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Rehabilitation Model for Post-Disaster Post-Traumatic Stress Syndrome: Relaxation-Based Supervised Exercise

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Abstract

Objectives: This study aimed to evaluate the effects of relaxation-based exercises on individuals experiencing post-earthquake stress-related symptoms in an earthquake-prone region.
Methods: This randomized, waitlist-controlled, parallel group study included 46 participants with moderate post-traumatic stress levels (Posttraumatic Stress Diagnostic Scale, PDS) and anxiety for over 1 month (Beck Anxiety Inventory, BAI score > 8). Participants were randomly assigned to a relaxation-based exercise group (REG, $n = 24$) or a waitlist control group (CG, $n = 25$). The REG received relaxation-based structured, supervised exercises for 4 weeks, while the CG awaited treatment. Assessments included the PDS, BAI, Beck Depression Inventory, Perceived Stress Scale-10, Pittsburgh Sleep Quality Index, and SF-12 Quality of Life Scale at baseline and 4 weeks post-intervention.
Results: Within-group analysis showed significant improvements in anxiety ($P = 0.001$), depression ($P = 0.001$), perceived stress ($P = 0.001$), and sleep quality ($P = 0.001$) for the REG. The CG showed decreased depression symptoms ($P = 0.011$) and improved sleep quality ($P = 0.012$). There were no significant group differences in quality-of-life outcomes ($P > 0.05$), though REG showed greater improvement in depression and perceived stress scores ($P < 0.05$).
Conclusions: Relaxation-based exercises can improve sleep quality in individuals experiencing post-earthquake stress, and reduce depression, anxiety, and perceived stress. This approach can be used as a novel rehabilitation model in preventive mental health for the community.

Earthquakes are considered to be the most destructive and uncontrollable cause of migration and life-threatening natural disaster among many different types of natural disasters.[1] Earthquakes negatively affect survivors both physically and psychologically.[2] Between 5.8% and 54% of adults and children who survive natural disasters develop major depressive disorder, and approximately 1/4 of earthquake survivors are later diagnosed with post-traumatic stress disorder (PTSD).[3,4] Factors such as the level of fear experienced, previous trauma, lack of social support, exposure to material and human losses, peritraumatic distress, age, gender, and education level are associated with stress-related symptoms like depression and anxiety.[3–6]

On February 6, 2023, 2 major earthquakes hit Türkiye, registering 7.8 and 7.6 on the Richter scale, with their epicenters near Kahramanmaraş. This major earthquake was followed by several aftershocks, each measuring over magnitude 6.[7] These earthquakes represent the most devastating disaster to hit Türkiye and southeast neighbors in recent centuries, affecting 15.8 million people.[8] In addition to causing significant personal and economic damage, the disaster had serious psychological consequences.[9] As a result of the threat to the basic needs and security needs of individuals, such as shelter, who are faced with such a devastating disaster, individuals have shown psychological problems including PTSD, anxiety, and depression.[10,11]

Exercise and relaxation techniques play a vital role in the recovery process for individuals with PTSD, helping to alleviate post-traumatic stress symptoms and support both physical and psychological well-being. In addition to aerobic, resistance, and mind-body exercises, relaxation strategies such as deep breathing, guided imagery, mindfulness-based stress reduction, meditation, and progressive muscle relaxation are particularly important in managing stress and its related symptoms. These techniques not only promote emotional resilience but also provide essential coping mechanisms for individuals recovering from trauma, fostering a sense of calm and control in their healing journey.[12–14] The relaxation response is a unified physiological and mental state of profound calm that helps mitigate the damaging impact of stress on the body.[15] Progressive muscle relaxation (PMR) exercise is one of the relaxation techniques that involve active contracting and gradually releasing muscles.[16,17] Based on the current literature, it is known that PMR exercises provide physiological and psychological relief in individuals who are

