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THE APPLICATION OF DIABETIC FOOT EXERCISES ON BLOOD GLUCOSE LEVELS IN ELDERLY PATIENTS WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT
Diabetes mellitus is a common disease in the elderly. Tingling is a symptom often felt by people with DM. Diabetic foot exercises are designed to improve blood circulation, strengthen leg muscles, and reduce symptoms of neuropathy, including tingling. Regular physical activity, including diabetic foot exercises, can increase insulin sensitivity, improve glucose metabolism, and help control blood sugar levels. Diabetic exercises are not only beneficial for physical fitness, but also have a direct positive impact on controlling blood glucose levels. Diabetic foot exercises also function to improve blood circulation and improve heart function. Regular physical activity, including exercises, can help improve blood circulation and reduce the risk of diabetes complications, such as neuropathy and foot ulcers. The purpose of this case study is to determine the application of diabetic foot exercises to blood glucose levels in the elderly with Type 2 Diabetes Mellitus at the Srondol Health Center. This type of case study is direct field research with a descriptive quantitative design. This study involved two subjects diagnosed with Type 2 Diabetes. Before the intervention, the initial glucose levels of 240 mg/dl and 197 mg/dl decreased to 211 mg/dl and 158 mg/dl after the exercise session. Diabetic foot exercise is an effective method to lower blood glucose levels and improve the quality of life of people with diabetes. By doing exercise regularly, people with diabetes can better manage their condition and prevent complications that may arise. Based on the results of the case study, it can be concluded that 2 respondents experienced a decrease in blood glucose levels after doing diabetic foot exercise.

Keywords: diabetic foot exercise; diabetes mellitus; elderly; glucose levels

INTRODUCTION
The elderly, often referred to as seniors, are an age group that is vulnerable to health problems. These problems increase as a person ages. The aging process experienced by the elderly results in a decline in all systems and functions. One of the functions that experience a decline is the physiological function. The decline in function leads to degenerative diseases that experience a decrease in various bodily functions due to aging, such as rheumatism, osteoporosis, heart disease, diabetes mellitus, hypertension, and cancer (Pusdatin Kemenkes RI, 2019).Type 2 Diabetes Mellitus is one of the most common diseases affecting the elderly and can cause various serious complications that impact their quality of life. Elderly individuals with diabetes often face difficulties in managing their health conditions, which can be exacerbated by the presence of other comorbidities such as hypertension, heart disease, and mental disorders (Guo, 2023; Lin et al., 2016). Research shows that elderly patients with diabetes have a higher risk of experiencing cardiovascular and cerebrovascular complications, which are the leading causes of morbidity and mortality in this age group (Jeong et al., 2023; Lin et al., 2016).Diabetes Mellitus (DM) is a disease characterized by the occurrence of hyperglycemia and disturbances in the metabolism of carbohydrates, fats, and proteins, which are associated with an absolute or relative deficiency in the action or secretion of insulin.

The symptoms complained of by Diabetes Mellitus patients include polydipsia, polyuria, polyphagia, weight loss, and tingling (Rahmasari & Wahyuni, 2019). Diabetes mellitus is classified into type 1 DM, type 2 DM, other types of DM, and gestational DM. Type 2 diabetes mellitus (T2DM) is a group of metabolic diseases characterized by hyperglycemia, occurring due to abnormalities in insulin secretion, insulin action, or both. The etiology of Diabetes Mellitus is a combination of genetic and environmental factors, as well as the secretion or action of insulin, metabolic abnormalities that disrupt insulin secretion, mitochondrial abnormalities, and a group of other conditions that impair glucose tolerance (Lestari & Zulkarnain, 2021). International Diabetes Federation (2021) stated that the number of diabetes sufferers worldwide increased to 19.5 million in 2021, with around 4.2 million deaths, with Indonesia ranking fifth. fifth place with 10.7 million deaths. In addition, the number of diabetes mellitus cases in Indonesia increases with age, usually found in the age group of 45 to 75 years (International Diabetes Federation, 2021). According to the Central Java Provincial Health Profile (2021), diabetes mellitus occurs with a prevalence of 13.91%, ranking as the second largest non-communicable disease in Central Java after hypertension, and must be addressed seriously. Meanwhile, according to the Central Java Provincial Health Office in 2021, there were 121,753 people suffering from diabetes mellitus (Badan Pusat Statistik Provinsi Jawa Tengah, 2022). Meanwhile, there are 902 cases of diabetes mellitus at the Srondol Community Health Center.

