REVIEW

# Efficacy of Progressive Muscle Relaxation in Adults for Stress, Anxiety, and Depression: A Systematic Review

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**Background:** The rise in the prevalence of mental health problems among adults worldwide has raised concerns, highlighting the critical need for evidence-based mental health interventions that are accessible, comprehensive, and effective. Previous research suggests that Progressive Muscle Relaxation (PMR) is a promising intervention widely used to reduce mental health problems. Nevertheless, the current literature on the efficacy of PMR among adults globally is fragmented, indicating a potential gap in this research area. Hence, this paper aims to systematically compile the research evidence on the efficacy of PMR in adults for stress, anxiety, and depression.

**Methods:** The Scopus, Web of Sciences, PubMed, PsycINFO, and Cochrane Central Register of Controlled Trials were searched from the earliest available evidence to 28th March 2023. The PRISMA (Preferred Reporting Items of Systematic Reviews and Meta-analyses) guidelines were followed, and the protocol was registered on the Open Science Framework. Joanna Briggs Institute (JBI) Critical Appraisal Tools were used to assess the quality of the included studies.

**Results:** A total of forty-six (46) publications from sixteen (16) countries covering more than 3402 adults were included in the review. The results show that PMR are effective in reducing stress, anxiety, and depression in adults. When PMR is combined with other interventions, the combined techniques have also consistently exhibited enhanced efficacy. Moreover, findings also indicate that the efficacy of PMR is heightened when implemented in conjunction with other interventions, surpassing its standalone efficacy.

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**Keywords:** progressive muscle relaxation, stress, anxiety, depression

## Introduction

There is more to mental health than the absence of mental disorders. According to the World Health Organization (WHO),[1] the term "mental health" refers to a state of psychological well-being that allows individuals to successfully manage the challenges of life, recognize their strengths, participate in study and work, and make significant contributions to the communities. There is a broad continuum of mental health that is experienced differently by each individual. It carries diverse levels of challenges and distress as well as possibly highly distinct social and psychological impacts. Being typically capable of thinking, feeling, and acting in a way that satisfies one's desires in life is a sign of good mental health. However, if one has experienced a phase of poor mental health such as stress, anxiety, and depression, they will likely find everyday life as challenging or even impossible to deal with the frequent thoughts, feelings, or responses. These poor conditions could lead to more serious psychiatric disorders or conditions such as clinical anxiety, depression, bipolar disorders, schizophrenia, or even suicide.[2–4] The aforementioned statement emphasizes the critical need to swiftly

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address stress, anxiety, and depression as these are major contributors to the wider range of mental health issues that people may encounter.

Stress may not be typical of the person or the environment; rather, it is a complex system formed by the interplay of specific psychological and physiological elements with the surroundings,[5] while anxiety is a mental condition characterized by unpleasant emotions, unease, anxiety about the future, or dread of reacting to the present without a clear trigger.[6] According to World Health Organization,[7] depression is a widespread mental health condition that impacts over 300 million individuals globally. Depression is commonly characterized by symptoms like poor mood, interest loss, changes in weight or appetite, sleep difficulties, psychomotor changes, guilt feelings, lack of focus, and suicidal thoughts or attempts in the past.[8] An earlier research conducted among adult population in 2020 revealed that nearly half of the study sample (48.1%) were affected with mild to extremely severe stress, anxiety, and depression.[9] These figures are very alarming since they could trigger negative affect, which includes erratic feelings and apathy[10] among the adults.

To address those mental health issues, experts have suggested several recommendations like maintaining physical well-being, partaking in recreational activities, staying positive, socializing, and learning relaxation exercises[11] Relaxation exercises have been found to be effective for a person's physical and mental well-being by enabling one's breathing to calm down, decreasing blood pressure, easing stress, and minimizing muscle spasm.[12,13] Moreover, there are emerging studies on the use of relaxation exercises as part of an interdisciplinary prevention or intervention approach for stress, anxiety, and depression,[14–17] and relaxation techniques like progressive muscle relaxation (PMR) are capable of successfully tensing and relaxing different muscle groups.[18]

Of all the relaxation techniques, the PMR technique is the most straightforward to understand and to be used as it is accessible, affordable, self-induced, and offers no adverse impacts.[19] Utilizing PMR is particularly effective in reducing stress, anxiety, and depression. By differentiating between sensations of tension (a purposeful tensing of the muscles) and relaxation (a conscious, deliberate release of the muscles' tension), PMR makes it easier to identify muscles or muscle groups that are persistently tense.[18,20]

Systematic reviews on PMR by previous scholars have focused on the impact of the exercises on patients with serious illnesses such as cancer patients, schizophrenic patients, and those who are undergoing surgery[14,21,22] in reducing their mental health problems. However, to our knowledge, there are no systematic reviews that assess the efficacy of PMR interventions on stress, anxiety, and depression of the general adult population, thus contributing to the current body of knowledge.

## Methodology

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guided the present study. PRISMA was developed to assist reviewers in clearly describing their studies' purpose, methods, and findings.[23] Using this guideline, the reviewers developed pertinent research questions based on the PICO framework. This framework aids reviewers in structuring research questions by dividing them into four main parts: Population, Intervention, Comparison, and Outcome.[24] Based on the framework, one research question is formulated: Does Progressive Muscle Relaxation (PMR) effectively reduce stress, anxiety, and depression among adults? In this review, adults are defined as those who are 18 years of age or older.[25] The review's objectives, inclusion criteria, and methods of analysis were pre-specified and documented in a protocol filed on Open Science Framework (OSF) on the 7th March 2023; DOI: https://doi.org/10.17605/OSF.IO/U2HZP.

### Search Strategy

The reviewers conduct a comprehensive search of five electronic databases; Scopus, Web of Sciences, PubMed, PsycINFO, and Cochrane Central Register of Controlled Trials. The reviewers used various keywords for the literature search to match the study's context and succeed in enhancing the keywords while constructing a comprehensive search string (based on phrase searching, field code function, Boolean operator, truncation, and wild card). The search terms utilized for all the databases included are presented in Table 1.

**Table I** The Search Terms

| Databases | Concept | Search Terms |
|---|---|---|
| Scopus, Web of Science, PubMed, PsycINFO, and Cochrane Central Register of Controlled Trials | PMR | "Progressive muscle relaxation*" OR PMR |
| | Intervention/ Prevention | Intervention* OR therap* OR prevention* OR training* OR strateg* OR program* OR technique* OR exercise* |
| | Stress, Anxiety, Depression | Mental* OR psychiatr* OR psycholog* OR depress* OR anxi* OR stress* OR wellbeing OR well-being OR distress* |

## Selection Criteria

This review includes publications that fit two distinct criteria: (1) Those that explore the effects of PMR on stress, anxiety, and depression in adults, either as a standalone intervention or in combination with additional intervention approaches; and (2) Studies that implement rigorous methodologies, utilizing either a Randomized Controlled Trial (RCT) or a Quasi-Experimental Design (QED). For this review, the inclusion criteria necessitate studies to includes all studies that investigate the efficacy of PMR on stress, anxiety, and/or depression symptoms, focus on experimental research, look at non-clinical cases among adults, and have been published in English language from earliest time until 28th March 2023. Conversely, the review excludes all meta-analysis papers, systematic review papers, students' thesis, or unauthorized or unrecognized dissertations, any non-experimental research, all clinical cases, and non-English articles or studies.