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studying at the undergraduate level, reduce stress in fibromyalgia syndrome, and alleviate anxiety and depression symptoms in coronary heart patients.[18–20] Diaphragmatic breathing exercises that aim to breathe more deeply and expand the lungs towards the diaphragm can also be used to reduce anxiety or symptoms, which is a stress-related disorder.[16–19] Deep breathing enhances blood flow by lowering respiratory rate, pulse rate, and blood pressure, and reduces sympathetic reactions by improving vagal activity.[21] These exercises can be easily learned and applied without equipment. In addition, when the person identifies a stress trigger, the fact that these exercises can be applied on their own makes the individual ready for stress management.[22,23]

Studies have documented the benefits of breathing exercises and relaxation techniques for managing stress and related symptoms.[19,21,24,25] However, there is limited research on these interventions specifically for individuals who have survived natural disasters. One previous study explored the effect of a relaxation-based yoga program on stress-related symptoms in earthquake survivors.[26] Based on their findings, it is hypothesized that relaxation-based exercises may also be effective for individuals experiencing PTSD symptoms. This study aims to examine the effects of relaxation-based exercises, specifically PMR and diaphragmatic breathing, on symptoms associated with post-earthquake stress. This study hypothesizes that relaxation-based exercises will improve symptoms in individuals experiencing post-earthquake stress-related conditions. The expected improvements in anxiety, depression, perceived stress, and sleep quality could be essential in informing preventive public health initiatives and intervention strategies within a novel rehabilitation model.

Methods

Trial Design and Setting

This prospective, randomized waitlist-controlled trial was conducted in Hatay, Türkiye between March 2023 and October 2023. The Consolidated Standards of Reporting Trials (CONSORT 2010) criteria were followed in conducting the study.[27]

Participants

Participants were recruited through communication with AFAD (Disaster and Emergency Management Authority), community-based outreach, and online and social media announcements targeting individuals affected by the Gaziantep-Maraş earthquake. To ensure effective recruitment, one of the authors collaborated with AFAD and local civil society organizations operating in the region. The same author, who had received psychosocial rehabilitation training, traveled to the affected areas, particularly container cities, to establish direct contact with potential participants. During these visits, the study team provided general assistance and informed individuals about the study, creating the necessary infrastructure for participation. Initial assessments were conducted on-site to determine eligibility, and individuals who had internet access within container cities and met the inclusion criteria were invited to participate in the study. The intervention sessions were then delivered online in a supervised format to ensure accessibility while maintaining the structured nature of the program.

Approximately 350 people lived in the container city that was reached. From these records, individuals who voluntarily wished to participate were first screened by the civil society organization. A total of 92 individuals who met the criteria—having the necessary infrastructure, being within the required age range (25-60 years), and reporting anxiety symptoms—were included in the study for further evaluation of their symptom severity. Participants were required to have at least moderate post-traumatic stress according to the Post-Traumatic Stress Diagnostic Scale (PDS > 10) and to have experienced anxiety for more than 1 month (Beck Anxiety Inventory score > 8). These tests were performed in the native Turkish language by the author who had received psychosocial rehabilitation training.

Included in the study were those who were in the earthquake zone when the earthquake occurred; those residing in container cities who were pre-identified by local civil society organizations as earthquake survivors; individuals who exhibited moderate post-traumatic stress symptoms; native Turkish speakers; individuals who could understand and follow verbal commands; those with internet access; and those who were able to participate in video calls. Participants were excluded if they had a history of major depressive disorder, bipolar disorder, schizophrenia, or any serious psychiatric illness that could independently affect stress, anxiety, or sleep quality. Those who had used psychiatric medications such as antidepressants, anxiolytics, or antipsychotics within the past 6 months were also excluded because of their potential effects on psychological outcomes. Exclusion criteria were serious chronic illnesses that could affect study outcomes, including uncontrolled diabetes with complications, serious cardiovascular disease (e.g., heart failure, history of stroke, uncontrolled hypertension), chronic respiratory conditions affecting breathing exercises (e.g., severe COPD, uncontrolled asthma), neurological disorders affecting cognitive or physical function (e.g., Parkinson's disease, Alzheimer's, multiple sclerosis), and autoimmune or inflammatory diseases known to affect mental health (e.g., lupus, severe rheumatoid arthritis). Additionally, individuals with a Montreal Cognitive Assessment (MoCA) score ≤21, indicating cognitive impairment, were not included because they may have had difficulty following the exercise instructions. Participants with serious musculoskeletal or neurological conditions that would prevent them from participating in relaxation-based exercises and those without internet access or the ability to make video calls were excluded due to the online delivery format of the intervention. Finally, participants who missed more than 2 consecutive sessions of the 12 scheduled sessions during the 4-week intervention period continued to attend but were excluded from the final analysis.

