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Buerger Allen exercise in patients with diabetes mellitus type II to improve peripheral blood circulation and blood glucose levels

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a prevalent chronic metabolic disorder among the elderly, characterized by elevated blood glucose levels and a high risk of complications, including impaired peripheral circulation. Older adults are particularly susceptible due to physiological decline and reduced physical activity. The Buerger Allen exercise is known to enhance peripheral blood flow and assist in controlling blood glucose levels.
Purpose: To examine the effect of Buerger Allen exercises on peripheral circulation among elderly individuals with type 2 diabetes mellitus.
Method: A quantitative quasi-experimental design with a one-group pretest–posttest approach was applied. The intervention involved performing Buerger Allen exercises three times per week for two weeks, with each session lasting 17 minutes. The study included 10 elderly participants residing in Atakkae Village, with data collected at the Salewangeng Community Health Center. A total sampling technique was employed, resulting in a sample size of 10 respondents.
Results: The mean Ankle Brachial Index (ABI) increased from 0.94 mmHg (pretest) to 0.99 mmHg (posttest), indicating improved peripheral circulation. Additionally, the average random blood glucose (RBG) level decreased from 323.6 mg/dL to 308.3 mg/dL after the intervention. Statistical analysis yielded a p-value < 0.05 for both parameters, signifying a significant effect of the Buerger Allen exercise on peripheral blood circulation and glucose reduction.
Conclusion: Buerger Allen exercises are effective in enhancing peripheral blood circulation and lowering blood glucose levels among elderly patients with type 2 diabetes mellitus.

Keywords: Beurger Allen Exercise; Blood Glucose Levels; Elderly; Peripheral Blood Circulation; Type 2 Diabetes Melitus.

INTRODUCTION

Diabetes mellitus (DM) is a non-communicable disease caused by the body's insufficient insulin production (Qusyairi, Sani, & Hasan, 2022). Diabetes mellitus is also a common disease that occurs in society, both long-term and short-term (Saputri, 2020).

Diabetes mellitus cases increased by approximately 422 million worldwide in the past three years (World Health Organization, 2022). Indonesia has a high risk of diabetes mellitus, with 6.2% or 10 million sufferers in 2022 (Yuningsih & Rosita, 2022). In 2022, the prevalence of diabetes mellitus in South Sulawesi continued to increase by 23% (Maria, Wahiduddin, Thaha, & Firman, 2024). Data from the Health Office indicates that the second-highest number of non-communicable disease cases in Wajo, after hypertension, is diabetes mellitus, with an estimated 6,544 cases in 2023 across all ages. In

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2024, the number of diabetes mellitus cases was recorded at 4,958. Salewangeng Community Health Center was the third-highest health care facility with 413 cases of diabetes mellitus across all ages in 2023 (Statistics Indonesia of Wajo Regency Office, 2024).

Most diabetes mellitus cases are due to type 2 diabetes mellitus (Aryani, Hisni, & Lubis, 2022). The highest prevalence is also found in type 2 diabetes mellitus (Murtiningsih, Pandelaki, & Sedli, 2021). Type 2 diabetes mellitus, which is associated with peripheral circulatory disorders, continues to increase globally (Yammar, Wardanengsih, Utami, Barangkau, Darwis, & Fatmawati, 2024). Type 2 diabetes mellitus is a metabolic disease characterized by impaired glucose metabolism and can also cause complications, including impaired peripheral blood circulation (Deski, & Yendrial, 2024). Problems often occur among diabetes mellitus patients due to high blood glucose levels (Yuningsih & Rosita, 2022). Blood glucose levels increase with age, which makes more and more elderly people at risk of developing diabetes mellitus. Diabetes Mellitus is one of the diseases experienced by most elderly people (Listyarini, Budi, & Assifah, 2022; Milita, Handayani, & Setiaji, 2021).

According to the Indonesian Ministry of Health, reduced physical activity can also contribute to increased Diabetes Mellitus in the elderly (Listyarini et al., 2022). Physical activity is the main principle in preventing more serious peripheral vascular disease in diabetes patients, and one type of exercise that can be done is the Buerger Allen Exercise (Gavit, 2021). The Buerger Allen Exercise aims to improve blood circulation to the legs by utilizing changes in gravity through active ankle movement, which helps smooth the functioning of blood vessel muscles and increases blood flow in the arteries and veins (Lenggogeni, 2023).

