APPLICATION OF FOOT EXERCISE THERAPY ON BLOOD GLUCOSE LEVELS IN OLDER ADULTS WITH TYPE II DIABETES MELLITUS IN BANDAR LAMPUNG

Efa Trisna[1*], Jamila Jamila[2], Setiawati Setiawati[2], Sri Hartati[3], Wahyu Dwi Ari Wibowo[3]

[1]*Department of Nursing, Health Polytechnic of Tanjung Karang, Bandar Lampung, Indonesia*
[2]*Department of Midwifery, Health Polytechnic of Palembang, Palembang, Indonesia*
[3]*Department of Nursing, Health Polytechnic of Palembang, Palembang, Indonesia*

**Corresponding author*: lkdefatrisna@gmail.com

Abstract

Diabetes mellitus (DM) type II is a major health concern among older adults, requiring continuous management to prevent complications. Physical activity is an important component of diabetes care, and foot exercise has been proposed as a simple, inexpensive, and accessible alternative. This study aimed to compare the effect of foot exercise and brisk walking on random blood glucose levels in older adults with type II DM. A quasi-experimental design with a pre- and post-test control group was conducted involving 100 respondents. Participants were divided into two groups: the intervention group performed foot exercise for 15–30 minutes daily, while the control group performed brisk walking for the same duration over one week. Random blood glucose levels were measured before and after the interventions using standardized procedures. Both interventions significantly reduced random blood glucose levels. However, foot exercise demonstrated a greater mean reduction compared to brisk walking, as indicated by paired t-test analysis. Foot exercise can be recommended as a practical and effective complementary therapy for older adults with type II diabetes mellitus, especially for those with limited mobility or time. Incorporating this simple activity into daily routines may support improved diabetes self-management..

Keywords: DM; Brisk Walking Exercise; Foot Exercise.

Presented at the 5th Bengkulu International Conference on Health (B-ICON), Bengkulu-Indonesia, October 28-29th, 2025

Published: December 31st, 2025

e-ISSN: 2986-027X

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease characterized by elevated blood glucose levels, which can cause serious damage to organs such as the heart, blood vessels, eyes, kidneys, and nerves (Wibowo et al., 2024). Type II DM generally occurs in adults as a result of the body's resistance to insulin or insufficient insulin production (Pan American Health Organization, 2022). Symptoms of type II DM include frequent urination, excessive thirst, persistent hunger, weight loss, visual disturbances, and fatigue. These symptoms are often recognized only after several years or when serious complications have occurred (World Health Organization, 2021). The International Diabetes

Federation (IDF) reported that the number of people with diabetes worldwide in 2021 reached 537 million, and this figure is predicted to continue increasing to 643 million in 2030 and 783 million in 2045 (Kemenkes, 2024). Diabetes mellitus is one of the leading causes of death worldwide, accounting for 1.5 million deaths in 2019, with a twofold increased risk of premature mortality. The highest number of deaths from DM was recorded in the Western Pacific, with 717,000 people dying from DM in 2021 (World Health Organization, 2021).

Based on the Indonesian Health Survey (SKI) in 2023, a total of 877,532 people in Indonesia were diagnosed with diabetes mellitus (DM). However, only 14,935 patients (1.7%) routinely underwent treatment and disease control. The age group of 55 years and above dominated the number of patients, with a total of 136,780 individuals. In addition, the most common type of DM experienced by the Indonesian population was type II DM, accounting for 50.2% of the total cases (KPKI, 2023). According to the 2018 Basic Health Research (RISKESDAS), the prevalence of DM in Indonesia reached 1,017,290 cases. Among these, 9.3% did not seek any form of treatment, 85.5% had never routinely checked their blood sugar levels, and 50.4% did not take diabetes medication—often believing they were already healthy and did not require further care. Lampung Province ranked among the top seven provinces with the highest number of DM cases, reporting 32,148 cases, while Bandar Lampung City alone contributed 3,878 cases (RISKESDAS, 2018). According to data from the Lampung Provincial Health Office, the number of DM patients in Lampung in 2022 reached 89,981, with Bandar Lampung City having the highest number, at 18,644 cases.