## Study Search, Selection, and Retrieval Processes

The research procedure includes a methodical flow that starts with a thorough database search, followed by exporting the identified articles into the reference management software EndNote X7. After that, duplicates were removed and both the titles and abstracts were screened for relevancy. The process continued by retrieving the full texts of the publications that had been shortlisted. Some articles were unable to be retrieved due to access restrictions on databases, full-text not available, limited database archive, and is a conference abstracts. Finally, a thorough evaluation of these full texts was done to determine which articles are most significant based on the aforementioned criteria. The process was carried out independently by two different reviewers, who then met to compare their findings and reach a consensus. In cases where a consensus was elusive, the reviewers engaged a senior researcher for guidance and resolution.

## Quality Assessment of the Included Study

Following the screening procedure, two (2) reviewers used revised Joanna Briggs Institute (JBI) Critical Appraisal Tools[26,27] to complete the quality assessment on all the selected papers. The reviewers used two (2) different checklists from the revised JBI critical appraisal tools.

The first tool was a checklist called the "Revised Randomized Controlled Trial Checklist". This checklist was used to review papers that used the Randomized Controlled Trial (RCT) design. The checklist provided a thorough, standardized methodology for evaluating many components of RCTs, including internal validity, all types of bias checklists, statistical conclusion validity, randomization protocols, blinding methods, and attrition rates, among other crucial variables.[26] This tool examines thirteen (13) significant components for the systematic review. The checklists consist of four distinct responses: Yes, No, Unclear, and Not Applicable.[28] For this checklist, each of the items received a score for adherence. Items marked with a "Yes" earn a score of one (1), signifying adherence to the checklist criterion, whilst any other replies - "No", "Unclear", or "Not Applicable", receive a score of zero (0), suggesting a lack of assurance or non-relevance to the specific criterion. Previous research on the JBI critical appraisal tool confirms that the attribution of cut-off values or scores that identify a study as being of low, moderate, or high quality is best selected by the systematic reviewers themselves.[29] The aforementioned approach enables reviewers to determine these thresholds based on the specific requirements and circumstances of their assessment, resulting in a more personalized and precise evaluation process. For the current review, the reviewers opted to implement the scoring system from earlier studies.[30,31] Under the

assessment criteria, studies obtaining 70% or more of the maximum attainable score were classified as "high quality", those scoring between 50% and 70% were classified as "moderate quality", while studies with scores falling below the 50% threshold were classified as "poor quality". Moreover, for this checklist, those earning ten (10) points or more were classified as "high quality", those that scored between seven (7) and ten (10) points were deemed "moderate quality", and articles that accrued six (6) points or less were categorized as "poor quality".

The second tool was the "Revised Checklist for Quasi-Experimental Studies". This checklist functioned as an evaluative measure for all studies that used a quasi-experimental design (QED), offering a formal framework for examining the robustness and dependability of the procedures used, how they were carried out, and the subsequent validity of the results.[26] This tool examines nine (9) significant components for the systematic review. Similar to RCT tool, this checklist consists of four distinct responses: Yes, No, Unclear, and Not Applicable. Each of the items received a score for adherence. Items marked with a "Yes" earn a score of one (1), signifying adherence to the checklist criterion, whilst any other replies - "No", "Unclear", or "Not Applicable", receive a score of zero (0), suggesting a lack of assurance or non-relevance to the specific criterion. Moreover, studies obtaining 70% or more of the maximum attainable score were classified as "high quality", those scoring between 50% and 70% were classified as "moderate quality", while studies with scores falling below the 50% threshold were classified as "poor quality".[30,31] Those earning seven (7) points or more were classified as "high quality", those that scored between five (5) and seven (7) points were deemed "moderate quality", and articles that received four (4) points or less were categorized as "poor quality".

The quality assessment instructs reviewers to include articles with high and moderate qualities only. Two reviewers made decisions on the study's eligibility and quality. All possible disagreements were settled through discussion. If no conclusion was achieved, a third reviewer who is a senior researcher is brought in to assist in reaching a final decision. The careful assessments ensured that the research included in the review met a high standard of methodological quality. Next, two independent reviewers extracted the data, and the findings are provided in the next section.

## Data Extraction

Data extraction was done by one independent reviewer and subsequently cross-checked by another reviewer to ensure accuracy and consistency. Following a meticulous data extraction procedure, relevant data addressing the study questions were collected from the reviewed publications and systematically organized into tables. For this review, the findings are divided and presented in two separate tables. The first table focuses primarily on the effects of Progressive Muscle Relaxation (PMR) procedures on the stress, anxiety, and depression in adults, whereas the second table presents on the effects of PMR on stress, anxiety, and depression when paired with other interventions. The extraction tables consisted of: (1) General information (Authors, Publication Years, and Country); (2) Training Duration (minutes/length); (3) Frequency of Training (per week); (4) Participants (Sample Size, Setting, Dropout Rates); (5) Study Design (RCT or QED, Pre-test, Post-Test, and Follow-Up); (6) Research Instruments; (7) Components/Contents of the PMR; (8) Outcome Measures (with effect size where available); (9) Key Findings; and (10) Quality of the Article. The categories were constructed based on reading knowledge and extensive systematic literature reviews by previous scholars.[21,32,33] The data extraction for the current study is illustrated in Table 2 and Table 3

## Results
### Results of the Search
A thorough database search yielded 3205 findings. During the initial screening phase, two reviewers identified and eliminated 1336 duplicate papers. Following that a thorough screening of research titles and abstracts was performed to eliminate another 1708 publications from the remaining findings. Next, 65 articles were not retrieved due to access restrictions on databases, full-text not available, limited database archive, or is a conference abstracts. The remaining 96 full-text publications were then screened based on the inclusion and exclusion criteria. Finally, based on the specified criteria, the reviewers eliminate additional 50 findings that did not meet the inclusion criteria due to clinical studies. As a result, the final phase of the selection approach yields 46 articles from 16 countries (Figure 1) that match all of the inclusion requirements. Figure 2 illustrates the PRISMA flow diagram for the included and excluded studies.

