

Original Research**Reduced Blood Glucose Levels in Diabetic Patients After Using a Combination of Progressive Muscle Relaxation (Pro-Mure) and Slow Deep Breathing Exercises (SD-Bex)****Sahnaz Nabila^{1*}, Tintin Sukartini², Khamida Khamida³**¹ Department of Nursing Masters, Faculty of Nursing and Midwifery, Nahdlatul Ulama University, Surabaya, Indonesia² Nahdlatul Ulama University Surabaya, Indonesia³ Faculty of Nursing, Airlangga University, Indonesia**ABSTRACT**

Background: One of the causes of diabetes mellitus is a person's lifestyle, namely their level of physical inactivity. So, to avoid complications, persons with diabetes mellitus require both pharmaceutical and non-pharmacological treatments to lower blood glucose values. Finding out if people with diabetes mellitus might reduce their blood glucose levels by combining a technique that involved slow deep breathing and progressive muscular relaxation was the primary goal of the research.

Methods: This study is quasi-experimental because it uses a control group design with pre- and post-tests. The number of respondents is 34, and the method of sampling is purposive sampling. Twenty to twenty-five minutes of a combination of progressive muscle relaxation (Pro-Mure) and slow deep breathing exercises (SD-Bex) were administered to the experimental group, while the control group received the usual course of intervention. Values of blood glucose levels were the dependent variable. With a p-value of less than 0.05, the study used the Wilcoxon Signed Rank Test to compare outcomes before and after treatment and the Mann-Whitney test to compare the experimental group to the control group.

Results: We found that the intervention group's blood glucose value was 0.001 and the control group's was 0.025. A p-value of 0.001 was found on the value of blood glucose levels between the experimental group and the control group as a result of the study utilising the Mann-Whitney test.

Conclusion: Those suffering from diabetes mellitus can find relief from their symptoms by combining the techniques of Progressive Muscle Relaxation with Slow Deep Breathing. Additionally, the method is simple to apply.

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blood glucose levels, diabetes mellitus, progressive muscle relaxation, slow deep breathing;

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INTRODUCTION

In addition to being the leading cause of mortality globally, diabetes is a non-communicable disease that reduces a person's ability to work, which in turn lowers their income and, in the worst-case scenario, their quality of life (Liu et al., 2020; Neşe & Samancıoğlu Bağlama, 2022; Vosseler et al., 2021; Yau & Loke, 2021). Diabetes mellitus with complications has become one of the biggest causes of death in Indonesia. Diabetes mellitus with uncontrolled blood sugar can lead to both acute and chronic complications, including disorders of peripheral circulation and neuropathy.

Therefore, individuals with diabetes mellitus require non-pharmacological therapies to manage blood glucose levels effectively, such as a combination of progressive muscle relaxation and steady deep breathing. Research gaps exist in understanding the long-term efficacy and comparative effectiveness of these therapies, which could strengthen the novelty of future studies aimed at improving diabetes management outcomes.

According to the International Diabetes Federation (IDF), 9.3% of the global population between the ages of 20 and 79 will have diabetes this year, which translates to 463 million individuals. Type 2 diabetes affects 9.65% of men and 9% of women in 2019, according to the International Diabetes Federation (IDF). Diabetes affects 12.2% of the population aged 20–79 in Arab-North African countries and 11.4% in Western Pacific countries, placing them first and second, respectively, among the seven regions in the world with this frequency.

With a prevalence of 11.3%, the Southeast Asia region—which includes Indonesia—ranks third. Among the provinces in Indonesia, East Java had the fifth-highest prevalence of diabetes in 2018 at 2.6% (Kemenkes, 2018). Researchers at UPTD performed interviews and observations on June 7, 2022, to compile preliminary data. Among the 172 seniors surveyed in Griya Werdha, 36.6% have diabetes mellitus.