One of the main challenges in managing diabetes in the elderly is the decline in cognitive and physical abilities, which can interfere with their ability to perform effective self-care. This contributes to difficulties in maintaining good blood glucose control, which is crucial for preventing further complications (GÜNDOĞDU & Kılavuz, 2023; Ida & Murata, 2022). Additionally, elderly individuals with diabetes are also more susceptible to hypoglycemia, which can lead to acute cardiovascular events and increase the risk of death (Si, 2025).Diabetes mellitus can cause complications often experienced by patients, namely Diabetic Ketoacidosis (DKA) and Hyperglycemic Hyperosmolar State (HHS), as well as foot problems (diabetic ulcers, athlete's foot, fungal nail infections, dry skin, blisters) known as diabetic foot, which occur in about 15 percent of patients. To treat DM, three types of therapy are recommended: adopting a healthy lifestyle, regularly performing diabetic foot exercises, and taking medication. One of the physical exercises for diabetes patients to improve blood circulation and prevent foot wounds is foot exercises (Rahmasari & Wahyuni, 2019). Diabetes foot exercises are recommended to be done regularly, as they have been proven effective in helping to control blood sugar levels (Idris et al., 2023). Diabetes foot exercises are exercises aimed at improving blood circulation in the feet and preventing swelling and wounds. This exercise can be done at any time according to the patient's condition, as it is performed in a sitting position and in a relaxed state (Hidayah et al., 2022). Diabetes foot exercises are physical exercises where the movements are performed by moving the muscles and joints of the feet (Riskiyanah & Mochartini, 2024).

Research by Fadli shows that diabetic exercise can lower blood sugar levels in the elderly, which is an important factor in diabetes management. With the decrease in blood sugar levels, neuropathy symptoms such as tingling can be reduced, thereby improving the comfort and quality of life for the elderly (Fadli, 2023). In addition, foot exercises can also help improve balance and coordination, which are often disrupted in the elderly with diabetes (Dewi et al., 2021). This is important to prevent falls and injuries, which are high risks for this age group.The purpose of performing diabetic foot exercises is to improve health and physical fitness because they have been proven to lower glucose levels in the body and prevent cardiovascular diseases. This exercise is to train the joints of the feet, muscle strength, and range of motion. According to research conducted by Ruben, Rottie, Karundeng, it is argued that diabetic foot exercises for DM patients can provide activities that can suppress the increase in blood glucose levels (Ruben et al., 2016). The application of diabetic foot exercises can also reduce neuropathic pain in

diabetes patients, indicating that this intervention is effective in addressing disturbing symptoms (Pradana & Pranata, 2023).

Diabetic foot exercises for the elderly are not only beneficial for physical health but can also improve mental and emotional well-being. Physical activities such as foot exercises can stimulate the production of endorphins, which act as natural pain relievers and can reduce feelings of anxiety or depression often experienced by the elderly (Dewi et al., 2021). Thus, diabetic foot exercises not only help alleviate tingling but also provide significant psychological benefits. By regularly doing foot exercises, the elderly can experience improvement in tingling symptoms and enhance their functional abilities in daily activities. With the implementation of diabetic foot exercises that can lower blood sugar levels, it is considered one of the indications for improvement and an effective method in the care of DM patients. Researchers conducted this case study to determine the application of diabetic foot exercises on blood glucose levels in elderly people with Type 2 Diabetes Mellitus at the Srondol Health Center, so that it can help improve blood circulation and reduce the risk of diabetes complications, such as neuropathy and foot ulcers.

METHOD

The type of design in this case study is a field research type with a case study design, which in this research uses a descriptive quantitative design that illustrates the application of diabetes foot exercises on blood sugar levels in the elderly. In this case The type of design in this case study is a type of field research with a case study design, which in this study uses a quantitative descriptive design that describes the application of diabetic foot exercises to blood sugar levels in the elderly. In this case study, the researcher used standard operating procedures and pretest and posttest observation sheets. Data presentation in the form of tables and narratives. The total number of subjects is 2 people. The number of controlled DM patients [1] at the Srondol Health Center from September 11 to October 31, 2024 was 89 people. The inclusion criteria were DM patients who were monitored at the Srondol Health Center during the study, type 2 DM patients with ulcers or gangrene. The exclusion criteria were DM patients who were not willing to be research subjects, type I DM patients. The number of respondents who met the inclusion criteria in this study was 2 people. This case study was conducted once, namely on November 1, 2024 at the Srondol Health Center, Semarang. DM patients who agreed to become respondents had their blood glucose levels measured to become pre-test data. Then the respondents were taught and guided to do diabetic foot exercises. After doing the exercise, respondents were asked to rest for 15 minutes and then blood glucose levels were measured for post-test data.

