

Exercise therapy for preventing physical and psychological trauma in earthquake-prone areas: A systematic review

Eriyono Budi Wijoyo¹, Mustikasari^{2*}

ABSTRACT

Background: Earthquakes impose both physical injuries and psychological disorders such as post-traumatic stress disorder (PTSD), depression, and anxiety. This study aimed to evaluate the effectiveness of exercise therapy in preventing and managing physical and psychological trauma among populations in these regions.

Methods: The protocol was registered in PROSPERO (registration number: CRD420251130734) and followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. A literature search was conducted in PubMed, ScienceDirect, and ProQuest (January 2014–August 2025) using MeSH terms and Boolean operators. Eligible studies included the randomized control trial (RCT), quasi-experimental, cohort, and controlled field trials examining exercise interventions for trauma-related outcomes in earthquake settings. Two reviewers independently screened studies, extracted data, and assessed quality using the PEDro scale.

Results: Nine studies met the criteria, covering adolescents, older adults, disaster survivors, and refugees. Interventions ranged from yoga and aerobic training to strengthening and community-based rehabilitation. Exercise therapy consistently improved physical (pain, mobility, function) and psychological outcomes (PTSD, anxiety, depression), but methodological flaws, lack of blinding, concealed allocation, and intention-to-treat analysis limited the evidence to moderate quality.

Conclusion: Exercise therapy supports both physical recovery and psychological resilience in earthquake-affected populations, but more high-quality RCTs with standardized protocols are needed to strengthen evidence and inform its integration into disaster management.

Keywords: Earthquake, exercise therapy, physical trauma, psychological trauma, rehabilitation.

Cite This Article: Wijoyo, E.B., Mustikasari. 2025. Exercise therapy for preventing physical and psychological trauma in earthquake-prone areas: A systematic review. *Physical Therapy Journal of Indonesia* 6(2): 212-219. DOI: 10.51559/ptji.v6i2.330

¹Doctoral Program of Nursing, Faculty of Nursing, Universitas Indonesia, Depok, Indonesia;

²Department of Mental Health Nursing, Faculty of Nursing, Universitas Indonesia, Depok, Indonesia.

*Corresponding author:

Mustikasari;
Department of Mental Health Nursing,
Faculty of Nursing, Universitas Indonesia,
Depok, Indonesia;
mustikasari@ui.ac.id

Received: 2025-03-30

Accepted: 2025-07-23

Published: 2025-09-27

INTRODUCTION

Earthquakes are destructive natural disasters that cause physical and psychological suffering in impacted communities. They impose a double burden of acute physical injuries and mental health issues, such as post-traumatic stress disorder (PTSD), anxiety, depression, and sleep disruptions.^{1,2} The 2023 Turkey-Syria earthquakes demonstrated this impact, affecting 9.1 million people, resulting in over 50,000 deaths, 115,000 injuries, and massive building loss, necessitating extensive reconstruction efforts.³ Post-earthquake assessments indicate that neuro-musculoskeletal injuries are the most common, necessitating short- to medium-term rehabilitation to restore mobility, improve everyday functioning, and prevent long-term disability.^{4,5}

Recent studies demonstrate that

rehabilitation is still poorly incorporated into disaster preparedness and response in many low- and middle-income countries (LMICs). Shortages of skilled people, limited catastrophe training, and inadequate referral pathways impede survivors' functional rehabilitation, undermining the continuity of treatment from the acute phase to the community.⁶ However, cross-system integration and community-based initiatives are critical for speedy, equitable recovery.^{7,8} Exercise and physical activity have also been shown in studies to enhance physical outcomes (pain, mobility, and function) while decreasing psychological symptoms.⁹

In earthquake-prone locations, trauma-informed, community-based, multimodal exercise programs (aerobic, strength, and balance/functional training) can help prevent problems, speed up recovery, and minimize psychological

distress. Post-earthquake rehabilitation reports underline the critical necessity for structured, long-term programs ranging from shelters to community-based rehabilitation (CBR) facilities.¹⁰⁻¹² Thus, examining the most recent information on exercise models, dosage, intensity, and delivery mechanisms in earthquake settings is critical for guiding policies and practices in physiotherapy, nursing, and rehabilitation medicine.⁴