Randomization

Randomization was performed using the "random number table" method, assigning numbers to participants based on the order of their application for the assessment. Of the 49 eligible participants, 24 were randomized into the relaxation exercises group (REG) and 25 into the control group (CG). The CONSORT flowchart of the study is shown in Figure 1.

Procedures

Participants completed a baseline assessment, which included self-reported surveys. Following the 4-week intervention of relaxation exercises or waitlist-control period, they repeated the same assessments at week 5.

Relaxation-based structured, supervised exercises intervention

The intervention included an online, supervised program comprising 12 sessions spread across 4 weeks, with 3 sessions held each

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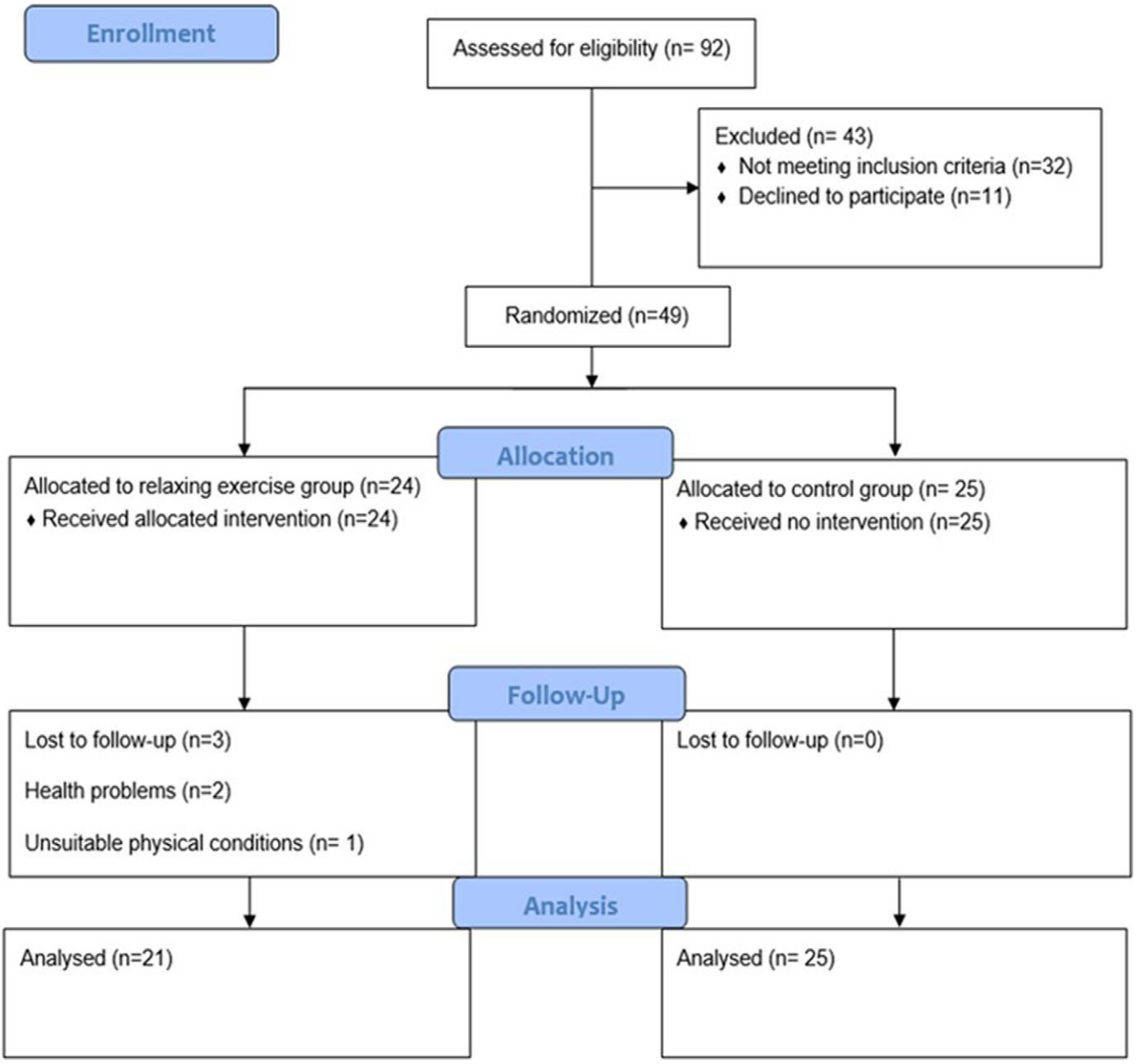