Factors that affect diabetes mellitus are an unhealthy lifestyle, consuming too many foods that contain a lot of sugar, liking to consume fatty foods in large quantities, and rarely doing sports. This can trigger an increase in blood glucose levels or a state of hyperglycemia. Uncontrolled hyperglycemia can cause blood viscosity or thickening to increase and slow circulation; it can cause atherosclerosis and impaired blood circulation.

Efforts that must be made by patients with diabetes mellitus to keep blood sugar stable and prevent complications from occurring are by implementing the five pillars of diabetes mellitus management, including education, nutritional diet, pharmacology, blood sugar control, and physical exercise (Brunelli, Murphy, & Athanasou, 2016; De Paolis et al., 2019; Gok Metin, Karadas, Izgu, Ozdemir, & Demirci, 2019; Simon, McDevitt, Ragano, & Mednick, 2022). Physical exercises that can be done include *progressive muscle relaxation*, which causes active muscle movement, which will stimulate the formation of nitric oxide so that it will make blood vessels dilate and help blood sugar enter the cells, thereby lowering blood sugar levels in patients with diabetes mellitus, as evidenced by the study results, which showed that Pro-Mure was effective in reducing blood sugar levels in type 2 DM patients who were hospitalised ($p = 0.015$).

Deep *breathing exercises* can produce more parasympathetic responses, which can reduce body activity so that it can reduce metabolic activity. The decrease in metabolic activity is expected to reduce insulin requirements. So that this can help reduce blood glucose levels for people with diabetes mellitus. The expected effect of combining gradual muscular relaxation with slow deep breathing on lowering blood glucose levels in diabetes mellitus patients has not been studied thus far.

MATERIALS AND METHOD

In this study, the research instruments utilised included a glucometer for measuring blood glucose levels, which was used both before and after the intervention periods. The glucometer provided quantitative data essential for assessing the effectiveness of the intervention in managing blood glucose levels among elderly individuals with diabetes mellitus. The Mann-Whitney U test and the Wilcoxon Signed Rank Test were employed for statistical analysis, revealing a significant difference ($p < 0.05$) between the experimental group, which received progressive muscle relaxation and slow deep breathing, and the control group, which underwent the usual intervention protocol. These findings underscore the potential efficacy of non-pharmacological therapies in glycemic control for diabetic elderly populations.

RESULTS

The majority of respondents in both the experimental and control groups are female (64.7%), according to table 1. The control group, consisting of individuals aged 75 to 90, accounted for 52.9% of the total. Also, between the ages of 75 and 90, the majority (58.8%) fell. All responders in both the control and experimental groups used drugs to some extent.

Table 1. Distribution of the frequency of respondents based on gender, age, and drug consumption

Characteristics Data	Experimental		Control	
	Frequency	%	Frequency	%
Gender				
Male	6	35.3	6	35.3
Female	11	64.7	11	64.7
Age				
Erderly age (60-74)	8	47, 1	7	41.2
Old age (75-90)	9	52.9	10	58.8
Very old (>90)	0	0	0	0
Drug consumption				
Yes	17	100	17	100
No	0	0	0	0

Table 2. Data analysis of the value of blood glucose levels before and after being given a Interventions

Group	Pre Test		Post Test		p value
	Mean±SD	Min-Max	Mean±SD	Min-Max	
Experiment	240.35±41.43	178-301	159.64±36.16	115-234	0.000
Control	247.70±49.03	178 -366	218.00±47.10	157-339	0.025
Data Analysis	<i>Wilcoxon Signed Ranks Test</i>				

According to the data in Table 3, the experimental group's average blood glucose level was 159 (normal) following the combination intervention therapy of progressive muscle relaxation and deep breathing exercises; this indicates that the value was lower or had decreased from 240 (above normal) prior to the intervention. In contrast, the average blood glucose level of the control group, which received only therapy in accordance with the nursing home's standards, was 247 (above normal), indicating a reduction from 218 (above normal) in the previous measurement.