The main barriers included a lack of understanding about exercise treatment in earthquake-prone locations, worries about long-term viability, and insufficient professional expertise. While mitigating programs exist, exercise-based approaches to improving physical readiness and psychological resilience are understudied. Exercise improves strength, endurance, and mental health, perhaps lowering earthquake-related pain, but the available

research is scattered and lacks systematic integration. A systematic review is thus required to combine data, clarify advantages, and guide evidence-based disaster mitigation strategies. This study assesses the efficacy of exercise therapy in preventing and treating physical and psychological trauma in impacted populations.

METHODS

This systematic review summarized evidence on exercise therapy for preventing physical and psychological trauma in earthquake-prone areas. The protocol was developed using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) checklist and registered in PROSPERO (registration number: CRD420251130734).^{13,14} The review question was structured with the PICO framework: Population: individuals or communities in earthquake-prone areas; Intervention: exercise interventions; Comparator: no intervention, usual care, wait-list, or psychoeducation; Outcomes: physical and psychological trauma.

Literature searches targeted studies on exercise interventions for trauma prevention in earthquake-prone areas. Keywords were adapted from medical subject headings (MeSH), including “Exercise Therapy,” “Physical Trauma,” “Psychological Trauma,” and “Earthquakes.” Searches were conducted in PubMed, ScienceDirect, and ProQuest, with tailored strategies for each database.

Eligibility criteria included randomized controlled trials (RCTs), cluster-RCTs, quasi-experimental studies, controlled before-and-after studies, cohort studies, and relevant controlled field trials in earthquake settings. Systematic reviews were screened for primary studies. Populations included adolescents, adults, and older adults in earthquake-affected or high-risk communities. Interventions involved exercise or movement intended to prevent or treat trauma. Eligible studies reported at least one physical or psychological outcome with pre- and post-intervention data, were published between January 1, 2014, and August 20, 2025, and written in English. Exclusions were case reports, editorials, protocols without results, animal studies, non-

exercise interventions, and studies without relevant outcomes.

For data collection, the first author (EBW) screened titles, abstracts, and full texts, removing unrelated or duplicate articles. Two authors (EBW, M) independently screened the remaining studies, retrieving full texts for final inclusion. Data extraction covered study details (title, authors, year, country, and design), intervention characteristics, and measured outcomes. Findings were qualitatively synthesized and summarized in Table 1. Quality and risk of bias were assessed using the PEDro scale (0–10) for RCTs and quasi-randomized trials (Table 2). Two reviewers (EBW, M) independently evaluated study quality and risk of bias, resolving disagreements through discussion. Articles with high risk of bias were excluded. Figure 1 showed the study selection process using a PRISMA flow diagram, illustrating study identification, screening, eligibility, and inclusion.

RESULTS

Nine studies conducted in earthquake-prone or disaster-affected settings were included in this review, spanning randomized controlled trials, quasi-experimental studies, prospective cohorts, and pre-post interventions. Interventions ranged from structured exercise classes, yoga, and rehabilitation programs to disaster-preparedness and evacuation drills, with outcomes assessing physical function, psychological well-being, and quality of life.

In Iceland, Thordardottir et al.²² found that a six-week hatha yoga program improved stress, sleep, concentration, and quality of life, though between-group differences lost significance after Bonferroni correction. Similarly, Moriyama et al.¹⁶ reported no group differences in well-being or HRQOL among Japanese elderly evacuees, but the intervention group showed a reduced risk of decline in subjective well-being (OR = 0.23, 95% CI: 0.06–0.88).