Based on preliminary data obtained by the researchers on December 24, 2024, from the Salewangeng Community Health Center, a total of 355 diabetes mellitus cases were recorded from January to November across all age groups. Among them, 66 cases occurred in men and 122 in women with type 2 diabetes mellitus, comprising 188 elderly individuals aged 60 years and above. The Salewangeng Community Health Center serves six sub-districts, with Atakkae Sub-district reporting the highest number—50 elderly individuals diagnosed with type 2 diabetes mellitus. However, not all of these patients have received Buerger Allen Exercise training. The absence of such therapeutic intervention may increase the risk of severe complications. Type 2 diabetes mellitus can lead to various serious complications if not managed through appropriate and comprehensive treatment strategies (Muslim, Mahendra, Paramitha, Dewi, & Texaga, 2023).

Research related to the effect of Buerger Allen Exercise on peripheral blood circulation and blood glucose levels in the elderly is also still limited and not very popular among the public (Salihun, Idris, & Ariyandy, 2022). This can be seen from the absence of researchers researching Buerger Allen Exercise therapy at Salewangeng Community Health Center.

RESEARCH METHOD

A quantitative design using a quasi-experimental approach with a one-group pretest–posttest design was employed. A single intervention was administered to one group of participants, where both the Ankle-Brachial Index (ABI) and Random Blood Glucose (RBG) were measured before and after the intervention.

The study was conducted over a two-month period, from April to June 2024, in Atakkae Village. The research population included all elderly individuals diagnosed with type 2 diabetes mellitus (T2DM) residing in the area. A total sampling technique was applied, as only 10 individuals met the inclusion criteria. Participants who consented to join the study signed informed consent forms and subsequently participated in the therapy. Demographic data were collected using a structured questionnaire describing participants' characteristics.

The Buerger Allen exercise was performed for 17 minutes per session, three times a week for two weeks. The procedure consisted of several positions: lying supine with the legs elevated at a 45° angle, sitting on the bed with legs hanging down, performing dorsiflexion and plantar flexion followed by inward and outward foot movements, and finally lying supine again with the feet covered by a blanket.

To determine the effectiveness of the Buerger Allen exercise in stabilizing peripheral blood

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circulation and reducing blood glucose levels, statistical analyses were performed using SPSS version 26. Differences between pretest and posttest values were analyzed using the Paired Sample t-test for normally distributed data, or the Wilcoxon Signed-Rank Test for non-normally distributed data. A p-value < 0.05 was considered statistically significant.

This research has been declared ethically appropriate by the Health Research Ethics Committee of the STRADA Institute of Health Sciences with the number: 001443/EC/KEPK/I/07/2024.

RESEARCH RESULTS

Table Characteristics of the Participants (N=10)

Variable	Results	p-value
Age (Mean±SD)	(64.44± 3.08)	
Gender (n/%)		
Male	5/50.0	
Female	5/50.0	
Duration of Type II Diabetes (n/%)		
1-2 Years	6/60.0	
3-4 Years	4/40.0	
>5 Years	-	
Daily Activities (n/%)		
Cleaning the House	-	
Cooking	5/50.0	
Farming	3/30.0	
Gardening	2/20.0	
Peripheral Blood Circulation (Mean±SD)		
Pre	(0.80±0.022)	0.000
Post	(0.92±0.032)	
Random Blood Glucose Levels (Mean±SD)		
Pre	(323.6±55.40)	0.000
Post	(208.3±50.35)	

The table above presents the characteristics of 10 elderly participants diagnosed with type 2 diabetes mellitus. The mean age of the respondents was 64.44 years (SD ±3.08), consisting of five men and five women. The majority had been living with type 2 diabetes for approximately one to two years. Most participants were routinely engaged in daily activities such as cooking, which contributed to random blood glucose levels that remained above the normal range. Results of the paired sample t-test indicated a p-value of 0.000 (<0.05), demonstrating that Buerger Allen Exercise therapy significantly improved peripheral blood circulation among elderly individuals with type 2 diabetes mellitus. The mean ankle-brachial index (ABI) increased from 0.80 mmHg before intervention to 0.92 mmHg after intervention. Similarly, the paired sample t-test showed a p-value of 0.000 (<0.05) for blood glucose levels, indicating that Buerger Allen Exercise therapy was effective in lowering random blood glucose levels. The mean RBG value decreased from 323.6 mg/dl prior to the intervention to 208.3 mg/dl post-intervention.

