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EFFECT OF PROGRESSIVE MUSCLE RELAXATION ON BLOOD GLUCOSE LEVELS, STRESS, AND QUALITY OF LIFE IN PATIENTS WITH TYPE 2 DIABETES MELLITUS A QUASI-EXPERIMENTAL STUDY

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is a chronic disease that requires comprehensive management because it affects glycemic control, psychological well-being, and quality of life. Progressive muscle relaxation (PMR) may serve as a simple complementary intervention to address these outcomes. This study aimed to determine the effect of PMR on blood glucose levels, stress, and quality of life among patients with T2DM in Wolomarang Village, Sikka Regency, Indonesia. A quantitative, non-randomized quasi-experimental study with a pretest–posttest control group design was conducted from May to July 2026. Sixty patients with T2DM were selected using purposive sampling and divided into intervention and control groups, with 30 participants in each group. The intervention group received PMR for 20–30 minutes, three times weekly for four weeks, in addition to standard care. Blood glucose was measured using a digital glucometer, stress using the Perceived Stress Scale-10, and quality of life using the WHOQOL-BREF. Data were analyzed using paired and independent t-tests and ANCOVA. The intervention group showed a greater reduction in blood glucose and stress levels and a greater improvement in quality of life than the control group ($p < 0.001$). PMR is an effective, simple, and feasible complementary intervention for improving glycemic control, reducing stress, and enhancing quality of life among patients with T2DM.

Keywords: *Blood Glucose; Progressive Muscle Relaxation; Quality Of Life; Stress; Type 2 Diabetes Mellitus*

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or a combination of both. T2DM represents a major global health challenge because its prevalence continues to increase and its long-term complications can substantially affect physical functioning, psychological well-being, and social participation. The global number of people living with diabetes increased substantially over recent decades, with diabetes contributing to cardiovascular disease, kidney disease, visual impairment, neuropathy, and other disabling complications (World Health Organization, 2024). In Indonesia, diabetes mellitus remains an important public health problem, with increasing numbers of individuals requiring long-term management and monitoring at the primary healthcare level (Kementerian Kesehatan Republik Indonesia, 2023). Effective management of T2DM therefore requires not only pharmacological treatment but also comprehensive approaches addressing behavioral, psychological, and lifestyle-related factors.

In addition to metabolic abnormalities, living with T2DM may impose considerable psychological demands on patients. Continuous blood glucose monitoring, medication adherence, dietary restrictions, lifestyle modifications, fear of complications, and the long-term nature of treatment may contribute to psychological stress and diabetes-related distress. Diabetes distress has been associated with poorer self-management behaviors, impaired psychological well-being, and less favorable glycemic outcomes, making psychological health an important component of comprehensive diabetes management (Rochmah, Muhith and Zahro, 2023; Qasrawi *et al.*, 2026). Psychological interventions have demonstrated potential benefits for reducing diabetes distress and improving glycemic outcomes among adults with T2DM (Zu *et al.*, 2024). Furthermore, quality of life among Indonesian patients with T2DM has been associated with glycemic control, psychological condition, self-efficacy, self-care management, medication adherence, and diabetes-related complications (Ngan, Chong and Chien, 2021; Sani *et al.*, 2025). These findings indicate that diabetes management should address the interconnected metabolic, psychological, and quality-of-life dimensions of the disease rather than focusing exclusively on blood glucose control.