Figure 1. CONSORT flow diagram of the study.

week. Each 40-minute session included preparation/warm-up, progressive muscle relaxation (PMR) + diaphragmatic breathing exercises, and a cool-down period. Participants were instructed to wear comfortable, non-tight clothing, sit in a well-supported position, and focus on their entire body. During the 5-minute warm-up, participants engaged in slow and deep diaphragmatic breathing exercises. The 30-minute PMR exercises aimed to reduce anxiety and tension through muscle control. Participants focused on 1 muscle group at a time while contracting and relaxing 16 major muscle groups. Each contraction was followed by 5 seconds of deep diaphragmatic breathing, and relaxation was achieved with 10-15 seconds of exhalation. The session concluded with a 5-minute cool-down period during which participants performed additional diaphragmatic breathing exercises. Relaxing background music composed by Daniel Kobialka was played, featuring elements such as rhythm, melody, and harmony with a tempo that did not increase the resting heart rate.[28] The initial session was conducted face-to-face to ensure proper screening, provide detailed instructions, and establish a structured exercise framework. This in-person encounter allowed participants to familiarize themselves with the program, ask questions, and receive guidance, improving adherence to the intervention. Subsequent sessions were delivered online to address post-earthquake logistical challenges, such as transportation disruptions and displacement. As internet access was available in container cities, online sessions ensured continuous supervision and accessibility, allowing participants to engage in the program without additional burdens.

Waitlist-control condition

The CG was instructed to continue their normal activities until they received their treatment. Following the 4 weeks waitlist period and a 1-week assessment, participants in the CG were offered the same

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intervention as the REG due to ethical considerations. This approach ensured that all participants, including those initially assigned to the waitlist-control condition, had the opportunity to receive the therapeutic intervention they sought through their participation in the study.

Outcome measures

The main outcome was perceived stress, while secondary outcomes included anxiety, post-traumatic stress, depression, sleep quality, and overall quality of life (QoL). Data were collected both at baseline and at the end of the 4-week intervention in face-to-face sessions. Demographic variables, such as age in years, weight in kg, height in cm, body mass index (BMI) in kg/m^2, education level, history of smoking and alcohol use, chronic diseases, and participation in counseling or alternative therapies, were documented prior to the assessment.

Outcome measures included several validated scales to assess various aspects of mental health and QoL. The Post Traumatic Stress Diagnostic Scale (PDS), a 49-item self-report questionnaire, was used to assess the severity of PTSD symptoms, with scores from 1-10 categorized as mild, 11-20 as moderate, 21-35 as moderate to severe, and above 36 as severe.[29,30] Anxiety levels were assessed using the Beck Anxiety Inventory (BAI), a self-report scale ranging from 0-63, with scores from 0-7 categorized as minimal, 8-15 as mild, 16-25 as moderate, and 26-63 as severe.[31] Depression severity was assessed with the Beck Depression Inventory (BDI), a 21-item Likert scale with scores from 0-63, indicating minimal (0-9), mild (10-18), moderate (19-29), and severe depression (30-63).[32,33] The Perceived Stress Scale-10 (PSS-10), a 10-item questionnaire rated from 0-4, measured perceived stress over the past month, with higher scores reflecting greater stress.[34] Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a 19-item scale with scores ranging from a minimum of 0 to a maximum of 21. Higher scores indicate more severe sleep disturbances.[35,36] Finally, the SF-12 Quality of Life Scale, comprised 12 questions assessing both mental and physical health components.[37]

Statistical Analysis

Sample size calculation

Using an effect size of 0.5, a level of significance (α) of 0.05, and a statistical power (1-β) of 0.95 from earlier research, sample size calculations were carried out using G-Power 3.1.9.7.[26] This

calculation indicated that a minimum of 44 participants was required. Considering the 10% dropout rate, it was planned to include 48 participants.

