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THE EFFECT OF ACTIVE LOWER ROM EXERCISES ON THE RISK OF PERIPHERAL NEUROPATHY IN TYPE 2 DIABETES MELLITUS PATIENTS

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Abstract*. Diabetes Mellitus (DM) is a long-term metabolic disorder marked by elevated blood sugar levels and can lead to long-term complications, including peripheral neuropathy, which causes decreased foot sensitivity and increases the risk of ulcers and amputation. Preventive efforts can be carried out through physical exercises such as Active Lower Range of Motion, which help improve peripheral blood circulation and nerve sensitivity. This study employed a quasi-experimental approach using a pretest–posttest control group design involving 36 respondents with type 2 DM. The intervention consisted of regular Active Lower ROM exercises, and foot sensitivity was assessed using a 10-gram monofilament. The results showed that most respondents were 60–70 years old and predominantly female. Wilcoxon and Mann-Whitney analyses indicated a notable change was observed between the pre-intervention and post-intervention results (p=0.000), demonstrating that ALROM exercises effectively reduce the risk of peripheral neuropathy. This exercise can serve as a safe, simple, and beneficial non-pharmacological therapy for individuals with type 2 DM*

Abstrak: Diabetes Mellitus (DM) adalah gangguan metabolik kronis yang diciriksn oleh peningkatan kadar glukosa darah dan dapat menimbulkan komplikasi jangka panjang, termasuk neuropati perifer yang menyebabkan penurunan sensitivitas kaki hingga risiko ulkus dan amputasi. Upaya pencegahan dapat dilakukan melalui latihan fisik seperti Active Lower Range of Motion yang berfungsi meningkatkan sirkulasi darah perifer dan sensitivitas saraf. Penelitian ini menerapkan desain quasi experiment dengan pretest-posttest control group pada 36 responden penderita DM tipe 2. Intervensi berupa latihan Active Lower ROM dilakukan secara teratur, dan pengukuran sensitivitas kaki menggunakan Monofilament 10-g. Hasil menunjukkan mayoritas responden berusia 60–70 tahun dan didominasi perempuan. Analisis Wilcoxon dan Mann-Whitney menunjukkan perbedaan signifikan sebelum dan sesudah intervensi (p=0,000), menandakan latihan ALROM efektif menurunkan risiko neuropati perifer. Latihan ini dapat menjadi terapi nonfarmakologis yang aman, mudah, dan bermanfaat bagi penderita DM tipe 2.

INTRODUCTION

Diabetes Mellitus (DM) is a non-communicable disease that has developed into a major public health problem, not only in Indonesia but also globally (Devitasari et al., 2024). According to the World Health Organization (WHO), DM is a chronic metabolic disorder characterized by persistent hyperglycemia, which over time can lead to damage to the heart, blood vessels, eyes, kidneys, and nervous system (WHO, 2021). Although Diabetes Mellitus cannot be cured and is often referred to as a "silent killer," it can be controlled through proper management, making lifelong care essential (Aini et al., 2025).

Globally, the prevalence of DM has increased significantly. WHO data show that the prevalence of Diabetes Mellitus among adults doubled from 7% to 14%, with approximately 450 million adults aged 30 years and older living with the disease. About 59% of these individuals were reported to have not received treatment in 2022 (WHO, 2024). Indonesia ranks seventh among the ten countries with the highest number of people with Diabetes Mellitus worldwide (Devitasari et al., 2024). The International Diabetes Federation (IDF) projects that by 2030, the number of individuals with Diabetes Mellitus in Indonesia will reach 10.7 million, with the majority of cases being Type 2 Diabetes Mellitus (IDF, 2021).

National data also indicate an increasing burden of Diabetes Mellitus in Indonesia. The Indonesian Health Survey (SKI) in 2023 reported a Diabetes Mellitus prevalence of 1.7% across all age groups. Based on blood glucose examinations among individuals aged ≥15 years, 11.7% were identified as having diabetes, indicating an increased prevalence when assessed using biochemical measurements (Ministry of Health, 2024; Health Development Policy Agency, 2023). By type, Type 2 Diabetes Mellitus is the most prevalent, accounting for 50.2% of all diagnosed cases (Kemenkes, 2024).