The increasing prevalence of DM—particularly among older adults—is driven by rising life expectancy and lifestyle changes, posing a substantial burden on global public health systems (Yun et al., 2024). This age group is particularly vulnerable to a unique diabetes phenotype characterized by vascular disease, neuropathic complications, and mental dysfunction, all of which collectively increase the risk of disability and death (Chami & Khaled, 2022). The management of diabetes mellitus (DM) can be carried out through pharmacological and non-pharmacological therapies. Pharmacological management involves the use of insulin and oral hypoglycemic agents, while non-pharmacological management includes weight control, physical exercise, and dietary regulation (Wibowo et al., 2024). Effective diabetes management in older adults requires a holistic approach that encompasses personalized nutrition planning, user-friendly glucose monitoring technologies, and tailored physical exercise programs to address barriers in this age group, particularly mobility limitations and fear of injury (Trisna et al., 2025)

Physical activity that involves muscle contraction has been shown to improve insulin sensitivity, allowing the body to use available insulin more efficiently to absorb glucose and convert it into energy

(American Diabetes Association, 2022). Several studies indicate that individuals with DM often face barriers to performing physical activity, primarily due to time constraints. Therefore, the Directorate of Non-Communicable Disease Prevention and Control (P2PTM) recommends physical activities that can be performed anywhere, even while relaxing with family, such as diabetes foot exercise (Kemenkes, 2018). According to Trisna & Musiana, (2018) foot exercise has been proven to reduce blood glucose levels and improve the ankle-brachial index (ABI) in DM patients. Foot exercise helps improve blood circulation, strengthen small foot muscles, prevent foot deformities, and compensate for limited insulin availability in DM patients. Research conducted by Trisna et al., (2025) The approach utilized family-centered nursing care with education and monitoring of blood glucose before and after each foot exercise session. Subject I demonstrated a reduction in random blood glucose levels from 232 mg/dl to 182 mg/dl after three sessions, while Subject II showed a decrease from 248 mg/dl to 189 mg/dl.

A study conducted by Andari et al., (2023) demonstrated that performing foot exercise three times per week for 10–15 minutes over the course of one month significantly reduced postprandial blood glucose levels in patients with type II DM, showing a marked decrease from an average of 221.2 mg/dl to 216.4 mg/dl. Foot exercise can therefore serve as an effective and relaxing intervention that can be performed anytime and anywhere. This activity primarily improves blood circulation, facilitating better nutrient delivery to tissues and strengthening muscles, which contributes to lowering blood glucose levels (Wibowo et al., 2024). Supporting evidence from Rosyid & Angraini, (2022) also indicated that foot exercise produced significant changes in blood glucose levels and improved sensory neuropathy in the lower extremities of diabetic patients. Similarly, Yulita et al., (2019) found a significant reduction in neuropathy scores and blood glucose levels among patients who participated in foot exercise programs. Therefore, foot exercise can be considered as one of the alternative therapies that can be performed flexibly anywhere and anytime, making it particularly suitable for older adults who often face limitations in mobility, time, and access to structured physical activity programs. This simple yet effective form of exercise does not require special equipment, can be done independently or with family support, and has been shown in several studies to improve blood circulation, strengthen lower limb muscles, and contribute to lowering blood glucose levels.

MATERIALS AND METHODS

This study employed a quantitative approach with a quasi-experimental method using a pre- and post-test control group design. Respondents were randomly assigned into two groups: the intervention group and the control group.

The research population consisted of older adults diagnosed with type II diabetes mellitus in Bandar Lampung. A total of 100 respondents were selected through random sampling and equally divided into two groups, with 50 respondents in the intervention group and 50 respondents in the control group.
Inclusion criteria;

a. Patients who agreed to participate as respondents.
b. Patients with blood glucose levels above normal range.
c. Willing to follow the entire research procedure.

Exclusion criteria;

a. Patients with impaired physiological function of the feet, making it difficult to perform foot exercise or brisk walking.
b. Patients with psychological problems such as depression, excessive anxiety, or worry that might interfere with participation.

