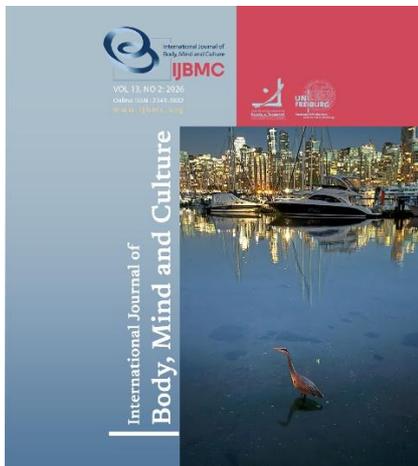


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The Effects of Sports Massage Versus Active Recovery on Anxiety and Blood Glucose in Postmenopausal Women With Type 2 Diabetes: A Randomized Pilot Study

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ABSTRACT

Objective: To compare the effects of sports massage and active recovery on anxiety symptoms and capillary blood glucose in postmenopausal women with type 2 diabetes mellitus (T2DM).

Methods and Materials: This randomized, controlled pilot trial enrolled 20 postmenopausal women (≥ 50 years) with T2DM, who were randomly assigned to a sports massage group ($n=10$) or an active recovery group ($n=10$). Both groups performed low-impact aerobic exercise; afterward, the sports massage group received a 20-min lower-limb sports massage and the active recovery group performed 20-min low-intensity activity (walking/stretching), three times weekly for 4 weeks. Anxiety was assessed with the Hamilton Anxiety Rating Scale (HAM-A) by trained assessors blinded to group allocation. Capillary blood glucose was measured pre- and post-intervention using an Easy Touch glucometer. Outcomes were analyzed using ANCOVA, adjusting for baseline values (SPSS v27).

Findings: After adjustment for baseline scores, the sports massage group showed lower post-intervention anxiety than the active recovery group ($M_{adj}=14.03\pm 0.87$ vs 16.97 ± 0.87 ; mean difference= -2.94 ; $p=0.022$) and lower post-intervention blood glucose ($M_{adj}=116.89\pm 2.52$ vs 125.54 ± 2.52 ; mean difference= -8.65 ; $p=0.021$; $\eta^2=0.14$). Group effects were significant for anxiety ($F=6.84$, $p=0.011$) and blood glucose ($F=5.85$, $p=0.021$).

Conclusion: In this small pilot sample, sports massage following exercise was associated with greater reductions in anxiety and capillary blood glucose than active recovery. Larger, adequately powered trials with standardized glycemic measures (e.g., fasting glucose and HbA1c) and better control of diet/medication are warranted.

Keywords: Sports massage, active recovery, anxiety, capillary blood glucose, type 2 diabetes mellitus, postmenopausal women, randomized pilot trial.

Introduction

Postmenopausal women represent a population with distinct physiological and psychological vulnerabilities, and their well-being is a growing global health concern with broad social and economic implications (Elsayed et al., 2022). Among postmenopausal women, those living with type 2 diabetes mellitus (T2DM) face additional challenges in maintaining optimal glycemic control and overall quality of life (Huynh et al., 2024). Physiological ageing and the transition into menopause contribute to alterations in multiple organ systems (Li & Guo, 2024; Nontakhod et al., 2022), including reduced pancreatic beta cells (Esefeld et al., 2021), which may result in impaired insulin secretion and elevated blood glucose levels (Ezzo et al., 2001; Scott et al., 2021; Veseta et al., 2023; Wang et al., 2021). In individuals with diabetes, glycemic status is a key marker of physiological function (Mohammadi & Zare, 2020), while psychologically it can be assessed through the level of anxiety (Veseta et al., 2023). Diabetes and signs of anxiety are now recognized as significant public health issues worldwide (Basiri et al., 2023; Tripathi et al., 2024). Anxiety can cause stress, impacting the sympatho-adreno-medullary system, resulting in symptoms like sweating, hyperventilation, and elevated pulse rate and blood pressure. Moreover, anxiety can lead to mental, emotional, behavioral, and health problems (Subramaniam et al., 2019). This indicates that managing anxiety and blood glucose levels is especially crucial for postmenopausal women with T2DM.

