

Implementation of a Combination of Insulin Therapy and Foot Exercises on Lowering Blood Glucose in Patients with Diabetes Mellitus

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ABSTRACT

Introduction: Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from inadequate insulin production or impaired insulin utilization. Blood glucose can be managed through pharmacological and non-pharmacological approaches. Combining insulin therapy with diabetic foot exercises may improve insulin sensitivity and peripheral blood circulation, thereby helping to reduce blood glucose levels. This study aimed to describe the implementation of combined insulin therapy and diabetic foot exercises in patients with diabetes mellitus at Dr. Adjidarmo General Hospital, Rangkasbitung.

Methods: A case study design was conducted involving two patients with diabetes mellitus over a three-day observation period. Data were collected through interviews, physical examinations, observations, blood glucose measurements, and documentation.

Results: Following the combined intervention for 3×24 hours, both patients experienced reductions in blood glucose levels accompanied by improvements in hyperglycemic symptoms, including dizziness, weakness, excessive thirst, and polyuria.

Conclusion: These findings suggest that combining insulin therapy with diabetic foot exercises may contribute to improved short-term glycemic control. Nurses play an essential role in providing health education, encouraging treatment adherence, promoting regular foot exercises, and supporting healthy lifestyle practices to maintain blood glucose control and prevent diabetes-related complications.

Keywords: *diabetes mellitus; insulin therapy; foot exercises; blood glucose levels*

INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disorder that occurs due to the inability of the pancreas to produce enough insulin for the body or due to the body's inability to use the insulin produced (Fatihaturahmi et al., 2023). Diabetes Mellitus (DM) is divided into several types, including Type 1 Diabetes Mellitus, Type 2 Diabetes Mellitus, Gestational Diabetes Mellitus, and Other Types of Diabetes Mellitus (Syaripudin, 2026).

Type 1 diabetes mellitus occurs due to an autoimmune disorder, so that the insulin-producing pancreatic cells are damaged and the body is unable to produce insulin. This condition is commonly experienced at a young age and requires lifelong insulin therapy. Type 2 diabetes

mellitus occurs due to insulin resistance, which is when the body's cells do not respond optimally to insulin, and can be accompanied by a decrease in insulin production. This condition is often related to unhealthy lifestyles, obesity, and hereditary factors. Gestational Diabetes Mellitus occurs during pregnancy and usually goes away after delivery, but it can increase the risk of developing type 2 Diabetes Mellitus later in life. In addition, other types of Diabetes Mellitus are caused by certain conditions, such as genetic disorders, disorders of the pancreas, and side effects from the use of drugs (Frida et al., 2025).

In addition to these causative factors, a person's risk of developing Diabetes Mellitus is also influenced by several factors including an unhealthy diet by consuming excessive sugar and

fat and low fiber, lack of physical activity that can cause obesity, genetic factors or family history with Diabetes Mellitus, smoking habits and alcohol consumption, stress and obesity that trigger insulin resistance as the main factors in the development of type 2 Diabetes Mellitus, and increasing age which naturally increases the risk of Diabetes Mellitus. Given the many risk factors and the large impact that can be caused, ranging from complications to other organs of the body, additional degenerative diseases, decreased quality of life, to the risk of an increase in Diabetes Mellitus disease, it is a serious health problem. It needs to receive attention from the public and individuals from an early age (Suryati, 2021).

However, of all types of Diabetes Mellitus, a person with Diabetes Mellitus generally experiences similar symptoms such as polyuria (frequent urination), polydipsia (frequent thirst), polyphagia (frequent hunger), and weight loss, for which the cause is not clearly known (Febrinasari et al., 2020). In addition, in some cases, symptoms can appear slowly over a long period of time so that they are often unnoticed, with complaints such as frequent tingling, feeling hot or piercing in the skin, numbness in the skin, cramping, fatigue and drowsiness, blurred vision, itching in the genital area, decreased sexual function and disorders during pregnancy such as miscarriage (Ferawati et al., 2020).

The prevalence of Diabetes Mellitus worldwide in adults (20-79 years old) is 589 million people and is predicted to increase to 853 million people by 2050 (International Diabetes Federation, 2025). In the Southeast Asia region (SEA), the number of adults aged 20–79 years living with Diabetes Mellitus in 2024 will be recorded at 106.9 million people and it is estimated that there will be an increase of 73% in the Southeast Asia region, so that the total number of people with Diabetes Mellitus is predicted to reach around 185 million people by 2050 (International Diabetes Federation, 2026b).