Data analysis

Statistical analysis was performed using Statistical Package for Social Sciences for Windows (Version 24.0, SPSS) program. The distribution of the data was evaluated according to skewness and kurtosis values, and because the skewness and kurtosis values remained within the ±2.0 range limit range, it was determined that it was suitable for normal distribution. Descriptive statistics for continuous variables in the study were presented as mean, standard deviation (SD), minimum, and maximum values, while categorical variables were described using frequency and percentage. Pearson chi-square tests compared categorical data between groups, with Fisher's Exact Test used when appropriate. Independent sample *t* test was used for independent group comparisons (between groups). The difference between measurements at different times between dependent groups (within group) was examined with the Paired Sample Test. The differences between the groups were examined with 2 (group) × 2 (time) repeated measures ANOVA. Obtained data were evaluated at a 95% confidence interval and a significance level of $P < 0.05$. The post-hoc Bonferroni test was employed to examine significant interactions between groups and time. Effect sizes (ES) for between-group comparisons were determined using Cohen's *d*, with ES interpreted as large ($d = 0.80$), medium ($d = 0.50$), and small ($d = 0.20$).[38]

Ethical considerations

All procedures adhered to the ethical guidelines set by the committee responsible for human experimentation and complied with the Helsinki Declaration of 1975, as updated in 2008. Istanbul Medipol University institutional review board approved all recruitment and testing procedures on March 02, 2023 with the decision numbered E-10840098-772.02-1709. Individuals participating in the study were informed about the purpose, duration, benefits, procedures involved, and potential risks of the study. All participants provided informed consent following the Helsinki Declaration and were informed of their right to withdraw from the study at any stage. Permission was obtained to use the questionnaires. Clinical trial registration was obtained at www.clinicaltrials.gov with the number NCT06013280.

Results

The eligibility of 92 earthquake survivors was evaluated, and 43 chose not to participate because they did not match the requirements for inclusion. In total, 49 participants, 24 people in the relaxation exercise group and 25 people in the CG, were included; 46 of them completed the study, with 2 withdrawing REG due to health problems and 1 not being able to complete the study due to not being able to provide the unsuitable physical condition to participate in the exercises. The participant flow is detailed in the CONSORT flow diagram (Figure 1).

Baseline Characteristics

Table 1 shows the clinical characteristics of participants. At the baseline measurement, the groups were similar in all aspects except for the Perceived Stress Scale-10 (PSS-10) scores. The baseline stress level was significantly higher in the REG compared to the CG ($P = 0.043$) (Table 2).

Post-traumatic stress

No significant differences were observed between the groups in baseline and final Post-Traumatic Stress Diagnostic Scale (PDS) measurements ($P > 0.05$). Within-group analysis revealed no significant changes for either the REG or the CG ($P > 0.05$). Although the mean PDS score decreased in the REG after the intervention, this reduction was not significant ($P > 0.05$) (Table 2).

Anxiety

Significant reductions in BAI scores were observed in the REG ($P = 0.001$), whereas no significant changes were observed in the CG ($P = 0.247$) (Table 2).

Depression

Significant reductions in BDI scores were observed post-intervention in both the REG ($P = 0.001$) and the CG ($P = 0.011$). Post-treatment, between-group comparisons indicated that the REG was superior to the CG ($P = 0.042$). The between-group effect sizes were small 4 weeks after the baseline assessment (ES < 0.2) (Table 2).