Exercise is a core component of diabetes management and is recommended as a first-line strategy for individuals with T2DM (Kirwan et al., 2017). Regular physical activity improves overall health and functional capacity in older adults (Nontakhod et al., 2022), and adherence to appropriate exercise routines can contribute to better glycemic control in people with diabetes (Kasmad et al., 2022; Li & Guo, 2024; Rosdiana et al., 2024). However, despite well-documented benefits of exercise itself, the post-exercise recovery phase remains underexplored, particularly among postmenopausal women with T2DM. Approaches such as active recovery have been suggested to support physiological restoration after exercise (Patra et al., 2023), while sports massage has been proposed to enhance recovery processes (Davis et al., 2020). Despite its potential

benefits, the application of massage therapy in diabetic patients, especially concerning its effects on blood glucose and anxiety, remains limited.

Massage therapy has been widely recognized in sports science for its potential effects on physical recovery and psychoemotional well-being (Alauddin et al., 2023; Veseta et al., 2023). Evidence suggests that massage may increase local blood flow in the lower extremities and improve joint range of motion (ROM) in individuals with diabetic peripheral neuropathy (Chatchawan et al., 2020), and it may help alleviate anxiety symptoms (Subramaniam et al., 2019). Although these findings are promising, most available research focuses on athletes or younger populations, limiting their direct applicability to postmenopausal women with T2DM. Furthermore, the proposed mechanism remains hypothetical, as physiological mediators such as HRV or cortisol were not assessed in most studies and are not measured in the present study.

Past research has demonstrated that women after menopause undergo a decrease in their quality of life, which is supported by increased depression levels (Elsayed et al., 2022). Strength training exercises enhance the functional abilities, health-related quality of life, and overall well-being of older adults (Sánchez-Roa et al., 2024). Prior studies have shown that postmenopausal women with T2DM require appropriate management, including exercise, to improve their health and elevate their quality of life (Huynh et al., 2024). Complementary interventions such as combined physical activity and massage therapy may further enhance mental well-being in older women (Nontakhod et al., 2022). However, the extent to which post-exercise massage or active recovery specifically benefits postmenopausal women with T2DM has not been thoroughly investigated.

Despite emerging evidence on exercise and massage in different populations, there remains a lack of focused research assessing post-exercise recovery strategies in postmenopausal women with T2DM. Studies examining the comparative influence of sports massage and active recovery on both glycemic outcomes and anxiety in this population are particularly limited. Therefore, this study aims to evaluate the effects of sports massage versus active recovery performed after low-impact aerobic exercise on blood glucose levels and anxiety among postmenopausal women with T2DM.

Methods and Materials

Study Design

This research utilized a randomized controlled pilot trial including 20 postmenopausal women with T2DM, who were randomly allocated to a sports massage group or an active recovery group.

Participants

The study comprised 20 postmenopausal women aged 50 years or older from the local area. Participants were required to have been in the postmenopausal phase for at least 12 weeks and to have no health conditions that might interfere with involvement in the exercise program. Approval for this research has been obtained from the Health Research Ethics Committee at the Politeknik Kesehatan Kementerian Kesehatan Bandung with ethical permit number 06/KEPK/EC/XII/2022.

Study organization

Treatment sports massage and active recovery after doing low-impact aerobic sports activities. Sports Massage Group: Participants received a 20-minute sports massage focused on the lower limbs, three times per week for 4 weeks. The massage methods used featured effleurage (long, smooth strokes), petrissage (kneading), friction (intense pressure), shaking (quick movements), tapotement (tapping rhythms), vibration (shaking actions), stroking (soft rubbing), walken (rubbing along muscles), and skin rolling (pinching and lifting the skin). The first massage sessions were

performed on the left and right legs, in both the prone and supine positions, focusing on the region from the calf to the upper thigh. The motions were aimed upward to enhance better blood circulation and lymphatic movement. Participants in the active recovery group performed low-intensity exercises such as walking or stretching for 20 minutes, three times weekly, over four weeks. These activities aimed to promote recovery by improving blood flow and decreasing muscle tightness without causing considerable fatigue. Anxiety was evaluated through the Hamilton Anxiety Rating Scale (HARS), a validated instrument for evaluating the severity of anxiety. Blood glucose levels were measured using the Easy Touch before and after the intervention period to assess changes in glycemic control.