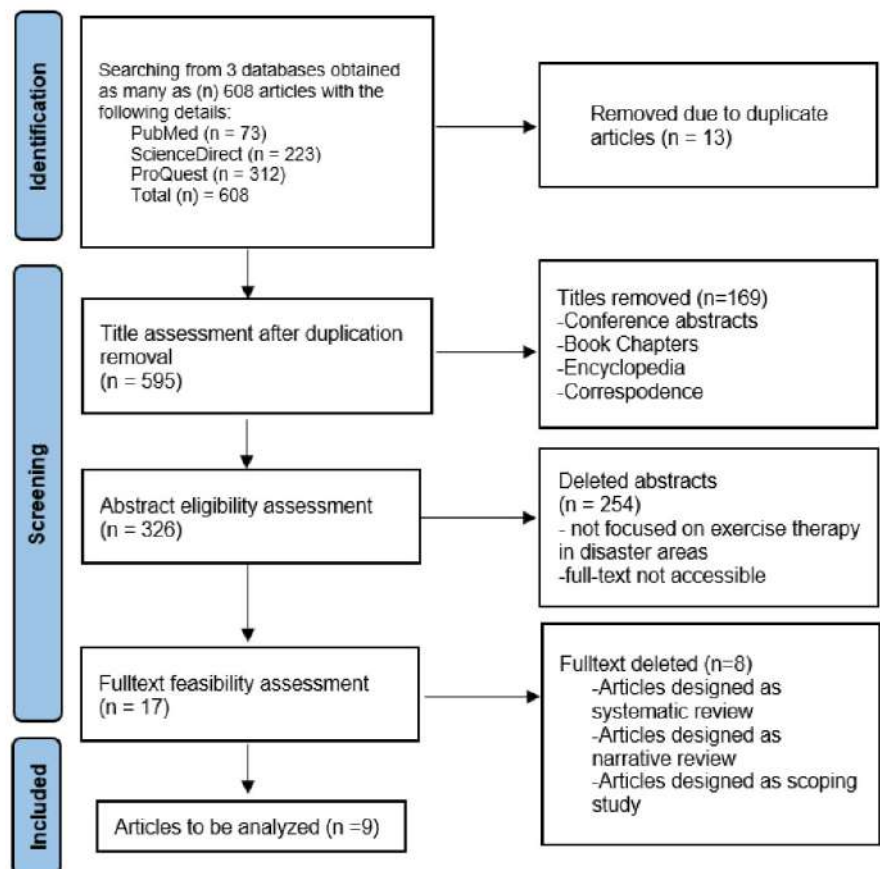


Figure 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram

Table 1. Characteristics of the studies included in the systematic review

No	Author & years	Study design	Questionnaire	Intervention	Results
1	Thordardottir et. al., 2014 ²²	This study was a non-randomized community intervention with pre- and post-intervention assessments.	Five questionnaires assessing psychological and physiological well-being were administered before and after the intervention: The study employed several standardized instruments to assess psychological and well-being outcomes: the Perceived Stress Scale (PSS-10) for general stress, the Posttraumatic Stress Diagnostic Scale (PDS) for PTSD, the Beck Depression Inventory-II (BDI-II) for depression, the Beck Anxiety Inventory (BAI) for anxiety, and the Icelandic Quality of Life scale (IQL) for overall quality of life.	The intervention group participated in a six-week integrated Hatha yoga program, meeting twice weekly for 60 minutes. The program combined mild-to-moderate physical activity with mindfulness, meditation, yogic breathing, and relaxation techniques.	Although the MANOVA initially showed group differences in sleep quality ($p=.03$) and social relations ($p=.04$), these differences did not remain significant after applying the strict Bonferroni correction ($\alpha=.005$). Crucially, both groups demonstrated marked improvement in stress and related symptoms—including sleep, concentration, well-being, quality of life, depression, and anxiety—following the intervention.
2	Moriyama, 2020 ¹⁶	This study was a two-way parallel cluster-randomized trial.	The primary outcome was subjective well-being (SWB), which researchers measured using the Japanese version of the World Health Organization-Five Well-being Index (WHO-5-). Secondary outcomes included health-related quality of life (HRQOL), assessed by the Medical Outcomes Study Short-Form 12 (SF-12), and physical activity level, evaluated using the Physical Activity Questionnaire for Elderly Japanese (PAQ-EJ).	Participants in the intervention group attended eight weekly classes at each RPH complex from January to March 2019. Each session included a 30–40 minute lecture followed by a 20–30 minute group exercise.	