The primary instrument used in this study was a digital glucometer (brand and accuracy specifications provided), which was applied to measure random blood glucose levels (mg/dl) before and after the intervention. Respondents' characteristics were recorded using structured observation sheets. The intervention group was given foot exercise therapy, while the control group received brisk walking exercise. Both interventions were conducted daily for 15–30 minutes over a one-week period. Blood glucose levels were measured prior to and after the intervention in both groups. The exercise procedures followed standardized guidelines as previously validated in diabetes care research, ensuring safety and feasibility for older adults.

Data were collected through direct observation and blood glucose monitoring. Each respondent underwent blood glucose measurements twice (pre-test and post-test). The collected data were processed using statistical software. Descriptive statistics were used to summarize respondents' characteristics and mean blood glucose levels. A paired t-test was applied to assess within-group differences before and after intervention, while an independent t-test was used to compare differences between the intervention and control groups. The significance level was set at $p < 0.05$.

This research received ethical clearance from the Health Research Ethics Committee of Politeknik Kesehatan Tanjung Karang, with approval number No. 332/KEPK-TJK/V/2025. All respondents were informed about the purpose, benefits, and procedures of the study, and written informed consent was obtained prior to participation.

RESULTS AND DISCUSSION

Table 1. Characteristics of Respondents

No	Characteristics	Frequency (n)	Percentage (%)
1.	Gender		
	a. Male	21	21%
	b. Female	79	79%
2.	Age		
	a. 60–69 years	48	48%
	b. 70–79 years	42	42%
	c. >80 years	10	10%
3.	Duration of diabetes		
	a. 1–5 years	63	63%
	b. 6–10 years	25	25%
	c. >10 years	12	12%
4.	Comorbidities		
	a. Hypertension	44	44%
	b. Gastritis	6	6%
	c. Joint and bone problems	10	10%
	d. None	40	40%
5.	Physical activity history		
	a. Regular	39	39%
	b. Irregular	61	61%
6.	Medication adherence		
	a. Regular	27	27%
	b. Irregular	73	73%

Based on Table 1, the characteristics of respondents show that the majority of diabetes mellitus patients were female (79%), while only 21% were male. In terms of age group, most respondents were between 60–69 years (48%), followed by 70–79 years (42%), and >80 years (10%). Regarding the duration of diabetes, the majority had been living with the condition for 1–5 years (63%), while 25% had experienced it for 6–10 years, and 12% for more than 10 years. The most common comorbidity was hypertension (44%), followed by joint and bone problems (10%) and gastritis (6%). From the perspective of physical activity, most respondents did not exercise regularly (61%) compared to those who did (39%). Similarly, most respondents were irregular in taking their medication (73%).

Based on Table 1, the characteristics of respondents show that the majority of patients with type 2 Diabetes Mellitus were female (79%), while males accounted for only 21%. This result is supported by the findings of the Basic Health Research (RISKESDAS) 2018, which reported that DM is more prevalent among women compared to men (RISKESDAS, 2018). Further supported by research conducted by Rosita et al., (2022), it was stated that women are 2.15 times more at risk of developing

type 2 diabetes mellitus than men. Women are more susceptible due to the greater likelihood of increased body mass index. The cyclical syndrome (premenstrual syndrome), as well as post-menopause, causes fat distribution in the body to accumulate more easily due to hormonal processes, thereby increasing the risk of type 2 diabetes mellitus.

Based on the duration of diabetes, the majority of respondents had been diagnosed for 1–5 years (63%). In terms of physical activity, more respondents did not engage in regular physical activity (61%), and most also reported irregular medication adherence (73%). These findings are in line with the study by Alza et al., (2020) which showed a relationship between the duration of DM and the prevalence of regular physical activity and medication use. Patients diagnosed for less than 5 years were generally less likely to take medication regularly and engage in physical activity. Other contributing factors, especially among older adults, include limited range of motion and physical weakness (Karolus et al., 2023).