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DISCUSSION

Changes in peripheral blood circulation

Physical activity, including the Buerger Allen Exercise, plays an essential role in preventing the progression of vascular complications in individuals with diabetes mellitus (Gavit, 2021). Several studies have demonstrated that this exercise enhances and smoothens blood circulation, thereby improving blood flow to the lower extremities and reducing the risk of foot ulcers among diabetic patients. Consequently, regular foot exercises and physical activity are considered effective strategies for managing and preventing diabetes-related complications (Naning & Muftadi, 2024; Lenggogeni, 2023).

Building on these findings, the present study investigated the effect of Buerger Allen Exercise therapy on peripheral circulation among elderly patients with Type 2 Diabetes Mellitus (T2DM) by assessing changes in the Ankle-Brachial Index (ABI) before and after the intervention. After six sessions conducted over two weeks, results revealed a notable improvement in peripheral circulation, with the mean ABI increasing from 0.80 mmHg pre-intervention to 0.92 mmHg post-intervention. This improvement indicates enhanced blood flow, which may result from decreased vascular resistance and increased arterial elasticity—consistent with previous studies showing that higher ABI values reflect better peripheral circulation (Akbar, 2023).

The consistent rise in ABI values across participants throughout the intervention period suggests progressive improvement in vascular function due to repeated stimulation. These findings align with prior research reporting significant increases in ABI following Buerger Allen Exercise interventions conducted over six sessions within six days, each lasting approximately 15 minutes (Salam & Laili, 2020; Romlah & Mataputun, 2021). Similarly, a study demonstrated a statistically significant improvement in ABI using a paired t-test after six consecutive days of intervention (Ibrahim, Aisyah, & Suaib, 2024). The present study, however, adopted a three-times-per-week schedule over two weeks, allowing a rest day between sessions. This approach aimed to minimize fatigue, facilitate adaptation to the exercise, and promote better compliance among participants with varying activity levels. Such flexibility may also enhance long-term adherence and sustainability of the intervention. Although all respondents exhibited improved ABI scores, the degree of change varied, reflecting individual differences in response to the same exercise regimen (Ibrahim et al., 2024; Wijayanti & Warsono, 2022).

The Buerger Allen Exercise is specifically designed to promote blood flow to the lower limbs through gravitational and muscular mechanisms (Thakur, Sharma, Sharma, Thakur, & Jelly, 2022). The exercise sequence consists of alternating positions—leg elevation, dependent positioning, and rest—to optimize venous emptying and arterial filling. During the elevation phase, gravity aids venous drainage and increases venous return to the heart, thereby enhancing cardiac output. In the dependent phase, when the legs hang down, gravity facilitates arterial perfusion to the lower extremities, while dorsiflexion and plantar flexion movements stimulate muscular contractions that further improve blood flow. These movements also help maintain tendon flexibility and prevent joint stiffness. The final resting phase in the supine position promotes reperfusion of the limbs by eliminating gravitational resistance to blood flow (Chang, Chen, Shen, Lin, Hsu, & Lin, 2016; Patidar, 2018).

Given its practicality, low cost, and simplicity, the Buerger Allen Exercise is highly suitable for integration into promotive and preventive programs at the primary healthcare level. It can be performed independently by older adults or with assistance from caregivers and health workers. Previous studies have also emphasized its benefits for elderly individuals with limited mobility (Takahepis, Suprapti, & Hastono, 2021). Moreover, this intervention is particularly applicable in rural or resource-limited settings, where access to advanced healthcare services may be restricted. Peripheral blood circulation can be conveniently assessed using standard blood pressure monitoring tools—by measuring blood pressure at the ankles and arms before and after the exercise session (Lenggogeni, 2023).

The results of this study demonstrated a p-value < 0.05, confirming that performing the Buerger Allen Exercise three times per week for two weeks

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significantly improved blood circulation. Consequently, it can be concluded that regular participation in the Buerger Allen Exercise not only enhances peripheral circulation but also contributes to lowering blood glucose levels and improving Ankle-Brachial Index values in elderly patients with type 2 diabetes mellitus.