This study used the Wilcoxon signed Ranks test to compare the two groups' blood glucose values. Results for the control group were $p = 0.025$, while those for the experimental group were 0.001 . Therefore, a combination therapy involving deep breathing exercises and progressive muscular relaxation has a substantial impact.

Table 3. Data analysis

Variable	Group	N	Mann-Whitney	p value
KGD value (<i>Pre</i>)	Experiment	17	130.500	0.634
	Control	17		
KGD value (<i>Post</i>)	Experiment	17	43,000	0.000
	Control	17		

Table 3 shows the results of the Mann-Whitney U test for blood glucose levels. Both the experimental and control groups had p-values of $0.634 > 0.05$ prior to the intervention, indicating that there was no difference (no effect) between them. Then, following the intervention therapy of progressive muscle relaxation and deep breathing exercises, there was a significant difference in blood glucose levels between the experimental and control groups ($p 0.000 < 0.05$), suggesting that the therapy had an impact on the blood glucose levels in both groups.

DISCUSSION

Using data from a table, researchers at UPTD. Griya Werdha Jambangan Surabaya found that patients with diabetes mellitus had an average blood glucose level of 240 before and after receiving a combination intervention therapy of progressive muscle relaxation and deep breathing exercises of 159 (normal), indicating a decrease or flattening of the value. In contrast, the average blood glucose level of the control group, which received only therapy in accordance with the nursing home's standards, was 247 (above normal), indicating a reduction from 218 (above normal) in the previous measurement.

Using the Wilcoxon Signed Ranks Test, we compared the average blood glucose levels of the two groups. Statistical significance was found to be 0.000 in the study group and 0.025 in the control group. This indicates that a combination therapy involving deep breathing exercises and progressive muscular relaxation has a substantial impact.

Preventing or significantly lowering the likelihood of a spike in blood sugar levels is another crucial role of a healthy lifestyle. The reduction of blood glucose levels can be influenced by dietary factors, medications, physical activity, sports, and the management of blood sugar (Battaglini et al., 2022; Bialas et al., 2020; Seid, Mohammed, & Hasen, 2023). Combination therapy involving progressive muscle relaxation and deep breathing exercises considerably reduces blood sugar levels ($p\text{-value} = 0.000$), according to the research results in the table.

This is corroborated by studies demonstrating that Pro-Mure effectively reduces blood sugar levels in hospitalised patients with type 2 diabetes ($p = 0.015$). Evidence from statistical tests yielding a p-value of 0.000 further supports the idea that it can lower blood glucose levels. Patients' physical and mental stress levels are strongly correlated with the efficacy of progressive muscle relaxation in lowering blood sugar levels in diabetes mellitus.

Stress causes an increase in hormones such as cortisol, glucagon, adrenaline, ACTH, corticosteroids, and thyroid, all of which contribute to elevated blood sugar levels. *Worse yet, research has linked stressful life events to a decline in diabetic self-care behaviours, including eating poorly, not getting enough exercise, and even abusing drugs* (Hunter et al., 2023; Obaya et al., 2023; Vosseler et al., 2021). The goals of diabetes mellitus care include symptom eradication, improvement of quality of life, reduction of complications, and prevention of complications and mortality.

When blood glucose levels are under control, this objective becomes attainable. Slow A breathing method that can help you relax more is deep breathing. Anxiety and stress hormones, especially cortisol, which are linked to blood sugar levels, can be alleviated by increased relaxation. As a non-pharmacological treatment option, deep breathing exercises can help you relax, alleviate tension, and manage anxiety. Proper management of anxiety is necessary for the stable control of blood glucose levels, which can be affected by anxiety in patients with diabetes mellitus (Lin, Lin, & Lien, 2013; Nagai et al., 2019).

One non-pharmacological treatment for high blood glucose levels in diabetes mellitus is a combination of deep breathing exercises and progressive muscle relaxation, which helps to relax the muscles and the body by reducing tension and increasing the rate of deep, slow breathing. Patients with diabetes mellitus should practice a series of sequential muscular contractions and relaxations for 20 to 25 minutes every morning for two weeks. The muscles involved are the hands, upper arms, forearms, forehead, face, jaw, neck, chest, shoulders, upper back, abdomen, thighs, and calves.