Indonesia is one of 38 countries and regions in the Western Pacific region, with the total adult population in Indonesia in 2024 recorded at 185,217,400 people, while the number of people with Diabetes Mellitus in adults is 20,426,400 people with a prevalence of 11.3% of the total adult population (International Diabetes Federation, 2026a). Based on data from the health profile of Banten Province in 2024, it was found that 223,577 people with Diabetes Mellitus received health services in Banten Province (Prov. Banten, 2024), in Lebak Regency in 2024 as many as 15,706 people, in 2025 as many as 23,737 people, and in 2026 as many as 4,033 people the number of patients with Diabetes Mellitus at dr. Adjidarmo Rangkasbitung Hospital was recorded at 446 people in 2023, 1277 people in 2024, and 466 people in 2025 (Adjidarmo Rangkasbitung, 2026).

The high prevalence of Diabetes Mellitus is inseparable from the pathophysiological mechanisms in the body, where understanding the role of hormones in the body is important because these hormones regulate the entry of glucose into body cells as a source of energy. This hormone is produced by the pancreatic gland and is needed for most glucose to enter the cells. If there is a disruption in insulin, such as production that is inhibited or not produced at all, glucose will have difficulty entering the cells, so that blood sugar levels increase. If this condition lasts for a long time, the body's cells that need glucose can be damaged due to lack of energy, while high blood sugar levels can damage nerves and various other organs of the body (Haryati et al., 2023). This condition will worsen if the disease is not controlled and triggers complications; these complications are divided into two, namely microvascular and macrovascular (Kemenkes, 2024).

Facing the high risk of complications in people with Diabetes Mellitus, it is necessary to make appropriate disease management efforts through health education for patients and families. Nurses are required to have optimal abilities in

providing health education, which includes promotive (health improvement), preventive (prevention), curative (treatment), and rehabilitative (restoration of body functions) (Luh et al., 2025). Management of Diabetes Mellitus can be done through pharmacological and non-pharmacological approaches. Pharmacologically, insulin therapy is used to lower blood glucose levels by improving glucose transport into body cells and inhibiting the conversion of glycogen and amino acids into glucose (Haryati et al., 2023).

Meanwhile, a non-pharmacological approach can be carried out through diabetic foot exercises as a form of physical exercise that is included in the four main pillars of diabetes mellitus management. This exercise involves movement of the muscles and joints of the legs, which aims to improve the patient's self-care ability and prevent complications, especially diabetic neuropathy (Wijonarko et al., 2024).

Although insulin therapy is the primary therapy in controlling blood glucose levels in patients with Diabetes Mellitus, nonpharmacological approaches such as diabetic foot exercises have also been reported to help improve muscle activity, improve peripheral circulation, and support blood glucose control. However, research describing the implementation of the combination of insulin therapy and diabetic foot exercises in clinical practice is still limited, especially in the form of case studies. Most previous studies have focused on insulin therapy or diabetic foot exercises separately, so the picture of the simultaneous application of both interventions as well as changes in blood glucose levels that occur during the treatment process has not been widely reported. This condition shows a research gap related to the implementation of a combination of pharmacological and nonpharmacological therapies in patients with Diabetes Mellitus in nursing practice. Therefore, this case study was conducted to describe the

implementation of a combination of insulin therapy and diabetic foot exercises as well as changes in blood glucose levels in patients with Diabetes Mellitus during the observation period.

METHOD

Study Design

This study employed a descriptive single-case study design to provide an in-depth description of the patient's condition, nursing assessment, intervention, and outcomes following the implementation of the nursing care plan.

Setting & Participants

Respondents in this study were selected using the purposive sampling technique, which is the deliberate selection of subjects based on characteristics that are in accordance with the research objectives. The inclusion criteria in this study included patients who underwent treatment in the Internal Medicine Room with a medical diagnosis of Type 2 Diabetes Mellitus, adult patients aged 18–59 years who did not have complications of diabetic neuropathy or diabetic ulcers, and did not experience weakness in the lower extremity muscles so that they were able to participate in diabetic foot exercises.

The exclusion criteria include patients who cannot read and write, experience decreased consciousness, and do not receive insulin therapy. Based on these criteria, two respondents were selected, namely Mrs. M and Mrs. S. Both patients met all the inclusion criteria and did not meet any of the exclusion criteria. In addition, both received insulin therapy according to the treatment program, had a physical condition that allowed them to do diabetic foot exercises, and were willing to participate in the entire series of observations and interventions during the 3×24-hour study period. In the implementation of this case study, the researcher respects the rights and gives freedom to Mrs. M and Mrs. S in making decisions related to the nursing care actions carried out. Mrs. M and

Mrs. S made a decision and were given informed consent as proof of consent in the implementation of the case study.

