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Walking Exercises for Diabetes Mellitus Patients with Unstable Blood Glucose Levels: Case Report

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ABSTRACT

Controlling blood sugar levels is the key to the treatment program by reducing weight, dieting, and exercising. Physical activity is one-factor affecting glycemic management for Diabetes Mellitus (DM) patients. This case study aimed to maintain the stability of blood sugar levels in DM patients by applying walking exercises. The design of this research was case report with a nursing process approach carried out on Diabetes Mellitus patients with nursing problems of unstable blood sugar levels. Nursing care was carried out for seven days at Bendo Community Health Center. The intervention implemented is walking exercises. The case study results are presented in the form of nursing documentation. The case study results showed that the patient's blood sugar levels tended to be stable starting on the second day of the intervention. An increase in whole-body insulin sensitivity mostly explains exercise-induced glycemic control. The long-term advantages of frequent exercise on glycemic control are related to the cumulative effect of transitory gains in insulin sensitivity and glycemic control after each bout of exercise rather than structural changes in insulin sensitivity.

Keywords: blood sugar level; diabetes mellitus; walking exercise

Background

Increased blood glucose levels caused by either a limitation in insulin production or an inability to utilize insulin are the hallmark of diabetes mellitus (DM), a family of metabolic diseases (1). The main treatment objective in preventing organ damage and other diabetes-related problems is still maintaining glucose control, which is crucial to patient care. In 2017, 462 million individuals had diabetes mellitus, and by 2045, that figure is expected to rise to 643 million (2). With an 8.6% prevalence of type 2 diabetes mellitus patients among the entire population, Indonesia ranks sixth (3). Out of all the Indonesian provinces, East Java Province has the highest prevalence of diabetes mellitus, ranking fifth (4). In the Magetan Regency Health Office, diabetes mellitus is the second-highest prevalence, with 2,963 cases. Meanwhile, in 2023, there were 811 cases of diabetes mellitus at the Bendo Community Health Center (5).

One of the main risk factors for diabetes mellitus and its aftereffects is a sedentary lifestyle (6). For DM, physical exercise has been suggested as a key nonpharmacological therapy approach. Exercise can help prevent insulin resistance, a condition linked to diabetes, and is essential for managing all types of the illness (7). Many people nowadays are aware that a sedentary lifestyle is a contributing factor to diabetes. Diabetes mellitus can be efficiently

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treated and prevented by engaging in regular physical activity, such as exercise (8). Regular exercise has several benefits for people with diabetes mellitus, including improved insulin sensitivity, decreased blood glucose, and prevention. Preventative medicine advises lifestyle modifications, including regular exercise, to reduce the chance of developing specific conditions (7).

Thus, improving cardio-metabolic risk factors by long-term exercise can result in improved health outcomes. Exercise can alter each fiber's response to insulin without making them enlarge. Exercise is proven to help regulate glycemic management and cardiovascular risk factors (9). Furthermore, it improves DM patients' metabolic profiles. Hexokinase, glycogen synthase, skeletal muscle capitalization, blood flow, and GLUT4 are all increased during exercise (10). The American Diabetes Association (ADA) recommends 90 minutes of strenuous aerobic exercise per week or at least 150 minutes of moderate-intensity physical activity per week, spread out across at least three days and no more than two days without physical activity (11). Resistance training has been shown to boost the body's use of glucose by promoting a muscle fiber type shift and hypertrophy response in working muscles. Resistance exercise improves body composition and flexibility, builds and maintains muscles, and reduces the risk of cardiovascular disease. Potential underlying mechanisms for the positive effects of resistance strength training include increased total muscle mass, increased numbers of insulin receptors in muscle cells, and increased numbers of glucose transporter (GLUT) proteins. One of the easy activities that diabetic individuals undergoing treatment may perform is walking exercises. These benefits include improved glucose regulation, bone mineral density, and blood lipid profiles in healthy persons (12).

Research Objectives

This case report analyzes the application of walking exercises in diabetes mellitus patients with nursing problems of unstable blood glucose levels at the Bendo Magetan Community Health Center.

Methods

This study's design is a case report using a nursing process method, which encompasses assessment, nursing issue formulation, intervention development, implementation, and evaluation. The patient undergoing treatment has been diagnosed with diabetes mellitus and is experiencing fluctuating blood sugar levels. The Indonesian Nursing Diagnosis Standards' major and minor data serve as the foundation for patient selection. The Bendo Community Health Center was the site of the case. For seven days, nursing care was provided. Every piece of information is recorded using nursing documentation. This case report underwent ethical testing at the health research ethics commission of the Faculty of Health Sciences, Muhammadiyah University of Ponorogo, and was declared ethically sound with certificate number 527/ER/KEPK/2024.