Statistical analysis

The data analysis in this study was conducted using SPSS 27, which included a frequency distribution test to examine sample characteristics. To evaluate the effect of sports massage relative to the active comparator, an analysis of covariance (ANCOVA) was performed for each outcome, adjusting for baseline values as covariates, consistent with recommendations for randomized pilot trials. Model assumptions were checked using residual diagnostics, and the primary analysis estimated adjusted mean differences with 95% confidence intervals. Because this was a pilot study, a priori sample size calculation was performed; thus, the findings should be interpreted as preliminary.

Findings and Results

This study analyzed 20 individuals with diabetes mellitus. Of these, 10 participants received sports massage intervention, while the remaining 10 were

assigned to the control group, which underwent active recovery. The research data will be presented in the following Table 1.

Table 1

Frequency distribution of respondent characteristics

Variable	Sports massage therapy group (n=10)			Active recovery group (n=10)		
	Mean ± SD	Min	Max	Mean ± SD	Min	Max
Age	58.8 ± 5.4	54.0	62.0	57.2 ± 5.5	52.0	60.0
Height (cm)	160.7 ± 6.2	154.0	173.0	159.1 ± 9.0	142.0	168.0
Body Weight (kg)	70.3 ± 6.7	63.0	85.0	61.6 ± 7.3	52.0	73.0
BMI (kg/m ²)	29.3 ± 3.6	21.9	33.0	31.1 ± 2.5	27.0	36.2
Long Suffering from DM (years)	8.4 ± 3.5	3.0	13.0	8.8 ± 4.2	4.0	17.0

The characteristics of the respondents are detailed in Table 1. The intervention group had an average age of 58.8 ± 5.4 years, while the control group had an average

age of 57.2 ± 5.5 years. The intervention group had an average height of 160.7 ± 6.2 cm, compared to 159.1 ± 9.0 cm in the control group. The average weight was 70.3

± 6.7 kg for the intervention group and 61.6 ± 7.3 kg for the control group. The BMI for the intervention group was 29.3 ± 3.6 kg/m², while the control group had a BMI

of 31.1 ± 2.5 kg/m². Additionally, the average duration of diabetes among the respondents was 8 years.

Table 2

pre-test and post-test results

Variable	Times	
	Pre-test (Mean \pm SD)	Post-test (Mean \pm SD)
Blood glucose		
Sports massage therapy group	139.4 \pm 39.6	120.5 \pm 27.6
Active recovery group	129.8 \pm 31.22	121.9 \pm 30.8
Anxiety levels		
Sports massage therapy group	25.7 \pm 3.6	14.2 \pm 2.5
Active recovery group	25 \pm 4.4	16.8 \pm 5.6

The covariate, pre-test anxiety levels, was significantly related to the post-test score, $F = 5.72$, $p < .022$, $\eta^2 = 0.29$. After controlling for pretest, there was a significant effect of group on post-test scores, $F = 6.84$, $p = 0.011$, $\eta^2 = 0.10$, indicating a medium effect size. The adjusted mean posttest score was higher in the sports massage therapy group ($M_{adj} = 77.9$, $SE = 1.4$) than in the active recovery group ($M_{adj} = 71.6$, $SE = 1.3$), suggesting that the instructional method used in the sports massage therapy group was more effective than that used in the active recovery group. Adjusted means showed that the sports massage therapy group reported lower post-test anxiety ($M_{adj} = 14.03$, $SE = 0.87$, 95% CI [12.27, 15.79]) than the sports massage therapy group ($M_{adj} = 16.97$, $SE = 0.87$, 95% CI [15.21, 18.73]).

Discussion and Conclusion

The research findings showed that the group receiving sports massage had a notable decrease in blood glucose levels and anxiety. In comparison, the control group that received active recovery did not show a notable reduction in these measures. Active recovery does not demonstrate a notable impact, yet there is a decreasing trend. The results of this study are supported by previous research showing that foot massage lowers blood glucose levels in individuals with type 2 diabetes (Alwiyah & Mukarromah, 2022). Besides that, massage can reduce feelings of anxiety (Subramaniam et al., 2019). The results of this research highlight the effectiveness of sports massage and active recovery interventions in decreasing athletes' heart rate (HR) and ratings of perceived exertion (RPE) (Patra et al., 2023). Massage speeds up the clearance of blood lactic acid, while active stretching also aids its faster recovery (Haetami & Triansyah, 2021). Participating in physical exercise and

Pairwise comparisons based on the estimated marginal means indicated that this difference was statistically significant (mean difference = -2.94 , $SE = 1.23$, $p = 0.022$).