**Table 2** Progressive Muscle Relaxation (PMR)

| No | Author (Year)/ Country | Duration (Minutes/ Length) | Frequency Per Week | Participants | Study Design | | | | Research Instrument | Components/ Content of PMR | Outcome Measures (with Effect Size Where Available) | Key Finding | Quality of the Article |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | EXP | Pre-test | Post-test | F-Up | | | | | |
| 1 | Avants et al[34] (1990) United States | 20m at laboratory/ 1 session | 1 session only | 40 university students (PMR: 20, CG: 20) S: Laboratory DO: 0% | QED | / | / | | STAI | Use Jacobson's PMR exercise by Bernstein, Borkovec.[35] | Anxiety | PMR did not significantly reduce (=) anxiety among the participants. | High |
| 2 | Battaglini et al[36] (2022) Brazil | 30–40m at classroom / 12 sessions | Once or twice/ week | 59 athletes (PMR: 29, CG: 30) S: Classroom DO: 0% | QED | / | / | | CSAI-2, RESTQ-Sport | Use the adapted Jacobson's PMR exercise by Sándor.[37] | Stress (d=0.29), Anxiety (d=1.30) | There is a significant decrease (↓) in cognitive anxiety score and specific stress score in IG compared to CG. | High |
| 3 | Chaudhuri et al[38] (2014) India | 20m at home/ 12 weeks | 7 days/ week | 64 female healthcare workers (PMR: 64→57) S: At home DO: 10.9% | QED | / | / | | PSS | Use Jacobson's PMR exercise protocol by Varvogli, Darviri.[39] | Stress (d=4.12) | There is a significant decrease (↓) in stress scores at the post-test compared to the pretest. | High |
| 4 | Chellew et al[40] (2015) Spain | 5 45m session/ 1 week. | 5 days/ week | 101 university students (APMR: 101) S: N/A DO: 0% | QED | / | / | | SRLE | Use the abbreviated Jacobson's PMR exercise by Bernstein, Borkovec.[35] | Stress (d=0.38) | There is a decrease (↓) in stress score and cortisol secretion level at post-test compared to pretest in IG. | High |
| 5 | Silveira et al[41] (2020) Brazil | 10–15min at classroom/ 8 weeks | Once/ week | 16 nurses (PMR: 16) S: Classroom DO: 0% | QED | / | / | | WSS | Use the Jacobson's PMR exercise. | Stress (d=0.36) | There is a decrease (↓) in stress score at post-test compared to pretest. | High |
| 6 | Dolbier & Rush[42] (2012) United States | 20m at laboratory/ 1 session | 1 session only | 128 university students (APMR: 66, CG: 62) S: Laboratory DO: 0% | QED | / | / | | EMAS-S | Use the abbreviated Jacobson's PMR exercise. | Anxiety (d=0.25) | There is a significant decrease (↓) in anxiety score in post-test compared to pretest in both IG & CG. | High |
| 7 | Ganjeali et al[43] (2022) Iran | 20m at home / 2 weeks + 2–60m classroom | 7 days/ week | 46 nurses (PMR: 23, CG: 23) S: Classroom & at home DO: 0% | RCT | / | / | | DASS-21 | Use the Jacobson's PMR exercise by Toqan, Malak, Ayed, Fashafsheh, Salameh, Sarhan, Azizeh, Batran.[44] | Stress (d=1.47), Anxiety (d=1.61) | There is a decrease (↓) in stress and anxiety score at post-test compared to pretest in the IG. | High |
| 8 | Gao et al[45] (2018) China | 5m at home/ 12 weeks | 7 days/ week | 78 university participants (students and employees) (PMR: 47→25→14F-Up, CG: 31→25) S: At home DO: 35.9% | QED | / | / | / (1 month) | PSS | Use the Jacobson's PMR exercise. | Stress (d=0.42) | There is a significant decrease (↓) in stress score at post-test compared to pretest in the IG. | High |

(Continued)

**Table 2** (Continued).

| No | Author (Year)/ Country | Duration (Minutes/ Length) | Frequency Per Week | Participants | Study Design | | | | Research Instrument | Components/ Content of PMR | Outcome Measures (with Effect Size Where Available) | Key Finding | Quality of the Article |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | EXP | Pre-test | Post-test | F-Up | | | | | |
| 9 | Gustainiene et al[46] (2015) Lithuania | 6 sessions at laboratory/ 4 weeks | Once or twice/ week | 95 university students (PMR: 47, CG: 48) S: Laboratory DO: N/A | QED | / | / | | PSS | Use the Jacobson's PMR exercise. | Stress (d=0.31) | There is a decrease (↓) in stress score at post-test compared to pretest in IG. | High |
| 10 | Hayati et al[47] (2020) Iran | 15m /4 weeks + 2 sessions | Twice a day for 7 days / week | 76 elders (PMR: 38, CG: 38) S: N/A DO: 0% | QED | / | / | | GDS | Use the PMR audio file validated by Yousefi, Taraghi, Mousavinasab[48] | Depression (d=1.49) | There is a significant decrease (↓) in depression score in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | High |
| 11 | Jermaina et al[49] (2022) Indonesia | 30–60m/ 10 weeks | N/A | 20 beginner athletes (PMR: 20) S: Classroom DO: 0% | QED | / | / | | SAS | N/A | Anxiety | PMR did not significantly reduce (=) anxiety for beginner athletes. | High |
| 12 | Murphy[50] (1983) United States | 20m at small room and at home/ 2 weeks | 5 days/ week | 26 nurses (PMR: 17→9→8 F-Up, CG: 9→8 F-Up) S: Small room and at home DO: 30.8% | QED | / | / | / (3 months) | Trait-anxiety scale of STAI | Use the Jacobson's PMR exercise by Bernstein, Borkovec.[35] | Anxiety | There is a significant decrease (↓) in trait anxiety score in post-test compared to pretest in both IG and CG. | High |
| 13 | Mustafa et al[51] (2021) Pakistan | 4 sessions/ 4 weeks | N/A | 10 female nurses (PMR: 10) S: N/A DO: 0% | QED | / | / | | DASS-21 | N/A | Stress (d=2.45), anxiety (d=0.53), depression (d=1.95) | There is a significant decrease (↓) in stress and depression score but not in anxiety at post-test compared to pretest in IG. | High |
| 14 | Palkar et al[52] (2021) India | 45m at home/ 4 weeks + 3 sessions at seminar hall | 7 days/ week | 114 medical students (PMR: 43, CG: 71) S: Seminar Hall & at home DO: 0% | QED | / | / | | PSS, TAS | N/A | Stress (d=0.45), Anxiety (d=0.35) | There is a significant decrease (↓) in stress and anxiety score at post-test compared to pretest in IG. | High |
| 15 | Prakash Jha et al[53] (2020) India | 30m/ 2 weeks | 7 days/ week | 30 elderlies (PMR: 30) S: N/A DO: 0% | QED | / | / (twice) | | GDS | N/A | Depression | There is a significant decrease (↓) in depression score at post-test compared to pretest. | High |
| 16 | Yilmaz et al[54] (2018) Turkey | 28m at home/ 8 weeks | 3 days/ week | 65 caregivers of elders (PMR: 33→23, CG: 32→21) S: At home DO: 32.3% | RCT | / | / | | BDS | Use the "Relaxation Exercises" (prepared by the Turkish Psychologists Association)[55] | Depression (d=0.86) | There is a significant decrease (↓) in depression score at post-test compared to pretest in IG. | High |