Based on data from the profile of the Jambi Provincial Health Office, the number of Diabetes Mellitus cases reached 40,566 in 2023. Among all cities and regencies in Jambi Province, Jambi City contributed the highest number of Diabetes Mellitus cases in 2023, totaling 13,060 cases (Dinas Kesehatan Provinsi Jambi, 2023). According to information obtained by the researcher from a preliminary study conducted at the Jambi City Health Office in 2023, among the 20 public health centers (Puskesmas) distributed throughout Jambi City, Puskesmas Pakuan Baru recorded the highest number of Diabetes Mellitus cases, with a total of 2,228 cases. Referring to official records from the Jambi City Health Office for the period 2022 to 2023, Puskesmas Pakuan Baru

experienced a very significant increase in Diabetes Mellitus cases, rising from 355 cases in 2022 to 2,228 cases in 2023.Type 2 Diabetes Mellitus can lead to various chronic complications, including retinopathy, nephropathy, cardiovascular disease, and peripheral neuropathy. Diabetic peripheral neuropathy is one of the most common complications, affecting approximately 25–50% of individuals with DM worldwide (Purnamawati et al., 2022). This condition results from prolonged hyperglycemia that damages peripheral nerves, particularly in the lower extremities. Consequently, individuals may experience reduced foot sensitivity, tingling, numbness, burning sensations, or pain, leading to loss of protective sensation and an increased risk of diabetic foot ulcers, infections, and lower-limb amputation (Setiawan, 2021; Sumartini et al., 2022). Reduced foot sensitivity is a key clinical manifestation of peripheral neuropathy. Individuals with neuropathy may be unable to percei.

Therefore, measuring the level of foot sensitivity is a crucial step, particularly in individuals with Type 2 Diabetes Mellitus, as an effort for early detection or to identify and assess disturbances in peripheral blood circulation (Sani et al., 2024). If diabetic complications such as peripheral neuropathy are not detected early, this condition may potentially progress to more severe complications, including decreased foot sensitivity and the development of diabetic foot ulcers, which can ultimately lead to amputation as a major cause of disability, morbidity, and mortality among patients with Diabetes Mellitus (Asih et al., 2023).

Elevated blood glucose levels can reduce foot sensitivity. Imbalances in blood glucose levels in the lower extremities may manifest as symptoms such as tingling, a sensation of thickness in the soles of the feet, loss of pain perception, and an inability to perceive touch on the plantar surface of the feet(Asih et al., 2023). Foot sensitivity refers to sensory stimulation in the lower extremities that is influenced by nerve function and may lead to neuropathy. The presence of neuropathy causes individuals with Diabetes Mellitus to experience decreased foot sensitivity or reduced sensory input in the soles of the feet, accompanied by symptoms such as muscle cramps and body pain, particularly at night, as well as burning sensations, tingling, and a feeling of thickness in the soles of the feet (Suryati, 2021).

Physical exercise can help improve insulin receptor sensitivity, thereby contributing to better blood glucose stability. Consequently, nerve damage can be prevented, and blood circulation in the feet of patients with Diabetes Mellitus can be improved(Ode et al., 2023). Individuals with Diabetes Mellitus are recommended to

engage in various forms of physical activity, such as yoga, range of motion exercises, lower back exercises, ergonomic exercises, and logotherapy. Among these options, Active Lower Range of Motion exercise is a recommended form of exercise and has been shown to produce positive outcomes (Sani et al., 2024).

Active Lower Range of Motion is a form of exercise that involves joint movements of the lower extremities. During this exercise, the lower limb muscles undergo continuous contraction, which creates pressure on the venous blood vessels and stimulates venous return, thereby enhancing venous blood flow back to the heart. This process facilitates arterial blood flow, which plays an essential role in delivering oxygen and nutrients to body tissues through the blood vessels (Ramayanti et al., 2024).

Active Lower Range of Motion exercise has been shown to have beneficial effects for individuals with Type 2 Diabetes Mellitus. This finding is supported by a scientific study conducted by Fakhrudin Nasrul Sani, which reported an improvement in foot sensitivity in the intervention group after receiving Active Lower Range of Motion exercises performed three times per week for two weeks, compared to the control group that did not receive the intervention. These results indicate that the exercise intervention had a significant effect on foot sensitivity (Sani et al., 2024) .