Changes in blood glucose levels

Blood glucose levels tend to increase with age, making older adults more susceptible to developing diabetes mellitus (Listyarini et al., 2022). Consequently, researchers have explored various effective strategies for managing diabetes among the elderly. Managing type 2 diabetes mellitus in this population requires a practical and easily implemented approach, one of which is physical exercise interventions such as the Buerger Allen Exercise (BAE). In line with this, the present study also found that physical activity, including the Buerger Allen Exercise, enhances insulin sensitivity, thereby improving blood glucose control by increasing glucose utilization in active muscles. This process activates more insulin receptors, contributing to the regulation of blood glucose levels (Takahepis et al., 2021; Nurjanah, Aini, Herliyanti, Nuradini, Diel, Haeriyah, & Imanuddin, 2024).

The findings revealed that the Buerger Allen Exercise, conducted three times a week for two weeks (17 minutes per session) among 10 elderly participants with type 2 diabetes mellitus, successfully lowered random blood glucose (RBG) levels, with continuous improvement observed across sessions. The average pre-intervention RBG was 323.6 mg/dL, decreasing to 208.3 mg/dL post-intervention.

This reduction in blood glucose levels demonstrates a positive response to the therapy, although levels had not yet reached the clinically normal range (≤ 200 mg/dL). It suggests that achieving normal levels is likely with longer and more consistent interventions, especially in older adults who typically require extended timeframes to experience significant metabolic improvements. This finding supports previous research indicating that managing type 2 diabetes mellitus, as a chronic condition, demands prolonged intervention to achieve optimal outcomes (Marliyana & Nurhayati, 2023). Despite regular monitoring, blood glucose levels often fluctuate, sometimes increasing or decreasing (Ina, Utami, & Natalia, 2019), which can be attributed to biological variations and daily activities (Torimoto, Okada, Mori, & Tanaka, 2013).

These results are consistent with earlier studies, such as one reporting that daily Buerger Allen Exercise therapy for six consecutive days effectively reduced blood glucose levels in five diabetic respondents (Rahmawati & Ningrum, 2025). Building on this evidence, the present study implemented Buerger Allen Exercise three times a week over two weeks (six sessions total), with rest days between sessions. This schedule was designed to reduce fatigue and promote sustainable improvements through better physiological adaptation. However, contrasting evidence exists; another research found no statistically significant difference in blood glucose levels before and after Buerger Allen Exercise ($p > 0.05$) (Mataputun, Prabawati, & Tjandrarini, 2020).

Research with a similar exercise frequency also found that combining the Buerger Allen Exercise with warm foot soaks significantly reduced blood glucose levels in elderly individuals with type 2 diabetes mellitus (Savitri & Ratnawati, 2017). That study involved 12 interventions over 15 days and produced significant outcomes. Although the intervention schedule (three times a week for two weeks) resembles the current study, the two differ in focus—this study examined only the Buerger Allen Exercise and measured two dependent variables (blood glucose levels and blood circulation), while the previous research combined two interventions but assessed only one outcome.

Buerger Allen Exercise is an effective therapeutic intervention that lowers blood glucose levels through gentle leg movements, which enhance local muscle contractions, boost cellular metabolism, and increase glucose utilization, thus reducing blood glucose levels in individuals with type 2 diabetes mellitus (Mataputun et al., 2020). It is considered practical, simple, and cost-effective, making it highly suitable for elderly individuals with limited mobility and easily adaptable for home-based diabetes education programs. This aligns with previous research emphasizing its practicality and accessibility for elderly patients (Takahepis et al., 2021).

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To evaluate the intervention's effectiveness, an appropriate measurement tool—such as a glucometer—was used to assess changes in blood glucose levels. Random blood glucose (RBG) testing is a simple and effective method for monitoring and detecting metabolic disorders (Al Fariqi & Yunika, 2022; Riawan, Kristanto, & Ikawati, 2022).

Engaging in physical activity like the Buerger Allen Exercise improves insulin sensitivity and enhances glucose regulation. When the body is active, muscles require more energy, leading to increased glucose uptake. This, in turn, stimulates insulin receptors and facilitates better blood glucose control. As glucose—derived from carbohydrate metabolism—is efficiently utilized by muscles to meet energy needs, blood glucose levels subsequently decrease, particularly in diabetic individuals (Nurjanah et al., 2024).

Statistical analysis in this study produced a p-value < 0.05, indicating a significant decrease in blood glucose levels following the Buerger Allen Exercise intervention performed three times weekly for two weeks. Based on these findings, it can be concluded that regular participation in Buerger Allen Exercise effectively lowers blood glucose levels and positively influences random blood glucose values.

CONCLUSION

The Buerger Allen Exercises are effective to stabilize peripheral blood circulation and help reduce blood glucose levels in the elderly with type 2 diabetes.

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