| 17 | Zargarzadeh & Shirazi[56] (2014) Iran | At home/ 6 weeks + 4 30m sessions at classroom | Twice a day for 7 days/ week | 50 nursing students (PMR: 25→24, CG: 25) S: At home and classroom DO: 2.0% | QED | / | / | | STAS | N/A | Anxiety (d=2.54) | There is a significant decrease (↓) in anxiety score in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | High |
| 18 | Zhang et al[57] (2022) China | 30m classroom/ 6 weeks | Once/ week | 90 medical students (PMR: 45→42, CG: 45) S: Classroom DO: 6.7% | RCT | / | / | / (2 months) | TAS | Use standardized version of PMR by Bernstein, Borkovec.[35] | Anxiety (d=2.07) | There is a significant decrease (↓) in test anxiety score at post-test and at follow up compared to pretest in the IG. | High |
| 19 | Allison et al[58] (2020) United States | 10m at classroom / 1 session | 1 session only | 124 veterinary students (PMR: 124→101) S: Classroom DO: 18.5% | QED | / | / | | SRSI3 | N/A | Stress (d=0.93) | There is a decrease (↓) in stress scores at the post-test compared to the pretest. | Moderate |
| 20 | Barling & Raine[59] (2005) Australia | At home /3 weeks + 1 60m session | 7 days/ week | 30 volunteers (PMR: 15, CG: 15) S: At home DO: 0% | RCT | / | / | | DASS | N/A | Stress, anxiety, depression | There is a significant decrease (↓) in 1. IG compared to CG at post-test (anxiety). 2. stress, anxiety and depression scores in the post-test compared to the pretest in IG. | Moderate |
| 21 | Çapacı et al[60] (2022) Turkey | 30m at home/ 8 weeks | 4 days/ week (2 days with researchers, 2 days on their own) | 36 caregivers of elders (PMR: 18→10), CG: 18→10) S: At home DO: 44.4% | RCT | / | / | | BDI | Use the "Relaxation Exercises CD Sound Records" and "PMR Information Guide" (prepared by the Turkish Psychologists Association). | Depression (d=0.58) | There is a decrease (↓) in depression score in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | Moderate |
| 22 | Gökşin & Aşiret[61] (2021) Turkey | 28m at home/ 8 weeks | 3 days/ week | 58 elderly women (PMR: 24→21, CG: 34→28) S: At home DO: 15.5% | RCT | / | / | | GDS-15 | N/A | Depression (d=0.91) | There is a significant decrease (↓) in depression score in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | Moderate |
| 23 | İnangil et al[62] (2020) Turkey | 15m at practice room/ 2weeks | 3 days/ week | 60 nursing students (PMR: 30→28, CG: 30→28) S: Practice room DO: 6.7% | RCT | / | / | | STAI | Use the "Relaxation Exercises" (prepared by the Turkish Psychologists Association)[63] | Anxiety (d=0.62) | There is a significant decrease (↓) in state anxiety score in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | Moderate |
| 24 | Khasky & Smith[64] (1999) United States | 25m / 1 session | 1 session only | 76 university students (PMR: 20, CG: 56) S: N/A DO: 0% | RCT | / | / | | SQST | Use the Jacobson's PMR exercise script by Smith.[65] | Stress (d=1.07) | There is a significant decrease (↓) in stress score in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | Moderate |

*(Continued)*

**Table 2** (Continued).

| No | Author (Year)/ Country | Duration (Minutes/ Length) | Frequency Per Week | Participants | Study Design | | | | Research Instrument | Components/ Content of PMR | Outcome Measures (with Effect Size Where Available) | Key Finding | Quality of the Article |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | EXP | Pre-test | Post-test | F-Up | | | | | |
| 25 | Korkut et al[66] (2021) Turkey | 15m + 15m at laboratory/ one session | Twice in one session only. | 88 nursing students (PMR: 44→41, CG: 44) S: laboratory DO: 3.4% | RCT | / | / | | STAI | Use the Jacobson's PMR exercise. | Anxiety (d=0.49) | There is a decrease (↓) in anxiety score at post-test compared to pretest in IG. | Moderate |
| 26 | Kurian et al[67] (2021) India | N/A | N/A | 30 non-teaching staff (PMR: 30) S: N/A DO: 0% | QED | / | / | | JSS | N/A | Stress (d=4.31) | There is a significant decrease (↓) in stress score at post-test compared to pretest. | Moderate |
| 27 | Robb[68] (2000) United States | 15m at laboratory/ 1 session | 1 session only | 15 university students (PMR: 15) S: Laboratory DO: 0% | RCT | / | / | | State-anxiety scale of STAI Form Y-1 | Use the Jacobson's PMR exercise. | Anxiety (d=1.65) | There is a significant decrease (↓) in anxiety score in post-test compared to pretest in IG. | Moderate |
| 28 | Toqan et al[69] (2022) Palestine | 45m Lab room+ 10–15m at home/ 2 weeks | 5 days/ week | 60 nursing students (PMR: 60) S: Lab room and at home DO: 0% | QED | / | / | | State-anxiety scale of STAI Form Y-1 | Use the Jacobson's PMR exercise by Ramasamy, Panneerselvam, Govindharaj, Kumar, Nayak.[70] | Anxiety (d=4.20) | There is a decrease (↓) in anxiety score at post-test compared to pretest. | Moderate |
| 29 | Toqan et al[71] (2022) Palestine | 45m Lab room+ 10–15m at home/ 2 weeks | 5 days/ week | 90 nursing students (PMR: 90) S: Lab room and at home DO: 0% | QED | / | / | | State-anxiety scale of STAI Form Y-1 | Use the Jacobson's PMR exercise by Ramasamy, Panneerselvam, Govindharaj, Kumar, Nayak.[70] | Anxiety (d=4.57) | There is a decrease (↓) in anxiety score at post-test compared to pretest. | Moderate |
| 30 | Toqan et al[44] (2022) Palestine | 45m Lab room+ 10–15m at home/ 2 weeks | 5 days/ week | 48 male nursing students (PMR: 48) S: Lab room and at home DO: 0% | QED | / | / | | State-anxiety scale of STAI Form Y-1 | Use the Jacobson's PMR exercise by Ramasamy, Panneerselvam, Govindharaj, Kumar, Nayak.[70] | Anxiety (d=0.90) | There is a decrease (↓) in anxiety score at post-test compared to pretest. | Moderate |
| 31 | Vaughn et al[72] (1989) United States | 15m at home/ 4 weeks + 1 session at lunch room | 3 days/ week | 20 female clerical workers (PMR: 10→8, CG: 10) S: At home and Lunch Room DO: 10.0% | QED | / | / | | SRI | Use the Jacobson's PMR exercise by Jacobson.[18] | Stress | There is a significant decrease (↓) in stress score in IG compared to CG at post-test. | Moderate |

**Abbreviations**: PMR, Progressive Muscle Relaxation; EXP, Experiment; F-Up, Follow up; S, Setting; DO, Dropouts; RCT, Randomized control trial; QED, Quasi-experimental design; IG, Intervention group; CG, Control group; d, Cohen's d; TAS, Test anxiety scale; STAI, State-trait anxiety inventory; SAS, Zung Self-Rating Anxiety Scale; DASS, Depression; anxiety; stress scale; BDI, Beck Depression Inventory; CSAI-2, Competitive State Anxiety Inventory-2; RESTQ-Sport, Recovery-Stress Questionnaire for Athletes; PSS, Perceived Stress Scale; JSS, Job Stress Scale; GDS, Geriatric Depression Scale; WSS, Work Stress Scale; SRSI3, Smith Relaxation States Inventory 3; BDS, Beck Depression Scale; SRLE, Survey of Recent Life Experiences; STAS, Sarason test anxiety scale; EMAS-S, Endler Multidimensional Anxiety Scale—State; SQST, Smith Quick Stress Test; SRI, Stress Response Index.