Table 2. Random Blood Glucose (RBG) Scores Before and After Brisk Walking Exercise

Variable	Before (M ± SD)	After (M ± SD)	Difference (M ± SD)	t	p*
RBG	268.60 ± 52.648	199.84 ± 58.148	68.76 ± 38.819	12.525	.001

*Paired t-Test

The analysis in Table 2 shows that the mean random blood glucose (RBG) score before brisk walking exercise was 268.60, which decreased to 199.84 after the intervention, with a mean difference of 68.76. Statistical analysis using a paired t-test produced $t = 12.525$ with $p = 0.001$ ($p < 0.05$), indicating a significant difference between pre- and post-intervention RBG scores.

These results are consistent with research conducted by Martini et al., (2024) on type 2 diabetes mellitus patients at UPTD Puskesmas Mengwi III, which demonstrated the effectiveness of brisk walking exercise in lowering random blood glucose levels. Walking therapy, also known as brisk walking exercise, is a form of physical activity that involves the work of muscles, particularly the leg muscles, to move the body from one location to another. For individuals with diabetes mellitus, regular exercise supports disease management. This type of exercise is recommended three to five times a week, with a duration of approximately 30–45 minutes per session, and has been shown to be effective in reducing random blood glucose (Farida et al., 2025).

Brisk walking increases insulin sensitivity, enabling body cells to absorb glucose more efficiently with less insulin. This activity also suppresses glucose release from the liver and helps control postprandial glucose spikes, particularly when performed 10–30 minutes after meals (Saputra et al., 2023). In the long term, brisk walking reduces visceral fat and improves body composition, contributing to improved

insulin sensitivity. Supporting studies confirm these findings, showing not only significant reductions in random blood glucose but also decreases in fasting glucose levels after 8 weeks of brisk walking three times per week (Opoku et al., 2023).

Table 3. Random Blood Glucose (RBG) Scores Before and After Foot Exercise

Variable	Before (M ± SD)	After (M ± SD)	Difference (M ± SD)	t	p*
RBG	325.56 ± 78.042	185.02 ± 49.826	140.54 ± 56.242	17.669	.001

*Paired t-Test

The analysis in Table 3 shows that the mean random blood glucose (RBG) level of respondents before foot exercise intervention was 325.56 ± 78.042, which significantly decreased to 185.02 ± 49.826 after therapy. The mean reduction achieved was 140.54 ± 56.242. Statistical testing using paired t-test yielded $t = 17.669$ with $p = 0.001$ ($p < 0.05$), indicating a significant difference between RBG levels before and after foot exercise intervention.

These results are consistent with previous research by (Trisna & Musiana, 2018), which demonstrated the effectiveness of foot exercise in lowering blood glucose levels among DM patients. Effective diabetes management in older adults requires a holistic approach, including tailored physical exercise programs to address age-related barriers, such as mobility issues and fear of injury. One suitable program is foot exercise (Yun et al., 2024).

Foot exercise can be an effective and simple intervention, which can be performed anywhere and anytime, even by older adults with mobility limitations who still wish to exercise. Moreover, foot exercise requires relatively short sessions of about 15–30 minutes. This exercise primarily works by improving blood circulation, enhancing nutrient delivery to tissues, and strengthening muscles, which contribute to reducing blood glucose (Trisna et al, 2025). A study by Andari et al., (2023) showed that foot exercise significantly reduced postprandial blood glucose levels in type 2 diabetes patients, with a decrease from an average of 221.2 mg/dl to 216.4 mg/dl.

Further supported by research conducted by Rosyid & Angraini, (2022), it was found that foot exercise significantly altered blood glucose levels and improved sensory neuropathy status in the lower extremities of diabetes patients. Foot exercise is effective because it involves contractions of the leg muscles, which increase insulin sensitivity and facilitate glucose uptake by muscle cells. These simple movements also improve blood circulation, particularly in the lower extremities, leading to more optimal glucose metabolism.