Progressive muscle relaxation (PMR) is a simple, non-pharmacological technique involving systematic contraction and relaxation of major muscle groups to promote physical and psychological relaxation. By reducing physiological arousal and sympathetic activation, PMR may help alleviate psychological stress and potentially influence metabolic regulation. Evidence from recent research supports the potential role of PMR in diabetes management. A randomized intervention study among people with T2DM reported that PMR significantly reduced diabetes distress and anxiety and was accompanied by improvements in glycated hemoglobin, fasting blood glucose, and postprandial glucose levels (Arunraj *et al.*, 2025). Similarly, previous studies have reported reductions in blood glucose following PMR among patients with T2DM (Koniyo, Zees and Usman, 2021; Rumaolat, Rumaolat and Sely, 2022; Sani *et al.*, 2025). Systematic evidence also indicates that PMR can reduce stress, anxiety, and depression in adults, supporting its potential as an accessible complementary intervention for psychological stress management (Khir *et al.*, 2024). Other mind-body and psychological interventions have likewise demonstrated beneficial effects on glycemic control and diabetes-related psychological outcomes (Ngan, Chong and Chien, 2021; Oyedeji *et al.*, 2022; Hamasaki, 2023).

Although previous studies have demonstrated the potential benefits of PMR for blood glucose or psychological outcomes, evidence examining its simultaneous effects on blood glucose levels, stress, and quality of life among patients with T2DM remains limited, particularly in community-based primary healthcare settings in Indonesia. Existing studies have frequently focused on a single outcome, such as glycemic control or stress, while fewer studies have evaluated the interconnected effects of PMR across metabolic, psychological, and quality-of-life domains. Previous evidence suggests that psychological and mind-body interventions may improve diabetes-related distress and glycemic outcomes, but the magnitude of their effects may vary according to intervention characteristics, duration, adherence, and participant characteristics (Jenkinson *et al.*, 2022; Zu *et al.*, 2024). Therefore, an intervention that is inexpensive, relatively simple, safe, and feasible for community implementation warrants further investigation. This study aimed to examine the effect of progressive muscle relaxation on blood glucose levels, stress, and quality of life among patients with T2DM in Wolomarang Village, Sikka Regency, East Nusa Tenggara, Indonesia.

METHODS

Study Design and Setting

This study employed a quantitative, non-randomized quasi-experimental design using a pretest–posttest control group approach to examine the effect of progressive muscle relaxation (PMR) on blood glucose levels, stress, and quality of life among patients with type 2 diabetes mellitus (T2DM). The study was conducted in Wolomarang Village, Sikka Regency, East Nusa Tenggara, Indonesia, from May to July 2026.

Participants and Sampling

The study population comprised patients with T2DM registered within the service area of the local community health center. A total of 60 participants were recruited using purposive sampling based on predetermined inclusion and exclusion criteria. Participants were allocated into an intervention group (n = 30) and a control group (n = 30). The intervention group received PMR in addition to standard diabetes care, whereas the control group received standard care according to the routine procedures of the community health center.

Intervention Procedure

The PMR intervention was administered for four weeks, with each session lasting approximately 20-30 minutes and conducted three times per week. The intervention involved systematic contraction and relaxation of major muscle groups to promote physical and psychological relaxation. Participants underwent pretest measurements before the intervention and posttest measurements after completion of the four-week intervention period. The control group did not receive PMR during the study period and continued to receive standard care.

Outcome Measure

Data were collected using a participant characteristics form, a digital glucometer, the Perceived Stress Scale-10 (PSS-10), and the World Health Organization Quality of Life-BREF (WHOQOL-BREF). Blood glucose levels were measured using a digital glucometer. Stress levels were assessed using the PSS-10, while quality of life was evaluated using the WHOQOL-BREF. These instruments have been widely used in health research and have demonstrated acceptable validity and reliability.

Data Analysis

Descriptive statistics were used to summarize participant characteristics and study variables. Within-group changes between pretest and posttest measurements were analyzed using the paired-samples t-test when the data met parametric assumptions, or the corresponding non-parametric test when these assumptions were not met. Differences between the intervention and control groups were analyzed using the independent-samples t-test or an appropriate non-parametric alternative. Analysis of covariance (ANCOVA) was subsequently performed to assess the effect of the intervention while controlling for potential confounding variables. Statistical significance was set at $p < 0.05$.