Several previous studies have demonstrated that Active Lower Range of Motion exercises are effective in improving foot sensitivity among individuals with Type 2 Diabetes Mellitus (Asih et al., 2023; Sani et al., 2024; Wahyuningsih & Kusumaningrum, 2021). However, most of these studies primarily focused on changes in foot sensitivity as a single outcome, without comprehensively examining the risk of peripheral neuropathy as a clinical condition. In addition, earlier research was generally conducted in controlled or institutional settings and did not sufficiently explore the application of Active Lower Range of Motion as a structured nursing intervention within primary healthcare services, particularly at the community health center (Puskesmas) level.

Furthermore, previous studies often did not integrate local epidemiological contexts or address areas with rapidly increasing diabetes prevalence, such as Puskesmas Pakuan Baru, Jambi City. There is also limited evidence examining Active Lower Range of Motion implementation among patients who have not previously received structured non-pharmacological interventions, which may influence the magnitude of its effects on peripheral neuropathy risk.

Therefore, the novelty of this study lies in its focus on analyzing the effect of Active Lower Range of Motion exercises on the risk of peripheral neuropathy, rather than solely on foot sensitivity, among individuals with Type 2 Diabetes Mellitus. This study also introduces Active Lower Range of Motion as a feasible, nurse-led, non-pharmacological intervention implemented in a primary healthcare setting, addressing an existing gap between research findings and routine nursing practice. By incorporating local prevalence data and preliminary field findings, this study provides context-specific evidence to support the integration of ALROM exercises into community-based diabetes management programs. Consequently, the findings are expected to contribute new insights into preventive nursing strategies aimed at reducing peripheral neuropathy and diabetic foot complications in patients with Type 2 Diabetes Mellitus.

With the design of this study to analyze the effect of Active Lower Range of Motion (ROM) exercises on the risk of peripheral neuropathy among individuals with Type 2 Diabetes Mellitus, it is expected that healthcare professionals, particularly nurses, will gain a deeper understanding and enhanced skills in providing lower active ROM exercise interventions. This intervention is expected to have a positive impact on improving foot sensitivity in patients with Diabetes Mellitus. This study also aims to serve as a scientific basis for the development of nursing interventions focused on preventing peripheral neuropathy complications. In addition, nurses are expected to play a proactive role in providing patient education regarding structured and simple physical exercises to maintain peripheral nerve function and prevent the occurrence of diabetic foot ulcers. Through the implementation of these interventions, an improvement in foot sensitivity is anticipated, which may ultimately reduce the risk of diabetic foot and peripheral neuropathy in patients with Type 2 Diabetes Mellitus.

On May 3, 2025, a preliminary interview-based study was conducted among 7 patients with Type 2 Diabetes Mellitus in RT 15 Tambak Sari, Pakuan Baru Subdistrict. The findings revealed that 5 participants reported symptoms indicative of peripheral neuropathy, including tingling, numbness, a burning sensation, reduced plantar sensitivity, and intermittent throbbing pain in the soles of the feet. These findings suggest early manifestations of peripheral neuropathy among the majority of patients in this community. Given the presence of neuropathic symptoms and the absence of structured non-pharmacological interventions at the community level, this setting was selected as the study site to evaluate the effectiveness of Active Lower Range of Motion

exercises as a feasible preventive nursing intervention for reducing the risk of peripheral neuropathy in patients with Type 2 Diabetes Mellitus.

Referring to the explanation above, the researcher is motivated to carry out a study entitled “The Effect of Active Lower ROM Exercises on The Risk ff Peripheral Neuropathy In type 2 Diabetes Mellitus Patients”. Based on the background described above, this study addresses the question of whether Active Lower Range of Motion exercises have an effect on the risk of peripheral neuropathy among patients with Type II Diabetes Mellitus in the working area of Puskesmas Pakuan Baru, Jambi City. Therefore, the objective of this study is to determine the effect of Active Lower Range of Motion exercises on the risk of peripheral neuropathy in patients with Type II Diabetes Mellitus within this primary healthcare setting.

METHOD

This research is a quantitative study that applies a quasi-experimental method using a pretest–posttest control group design. The population of this study consisted of all Type II Diabetes Mellitus patients aged >59 years who visited Pakuan Baru Public Health Center in Jambi City in 2024, totaling 1,364 individuals. The participants were chosen through a purposive sampling method, resulting in 36 respondents who were separated into two groups: the intervention group (18 respondents) and the control group (18 respondents).