Results

A 67-year-old female patient with Diabetes Mellitus and hypertension. The patient said that sometimes he suddenly feels weak, easily tired, and his palms feel hot. General Condition: Good, Consciousness: compos mentis, GCS: E=4, V=5, M=6 blood pressure: 160/90 mmHg Respiration rate: 22 x/minute Pulse: 82 x/minute Temperature: 36.3°C HbA1c on August 27, 2024: 10.3 mg/dl random blood sugar on September 18, 2024: 389 mg/dl. The patient has had a history of hypertension for 2 years and suffered from kidney stones in 2016. The patient's therapy was Levemir 12 IU subcutaneous injection, Amlodipine 5 mg 1 x 1 tablet orally, and Simvastatin 40mg 1 x 1 tablet orally. Diagnostic examination revealed that the patient was suffering from hyponatremia and hyperglycemia. In carrying out nursing care, patients are

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given informed consent. The main nursing problem determined was the instability of blood sugar levels according to the Indonesian Nursing Diagnosis Standards (D.0027). The interventions carried out refer to the Indonesian Nursing Intervention Standards in the form of Hyperglycemia Management (I.03115), which consist of: Observation: 1) Identify possible causes of hyperglycemia 2) Identify what situations cause the body's need for insulin to increase (for example: frequently recurring diseases) 3) If necessary, monitor blood glucose levels 4) Monitor signs and symptoms of hyperglycemia (for example: polyphagia, polyuria, polydipsia, malaise, headache, blurred vision, and weakness) 5) Monitor fluid output and intake 6) Monitor pulse rate. Therapeutic: Consult with the medical team if hyperglycemia signs and symptoms persist or worsen. Education: 1) Advise to monitor blood glucose levels independently, 2) Advise to comply with diet and exercise (walking exercise), 3) Teach diabetes management (for example: use of oral medications, insulin, monitor fluid intake, carbohydrate replacement and assistance from health professionals).

Application of walking exercises is carried out after the assessment. These walking exercises are carried out using the many research. A few RCTs consistently showed improved blood glucose profiles after interruption of prolonged sitting in T2DM, e.g. 3 min every 30 min, and this effect was maintained for several hours (13). Walking, as recommended by the American Diabetes Association (ADA), is a great way for people with diabetes to improve their health. It's a low-impact aerobic exercise that can help lower blood sugar, improve insulin sensitivity, and reduce the risk of heart disease. The ADA recommends at least 150 minutes of moderate-intensity aerobic activity per week, which can be achieved through regular walking. Like any other training regimen, a walking prescription must contain some crucial guidance about movement technique and contextual factors: Warm-up: to prepare for proper joint range motions, various upper and lower limb stretching activities are helpful before starting a walking session;

The selection of footwear and apparel for walking has to be suitable for the terrain and season, as well as for comfort and safety; Extreme conditions: diabetic patients are free to wander in without any special restrictions. For these individuals, general health concerns about excessive temperatures are also relevant, particularly when combined with wind or humidity. Subjects that have cardiovascular abnormalities, however, require extra vigilance. At a given walking intensity, both high and low temperatures increase metabolic demands, hence it is generally advised to reduce pace and distance.

During the implementation of the intervention, blood sugar levels were monitored before and after foot exercises for 6 days. Measurements were taken one hour after the intervention was carried out. The intervention is carried out once a day. The results of monitoring blood sugar levels can be seen in Table 1 below:

Table 1. Monitoring blood sugar levels

Day	Blood sugar levels (gr/dl)		Number of changes (gr/dl)	Average (gr/dl)
	Before	After		
1	389	371	decrease 3	5,2
2	326	321	decrease 5	
3	248	243	decrease 5	
4	236	241	increase 5	
5	225	213	decrease 12	
6	220	218	decrease 2	

In the table, the results showed that blood sugar levels remained stable until day six. There was an increase on day four. The average change in blood sugar levels was 5.2 g/dl.