**Table 3** Progressive Muscle Relaxation with Other Interventions

| No | Author (Year)/ Country | Other Intervention | Duration (Minutes/ Length) | Frequency Per Week | Participants | Study Design | | | | Research Instrument | Components/ Content of Intervention | Outcome Measures (with Effect Size where Available) | Key Finding | Quality of the Article |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | EXP | Pre-test | Post-test | F-Up | | | | | |
| 1 | Alphonsa et al[73] (2018) India | Relaxation Therapy (RT) - Music, physical exercise and laughter therapy | 60m/ 4 weeks | Twice a day for 7 days/ week | 20 elderlies (PMR + RT: 10, CG: 10) S: N/A DO: 0% | QED | / | / | / (4 months) | DASS-21 | Use Jacobson's PMR exercise + RT (background music, followed by physical exercise and laughter therapy). | Stress, Anxiety, Depression | There is a decrease (↓) in stress, anxiety and depression scores at post-test and F-up compared to the pretest (in IG). | High |
| 2 | Corbett et al[74] (2019) Ireland | Stress Control (SC) | 15m PMR & SC at home/ 6 weeks + 1 session at the hall | N/A | 35 adults (PMR + SC: 35→22→20) S: At home and a hall DO: 37.1% | QED | / | / | / (3 months) | DASS-21 | Use Jacobson's PMR exercise + SC program by White.[75] | Stress (d=0.72), Anxiety (d=0.41), Depression (d=0.27) | There is a decrease (↓) in stress, and anxiety but not (=) depression score at post-test and F-Up compared to pretest (in IG). | High |
| 3 | Merakou et al[76] (2019) Greece | Counselling Services (CS) | 12m PMR at home+ 4 45m PMR session + 8 CS/ 8 weeks | PMR twice a day for 7 days + CS once/ week | 50 unemployed individuals (PMR + CS: 30, CG: 20) S: At home DO: 0% | QED | / | / | | DASS-21 | Use the Jacobson's PMR exercise + CS (provided by the mental health professionals of the PEPSAEE). | Stress (d=1.13), Anxiety (d=1.03), Depression (d=0.74) | There is a decrease (↓) in stress, anxiety and depression score 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | High |

*(Continued)*

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**Table 3** (Continued).

| No | Author (Year)/ Country | Other Intervention | Duration (Minutes/ Length) | Frequency Per Week | Participants | Study Design | | | | Research Instrument | Components/ Content of Intervention | Outcome Measures (with Effect Size where Available) | Key Finding | Quality of the Article |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | EXP | Pre-test | Post-test | F-Up | | | | | |
| 4 | Ortega et al[77] (2021) Spain | Cognitive Behavioural Therapy (CBT) | 120m session/ 5 weeks | Once / week | 44 nursing students (PMR + CBT: 15, CG: 29) S: N/A DO: 0% | QED | / | / | / (3 months) | KEZKAK questionnaire, STAI | Use the Jacobson's PMR exercise + CBT (emotional control, empathy, assertiveness, self-esteem, problem solving and time management) | Stress, Anxiety | There is a significant decrease (↓) in stress and state anxiety score in IG compared to CG at post-test and at F-Up. | High |
| 5 | Singer et al[78] (1988) United States | Stress management skills (SMS) | At home + 120m session at meeting room/ 10 weeks | Once a day for 7 days + once at meeting room/ week | 36 caregivers (PMR + SMS: N/A, CG: N/A) S: meeting room DO: N/A | QED | / | / | | STAI, BDI | Use the Jacobson's PMR exercise by Bernstein, Borkovec[35] + SMS (self-monitoring of stressful events and physiological reactions to them + modification of cognitions associated with distress) | Anxiety (d=0.59), Depression (d=0.53) | There is a significant decrease (↓) in anxiety and depression score in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). 3. CG depression increase (↑) slightly at post-test | High |
| 6 | Sundram et al[79] (2016) Malaysia | Deep Breathing (DB) | 15m at quiet room/ session (5x every 2 months) | N/A | 761 male automotive workers (PMR + DB: 468→148, CG: 293→221) S: Quiet room DO: 51.5% | QED | / | / | / (5x every 2 months) | DASS-21 | Use the Jacobson's PMR exercise by Jacobson[18] + DB. | Stress, anxiety, depression (Total: d=0.60) | There is a significant decrease (↓) in stress score but not (=) anxiety and depression in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | High |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Gallego et al[80] (2020) Spain | Music Therapy (MT) | 60m at classroom/1 session | 1 session only | 112 nursing students (PMR + MT: 56, CG: 56) S: Classroom DO: 0% | RCT | / | / | | | Heart rate | Use Jacobson's PMR exercise + MT (use a CD player with volume established at 50–60 decibels). | Stress | There is a significant decrease (↓) in heart rate (indicating a reduction of stress) in 1. IG compared to CG at post-test. 2. post-test compared to pretest (in IG). | Moderate |
| 8 | Korkut et al[66] (2021) Turkey | Nature sound (NS) | 15m + 15m at laboratory/ one session | Twice in one session only. | 89 nursing students (PMR + NS: 45→42, CG: 44) S: laboratory DO: 3.4% | RCT | / | / | | | STAI | Use the Jacobson's PMR exercise + the NS (rain, birds, wind, forest, ocean, waterfall, and stream) | Anxiety (d=1.14) | There is a decrease (↓) in anxiety score at post-test compared to pretest in IG. | Moderate |
| 9 | Masih et al[81] (2019) United States | Mindfulness Meditation (MM) | 20m PMR & MM at home + 30m session at laboratory/ 8 weeks | 7 days practice + 1 session/ week | 36 adults (PMR + MM: 19→17, CG: 17) S: At home and Laboratory DO: 5.6% | RCT | / | / | | | PSS, Trait-anxiety scale of STAI | Use the Jacobson's PMR exercise by Bernstein, Borkovec[35] + MM by Kabat-Zinn.[82] | Stress (d=0.40), Anxiety (d= 0.15) | There is a decrease (↓) in stress but not (=) trait anxiety score at post-test compared to pretest (in IG). | Moderate |
| 10 | Ozgundondu & Metin[83] (2019) Turkey | Music Therapy (MT) | 20m at classroom/ 8 weeks | Once/ week | 63 nurses (PMR + MT: 32→28, CG: 31→28) S: Classroom DO: 0% | RCT | / | / | / (1 month) | | PSS | Use the Jacobson's PMR exercise + MT (relaxing music developed by Daniel Kobialka) | Stress (d=2.06) | There is a significant decrease (↓) in stress score in IG compared to CG at post-test and at F-Up. | Moderate |
| 11 | Robb[68] (2000) United States | Music Therapy (MT) | 15m at laboratory/ 1 session | 1 session only | 15 university students (PMR + MT: 15) S: Laboratory DO: 0% | RCT | / | / | | | State-anxiety scale of STAI Form Y-1 | Use the Jacobson's PMR exercise + MT (use Daniel Kobialka's *Going Home Medley*).[84] | Anxiety (d=2.10) | There is a significant decrease (↓) in anxiety score in post-test compared to pretest. | Moderate |