The analysis included data from 18 intervention participants and 29 control participants. Initially, there were no significant group differences in subjective well-being (SWB) ($p=.41$) or in the mental ($p=.16$) and physical ($p=.42$) aspects of health-related quality of life (HRQOL). However, the intervention group showed a notably lower odds of decreased SWB over three months compared to the control group (OR =0.23, 95% CI:0.06–0.88). No significant group difference was found for changes in the mental (OR =0.75) or physical (OR =2.79) domains of HRQOL.
3	Filippou, 2025 ¹⁵	This study was a pragmatic randomized controlled trial (RCT)	The study utilized several standardized instruments to assess mental health: PTSD symptoms were measured using the 22-item Impact of Event Scale-Revised (IES-R). Additionally, the researchers assessed depressive symptoms with the 9-item Patient Health Questionnaire (PHQ-9), anxiety with the 7-item Generalized Anxiety Disorder scale (GAD-7), perceived stress with the 10-item Perceived Stress Scale (PSS-10), and well-being with the 5-item WHO Well-Being Index (WHO-5).	All assessments, both at baseline and during the exercise and sport intervention, were completed at the university, which is about a 40-minute drive from the camp. Participants were traveled in groups by bus for six days. Data collecting took place in a specified indoor area at the university. Each group of roughly 25 volunteers completed the operations in five to six hours per day, with breaks and snacks and a dinner offered at the end.	Ninety-eight participants (58% women; mean age 29.87 ± 10.12 years) completed both pre- and post-intervention assessments. Overall, participants exhibited a poor mental health profile, with 59% meeting criteria for PTSD. In the intervention group, attending sport and exercise activities twice or more per week was associated with improved PTSD symptoms ($p = .03$, $\eta^2_p = .05$), whereas those attending less frequently and the control group showed no change ($p \geq .95$, $\eta^2_p \leq .001$). The study found no significant impact on measures of depression, anxiety, stress, or general well-being.