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Table 1. Baseline characteristics of participants

Characteristics	REG (*n*=21)		CG (*n*=25)		*t*	*P*
	M ± SD	Min- Max	M ± SD	Min- Max		
Age (years)	44.23 ± 10.30	26–58	38.80 ± 8.77	26–58	1.934	0.60
BMI (kg/cm2)	25.89 ± 4.04	19.15–33.62	27.17 ± 4.63	19.63–37.55	–0.983	0.331
	n	**%**	***n***	**%**	**χ2**	***P***
Gender					4.760	0.052
Female	18	85.7	14	56.0		
Male	3	14.3	11	44.0		
Other	0	0	0	0		
Education					3.092	0.570
Primary School	3	14.3	1	4.0		
Secondary School	3	14.3	6	24.0		
High School	3	14.3	5	20.0		
University	11	52.4	10	40.0		
Graduate	1	4.8	3	12.0		
Smoking					0.038	0.845
Yes	9	42.9	10	40.0		
No	12	57.1	15	60.0		
Alcohol					0.053	0.578
Yes	3	14.3	3	12.0		
No	18	85.7	22	88.0		
Chronic Disease					1.885	0.170
Yes	7	33.3	4	16.0		
No	14	66.7	21	84,0		
City of residence at the time of the earthquake					3.959	0.412
Hatay	12	57.1	16	64.0		
Adana	6	28.6	4	16.0		
Gaziantep	1	4.8	3	12.0		
Osmaniye	1	4.8	2	8.0		
Kilis	1	4.8	0	0		
Previous use of alternative therapies					1.217	0.457
Yes	1	4.8	0	0		
No	20	95.2	25	100.0		

M: Mean, SD: Standart Deviation, CG: Control Group, REG: Relaxation Exercise Group. *$P < 0.05$.

Perceived Stress

At baseline, the Perceived Stress Scale-10 mean score was higher in the REG compared to the CG ($P = 0.043$). However, no significant difference was found between the groups in the fourth week measurement ($P = 0.538$). The REG group showed a statistically significant reduction ($P = 0.001$), while no significant change was observed in the CG ($P = 0.329$) in mean stress scores at 4 weeks compared to baseline. Significant group × time interactions for perceived stress were also noted ($P = 0.027$) (Table 2).

Sleep Quality

Pittsburgh sleep quality index scores showed significant improvement in both REG and CG ($P = 0.001$; $P = 0.012$). No significant reductions were noted in between group comparisons ($P > 0.05$) (Table 2).

Quality of Life

No significant differences were found within or between groups in any components of the SF-12 ($P > 0.05$) (Table 2).

Limitations

Results show that relaxation-based exercises, including PMR and diaphragmatic breathing applied to individuals experiencing stress-related symptoms after the earthquake, are promising and consistent with the literature. However, this study has several limitations.

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Table 2. Comparison of stress, anxiety, depression, sleep quality and quality of life within and between the two groups before and after 4 weeks of intervention

Outcomes	Groups	Time period		Within-group		Group * time interaction		
		Baseline (M ± SD)	Fourth week (M ± SD)	P^b	Mean Difference	95 % CI (Lower-Upper)	Effect Size (Cohen's *d*)	P^c
PDS	REG	23.42 ± 10.61	17.00 ± 11.66	0.057	3.794	(0.388–7.200)	0.052	0.126
	CG	23.80 ± 11.67	22.64 ± 13.72	0.467				
	P^a	0.911	0.145					
	Mean Difference	–0.371	–5.640					
BAI	REG	28.09 ± 13.20	15.23 ± 13.11	**0.001***	7.769	(3.888–11.649)	0.137	**0.011***
	CG	23.32 ± 13.31	20.64 ± 11.48	0.274				
	p[a]	0.230	0.144					
	Mean Difference	4.775	–5.401					
BDI	REG	18.00 ± 10.83	8.38 ± 6.54	**0.001***	7.210	(4.153–10.266)	0.054	0.119
	CG	18.84 ± 8.60	14.04 ± 10.78	**0.011***				
	P^a	0.771	**0.042***					
	Mean Difference	–0.840	–5.659					
PSS –10	REG	24.00 ± 5.69	18.04 ± 5.77	**0.001***	3.636	(1.593–5.679)	0.106	**0.027***
	CG	20.52 ± 5.62	19.20 ± 6.67	0.329				
	P^a	**0.043***	0.538					
	Mean Difference	3.480	–1.15					
PSQI	REG	10.90 ± 4.60	6.00 ± 3.88	**0.001***	3.592	(2.207–4.978)	0.077	0.063
	CG	9.72 ± 4.65	7.44 ± 4.69	**0.012***				
	p[a]	0.392	0.269					
	Mean Difference	1.184	–1.440					
SF–12/P	REG	42.26 ± 4.15	42.23 ± 5.28	0.981	0.025	(–2.649–2.700)	0.000	0.992
	CG	41.68 ± 5.95	41.67 ± 7.47	0.995				
	p[a]	0.706	0.775					
	Mean Difference	0.585	0.560					
SF–12/M	REG	36.45 ± 6.27	41.20 ± 9.54	0.074	–3.462	(–6.908-(–0.015))	0.013	0.452
	CG	36.36 ± 8.06	38.52 ± 7.10	0.358				
	P^a	0.968	0.281					
	Mean Difference	0.088	2.681					