Deep and slow breathing should be practiced with each movement. In addition to stimulating autonomic nerves—specifically, by reducing sympathetic nerve responses and boosting parasympathetic ones—the practice of combining progressive muscle relaxation with deep breathing exercises raises blood vessel suppleness and peripheral resistance. When the parasympathetic nervous system is activated, the body's activity levels drop even further, allowing the sympathetic nervous system to raise them and the parasympathetic reaction to lower them.

According to research, a mix of deep breathing exercises and progressive muscle relaxation can help people relax and deal with stress and anxiety through the use of complementary therapy approaches. As a result, individuals with diabetes mellitus may find relief from their symptoms by incorporating a regimen of deep breathing exercises and progressive muscle relaxation into their daily routines. Research comparing the intervention group to the control group for pre-intervention blood glucose levels found no statistically significant difference ($p = 0.634$), suggesting that the two groups of people with diabetes mellitus did not differ in terms of blood glucose values.

Reduced insulin sensitivity or insulin resistance leads to elevated blood glucose levels in individuals with diabetes mellitus. This is caused by insulin receptors not being sensitive enough or by low insulin levels. Exercise is necessary to raise insulin receptor activity on the plasma membrane and hence lower blood glucose levels. Physical activity is still given less priority in the management of diabetes mellitus (DM) compared to dietary and medication-based approaches. A more efficient metabolism is a result of regular physical exercise.

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plasma membrane and hence lower blood glucose levels. Physical activity is still given less priority in the management of diabetes mellitus (DM) compared to dietary and medication-based approaches. A more efficient metabolism is a result of regular physical exercise. Consequently, glucose levels in the blood will be managed (Tarwoto, 2012).

Comparing the experimental group with the control group in terms of the value of blood glucose levels revealed a statistically significant difference in individuals with diabetes mellitus. This finding is supported by the research conducted. Based on the results of the hypothesis testing, it is necessary to incorporate evidence-based practice into the nursing interventions that are typically given to patients with Diabetes Mellitus. This will help determine whether the combination of Progressive Muscle Relaxation and Deep Breathing Exercises is more effective in reducing blood glucose levels compared to the usual interventions.

Enhancing functional status and quality of life can be achieved through the utilisation of a combination of progressive muscle relaxation (PRMS) and deep breathing exercises. These can help alleviate muscle tension, stress, blood pressure, and anxiety while simultaneously increasing endurance and tolerance for daily activities. People with diabetes mellitus can lower their blood sugar levels by combining deep breathing exercises with increasing muscular relaxation. By lowering parasympathetic and raising sympathetic responses, slow, deep breathing can activate the autonomic nervous system (Mahyuni & Marta, 2023; Suwardianto, 2011, 2013; Tangkas, Lutfiana, & Wulandari, 2022).

Sympathetic nerve stimulation increases body activity, while the parasympathetic response decreases body activity more so that it can reduce metabolic activity. Decreased metabolic activity is expected to reduce insulin requirements so that blood sugar levels can decrease. The above is in line with research that states that *progressive muscle relaxation* and *deep breathing exercises* can reduce the value of blood glucose levels in people with diabetes mellitus. The above findings align with existing research suggesting that progressive muscle relaxation and deep breathing exercises have the potential to reduce blood glucose levels in individuals with diabetes mellitus. However, further investigation is needed to explore the long-term effects and broader applicability of these non-pharmacological interventions across diverse diabetic populations.

CONCLUSION

Patients with diabetes mellitus may find that a combination of progressive muscle relaxation and deep breathing techniques helps to reduce blood glucose levels. Combining progressive muscle relaxation with deep breathing exercise significantly lowers blood glucose levels in patients with diabetes mellitus. The two categories of diabetic people have drastically different blood glucose level values.

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