No	Author & years	Study design	Questionnaire	Intervention	Results
4	Tsuji, 2017 ²⁰	Prospective observational study.	Depressive symptoms using the 15-item Geriatric Depression Scale (GDS)	Researchers surveyed individuals before and after the disaster to determine their frequency of group exercise (≥ 4 days/week, 2-3 days/week, once a week, 1-3 times/month, a few times/year, or none) and daily walking duration (< 30 , 30-59, 60-89, or ≥ 90 minutes/day).	On average, the GDS score (a measure of depression) saw a small, non-significant increase of 0.1 points (95% CI: -0.003 to 0.207) from before to after the disaster. Concurrently, participants reported increases in group exercise frequency (1.9 days/year) and daily walking time (1.3 minutes/day). Importantly, both increased group exercise ($B = -0.139, p = 0.003$) and increased daily walking ($B = -0.087, p = 0.054$) were associated with significantly lower GDS scores when accounting for personal catastrophe experiences. However, this protective benefit was slightly weakened for survivors who experienced more significant home damage, as shown by the marginally significant interaction effects.
5	Katayama, 2021 ¹⁷	Randomized Controlled Trial (RCT)	The GSES was used to assess and compare self-efficacy levels. The SF-36 [®] was used to assess health-related quality of life changes following the intervention. A tsunami evacuation model course was created in Marugame City's physical education facilities (Kagawa Prefecture, Japan), modeled after the evacuation tower in Nankoku City (Kochi Prefecture). Physical fitness was assessed using a new test developed by Japan's Ministry of Education, Culture, Sports, Science, and Technology, which included grip strength (kg), flexibility (cm), one-leg balancing with eyes open (seconds), 6-minute walking distance (meters), and 10-metre obstacle walking time (seconds).	The 97 participants were divided randomly by gender into two groups: disaster prevention education (Group D; $n = 49$) and exercise education (Group E; $n = 48$). Group D got 30 minutes of disaster prevention education per week for four weeks, including disaster mechanisms, Japan-specific occurrences, preparedness, and evacuation behavior. For four weeks, Group E received 30 minutes per week of general exercise education aimed at preventing metabolic syndrome, locomotive syndrome, and dementia. For 10 weeks, both groups followed the identical 90-minute weekly physical fitness program, which included aerobic and strength training conducted by trained instructors.	No significant differences were observed between the groups in total evacuation time, physical fitness, or health-related QOL. However, Group D showed a significantly greater increase in GSES scores (1.4 ± 3.9) compared to Group E (-1.1 ± 7.5).
6	Grimmash, 2023 ¹⁹	Quasi eksperimental	Physical Activity Scale; Situational Motivation Scale (SIMS); Self-Efficacy Questionnaire for Children and Young Adolescents (SEQ-C); Mental Health Continuum-Short Form (MHC-SF); Godin Leisure-Time Exercise Questionnaire.	An 8-week structured exercise program for teens, with each session providing supervised physical activity to enhance fitness, emotional well-being, and mental health.	Participants initially reported moderate physical activity levels (5.5 ± 1.4), which significantly improved to 7 ± 1.5 following the eight-week program ($p = 0.013$). Similarly, situational motivation increased notably, rising from 26 ± 19.6 to 38.1 ± 16 ($p = 0.042$). The program also led to significant improvements in both social and psychological well-being. Notably, participants receiving weekly phone calls showed a parallel, though statistically non-significant, trend of improvement.

No	Author & years	Study design	Questionnaire	Intervention	Results
7	Adhikari SP et al., 2018 ¹¹	Pre-post experimental design	Assessment tools used included the World Health Organization Disability Assessment Schedule (WHODAS 2.0), the Timed Up and Go (TUG) test, and the Numerical Pain Rating Scale (NPRS).	Participants reported moderate physical activity levels (5.5 ± 1.4 on a 10-point scale), which improved considerably following the eight-week program (7 ± 1.5 ; $p = 0.013$). Situational motivation increased from 26 ± 19.6 to 38.1 ± 16 ($p = 0.042$), while social and psychological well-being also improved significantly. Participants who received weekly phone calls showed a similar trend of improvement, although the difference was not statistically significant.	All participants completed the rehabilitation without adverse effects. Treatment significantly reduced disability ($P < 0.001$, effect size = 0.63) and pain ($P = 0.007$), while changes in TUG were not significant.
8	Kuroda Y et al., 2018 ²¹	Cohort study	Applied the six domains of the BCL developed by Japan's Ministry of Health, Labour and Welfare (MHLW).	The exercise program was held year-round for litate evacuees in the meeting rooms of their temporary and public housing, with one-hour sessions occurring twice per month. Sports instructors designed and led the workouts, which were tailored to individual fitness levels and focused on improving strength, balance, and walking. Participants' fitness was formally assessed at both the beginning and end of the program.	Over the follow-up period, 24.2% of participants (280 individuals) developed functional disabilities. The study identified that higher Negative BCL domain scores significantly increased the risk for disability in Physical Function (HR 2.04), Cognitive Function (HR 1.37), and Depression (HR 1.60). Crucially, the exercise program offered strong protection: the Cox analysis showed that both low and high involvement in the program dramatically reduced the risk of disability compared to not participating at all (HR 0.27 and HR 0.30, respectively).
9	Greiner C et al., 2016 ¹⁸	Quasi eksperimental	At baseline, participants' age, sex, and height were recorded. Weight, blood pressure, health status, exercise participation, activity duration, sleep time, and treatment conditions were measured at baseline, 3 months, and 6 months. Physical function (FRT, TUG, OSB, CST) was assessed at the same intervals. Health-related quality of life (HRQOL) was evaluated using the Japanese SF-8 at baseline, 1 month, 3 months, and 6 months, with the 1-month point included to capture earlier changes.	Each exercise class lasted about one hour, consisting of 40 minutes of pamphlet-based exercises and 20 minutes for tea and socializing. A qualified public health nurse led the sessions with assistance from two aides, held weekly for 24 consecutive weeks.	Of the 45 participants who consented, 27 completed the 6-month program and were included in the analysis. Significant improvements were observed in FRT ($p = .000$), OSB ($p = .007$), and CST ($p = .000$). The SF-8 also showed significant gains in bodily pain ($p = .004$), general health perception ($p = .001$), and mental health ($p = .035$).