M: Mean, SD: Standart Deviation, CG: Control Group, REG: Relaxation Exercise Group, PDS: Posttraumatic Stress Diagnostic Scale, BAI:Beck Anxiety Inventory, BDI: Beck Depression Inventory, PSS-10: Perceived Stress Scale, PSQI: Pittsburgh Sleep Quality Index, SF-12: Short-Form Health Survey.
P^a: independent sample *t* test, P^b: paired sample *t* test, P^c: repeated measures ANOVA.
*$P < 0,05$, CI: Confidence Interval.

First, initial perceived stress levels differed between groups, potentially influencing the findings. Second, environmental factors that could enhance quality of life were not modified, and third, there was no long-term follow-up to assess the sustainability of the intervention's effects. Additionally, the study relied on self-reported questionnaires to assess PTSD symptoms, anxiety, depression, and perceived stress, which, despite being validated and widely used, are subject to response bias and the honesty of participants. To enhance future studies, increasing the sample size to ensure comparable baseline stress levels, extending the intervention duration, and incorporating strategies to promote physical activity and lifestyle changes are recommended. Furthermore, future research should address the limitations of self-reported data by integrating clinician-administered assessments or objective physiological measures to improve the accuracy of psychological outcome evaluations.

Discussion

This randomized controlled trial investigated the effects of progressive muscle relaxation (PMR) combined with diaphragmatic breathing exercises on post-earthquake stress-related symptoms in earthquake survivors. The results indicate that relaxation based structured exercises positively impacted anxiety, depression, perceived stress, and sleep quality. However, they did not significantly affect post-traumatic stress or QoL. Previous studies have demonstrated that PMR and diaphragmatic breathing can alleviate stress-related symptoms in various populations, including individuals

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recovering from Covid-19, cancer, those with schizophrenia, women undergoing health treatments, patients with rheumatic diseases like fibromyalgia and rheumatoid arthritis, and veterans with PTSD.[20,39–48] No previous studies have been identified that apply PMR and diaphragmatic breathing exercises specifically to earthquake survivors in the acute post-disaster period.

A study on adolescents with PTSD following the Kosovo War demonstrated a significant reduction in PTSD symptoms compared to a control group receiving no treatment, using a body-mind approach that included 12 sessions of meditation, guided imagery, and breathing techniques.[49] Similarly, research involving hatha yoga for earthquake survivors in southern Iceland showed a significant decrease in PTSD symptoms, attributing this improvement to the relaxation benefits of yoga.[26] Differences in findings between this study and those involving yoga may be attributed to the varying levels of earthquake intensity experienced by participants. For instance, the earthquake in Türkiye (7.6 Richter) was significantly more intense than the one in Iceland (6.1 Richter), and the severity of the earthquake and exposure levels are known to impact stress and related symptoms.[50]

PMR and diaphragmatic breathing exercises, known for their benefits in enhancing both physical and mental health, have been shown to reduce anxiety and depression and improve coping skills in stressful situations.[44,45,47,51] In line with this, Thordardottir et al. reported that a 6-week yoga intervention significantly reduced anxiety, depression, and stress symptoms in earthquake survivors.[26] The findings of the present study align with the existing literature, demonstrating the effectiveness of PMR and diaphragmatic breathing exercises in lowering anxiety, depression, and stress levels. Although the groups showing different PSS-10 levels at the beginning created a bias, the decrease in perceived stress was larger in REG and showed significance. This result may indicate that relaxation-based exercises are more effective in reducing perceived stress levels.