Table 4. Comparison of RBG Scores In Foot Exercise and Brisk Walking Exercise

Variable	Mean difference (M ± SD)	Maximum RBG	Minimum RBG	t	p*
Foot exercise	140.54 ± 56.242	156.524	124.556	7.427	.084
Brisk walking	68.76 ± 38.810	79.792	57.728		

*Independent t-Test

Analysis of Table 4 shows a comparison of random blood glucose (RBG) levels after two interventions: foot exercise and brisk walking exercise. The foot exercise group experienced a greater mean reduction of 140.54 ± 56.242 (range: 124.556–156.524), compared to the brisk walking group with a mean reduction of 68.76 ± 38.810 (range: 57.728–79.792). Physical activity is one of the key pillars in type 2 diabetes mellitus management, alongside diet regulation and pharmacological therapy. Both of these physical exercises demonstrated positive effectiveness in lowering RBG levels because they involve muscle contractions that increase glucose uptake from the blood into cells for energy use.

Brisk walking is a form of light-to-moderate intensity aerobic exercise that improves overall metabolism. It stimulates energy expenditure, enhances insulin sensitivity, and improves cardiovascular function (Opoku et al., 2023). Meanwhile, foot exercise works by stimulating contractions of the lower limb muscles, which improve peripheral blood circulation and insulin sensitivity. The simple movements in the ankle, knee, and toe joints encourage glucose uptake by muscles without requiring strenuous physical activity (Admin et al., 2021). Based on Table 4, although the t-test ($t = 7.427$; $p = 0.084$) showed no statistically significant difference ($p > 0.05$), the data trend indicated that foot exercise was more effective in reducing RBG compared to brisk walking. This is because foot exercise typically requires shorter sessions, which is advantageous for older adults with limited stamina or busy routines. Unlike walking, which requires more preparation, foot exercise can be performed in shorter, repeatable sessions alongside daily activities (Rosdiana et al., 2024).

A lot of older adults experience reduced mobility, joint stiffness, and risk of falls. Although brisk walking is inexpensive and easy to perform, it requires balance, leg strength, body stability, and greater stamina, which may be challenging for older adults. In contrast, foot exercise can be performed while sitting, involving calf lifts, knee bends, or ankle joint movements, which can be adapted to the physical condition of older adults, making it a suitable daily physical activity (Putri et al., 2025). Another advantage of foot exercise is its flexibility and independence from location or weather, allowing it to be performed at home alongside other activities. This supports consistent implementation since older adults are not hindered by environmental factors such as distance, rain, or road conditions, which may

interfere with brisk walking. Such consistency is crucial for maintaining stable blood glucose levels. Simple, routine, and lower limb–focused exercises are expected to enhance insulin sensitivity and improve peripheral blood circulation, both of which play an important role in glucose metabolism and regulation.

CONCLUSION

The findings of this study indicate that foot exercise is more effective in reducing random blood glucose levels compared to brisk walking exercise among older adults with type II diabetes mellitus. This result supports the potential of foot exercise as a practical and accessible non-pharmacological intervention to help improve glycemic control. Based on these findings, it is suggested that foot exercise can be recommended as an alternative physical activity, particularly for older adults with limited mobility and time constraints, as it can be performed easily, anytime, and anywhere. Further studies with longer intervention periods and larger sample sizes are encouraged to strengthen the evidence.

REFERENCES

Admin, Yora Nopriani, & Silvia Ramadhani Saputri. (2021). Senam Kaki Diabetes Pada Penderita Diabetes Mellitus (Studi Literatur).

Alza, Y., Arsil, Y., Marlina, Y., Novita, L., & Agustin, N. D. (2020). Aktivitas Fisik, Durasi Penyakit Dan Kadar Gula Darah Pada Penderita Diabetes Mellitus (Dm) Tipe 2.

American Diabetes Association. (2022). *Blood Sugar and Exercise*.

Andari, F. N., Rahmalena, R., & Wijaya, A. K. (2023). Efisiensi Senam Kaki Diabetik terhadap Penurunan Kadar Glukosa Darah Postprandial pada Klien DM Tipe II.