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Discussion

Patients with diabetes mellitus are at risk for severe outcomes. One such problem connected to increased morbidity, mortality, and medical costs is foot ulcers (14). Amputation and reduced physical mobility are significant risks for patients with diabetes mellitus. The suggested physical activity regimens for these patients at risk of developing foot ulcers are currently little understood. In addition to six days of walking exercises, this patient got nurse care for seven days. This exercise is performed once daily since the patient's blood pressure is usually raised from the start of the test. Significantly elevated blood sugar levels were also observed throughout the assessment. It might be challenging to treat people with type 2 diabetes as a single, homogenous group. For instance, a person's level of glucose management may differ from another's. Despite receiving the identical physical activity intervention, people with varied baseline HbA1c levels had diverse HbA1c responses, as demonstrated in earlier research (15).

The primary goals of diabetes management are to prevent complications and provide a high quality of life for persons with diabetes. In many studies, physical activity has been shown to provide therapeutic advantages (Cai et al., 2017). Over time, it has been demonstrated that exercise, in particular, benefits people with diabetes by positively altering body composition and glycaemic control, serving as a protective factor (Asfaw & Dagne, 2022). Both aerobic and anaerobic processes in cells use glucose to generate energy. Glucose is transported across cell membranes by transmembrane proteins known as glucose transporters, or GLUTs. Insulin increases glucose uptake by facilitating its entry into the skeletal and adipose tissues. It has been suggested that insulin-induced GLUT4 translocation from intracellular compartments to the cell membrane increases the overall rate of glucose flux into a cell (Wang et al., 2020). In order to avoid hyperglycemia and its related pathophysiological consequences, postprandial elevated blood glucose levels are quickly lowered by glucose absorption into peripheral tissue (16). The primary mediator of this process is the GLUT family member insulin-dependent glucose transporter type 4 (GLUT4), which is mainly expressed in muscle and adipocyte cells. All 14 transmembrane GLUT proteins share basic structural components, including 12 transmembrane segments, ATP and glucose binding sites, and N and C termini in the cell's cytoplasm (17). Insulin-induced GLUT4 translocation is necessary for the cellular absorption of glucose in muscle and fat cells, which reduces blood glucose levels (Heckmann et al., 2022). Exercise and PA are beneficial for people of all ages, including those with DM, prediabetic/MetS, and asymptomatic/healthy. Nevertheless, the outcomes are not definitive, and not all indicators of insulin sensitivity and glycemic control exhibit improvements, even within studies (Bird & Hawley, 2016). Because skeletal muscle cellular remodeling increases basal metabolism and oxidative capability, these alterations also impact body composition (18) The walking exercise improves glycemic control and body composition in people with diabetes mellitus. Walking significantly impacts postprandial glucose excursions in healthy populations and in those with type 1 diabetes (19). Postprandial walking may be more effective at lowering the glycemic impact of the evening meal in individuals with type 2 diabetes compared with pre-meal or no exercise and may be an effective means to blunt postprandial glycemic excursions (20). In other hand postprandial moderate-intensity walking, easily performable in daily life activities, was effective for improving glucose homeostasis (21) Previous hypotheses suggest that walking exercise causes physiological alterations that improve plasma glucose stability and aid in treating persistent hyperglycemia (22).

Most of DM patients prefer walking since it helps them maintain and lose weight and improves their glycemic control (23). However, sufficient walking must be done to get the advantages of a walking-based fitness program (24). Patients with diabetes should exercise for at least 30 minutes a day, at a moderate to high intensity. Ideally, this exercise should be spaced out throughout the course of the week and last at least ten minutes. Even though lower

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intensities should be initially prescribed for very deconditioned patients, most people with type 2 diabetes who are participating in walking-based exercise training should be encouraged to maintain an intensity between 40 and 59% heart rate reserve (HRR, which is calculated as a percentage of maximum heart rate minus resting heart rate) (13).

Conclusions and Recommendations

DM patients can better control their blood glucose levels by exercising. Healthcare professionals and their patients should be made aware of the importance of physical activity in blood glucose control. However, persons with DM typically do not follow exercise suggestions. The most basic human physical exercise that may be readily incorporated into daily life is walking. For many patients, it can be the first easy step in changing their lifestyle. Numerous writers assert that blood glucose monitoring plays a critical role in glycemic control for individuals with long-term conditions. There is sufficient evidence to recognize that walking is a useful therapeutic tool for people with DM. These findings could be explained by a variety of factors, such as socioeconomic and cultural factors, personal physical limitations, fear of hypoglycemia (in patients receiving insulin or some insulin secretagogues), doctors' lack of understanding of exercise prescription principles and their limited appreciation of the significance of lifestyle modifications in comparison to pharmaceutical tools, and the health care systems' lack of support for exercise programs. Lack of facilities for physical exercise and poor walkability might be other problems, particularly in big cities.

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