The inclusion criteria in this study consisted of respondents who were willing to participate until the completion of the study, patients with Type 2 Diabetes Mellitus aged over 59 years, and patients with Type 2 Diabetes Mellitus who exhibited decreased foot sensitivity based on baseline measurements (pretest) with sensitivity scores ranging from 1 to 8. The exclusion criteria included patients with Type 2 Diabetes Mellitus who had lower extremity injuries, diabetic foot ulcers, or comorbid conditions such as asthma and Chronic Obstructive Pulmonary Disease (COPD). Active Lower Range of Motion exercises were administered to the intervention group at a frequency of three times per week for two weeks, with each session lasting approximately 15–20 minutes.

The exercises were performed actively by the respondents in a sitting or lying position and included ankle flexion and extension, plantarflexion and dorsiflexion of the foot, inversion and eversion of the foot, as well as flexion and extension of the toes. Each movement was performed eight repetitions for each foot with slow and controlled motions. Peripheral neuropathy risk was assessed using a 10-g monofilament test on the

plantar surface of the feet. The examination was conducted at ten standardized points on each foot, resulting in a total of twenty testing points on both the right and left feet where pressure was applied using the 10-g monofilament. Each testing point was scored as 1 if the respondent was able to perceive the touch and 0 if the respondent was unable to perceive the touch, resulting in a total sensitivity score ranging from 0 to 10 for each foot. Based on the total sensitivity score, foot sensitivity was categorized as normal for scores of 9–10, low to moderate risk of peripheral neuropathy for scores of 6–8, and high risk of peripheral neuropathy for scores below 6.

Before collecting data from the respondents, the researcher obtained informed consent from those who agreed to participate in the study. Data were collected using an observation sheet based on the results of foot sensitivity examinations using a 10-g monofilament. Data collection was carried out by administering a pretest to both the intervention and control groups. The intervention group then received active lower range of motion exercises. Finally, a posttest was administered to both groups. The data were processed using non-parametric statistical methods, specifically the Wilcoxon test and the Mann–Whitney test.

RESULTS AND DISCUSSION

Table 1. Frequency Distribution of Respondents' Peripheral Neuropathy Risk Levels

		Foot Sensitivity Level							
		Normal		Low–moderate risk		High risk		Total	
		n	%	n	%	n	%	n	%
Intervention	Pre-test Right Foot	-	-	1	5,6	17	94,4	18	100
	Pre-test Left Foot	-	-	2	11,1	16	88,9	18	100
	Post-test Right Foot	13	72,2	5	27,8	-	-	18	100
	Post-test Left Foot	15	83,3	3	16,7	-	-	18	100
Control	Pre-test Right Foot	-	-	3	16,7	15	83,3	18	100
	Pre-test Left Foot	-	-	1	5,6	17	94,4	18	100
	Post-test Right Foot	-	-	2	11,1	16	88,9	18	100
	Post-test Left Foot	-	-	1	5,6	17	94,4	18	100

Based on Table 1, there was a change in the sensitivity levels of respondents in the intervention group. Before the intervention, the majority of respondents in the intervention group were classified as having a high risk, with 17 respondents (94.4%) in the right foot and 16 respondents (88.9%) in the left foot. After the intervention, the foot sensitivity levels of most respondents improved to the normal category, with 13 respondents (72.2%) in the right foot and 15 respondents (83.3%) in the left foot. Meanwhile, in the control group, no differences were observed between the pretest and posttest results, with most respondents remaining in the high-risk category, namely 15 respondents (83.3%) in the right foot and 17 respondents (94.4%) in the left foot.

The findings revealed a distinct and significant variation in foot sensitivity levels between the intervention and control groups. Before the intervention, which included active lower range of motion exercises, most respondents in the intervention group were in the high-risk category for their right and left feet. After the intervention, all respondents in the intervention group were in the normal category for their right and left feet, indicating significant improvement. Meanwhile, within the control group, no notable differences were detected between the pre-test and post-test outcomes, as the majority remained in the high-risk category for peripheral neuropathy.