RESULT

Table 1.
Characteristics of the respondents

Name	Age	Gender	Education	Work	Long suffering
Ny.J	52	Woman	junior high school	Housewife	2 years
Tn.T	65	Man	Elementary school	Entrepreneur	5 years

In table 1, The research respondents numbered 2 people, namely Mrs. J and Mr. T. Ms. J is 52 years old, a housewife, with a junior high school education, and has been suffering from diabetes for 2 years due to genetic factors. The second respondent, Mr. T, is 65 years old, works odd jobs, and has a primary school education. Mr. T has been suffering from diabetes for 5 years due to genetic factors.

Table 2.
blood glucose levels before and after diabetic foot exercise

Name	Pre test	Post test
Ny.J	240 mg/dl	211 mg/dl
Tn.T	197 mg/dl	158 mg/dl

Based on the research results, Ms. J's blood glucose level before being given diabetic foot exercises was 240 mg/dl, and after being given the exercises, the blood glucose level was 211 mg/dl, showing a decrease in blood glucose level with a difference of 29. Mr. T, before being given diabetic foot exercises, had a blood glucose level of 197 mg/dl. After being given the exercises, his blood glucose level was 158 mg/dl, showing a decrease in blood glucose level with a difference of 39.

DISCUSSION

In table 1, according to the Indonesian Ministry of Health (2009), the age range of 46-55 years is considered early elderly, while the age range of 56-65 years is considered late elderly. Diabetes mellitus (DM) is one of the common health issues faced by the elderly. There are several factors that contribute to the high prevalence of diabetes mellitus among the elderly population. First, the aging process itself causes a decline in organ function and metabolism, which affects glucose regulation in the body. The decrease in insulin sensitivity and the pancreas's ability to produce insulin become lower with age, which contributes to an increase in blood glucose levels (Prambudi, R. M. et al., 2023; Yuniarti & Handayani, 2018). Based on the research results, Ms. J's blood glucose level before being given diabetic foot exercises was 240 mg/dl, and after being given the exercises, the blood glucose level was 211 mg/dl, showing a decrease in blood glucose level with a difference of 29. Mr. T, before being given diabetic foot exercises, had a blood glucose level of 197 mg/dl. After being given the exercises, his blood glucose level was 158 mg/dl, showing a decrease in blood glucose level with a difference of 39.Second, an unhealthy lifestyle, including an unbalanced diet and lack of physical activity, also plays a significant role in increasing the risk of diabetes mellitus in the elderly. A diet high in carbohydrates and fats, along with low fiber intake, can lead to obesity, which is a major risk factor for type 2 diabetes (21,22). Additionally, the lack of knowledge about healthy lifestyles and disease management also exacerbates this condition (Hidayah et al., 2022; Nuraisyah et al., 2021).

The case study results showed that both respondents had a genetic history of diabetes mellitus in their families. Genetic factors play an important role in the development of diabetes mellitus, especially in the elderly population. Research shows that type 2 diabetes, which is the most common form of diabetes in adults, has a significant genetic component. Genetics can influence various aspects of this disease, including insulin secretion, insulin resistance, and glucose metabolism (Ozougwu et al, 2013). For example, individuals with a family history of diabetes are more likely to develop this disease as they age (Pillai & Pillai, 2017). Furthermore, research shows that certain genetic variations, such as angiotensin-converting enzyme (ACE) gene polymorphisms, may be associated with hypertension and diabetes in the elderly (Zhou et al., 2013). This indicates that genetic factors not only contribute to diabetes itself but also to other health conditions that often accompany diabetes, such as hypertension, which can worsen the prognosis of diabetes in the elderly (Damayanti, 2022).Diabetes mellitus (DM) is a disease that has different prevalence rates based on gender. Research shows that women tend to have a higher risk of developing type 2 diabetes mellitus compared to men. Several studies show that women have a higher prevalence in the elderly age group, especially over 60 years old. A study at the community health center found that female respondents had a 2.39 times higher risk of developing type 2 diabetes mellitus compared to male respondents (Rosita et al., 2022).