Table 2. Results of quality assessment of systematic reviews using the PEDro scale

Study	Eligibility (1)	Random allocation (2)	Concealed allocation (3)	Groups similar at baseline (4)	Blinding subjects (5)	Blinding therapists (6)	Blinding assessors (7)	>85% follow-up (8)	Intention-to-treat (9)	Between-group comparison (10)	Point measure & variability (11)	PEDro Score (0-10)
Thordardottiret al., 2014 ²²	1	0	0	?	0	0	?	?	?	1	1	3
Moriyama, 2020 ¹⁶	1	1	?	?	0	0	?	?	?	1	1	4-5
Filippou, 2025 ¹⁵	1	1	?	?	0	0	?	0	?	1	1	4
Tsuji, 2017 ²⁰	1	0	0	?	0	0	?	?	0	1	1	3
Katayama, 2021 ¹⁷	1	1	?	1	0	0	?	?	?	1	1	5-6
Gmmash, 2023 ¹⁹	1	0	0	?	0	0	?	1	?	0	1	3-4
Adhikari SP et al., 2018 ¹¹	1	0	0	0	0	0	?	1	?	0	1	2-3
Kuroda Y et al., 2018 ²¹	1	0	0	?	0	0	?	?	0	1	1	3
Greiner C et al., 2016 ¹⁸	1	0	0	?	0	0	?	0	0	0	1	2

Among asylum seekers in Greece, Filippou et al.¹⁵ observed that exercising at least twice weekly significantly reduced PTSD symptoms ($p = .03$), though no effects were seen for depression, anxiety, or stress. In a large Japanese cohort, Tsuji et al.²⁰ showed that more frequent group exercise and daily walking were linked to lower depressive symptoms, though benefits diminished among individuals with severe housing damage.

Katayama et al.¹⁷ found no differences in physical fitness or evacuation performance between disaster-prevention and general exercise education groups, but self-efficacy (general self-efficacy scale (GSES): 1-10) improved significantly in the disaster-prevention group. In Saudi Arabia, Gmmash et al.¹⁹ showed that an eight-week supervised exercise program improved physical activity levels, motivation, and mental health in adolescents.

In Nepal, Adhikari et al.¹¹ reported that a community-based rehabilitation program significantly reduced disability ($p < .001$) and pain ($p = .007$), though functional mobility (timed-up go (TUG) test) did not improve. In Japan, Kuroda et al.²¹ found that year-long exercise classes reduced the incidence of functional disability, with both low- and high-participation groups at significantly lower risk than non-participants. Finally, Greiner et al.¹⁸ reported improvements in physical performance (functional reach test (FRT), one-leg standing balance (OSB), chair stand test (CST) and quality of life (bodily pain, general health, mental health) after 24 weeks of weekly group exercise.

Overall, evidence indicates that structured exercise interventions can reduce disability, improve physical function, and support psychological well-being in earthquake-affected populations, although effectiveness varies by intervention type, frequency, and population characteristics.