(*Continued*)

**Table 3** (Continued).

| No | Author (Year)/ Country | Other Intervention | Duration (Minutes/ Length) | Frequency Per Week | Participants | Study Design | | | | Research Instrument | Components/ Content of Intervention | Outcome Measures (with Effect Size where Available) | Key Finding | Quality of the Article |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | EXP | Pre-test | Post-test | F-Up | | | | | |
| 12 | Tsiouli et al[85] (2014) Greece | Deep Breathing (DB) | 37m at home/ 8 weeks | Twice a day for 7 days/ week | 80 caregivers (PMR + DB: 40→19, CG: 40→25) S: at home DO: 45.0% | RCT | / | / | | PSS | Use the Jacobson's PMR exercise + DB. | Stress (d=1.87) | There is a significant decrease (↓) in stress score at post-test compared to pretest in IG. | Moderate |
| 13 | Tsitsi et al[86] (2017) Cyprus & Greece | Guided Imagery (GI) | 25m at home and 25m at private room/ 3 weeks | Once a day for 7 days at home + once at private room/ week | 54 caregivers (PMR + GI: 29, CG: 25) S: at home and private room DO: 0% | RCT | / | / | | HAM-A | Use the Jacobson's PMR exercise + GI (envisioning of a comfortable and restful place on the beach) by da Silva.[87] | Anxiety (d=0.37) | There is a decrease (↓) in anxiety score at post-test compared to pretest (in IG). | Moderate |
| 14 | Valarmathi & Vijayalakshmi[88] (2016) India | Deep Breathing (DB) | 30m at home/ 4 weeks | Twice a day for 7 days/ weeks | 54 caregivers (PMR + DB: 60) S: at home DO: 0% | QED | / | / | | N/A | Use the Jacobson's PMR exercise (20m) + DB (10m). | Stress (d=2.24) | There is a significant decrease (↓) in stress score at post-test compared to pretest. | Moderate |
| 15 | Wang et al[89] (2021) China | Health education (HE) | 90m of HE, PMR demonstration and PMR practice in 24 sessions + 30m at home/ 48 weeks | Twice a day for 7/ week | 110 caregivers of patients (EMR: 55, CG: 55) S: rehabilitation centre and at home DO: N/A | RCT | / | / | / (3,6,12months) | HADS | Use the Jacobson's PMR exercise by Kieffer[90] + health education on the acute stroke patients. | Anxiety, depression | There is a significant decrease (↓) in anxiety and depression score in IG compared to CG at 6 and 12 months. | Moderate |

**Abbreviations**: PMR, Progressive Muscle Relaxation; EXP, Experiment; F-Up, Follow up; S, Setting; DO, Dropouts; RCT, Randomized control trial; QED, Quasi-experimental design; IG, Intervention group; CG, Control group; d, Cohen's *d*; EMR, Education & Muscle Relaxation; HE, Health Education; HADS, Hospital Anxiety and Depression Scale; NS, Nature sound; DASS-21, Depression; anxiety; stress scale-21; CBT, Cognitive Behavioral Therapy; MT, Music Therapy; CS, Counseling services; PEPSAEE, Pan-Hellenic Association for Psychosocial Rehabilitation and Professional Reintegration; MM, Mindfulness Meditation; PSS, Perceived Stress Scale; STAI, State-trait anxiety inventory; SC, Stress Control; RT, Relaxation Therapy; GI, Guided Imagery; HAM-A, Hamilton's Anxiety Scale; DB, Deep Breathing; BDI, Beck Depression Inventory; SMS Stress management skills.
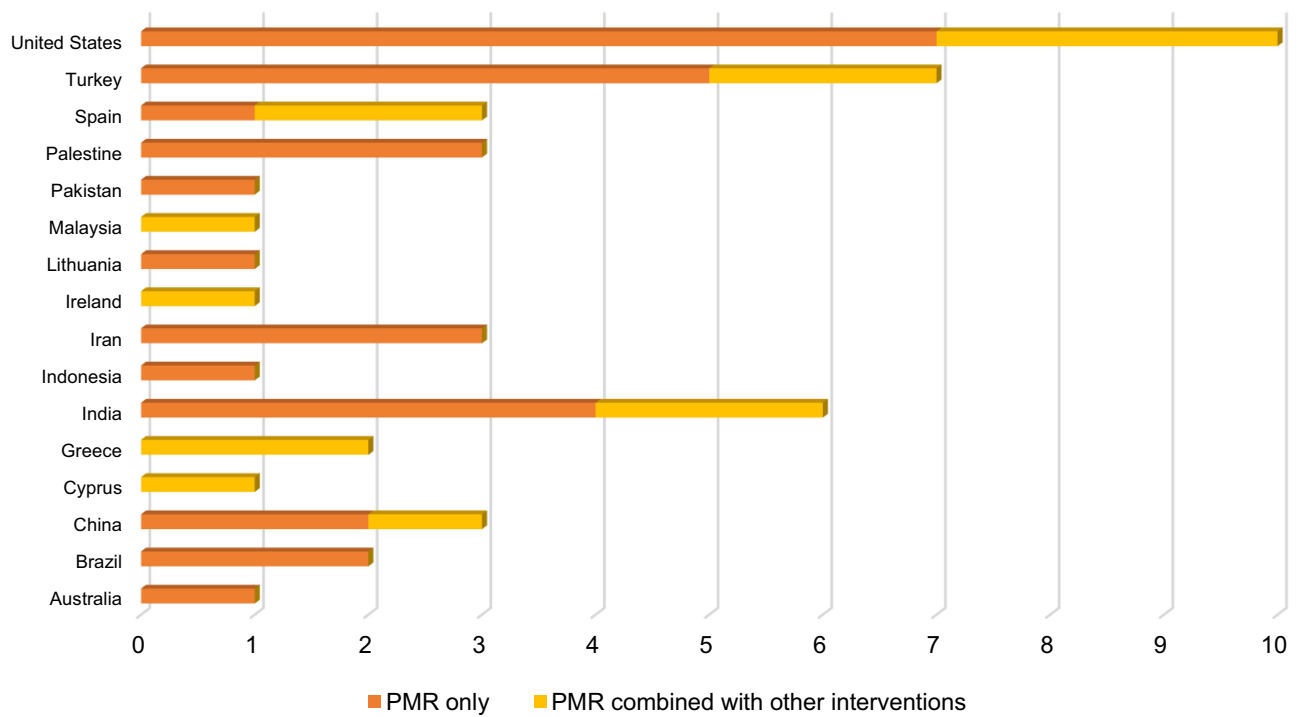
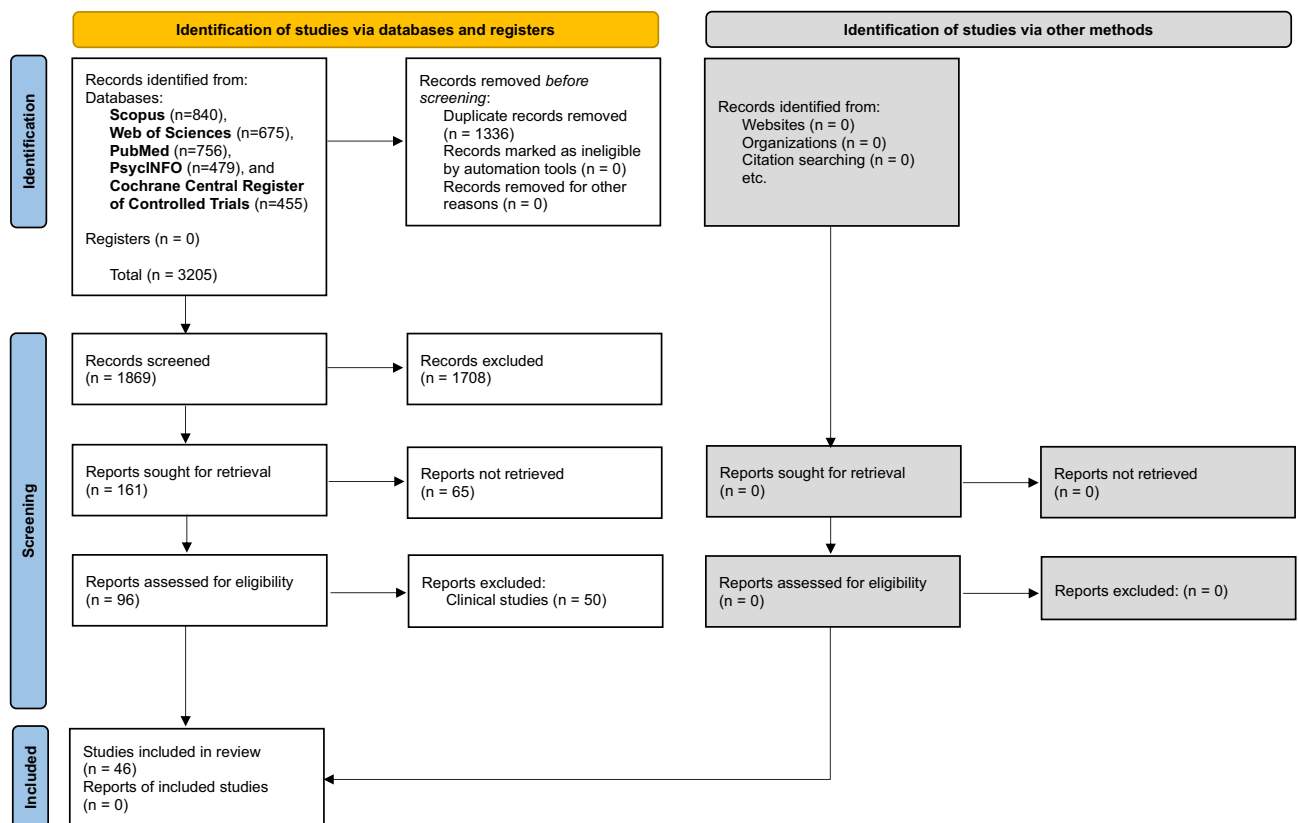**Figure 1** List of Countries Involved (16 Countries).