Variables & Measuremen

The intervention given to both patients was in the form of a combination of insulin therapy according to the doctor's therapy program and diabetic foot exercises. Both patients received the same insulin regimen, namely Ryzodeg insulin with a dose of 20 IU administered twice daily through subcutaneous injection according to the hospital's therapy schedule.

The implementation of diabetic foot exercises is carried out for 3×24 hours with a frequency of once every day. Each session lasts for ±15–20 minutes and follows the Standard Operating Procedures (SOP) of diabetic foot gymnastics used in the treatment room. Foot gymnastics consists of a series of movements that include warm-ups, flexion movements, extensions, abduction, adduction, ankle rotation, toe movements, and exercises using newspaper sheets, according to the diabetic foot gymnastics procedure. The intervention was administered directly by the researcher. On the first day, the researcher provided education and demonstrated each foot gymnastics movement to the patient. Furthermore, on the second and third days, patients performed foot exercises independently under the observation and guidance of the researcher to ensure that each movement was performed according to the procedure.

Data Collection

Data analysis was carried out descriptively by referring to the stages of data reduction, data presentation, and conclusions drawn. The data obtained from interviews, observations, physical

examinations, blood glucose level measurements, and documentation were first reduced by selecting relevant data according to the focus of the research. Furthermore, data were presented in the form of tables, graphs, and narrative descriptions to illustrate changes in blood glucose levels as well as the clinical conditions of the two patients during the observation period.

Data Analysis

The case study analysis was carried out by comparing the results of the implementation of a combination of insulin therapy and foot exercises in both patients through the discussion of changes in blood glucose levels and hyperglycemia symptoms observed for 3×24 hours. The results are then compared with theories and relevant previous research results to obtain conclusions according to the research objectives.

Ethical Approval

The implementation of this case study has been submitted to the Ethics Committee of Faletahan University and declared to have passed the Ethics Test with Ethical Clearance Number: 005802/Faletahan University/2026 issued on July 17, 2026.

RESULTS

This study was conducted on two patients with Diabetes Mellitus, namely Mrs. M and Mrs. S, who experienced instability in blood glucose levels with signs and symptoms of hyperglycemia in the form of polyuria, polydipsia, weakness, dizziness, and blurred vision. Both patients were given a combination of Ryzodeg 2x20 IU insulin therapy as pharmacological therapy and diabetic foot gymnastics as non-pharmacological therapy for 3×24 hours.

Table 1. Characteristics of Respondents (n=2)

Initial Respondents	Ny. M	Ny. S
Age	38 Years	53 Years
Gender	Women	Women
Long Suffering from DM	3 Years	Newly diagnosed
Diagnosis	Type 2 Diabetes Mellitus	Type 2 Diabetes Mellitus
Insulin therapy	Ryzodeg 2x20 IU	Ryzodeg 2x20 IU
Authoritative Diseases	Hypertension	Hypertension

Table 1 shows the characteristics of the two patients with Type 2 Diabetes Mellitus who were the subjects of the study. Mrs. M is 38 years old, while Mrs. S is 53 years old. Mrs. M has been suffering from Diabetes Mellitus for 3 years,

while Mrs. S is a newly diagnosed patient. Both patients received Ryzodeg insulin therapy with a dose of 20 IU twice a day, and both had comorbidities in the form of hypertension.

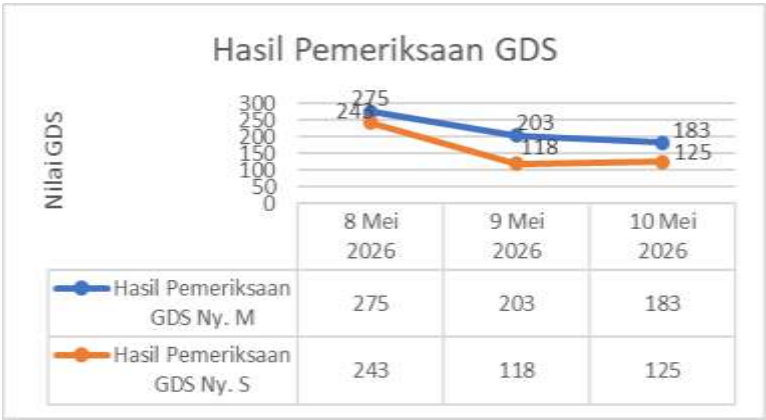


Figure 1. GDS Examination Results

Based on Figure 1, there was a decrease in blood glucose levels in both patients after a combination of insulin therapy and diabetic foot exercises. Mrs. M experienced a decrease in blood glucose levels from the first to the third day with a difference of 92 mg/dL, while Mrs. S experienced a decrease of 118 mg/dL. The results showed that both patients experienced improvements in blood glucose levels during the observation period.