Hormonal factors also play a role in the difference in diabetes prevalence between genders. Women experience significant hormonal changes during menopause, which can affect glucose metabolism and insulin sensitivity. Additionally, women tend to have more body fat in the hip and thigh areas, which can contribute to insulin resistance. Research also shows that women who are obese have a higher risk of developing diabetes compared to men with the same level of obesity. On the other hand, men also have a significant risk of diabetes, but the factors influencing this risk are often different. Men tend to have more visceral fat, which is associated with insulin resistance and an increased risk of diabetes. Additionally, a less active lifestyle and unhealthy eating patterns are more common among men, which can contribute to an increased risk of diabetes (Rosita et al., 2022).The results of the case study showed that both respondents had unstable jobs. One of the respondents works as a housewife. Work can have a significant influence on the development of diabetes mellitus (DM) and vice versa, diabetes can also affect a person's ability to work. Unhealthy or less active jobs can increase the risk of diabetes. Jobs that involve a sedentary lifestyle, such as office work, are associated with an increased risk of obesity and type 2 diabetes. Research shows that individuals who are physically inactive have a higher risk of developing diabetes mellitus compared to those who are active (Ramadhani et al., 2016). In addition, unhealthy eating patterns often associated with busy work schedules can also contribute to an increased risk of diabetes.

On the other hand, diabetes mellitus can affect a person's ability to work. Diabetes patients often experience complications that can affect their work productivity. For example, symptoms such as fatigue, vision problems, and neuropathy can disrupt a person's ability to perform their work tasks effectively (Noor et al., 2023). In addition, diabetes treatment that requires continuous attention and management can disrupt work routines and lead to higher absenteeism.In table 2, The results of the case study were obtained from both respondents after the diabetes foot exercise intervention, which resulted in a decrease in blood glucose levels. After the diabetes foot exercises were conducted on the elderly, there is evidence showing that the blood glucose levels significantly decreased. The research conducted by Sagita (2023) shows that the implementation of diabetes foot exercise therapy over five sessions successfully reduced blood glucose levels from 600 mg/dL to 190 mg/dL in patients with type 2 diabetes mellitus. After the diabetes foot exercise was performed on the elderly, the blood glucose levels decreased due to several physiological mechanisms related to physical activity. First, foot exercises as a form of physical activity can increase insulin sensitivity. When the muscles contract during exercise, they require more glucose for energy, thereby increasing glucose uptake by muscle cells (Rizka et al., 2022; Silva et al., 2019). This process occurs because physical activity stimulates an increase in the number of glucose transporter type 4 (GLUT-4) on the muscle cell membrane, which facilitates the entry of glucose into the cell (Zhou et al., 2022).

Foot exercises can also improve overall glucose metabolism. Physical exercise can reduce blood glucose levels by increasing the metabolic rate, which means the body becomes more efficient in using glucose as an energy source. Research shows that regular physical activity, including gymnastics, can lower fasting blood glucose levels and improve glycemic control in diabetes patients (Fathoni, 2018; Sha, 2024).In addition, leg exercises can help reduce body fat and increase muscle mass, both of which contribute to better glucose regulation. Reduction of visceral fat, which is often associated with insulin resistance, can help improve insulin sensitivity and lower blood glucose levels (Andiana et al., 2022; Schwingshackl et al., 2014).

CONCLUSION

Based on the results of the case study on the application of diabetic foot exercises on blood sugar levels in diabetes patients at the Srondol health center, it was shown that 2 respondents experienced a decrease in blood glucose levels after performing diabetic foot exercises. The study results showed that all respondents performed the demonstrated exercises correctly and

properly. This is supported by a proper and regular diet, taking medication, and exercising. Therefore, preventive and promotive actions are needed, such as early detection of DM risk factors and providing health education to the community about this issue. things related to diabetes mellitus. For healthcare facilities, it is advisable to conduct regular blood glucose tests for elderly patients as well as patients showing signs and symptoms of diabetes mellitus.

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