**Figure 2** PRISMA flow diagram for the included and excluded studies.
**Notes**: PRISMA figure adapted fromPage MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. International journal of surgery. 2021 Apr 1;88:105906. Creative Commons.[23]

## Quality of the Included Studies

Two independent reviewers conducted a quality assessment of each included study. As a results, twenty-four (24) studies were rated as high quality, whereas twenty-two (22) studies were rated as moderate quality. The quality of the studies is presented in the extraction tables from high to moderate quality (Table 2 and Table 3).

# Standalone Progressive Muscle Relaxation (PMR) Studies Vs PMR Combined with Other Interventions Studies

## Progressive Muscle Relaxation (PMR) Studies

Following the completion of the systematic review procedure, the reviewers identified thirty-one (31) papers concentrating on Progressive Muscle Relaxation (PMR), laying a complete framework for the synthesis and interpretation of the data. The summary of the systematic findings of the studies can be referred on Table 2. The efficacy of each outcome measures was illustrated in Figure 3.

### Randomized Controlled Trial (RCT)

Using the "Revised Randomized Controlled Trial Checklist",[28] the reviewers found three (3) studies of high quality,[43,54,57] and seven (7) studies of moderate quality.[59–62,64,66,68]

Following an exhaustive review, major findings demonstrated a significant trend in three (3) studies[43,59,64] that reported a substantial decrease in stress outcomes among adult volunteers, nurses and university students at posttest compared to pretest within the PMR group. Moreover, one (1) study[64] among university students discovered the potential efficacy of PMR, finding a substantial decrease in stress outcomes in the PMR group compared to the control group at the posttest evaluations. Nonetheless, one (1) study[59] found no significant reduction in stress levels among adult volunteers in the PMR group when compared to the control group at the post-test intervention stage.

For the anxiety outcomes, the systematic review's key findings revealed that six (6) studies[43,57,59,62,66,68] showed a significant reduction in anxiety levels on adult volunteers, nurses, and university students at posttest compared to pretest within the PMR group. Additionally, two (2) studies[59,62] further underscored the potential efficacy of PMR on anxiety among adult volunteers, and nursing students, respectively, finding a significant outcome in the PMR group in comparison to the control group at the posttest assessments.

In terms of depression, the key outcomes revealed that in four (4) studies[54,59–61] among adult volunteers, caregivers of elders, and elderly women, there was a significant decrease in depression post-test compared to pretest within the PMR group. Two (2) studies,[60,61] which further support the evidence for PMR, found a significant decrease in depressive outcomes in the PMR group compared to the control group among the caregivers of elders, and elderly women at the post-test measurement. However, a notable exception was observed in one (1) study[59] where there is no significant reduction in depression levels among adult volunteers in the PMR group compared to the control group at the post-test stage, adding a layer of complexity to the overall findings. The researcher points out, emphasizing the implications of the study's findings, that the PMR intervention may lack the requisite potency to effectively improve depression outcomes, underscoring the need for more comprehensive or integrated procedures. These results emphasize the potential of PMR as an effective relaxation training in the therapy for stress, anxiety, and
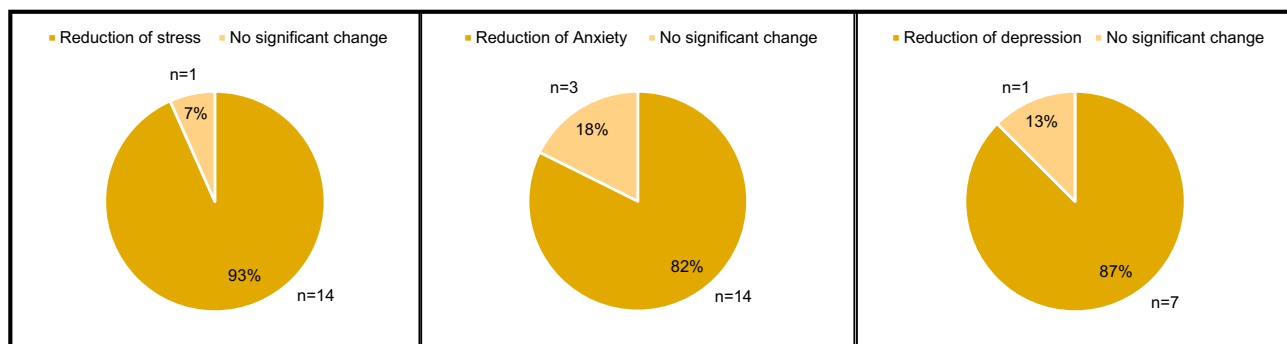


**Figure 3** The Efficacy of PMR on Stress, Anxiety and Depression.

depression. In numerous studies, the consistent reduction in stress, anxiety, and depression produces in the PMR group indicates its efficacy as a relaxing technique on adults' population.