DISCUSSION

The PEDro checklist found that the methodological quality of the nine analyzed studies ranged from 2 to 6 out of 10, with the majority ranking low to moderate. Katayama et al., Moriyama et al., and Filippou et al. demonstrated greater

quality employing RCT or cluster-RCT designs, resulting in more robust causal inference.¹⁵⁻¹⁷ However, information on concealment, blinding, and intention-to-treat analysis was frequently lacking. Adhikari et al. and Greiner et al. obtained low grades (2-3/10) for using uncontrolled pre-post designs or quasi-experimental techniques with high dropout rates. Almost all studies showed common faults, such as insufficient blinding, poor concealment, and the lack of intention-to-treat reporting, which increased the likelihood of selection and measurement bias and lowered confidence in the findings.^{11,18}

The study population was broad, including adolescents and young adults (with a concentration on Saudi teenagers)¹⁹, the elderly, natural disaster survivors (Tsuji et al., Kuroda et al., Katayama et al., Greiner et al.)^{17,18,20}, refugees/asylum seekers¹⁵, and those with physical disabilities. This variability demonstrates the broad application of physical interventions in a variety of situations, including post-disaster settings and community health initiatives for both older persons and youth.¹¹

The nine studies examined therapy such as yoga, mindfulness, community-based exercise, and rehabilitation programs. A 6-week comprehensive hatha yoga program decreased stress while improving sleep, focus, and quality of life. Community exercise courses, health education, and strength/balance training improved well-being, HRQoL, physical function, and self-efficacy.^{16-18,21} A 10-week organized fitness program for migrants reduced PTSD symptoms, especially among those who participated at least twice a week.¹⁵ A 12-session, two-week community rehabilitation program for earthquake survivors with physical limitations reduced disability and suffering, but had no meaningful effect on functional balance.¹¹ Finally, an eight-week structured exercise program for adolescents improved their physical activity, motivation, and mental health. This intervention is simple, community-based, and requires few resources, making it ideal for widespread implementation, particularly in post-disaster environments.¹⁹

Despite methodological constraints,

most research' conclusions indicate encouraging trends. Psychological benefits include decreased stress, sadness, anxiety, and PTSD, as well as increased motivation and well-being.^{15,16,19,20,22} Physical and functional advantages include increased capacity, balance, strength, and lower disability risk.^{11,17,18,21} Several studies also indicated increased HRQoL, albeit not all of the findings were significant.^{16,18,21} For example, Filippou et al. discovered only impacts on PTSD, but Moriyama et al. identified no significant HRQoL differences across groups despite a good trend.^{15,16}

This review has several study limitations. It only includes English-language publications published between 2014 and 2025, perhaps excluding key studies in other languages or from previous periods. Reliance on PubMed, ScienceDirect, and ProQuest may have resulted in publication bias, while eligibility limits on controlled research may have excluded important findings. Future research should use larger databases, non-English publications, and a range of study designs to offer more comprehensive information on the effectiveness of exercise programs in reducing physical and psychological trauma in earthquake-prone areas.

CONCLUSION

A review of nine studies found that physical interventions, such as yoga, community exercise, home-based rehabilitation, and structured activities for adolescents and refugees, improved physical and mental health as well as quality of life. Despite methodological limitations (low-to-moderate PEDro scores, lack of blinding, concealment, and intention-to-treat analysis), the evidence consistently shows that physical activity reduces stress, depression, anxiety, and PTSD, while enhancing physical function, motivation, and overall well-being. Community-based exercise and yoga programs, in particular, appear effective, affordable, and easy to implement, especially for vulnerable groups such as post-disaster populations, the elderly, adolescents, and refugees. High-quality RCTs are needed to strengthen the evidence and confirm these findings.

ETHICAL CONSIDERATIONS

This systematic review is based solely on published studies, without involving human or animal subjects. All sources are properly cited, and only peer-reviewed, reputable articles were included to ensure ethical research standards.

CONFLICT OF INTEREST

The authors declare no competing interests.

FUNDING

None.

AUTHOR CONTRIBUTIONS

EBW conceptualized the research, designed the study framework, and conducted the systematic article search and selection. M contributed to the analytical depth and refinement of the systematic review. All authors participated in drafting the manuscript and approved the final version.

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