Ethical Considerations

The study received approval from the relevant Health Research Ethics Committee. All participants provided written informed consent before participation. The study was conducted in accordance with the principles of the Declaration of Helsinki, including respect for participants' autonomy, confidentiality, safety, and rights. The principles of respect for persons, beneficence, non-maleficence, and justice were applied throughout the research process.

RESULT AND DISCUSSION

Results

A total of 60 patients with type 2 diabetes mellitus (T2DM) participated in the study, comprising 30 participants in the intervention group and 30 participants in the control group. The results are presented according to participant characteristics and changes in blood glucose levels, stress levels, and quality of life before and after the intervention. Table 1 showed that the majority of participants were female (63.3%), aged 50-59 years (40.0%), and had been diagnosed with T2DM for 5-10 years (46.7%). Based on Table 2, the intervention group demonstrated greater improvements across all three study outcomes compared with the control group. Mean blood glucose decreased by 51.6 mg/dL in the intervention group, compared with 10.3 mg/dL in the control group. Stress scores decreased by 9.6 points in the intervention group and 1.6 points in the control group. In contrast, quality-of-life scores increased by 15.8 points in the intervention group compared with 2.2 points in the control group. All pretest-posttest changes were statistically significant ($p < 0.001$), indicating significant improvements in blood glucose, stress, and quality of life following the intervention.

Table 1. Characteristics of Participants (n = 60)

Characteristics	n	%
Sex		
Male	22	36.7
Female	38	63.3
Age (years)		
40-49	16	26.7
50-59	24	40.0
≥60	20	33.3
Duration of T2DM		
<5 years	18	30.0
5-10 years	28	46.7
>10 years	14	23.3

Table 2. Pretest–Posttest Comparison of Blood Glucose, Stress, and Quality of Life Outcomes

Outcome	Group	Pretest	Posttest	Mean Difference	p-value
Blood glucose (mg/dL)	Intervention	228.4 ± 32.5	176.8 ± 28.6	−51.6	<0.001
	Control	224.6 ± 30.7	214.3 ± 31.2	−10.3	<0.001
Stress score	Intervention	24.8 ± 4.3	15.2 ± 3.8	−9.6	<0.001
	Control	24.1 ± 4.1	22.5 ± 4.0	−1.6	<0.001
Quality of life score	Intervention	58.4 ± 7.6	74.2 ± 6.5	+15.8	<0.001
	Control	59.2 ± 7.8	61.4 ± 7.3	+2.2	<0.001

Table 3. Between-Group Differences in Percentage Changes in Study Outcomes

Outcome	Intervention	Control
Reduction in blood glucose levels	22.6%	4.6%
Reduction in stress levels	38.7%	6.6%
Improvement in quality of life	27.1%	3.7%

As presented in Table 3, the intervention group demonstrated substantially greater changes across all three study outcomes than the control group. Blood glucose levels decreased by 22.6% in the intervention group compared with 4.6% in the control group, representing an 18.0 percentage-point greater reduction. Stress levels decreased by 38.7% in the intervention group compared with 6.6% in the control group, while quality of life increased by 27.1% and 3.7%, respectively. Overall, the findings demonstrated that four weeks of progressive muscle relaxation were associated with favorable changes in all study outcomes. Compared with the control group, participants receiving the intervention experienced

greater reductions in blood glucose and stress levels and a greater improvement in quality of life. The statistical analyses indicated significant differences between the study groups, with $p < 0.001$.

