the opinion of Salindeho, 2016 which states that physical activity has a significant relationship with limb disorders where low physical activity, one of which is not regularly exercising, is at risk for movement disorders. Exercises to maintain mobility and posture in the elderly also aim to maintain and improve joint movement throughout the body, increase muscle strength, stimulate blood circulation, maintain functional capacity, prevent contractures and maintain good posture [16].

According to Soelistijo, 2021, the benefits of exercise programs for the elderly, especially in the musculoskeletal system, are increased muscle strength, ROM (Range of Motion), flexibility, bone

density, and blood circulation. This is the opinion of Hirsch, et al. (2003) state that activity training and high-intensity ROM training in the elderly with idiopathic Parkinson's disease performed 3 times a week for 4 weeks can increase muscle strength and blood circulation. Similarly, research conducted by Salindeho showed that elderly people who were given four square-step training, namely one form of dynamic movement training for 2 weeks, had relatively more stable blood sugar levels.

The goal obtained after doing this foot exercise is to improve blood circulation in the feet of diabetic patients so that nutrients are smoothly distributed to these tissues [11]. The benefits of diabetic exercise on the heart organ, are an increase in strength and heart chambers increase in size, so that the pulsation is strong and the capacity is large. Both of these will increase the work efficiency of the heart. With high work efficiency, the heart does not need to beat too often [19]. In blood vessels, the elasticity of blood vessels will increase, due to the reduction of fat deposits and the addition of muscle contractility of the blood vessel wall. High elasticity of blood vessels will facilitate the flow of blood and prevent the onset of hypertension [19] The elasticity of the lungs will increase, so that the ability to expand and collapse will also increase [19]. Muscle flexibility and endurance will increase. This is due to the increase in the size of muscle fibers and the increase in the energy supply system in the muscles. Ligaments and tendons will increase in strength, as well as the attachment of tendons to bones [17].

CONCLUSIONS

The findings indicate that foot exercises have a significant effect on foot sensitivity in elderly individuals with diabetes mellitus in Magelang Regency. Regular foot exercise can help improve blood circulation, enhance nerve function, and prevent complications related to diabetic neuropathy, which is a common issue among diabetic patients. By maintaining foot sensitivity, elderly individuals with diabetes can reduce the risk of foot ulcers, infections, and other serious complications that may lead to mobility issues or even amputations. Therefore, incorporating foot exercise into routine diabetes management programs is essential for improving the overall foot health and quality of life of elderly patients with diabetes mellitus.

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