The covariate pre-test blood glucose was significantly related to post-test blood glucose, $F = 221.36$, $p < .001$, $\eta^2 = 0.86$. After controlling for the covariate, there was a significant effect of group on post-test blood glucose, $F = 5.85$, $p = 0.021$, $\eta^2 = 0.14$. Adjusted means indicated that the sports massage therapy group had lower post-test blood glucose ($M_{adj} = 116.89$, $SE = 2.52$, 95% CI [111.78, 121.99]) than the active recovery group ($M_{adj} = 125.54$, $SE = 2.52$, 95% CI [120.44, 130.64]). Paired comparisons based on the adjusted means showed a significant difference between the two groups (mean difference = -8.65 , $SE = 3.58$, $p = 0.021$).

receiving 90-minute massage therapy three times a week has been shown to enhance mental health in older women (Nontakhod et al., 2022).

In this randomized pilot study of postmenopausal women with type 2 diabetes (T2DM), sports massage administered after low-intensity aerobic exercise was associated with a significant reduction in blood glucose and anxiety levels in the same group over four weeks. In contrast, changes observed with active recovery alone were smaller and did not reach statistical significance in this sample. Although these findings are consistent with previous reports on the beneficial effects of exercise and massage on people with diabetes and the elderly (Bayat et al., 2020; Chatchawan et al., 2020; Huynh et al., 2024; Kirwan et al., 2017), they should be interpreted with caution due to the small sample size and limited statistical power.

Our results align with earlier studies suggesting that physical activity can improve glycemic control and psychological outcomes in postmenopausal or older

women (Elsayed et al., 2022; Mandrup et al., 2020; Sánchez-Roa et al., 2024) and that massage may have favorable effects on circulation, neuropathic symptoms, and anxiety in people with diabetes (Ezzo et al., 2001; Hernandez-Secorun et al., 2021; Veseta et al., 2023). However, most prior work has focused on different populations (e.g., adolescents with type 1 diabetes or athletes), limiting direct comparability to postmenopausal women with T2DM. Our study provides preliminary data specifically for this understudied population.

This study has important limitations. Firstly, the sample size is small, and there is no a priori calculation of the test's power, so this clinical trial must be considered exploratory. Secondly, despite our efforts to standardise the exercise and post-exercise protocols, other lifestyle factors, such as diet, medication adherence, and daily physical activity, were not controlled for or systematically recorded, which could have interfered with the observed changes in glucose and anxiety. Thirdly, there was no placebo or usual-care control group, and neither participants nor therapists were blinded to group allocation, which could introduce bias related to expectations and performance. Fourth, capillary blood glucose was measured at only two time points and reported as random rather than fasting; the timing of assessments was related to eating, and antidiabetes medication was not fully controlled. Furthermore, HbA1c was not systematically measured, which limits our ability to conclude long-term glycemic control.

Some limitations of this study include a small sample size, a relatively short intervention duration, and the absence of control for other lifestyle factors such as diet and daily physical activity. Therefore, additional studies with larger sample sizes, double-blind designs, and controls for confounding variables such as medication or fasting blood sugar, and assessment of outcomes such as HbA1c are necessary to reinforce these findings.

Conclusion

The results of this research show that sports massage therapy provides a clinically significant reduction in both blood glucose and anxiety levels in postmenopausal women with T2DM, suggesting its potential as a complementary therapy in diabetes management. Due to the small sample size, lack of blinding, limited dietary and medication control, and the exploratory nature of

the analysis, these results should be considered preliminary. Future research requires large-scale randomized controlled trials using standardized blood glucose indicators (including glycated hemoglobin HbA1c), clearly defining clinically significant differences, and establishing appropriate intergroup statistical models to determine the clinical significance of exercise massage as an adjunct therapy in this population.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Ethical considerations in this study included the fact that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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