The improvement in foot sensitivity in the intervention group aligns with Dorethea Orem's Supportive and Educative Nursing System theory, which emphasizes that nurses play a role in providing support, guidance, and education so that individuals can perform self-care independently. Through active lower ROM exercises, respondents received appropriate support and education, thereby improving their ability to maintain peripheral nerve function and help avert peripheral neuropathy complications in individuals with type 2 diabetes. This demonstrates that supportive and educational interventions can strengthen patient involvement in self-care (Sartika et al., 2025).

The findings of this research also align with previous studies confirming that regular active lower ROM exercises are effective in improving circulation and sensitivity in the lower extremities in people with type 2 diabetes (Asih et al., 2023). Thus, the implementation of Orem's theory-based interventions is not only conceptually relevant but also has practical implications in improving the well-being of individuals with diabetes by reducing the likelihood of peripheral neuropathy.

These findings confirm that active lower ROM exercises can bridge the limitations of respondents in maintaining healthy feet that are vulnerable to complications of peripheral neuropathy due to type 2 diabetes mellitus. Respondents are more easily

adapted to simple exercises that can be done independently compared to only verbal education or recommendations without direct practice. In addition, these exercises provide a real self-care experience and involve the active participation of respondents, thereby strengthening neuromuscular, improving blood circulation, and significantly increasing foot sensitivity. Thus, this intervention is not only preventive but also rehabilitative while supporting respondents' independence in carrying out daily care.

However, this study also revealed several limitations. In the control group, foot sensitivity did not experience significant changes. This was because the control group was not given active lower range of motion exercises, resulting in a stagnant risk of peripheral neuropathy in the control group. This suggests that without targeted physical exercise intervention, individuals with type 2 diabetes struggle to improve circulation and peripheral nerve function. Other studies have also emphasized that the absence of exercise intervention in people with diabetes mellitus leads to a higher risk of peripheral neuropathy and a reduced quality of life (Wahyuningsih & Kusumaningrum, 2021).

Meanwhile, in the intervention group, although post-test results showed a significant increase in foot sensitivity, pre-test results still showed limitations in the respondents' initial condition. Most respondents were initially in the high-risk category for peripheral neuropathy, both in the right and left feet, indicating decreased nerve function due to suboptimal glucose control and minimal independent exercise efforts. This is in line with findings that reveal that the high rate of peripheral neuropathy in DM patients is influenced by the duration of diabetes, a less active lifestyle, and the lack of structured physical exercise interventions appropriate to the respondents' abilities (Amour et al., 2020).

Thus, the findings of this research highlight the significance of providing simple, structured physical exercise interventions for individuals with type 2 DM. Active lower ROM exercises are not only effective in improving foot sensitivity but also serve as a preventative measure in preventing the development of more severe peripheral neuropathy. These findings also suggest that routine, repeated, and patient-specific exercises should be prioritized to address early nerve function limitations and prevent condition stagnation in patients who do not receive intervention.

Table 2. Results of Respondents' Peripheral Neuropathy Risk Test

		Mean	SD	z	p-value
Right foot intervention	Pre-test	1,06	0,236	-3,874	0,000
	Post-test	2,72	0,461		
Left foot intervention	Pre-test	1,11	0,323	-3,906	0,000
	Post-test	2,83	0,383		
Right foot control	Pre-test	1,17	0,383	-0,577	0,564
	Post-test	1.11	0,323		
Left foot control	Pre-test	1,06	0,236	-0,000	1,000
	Post-test	1,06	0,236		

Based on Table 2, the findings from the bivariate analysis utilizing the Wilcoxon test indicate a change between the pre-test and post-test scores in the intervention group. This is seen from the significant increase in the mean value of the right foot from 1.06 to 2.72 with a p-value of p<0,001and the mean value of the left foot from 1.11 to 2.83 with a p-value of p<0,001. Meanwhile, in the control group, there was no significant change between the pre-test and post-test. This is seen from the mean value of the right foot which only changed slightly and decreased from 1.17 to 1.11 with a p-value of 0.564, and the mean value of the left foot did not change, namely 1.06 on each foot with a p<0,001.