PMR has been shown to improve QoL and sleep quality in the post-Covid-19 period.[39,46] For instance, Lu et al. found that PMR enhanced the QoL in patients with chronic schizophrenia.[43] Similarly, earthquake survivors who participated in yoga interventions demonstrated significant improvements in sleep quality and overall QoL.[26]

However, in the present study, no significant differences were found in QoL, as measured by the SF-12, within or between the groups, regarding both physical and mental component scores. The profound and enduring impact of earthquake trauma on individuals, including a prolonged decline in QoL, suggests that effects may persist for years.[52] Consequently, long-term exercise and follow-up are recommended. Factors such as advanced age and economic difficulties are known to negatively affect QoL post-earthquake.[52] Short duration of the 4-week intervention in this study may explain the lack of significant differences observed in QoL outcomes. Additionally, the participants' living conditions and opportunities remained largely unchanged during the intervention period.

Norris et al. categorized different recovery trajectories after a disaster, showing that some individuals exhibit resilience or recovery, while others may experience chronic dysfunction or delayed distress. It also supports the idea that resilience is not a fixed personality trait but a dynamic process that can be improved with appropriate interventions.[53] Accordingly, this study suggests progressive muscle relaxation (PMR) and diaphragmatic breathing techniques to support individuals' transition from chronic or delayed dysfunction trajectories to resilience and recovery after a disaster. Integrating these techniques into long-term support programs for disaster victims may be considered a practical and effective strategy for enhancing psychological well-being. Similarly, Bonanno et al. show that resilience after a disaster is influenced by a variety of demographic, social, and environmental factors.[54] Given that many earthquake victims face financial instability, loss of social networks, and increased stress, it can be argued that relaxation-based interventions (PMR and diaphragmatic breathing) may provide an accessible and effective support mechanism for these individuals. These interventions are consistent with the comprehensive and community-focused psychological support approach of Bonanno et al. and also with the recommendations of Norris et al. for the continuity of psychological monitoring after a disaster.[53,54] Previous studies have shown that stress reactions seen in the early period after a disaster do not turn into long-term psychological disorders in every individual but may cause persistent stress and anxiety in some individuals.[54] In this context, this study aims not only to alleviate stress symptoms in the acute period, but also to help individuals develop stress management and self-regulation strategies in the long term. Considering the possibility that social support that can be provided through supervised sessions may increase resilience, the effect of relaxation techniques rather than social interaction was prioritized in this study. Participants were not guided in a way that would encourage social interaction, and the focus was entirely on the implementation of relaxation exercises. Moreover, PMR and diaphragmatic breathing are evidence-based techniques that enable individuals to cope with stress with or without social support.[20,39–48] Therefore, the findings of this study indicate that relaxation techniques are independently effective and can be considered as an important tool to support post-disaster mental health.

Future research should consider including strategies that address both psychological conditions and improvements in living conditions to achieve a more substantial enhancement in the QoL for earthquake survivors. Additionally, longitudinal studies are needed to assess the sustainability of these interventions over long periods of time and to determine their role in preventing chronic psychological disorders such as PTSD and long-term depression.

Conclusion

The findings of this study support the study hypothesis, indicating that PMR and diaphragmatic breathing exercises may effectively reduce anxiety, depression, and perceived stress levels, as well as improve sleep quality in individuals experiencing post-earthquake stress-related symptoms. These results suggest that relaxation-based supervised exercise can be used as a novel rehabilitation model for post-disaster post-traumatic stress syndrome.

The summary of this study was presented as an oral presentation at the 9th National Physiotherapy Congress on October 26-28, 2023. The abstract was published in the special issue of the Turkish Journal of Physiotherapy and Rehabilitation.

Author contribution. S.I.S.: Conceptualization, Data curation, Investigation, Methodology, Writing-original draft. G.E.S.: Conceptualization, Formal analysis, Investigation, Methodology, Supervision, Writing- review and editing.

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