In addition to a decrease in blood glucose levels, both patients also showed improvement in clinical conditions characterized by reduced complaints of dizziness, weakness, thirst, and frequency of urination. At the end of the evaluation, both patients were able to do activities independently and were able to demonstrate diabetic foot exercises well after being given education and exercise

During the 3×24-hour observation period, the two patients underwent insulin therapy according to the therapy program given, obtained a Diabetes Mellitus diet from the hospital, and participated in the implementation of diabetic foot gymnastics according to a predetermined schedule. During the treatment period, no signs of infection or other acute conditions were found that could potentially affect blood glucose levels. The patient's physical activity outside of the implementation of foot exercises is only in the fulfillment of daily activities while undergoing treatment in the inpatient room.

Based on the results of observation for 3×24 hours, the implementation of a combination of insulin therapy and diabetic foot exercises showed a decrease in blood glucose levels in both patients accompanied by an improvement in

hyperglycemia symptoms during the treatment period.

DISCUSSION

The results showed that the combination of insulin therapy and diabetic foot exercises for 3×24 hours was able to reduce blood glucose levels in both patients. In Mrs. M there was a decrease in blood glucose levels decreased from 275 mg/dL to 183 mg/dL, while in Mrs. S, they decreased from 243 mg/dL to 125 mg/dL. In addition, both patients also experienced improvement in hyperglycemia symptoms in the form of reduced complaints of dizziness, weakness, thirst, and frequency of urination.

The conditions found in both patients are in accordance with the research of Bagus et al. (2024) and Sary et al. (2026), which stated that the instability of blood glucose levels in patients with Diabetes Mellitus is characterized by an increase in blood glucose levels accompanied by symptoms such as polyuria, polydipsia, weakness, dizziness, and blurred vision due to impaired glucose metabolism. If not controlled, this condition can increase the risk of complications so that proper management is needed to maintain stable blood glucose levels.

A decrease in blood glucose levels was observed in both patients during the implementation of a combination of pharmacological and nonpharmacological therapies. Insulin therapy plays a role in increasing glucose transport into cells so that blood glucose levels can decrease, while diabetic foot exercises help to increase muscle activity and insulin sensitivity, which contributes to the use of glucose as an energy source. The results of this study are supported by Manumara et al. (2026), who show that diabetic foot exercises have the potential to help lower blood sugar levels in patients with Diabetes Mellitus. In addition, Darmawan et al.'s (2026) research explains that education on the use of insulin can increase patients' understanding and independence in carrying out therapy, thereby providing clinical

benefits in supporting the success of blood glucose control.

In this study, both patients showed a decrease in blood glucose levels after the implementation of a combination of insulin therapy and diabetic foot exercises for 3×24 hours. An improvement in hyperglycemia symptoms also accompanies the decrease in blood glucose levels. These changes are related to increased glucose utilization by body tissues during the implementation of physical activity in the form of foot exercises. This is in line with the research of Liu et al. (2025), which reported that physical activity can increase glucose and lipid metabolism so that it contributes to a decrease in blood glucose levels.

Regular physical activity is also known to improve the function of pancreatic β cells, increase insulin secretion and sensitivity, thereby helping to control blood glucose levels in patients with Type 2 Diabetes Mellitus. The findings are reinforced by research by McGee & Hargreaves (2024), which states that physical activity can increase the translocation of glucose transporter type 4 (GLUT-4) to the membrane of skeletal muscle cells. This process increases glucose uptake by muscle cells, which helps lower blood glucose levels, even in patients with Type 2 Diabetes Mellitus who experience insulin resistance.

The findings of this study showed that a decrease in blood glucose levels occurred in both patients during the implementation of a combination of insulin therapy and diabetic foot exercises. In addition, both patients received Ryzodeg insulin therapy with the same regimen, which was 20 IU given twice daily. The condition is thought to be related to the complementary effects between insulin therapy and physical activity. This is supported by research by Amaravadi et al. (2024), which reports that regular physical activity plays a role in improving glycemic control, improving fitness, and being associated with a reduced risk of DMT2.

Meanwhile, research by Jadoon et al. (2026) explains that insulin degludec/aspart (Ryzodeg) is a combination of long-acting basal insulin and fast-acting insulin that can provide more optimal blood glucose control, both at fasting and postprandial glucose levels, and is a safe insulin option for patients with Type 2 Diabetes Mellitus.