Table 3. Results of the Peripheral Neuropathy Risk Difference Test for Respondents

		Min-Max	Mean Rank	SD	z	p-value
Post-test right foot	Intervention	1-3	27,22	0,906	-5,361	0,000
	Control		9,78			
Left foot post-test	Intervention	1-3	27,42	0,955	-5,602	0,000
	Control		9,58			

Based on the Mann-Whitney test results in Table 3, a p-value p<0,001 was recorded for both the respondents' right and left feet, meaning the value is less than 0.05. This indicates that there is a notable distinction between the intervention group and the control group in the risk of peripheral neuropathy after the intervention in the form of active lower-of-motion exercises. The Mean Rank value in the intervention group for the right foot was 27.22 and the left foot was 27.42, which is higher than the control group at 9.78 for the right foot and 9.58 for the left foot. This difference indicates that the intervention group experienced better improvement in the risk of peripheral neuropathy compared to the control group. Thus, it can be concluded that the intervention provided had a significant effect in reducing the risk of peripheral neuropathy in both the right and left feet of the respondents.

Active lower range of motion exercises have been shown to be effective in enhancing foot sensitivity in people with type 2 diabetes. This is demonstrated by significant changes in the Wilcoxon test results in the intervention group, both in the right and left feet. In contrast, the control group showed no meaningful difference between the pre-test and post-test results. This indicates that without active lower ROM exercise intervention, foot sensitivity among individuals with type 2 diabetes tends to remain stable or stagnant, which can increase the risk of peripheral neuropathy.

In addition, a Mann-Whitney test was also conducted on post-test data from the intervention and control groups, showing that a significant distinction was observed between the intervention and control groups, both in the right and left foot with a p-value $p<0,001$ ($p<0.05$). Thus, it can be concluded that providing active lower ROM exercises is effective in reducing the risk of peripheral neuropathy in both the right and left foots of type 2 DM sufferers compared to the control group that did not receive intervention.

The effectiveness of active lower ROM exercises in lowering the likelihood of peripheral neuropathy among individuals with type 2 DM can be explained by several key factors. First, these exercises help improve blood circulation to the lower extremities, thus optimizing oxygen and nutrient supply to nerve tissue and supporting improved nerve sensitivity. Second, regular movement can stimulate neuromuscular activity and maintain peripheral nerve function, thereby reducing the risk of further damage. Third, these exercises are simple, safe, and can be performed independently by respondents, resulting in higher and more consistent adherence rates ovr the long term. These factors collectively contribute to improved foot sensitivity and a reduced likelihood of developing peripheral neuropathy in individuals with type 2 diabetes mellitus.

This aligns with the neuroplasticity theory, which states that the peripheral nervous system can improve its function through repeated stimulation, such as structured physical exercise. Stimulation in the form of movement in active lower ROM exercises can increase peripheral blood flow, stimulate nerve impulse transmission, and maintain muscle strength, thus optimizing sensory function in the feet (Sani et al., 2024). Furthermore, this approach aligns with Orem's self-care theory, particularly within a supportive-educational system, where people with type 2 diabetes are encouraged to perform simple but consistent independent exercises as a form of self-care to prevent further complications (Sartika et al., 2025).

The control group in this study showed no change in the risk level of peripheral neuropathy because they did not receive Active Lower ROM exercise intervention. The absence of physical stimulation causes peripheral blood flow, tissue oxygenation, and neuromuscular activation to remain at baseline levels, thus preventing improvement in sensory nerve function. Physiologically, peripheral neuropathy in type 2 diabetes is a progressive complication caused by chronic hyperglycemia, oxidative stress, and microvascular damage, so improvement does not occur without interventions that increase peripheral perfusion and nerve stimulation (Setiawan, 2021)'(Suryati, 2021). Peripheral neuropathy also frequently occurs in elderly patients, particularly those with a disease duration of 3–5 years and comorbidities such as hypertension and dyslipidemia. This condition aligns with the explanation that age, unstable blood sugar levels, and a history of comorbidities are determinants of peripheral neuropathy (Rante, 2023)'(Sumartini et al., 2022).