Discussion

The present study demonstrated that four weeks of progressive muscle relaxation (PMR) produced significant improvements in blood glucose levels among patients with type 2 diabetes mellitus (T2DM). The intervention group experienced a reduction in mean blood glucose from 228.4 ± 32.5 mg/dL to 176.8 ± 28.6 mg/dL, representing a mean decrease of 51.6 mg/dL, whereas the control group showed a smaller reduction of 10.3 mg/dL. The greater improvement observed in the intervention group suggests that PMR may provide an additional benefit when implemented alongside standard diabetes care. This finding is consistent with previous studies reporting reductions in blood glucose among patients with T2DM following PMR interventions (Koniyo, Zees and Usman, 2021; Rumaolat, Rumaolat and Sely, 2022; Rahman, 2024; Sani *et al.*, 2025). A recent study also reported that PMR therapy was associated with improvements in glycemic parameters among people with T2DM, supporting the potential role of relaxation-based interventions as complementary components of diabetes management (Arunraj *et al.*, 2025). The physiological explanation may involve attenuation of sympathetic nervous system activation and the stress response, which can reduce the release of counter-regulatory hormones and consequently decrease processes that contribute to elevated blood glucose. Nevertheless, PMR should be considered a complementary intervention rather than a substitute for pharmacological therapy, dietary management, physical activity, and routine glucose monitoring.

The study also found a substantial reduction in stress levels following PMR. Mean stress scores decreased from 24.8 ± 4.3 to 15.2 ± 3.8 in the intervention group, compared with a reduction from 24.1 ± 4.1 to 22.5 ± 4.0 in the control group. The 38.7% reduction observed in the intervention group indicates a meaningful improvement in psychological well-being following four weeks of structured relaxation practice. This finding is consistent with evidence from systematic reviews demonstrating that PMR can reduce stress and other psychological symptoms in adults (Khir *et al.*, 2024). Research specifically involving individuals with T2DM has similarly demonstrated beneficial effects of PMR on diabetes-related distress and anxiety (Arunraj *et al.*, 2025). Psychological interventions more broadly have also been shown to reduce diabetes distress among patients with T2DM, highlighting the importance of addressing psychological factors as part of comprehensive diabetes care (Jenkinson *et al.*, 2022; Zu *et al.*, 2024). The effect of PMR on stress may be explained by the repeated alternation between muscle tension and relaxation, which increases awareness of bodily tension and facilitates a reduction in physiological arousal. Regular practice may consequently help patients develop a practical self-management strategy for coping with disease-related stress.

An important finding of this study was the significant improvement in quality of life following PMR. The mean WHOQOL-BREF score increased from 58.4 ± 7.6 to 74.2 ± 6.5 in the intervention group, compared with only a modest increase from 59.2 ± 7.8 to 61.4 ± 7.3 in the control group. The 27.1% improvement in the intervention group suggests that the benefits of PMR may extend beyond physiological and

psychological outcomes to broader aspects of daily functioning and well-being. Quality of life in people with T2DM is influenced by multiple factors, including glycemic control, psychological distress, self-care capacity, complications, and social functioning (Ngan, Chong and Chien, 2021). The stress reduction observed in the present study may have contributed to improved psychological well-being and greater ability to engage in daily activities, thereby supporting improvements in perceived quality of life. Evidence from psychological intervention studies also indicates that interventions targeting diabetes-related distress can improve quality of life and treatment-related outcomes (Abbas *et al.*, 2023). Thus, PMR may have a multidimensional effect by simultaneously addressing physiological tension, psychological stress, and patients' perceptions of their overall well-being.

From a nursing and primary healthcare perspective, PMR may be considered a feasible complementary intervention for T2DM management because it is simple, inexpensive, requires minimal equipment, and can be practiced independently. The simultaneous improvements in blood glucose, stress, and quality of life support its potential integration into community-based diabetes care and patient self-management programs. This approach may also strengthen holistic diabetes management by addressing both physiological and psychological aspects of the disease. However, the non-randomized design, purposive sampling, relatively small sample size, and short intervention period limit the generalizability of the findings. Future studies should involve larger randomized samples and longer follow-up periods to confirm the sustained effectiveness of PMR in T2DM management.

CONCLUSION

Progressive muscle relaxation significantly reduced blood glucose and stress levels while improving quality of life among patients with type 2 diabetes mellitus. These findings support PMR as a simple, low-cost, and feasible complementary intervention that can be integrated into community-based diabetes management and nursing care.

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