Chami, M. A., & Khaled, M. B. (2022). Epidemiology, diagnosis, and assessment of diabetes mellitus in the elderly population: a purposive review.

Efa Trisna, Jamila Jamila, Setiawati Setiawati, Sri Hartati, Wahyu Dwi Ari Wibowo, Hadeci Lovenda Putri, F. Y. S. (2025). The Impact Of Regular Foot Exercise On Blood Glucose Reduction In Type Ii Diabetes Patients: A Case Study. *Mahesa*

Farida, N. U., Lestari, D. T., Jauhar, M., & Rohmaniah, F. A. (2025). Brisk Walking Menurunkan Kadar Gula Darah Diabetesi Di Wilayah Pedesaan.

Karolus, karolus H., Butar Butar, S., Pangaribuan, S. M., Siregar, S. W., & Batubara, K. (2023). Hubungan Aktivitas Fisik Dengan Kadar Glukosa Darah Pada Pasien Diabetes Mellitus di Ruang Penyakit Dalam RSUD Koja Jakarta.

Kemenkes. (2018). Lakukan senam kaki Diabetes secara rutin, dimana saja sambil bersantai.

Kemenkes. (2024). Saatnya Mengatur Si Manis – Sehat Negeriku. Sehat Negeriku.

KPKI. (2023). Survei Kesehatan Indonesia Tahun 2023. In *Badan Kebijakan Pembangunan Kesehatan Kemenkes*.

Martini, N. K. S., Prihandini, C. W., Putra, P. W. K., & Yunita, N. D. (2024). Pengaruh Brisk Walking Exercise Terhadap Glukosa Darah Pada Pasien Diabetes Melitus Tipe 2.

Opoku, B., De Beer-Brandon, C. R., Quartey, J., & Mshunqane, N. (2023). Effects of brisk walking on fasting blood glucose and blood pressure in diabetic patients.

Pan American Health Organization. (2022). *Diabetes*.

Putri, Y. E., Sari, S. P., & Witdiawati, W. (2025). The Effect of Diabetic Foot Exercise on Peripheral Perfusion and Fall Risk in Elderly with Diabetes Mellitus: Case Report.

Rosdiana, R., Rasyid, D., Djunaedi, D., & Noviar, R. A. (2024). Foot Exercises in Controlling Blood Sugar Levels in Elderly People with DM at the Baraka Community Health Center, Enrekang Regency, South Sulawesi.

Rosita, R., Kusumaningtiar, D. A., Irfandi, A., & Ayu, I. M. (2022). Hubungan Antara Jenis Kelamin, Umur, Dan Aktivitas Fisik Dengan Diabetes Melitus Tipe 2 Pada Lansia Di Puskesmas Balaraja Kabupaten Tangerang.

Rosyid, L. S., & Angraini, N. A. (2022). the Effect of Foot Exercise on Lower Extremity Sensory.

Saputra, I., Haskas, Y., Tinggi Ilmu Kesehatan Nani Hasanuddin, S., Perintis Kemerdekaan VIII, J., & Makassar, K. (2023). Pengaruh Latihan Fisik Jalan Cepat Terhadap Perubahan Kadar Gula Darah Sewaktu Pada Wanita Diabetes.

Trisna, E., & Musiana, M. (2018). Pengaruh Senam Kaki terhadap Kadar Glukosa Darah dan Nilai ABI Penderita DM.

Wahyu Dwi Ari Wibowo, Sapondra Wijaya, Susmini, Nadi Aprilyadi, D. S. (2024). Terapi nonfarmakologis pada pasien diabetes melitus.

World Health Organization. (2021).

Yulita, R. F., Waluyo, A., & Azzam, R. (2019). Pengaruh Senam Kaki terhadap Penurunan Skor Neuropati dan Kadar Gula Darah pada Pasien DM Tipe 2 di Persadia RS. TK. II. Dustira Cimahi.

Yun, J. S., Kim, K., Ahn, Y. B., Han, K., & Ko, S. H. (2024). Holistic and Personalized Strategies for Managing in Elderly Type 2 Diabetes Patients.