Furthermore, observations showed that most of the control group respondents rarely engaged in meaningful physical activity. The sedentary lifestyle commonly found in the control group also worsened peripheral blood flow due to the lack of foot muscle contractions that trigger venous return. Active lower ROM exercises have been shown to improve peripheral circulation, joint flexibility, muscle strength, and nerve sensitivity. However, because the control group did not receive this intervention, foot sensitivity remained stagnant. This is consistent with earlier research results indicating that without structured physical exercise, peripheral nerve function does not underg o significant changes and tends to remain at a high-risk level (Asih et al., 2023)'(Wahyuningsih & Kusumaningrum, 2021).

Thus, active lower ROM exercises not only play a role in maintaining mobility but also stimulate nerve function, increase foot sensitivity, and prevent the progression of peripheral neuropathy. This research also aligns with previous studies showing that active lower ROM can improve peripheral circulation and lower the likelihood of complications associated with type 2 Diabetes Mellitus.

Several previous studies also reinforce the urgency of active lower ROM exercise interventions in type 2 diabetes patients at risk for peripheral neuropathy. Research by Wahyuningsih (2022) found that regular range of motion exercises significantly improved foot sensitivity in type 2 diabetes patients, thereby reducing the risk of neuropathy complications (Wahyuningsih & Kusumaningrum, 2021). Similar results were also shown by Asih (2023) who reported that providing active lower ROM was

effective in improving sensory function of the feet and peripheral circulation (Asih et al., 2023). In fact, a study by Mangusada Hospital (2024) proved that active lower ROM exercises provided more optimal results in improving peripheral nerve sensitivity (Yuliantini et al., 2023). These findings emphasize that simple, structured, and independent physical exercise interventions are highly relevant as both preventive and rehabilitative strategies to lower the likelihood of peripheral neuropathy in individuals with type 2 Diabetes Mellitus.

Thus, the results of this study confirm that active lower range of motion exercises are not only relevant for improving foot sensation in individuals with type 2 DM, but can also be used as an alternative non-pharmacological intervention in preventing complications of peripheral neuropathy. These exercises have the potential to be implemented in various self-management programs for people with diabetes. The use of simple, practical, and independently performed exercises has been shown to improve patient compliance, reduce the risk of disability, and strengthen daily care skills.

Furthermore, this exercise can help people with diabetes develop healthy lifestyle habits and increase independence in managing their chronic disease, including preventing the progression of peripheral neuropathy. Therefore, it is hoped that this research will enable individuals with type 2 diabetes who experience peripheral neuropathy complications to perform and carry out this active lower ROM exercise, which has been proven effective in reducing peripheral neuropathy.

CONCLUSION

Based on the results of the study, the following conclusions can be drawn:

1. The majority of respondents in this study were aged 60–70 years, with 61.1% in the intervention group and 72.2% in the control group. Most respondents were female, accounting for 77.8% in both the intervention and control groups. The highest educational level in both groups was elementary school (50%). Most respondents in the intervention group were housewives (77.8%), while the majority in the control group were unemployed (66.7%). In addition, most respondents in both groups had been diagnosed with type 2 Diabetes Mellitus for 5–10 years, with 61.1% in the intervention group and 66.7% in the control group.
2. Before the Active Lower Range of Motion exercise intervention, the majority of respondents in both the intervention and control groups were classified as having a high risk of peripheral neuropathy. In the intervention group, 94.4% of respondents

had a high risk in the right foot and 88.9% in the left foot. In the control group, 83.3% had a high risk in the right foot and 94.4% in the left foot.

3. After the Active Lower Range of Motion exercise intervention, the level of peripheral neuropathy risk in the intervention group improved to the normal category, with 72.2% in the right foot and 83.3% in the left foot. In contrast, post-test results in the control group showed that the majority of respondents remained in the high-risk category, with 88.9% in the right foot and 94.4% in the left foot.
4. The results of the Wilcoxon test and the Mann–Whitney test indicated that Active Lower Range of Motion exercise had a significant effect on the level of peripheral neuropathy risk. The Wilcoxon test showed a p-value of 0.000, while the Mann–Whitney test also yielded a p-value of p<0,001, indicating a significant difference between the intervention and control groups.

The results of this study can be used as a consideration for Puskesmas Pakuan Baru in the planning and implementation of education and health promotion programs, particularly those related to the prevention of complications of type 2 Diabetes Mellitus within its service area. In addition, for nursing education institutions, this study may serve as an additional reference in the nursing education process and as a basis for encouraging students to develop innovative nursing interventions based on evidence-based practice in the community.

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