The patient's compliance can also influence the success of reducing blood glucose levels in managing Diabetes Mellitus independently. This is in line with Puzhakkal et al.'s (2025) research stating that the management of Diabetes Mellitus includes several important aspects, namely regular monitoring of blood glucose levels, adherence to drug or insulin therapy, the implementation of a healthy diet, regular physical activity, and emotional support. The application of these various components plays a role in maintaining stable blood glucose levels, reducing the risk of complications, and improving the quality of life of patients. This is supported by research by Nurmajida et al. (2025), which states that the implementation of the 3J diet (amount, type, and schedule) has the potential to help control blood glucose levels and prevent complications.

The results of this study are also in line with the research of Sidauruk et al. (2025), which showed that after three days of nursing care in patients with Diabetes Mellitus, there was a decrease in complaints of weakness, dizziness, thirst, and frequency of urination accompanied by an improvement in blood glucose levels even though they had not fully reached normal values.

This study has several limitations that need to be considered in interpreting the research results. This case study was conducted on only two patients with Diabetes Mellitus, so the results obtained may not be representative of the characteristics of all Diabetes Mellitus patients. In addition, the observation period was only 3×24 hours, so that it could not describe in depth the development of clinical conditions or changes in blood glucose levels of the two patients over a

longer period of time. This study also did not use a comparison group, namely Diabetes Mellitus patients who did not receive the implementation of a combination of insulin therapy and foot exercise, so the observed changes in blood glucose levels could not be directly compared with other groups. Therefore, the results of this case study cannot be generalized due to the limited number of respondents and the absence of a control group. However, this study provides an overview of the implementation of the combination of insulin therapy and diabetic foot exercises as well as changes in blood glucose levels that occurred in both patients during the observation period.

Recommendations For Future Research

Future research should employ larger sample sizes and more rigorous study designs, such as quasi-experimental or randomized controlled trials, to evaluate the effectiveness of combining insulin therapy with diabetic foot exercises on glycemic control. Longer follow-up periods are recommended to assess the sustainability of the intervention and its effects on long-term outcomes, including glycated hemoglobin (HbA1c), peripheral circulation, foot health, and quality of life. Future studies should also examine factors that may influence treatment effectiveness, such as medication adherence, dietary intake, physical activity, duration of diabetes, comorbidities, and self-management behaviors. In addition, exploring the feasibility of integrating structured diabetic foot exercise programs into routine diabetes care may provide valuable evidence for improving comprehensive diabetes management in clinical settings.

CONCLUSION

In both patients included in this case study, the implementation of a combination of insulin therapy and diabetic foot exercises was associated with a reduction in random blood glucose levels during the 3×24-hour observation period. The

decrease in blood glucose levels was accompanied by improvements in hyperglycemic symptoms, including dizziness, weakness, excessive thirst, and frequent urination. These findings suggest that the combined implementation of insulin therapy and diabetic foot exercises may provide short-term clinical benefits in improving glycemic control among patients with diabetes mellitus. However, given the descriptive nature of this case study and the limited number of participants, the findings should be interpreted with caution.

Patients with diabetes mellitus are encouraged to adhere to prescribed insulin therapy and perform diabetic foot exercises regularly as

part of a comprehensive self-management strategy to support glycemic control and reduce the risk of diabetes-related complications. Nurses are encouraged to incorporate diabetic foot exercises as a complementary non-pharmacological intervention alongside insulin therapy when providing holistic nursing care for patients with diabetes mellitus. Future research should involve larger sample sizes, longer observation periods, and more rigorous study designs to evaluate further the effectiveness of combining insulin therapy with diabetic foot exercises in improving glycemic outcomes and supporting evidence-based diabetes management.

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Conflict of Interest

The authors declare that they have no competing interests or conflicts of interest related to this study or its publication.

Authors' Contributions

W.S.; **N.M.R.:** Conceptualization, methodology, investigation, data collection, formal analysis, writing original draft, and project administration. **I.P.:** Supervision, methodology, validation, and writing review and editing. **Y.S.:** Data curation, investigation, visualization, and writing review and editing. All authors contributed substantially to the study, critically revised the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

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Declaration of Generative AI Use

Grammarly was used exclusively for language editing to improve the grammar, spelling, punctuation, and readability of the manuscript. It was not used to generate scientific content, analyze or interpret data, or develop the study's conclusions. The authors carefully reviewed all revisions and assume full responsibility for the accuracy and integrity of the final manuscript.

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