### Quasi-Experimental Design (QED)

Using the "Revised Checklist for Quasi-Experimental Studies",[28] the reviewers identified fifteen (15) studies of high quality,[34,36,38,40–42,45–47,49–53,56] and six (6) studies of medium quality.[44,58,67,69,71,72]

Following a thorough assessment, nine (9) studies[38,40,41,45,46,51,52,58,67] revealed noteworthy insights, indicating a discernable pattern of considerable drop in stress outcomes posttest in contrast to pretest within the PMR group among the female health care workers, nurses, university students and employees. Moreover, two (2) more studies[36,72] reported a significant reduction in stress outcomes in the PMR group compared to the control group among the athletes and female clerical workers, adding weight to the information at hand.

Next, when anxiety outcomes were analyzed, seven (7) studies[42,44,50,52,56,69,71] reported a significant decrease in levels of anxiety among university students, and nurses at posttest compared to pretest in the PMR group, highlighting the effective role of PMR in anxiety reduction. Besides, two (2) further studies[36,56] supported the discussion for PMR by demonstrating a substantial reduction in anxiety outcomes among athletes, and nursing students in the PMR group compared to the control group in the posttest phase. Interestingly, two (2) studies[42,50] conducted among university students and nurses, respectively, found a significant reduction in anxiety in the control group, a finding that calls for more research to uncover the underlying causes. However, in contrast to the great majority of the findings, three (3) studies[34,49,51] found no significant reduction in anxiety levels among university students, beginner athletes, and female nurses, respectively, at posttest compared to pretest in the PMR group.

Lastly, in analyzing depression outcomes, three (3) studies[47,51,53] found a notable decrease in depression levels among the elders, and female nurses' posttest compared to pretest in the PMR group, showing PMR's potential efficacy in battling depression. In addition, one (1) study among elders[47] reported a significant reduction in depression outcomes in the PMR group compared to the control group at the posttest stage. PMR has significant potential for cultivating mental well-being as a non-drug-based intervention, particularly or adults dealing with stress, anxiety, and depression.

Overall, the comprehensive analysis of the PMR studies in this review reveals a spectrum of Cohen's *d* effect sizes, spanning from d=0.29 to d=4.57 for stress, suggesting a range from small to large impact. Similarly, the effect sizes for anxiety fall between d=0.25 and d=2.54, indicative of a spectrum from small to large, while for depression, the range of d=0.58 to d=1.95 suggests a medium-to-large effect size. The effect sizes for each PMR studies are displayed in Table 2.

## PMR Combined with Other Interventions Studies

Following a thorough systematic analysis, the reviewers identified fifteen (15) studies that explicitly explore the effects of Progressive Muscle Relaxation (PMR) in combination with other interventions that include: Health education,[89] Nature Sound,[66] Music therapy,[68,80,83] Counseling Services,[76] Other relaxation techniques,[73,77,81,86] Stress control skills,[74,78] and Deep breathing.[79,85,88] The summary of the systematic findings can be referred on Table 3. The efficacy of each outcome measures was illustrated in Figure 4.
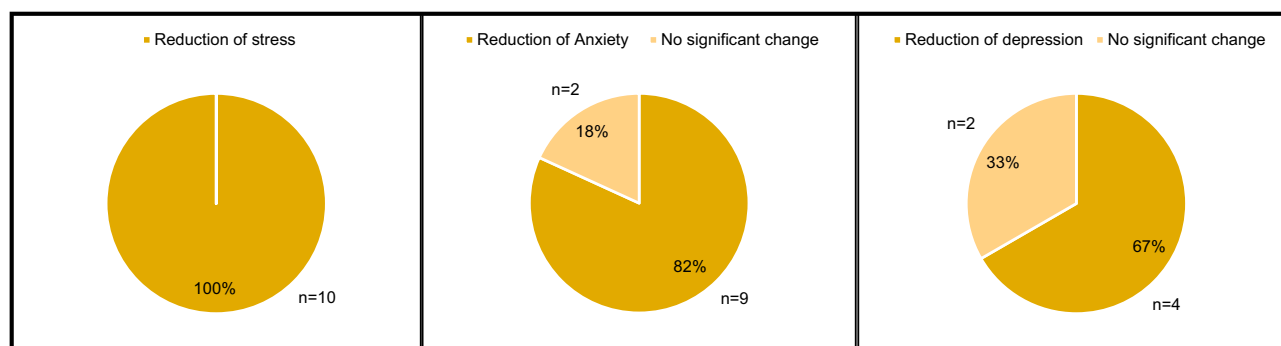


**Figure 4** The Efficacy of PMR combined with other interventions on Stress, Anxiety and Depression.

### Randomized Controlled Trial (RCT)

Using the "Revised Randomized Controlled Trial Checklist",[28] the reviewers found eight (8) studies of moderate quality.[66,68,80,81,83,85,86,89]

Upon the completion of an in-depth review, three (3) different research[80,81,85] evaluating stress outcomes found a significant decrease in stress levels among nursing students, general adults, and caregivers' posttest compared to pretest in the group receiving PMR paired with music therapy (MT), mindfulness meditation (MM), and deep breathing (DB), respectively. Furthermore, two (2) additional studies[80,83] found a significant reduction in stress outcomes in the PMR group, where PMR was combined with MT, when compared to the control group among nursing students, and nurses, respectively, at the posttest stage, adding to the evidence for the integrative approach.

When it comes to anxiety outcomes, three (3) studies[66,68,86] clearly demonstrate a significant decrease in levels of anxiety among university students, and caregivers following posttest compared to pretest within the group receiving PMR when coupled with nature sound (NS), MT, and guided imagery (GI), respectively, reinforcing the efficacy of this combined therapeutic approach in managing anxiety. In addition, a study among caregivers of patients[89] found a substantial reduction in anxiety outcomes in the group receiving PMR paired with health education (HE), when compared to the control group at posttest, lending credence to these findings. Nonetheless, one (1) study[81] found no statistically significant decrease in levels of anxiety among general adults at posttest compared to pretest in the group that received PMR alongside MM, highlighting the complexity and variability of coping with anxiety.

In terms of depressive outcomes, only one (1) study[89] demonstrating a significant reduction in depressive outcomes among caregivers of patients at the posttest stage in the group receiving PMR in combination with HE, when compared to the control group.

### Quasi-Experimental Design (QED)

Using the "Revised Checklist for Quasi-Experimental Studies",[28] the reviewers identified six (6) studies of high quality,[73,74,76–79] and one (1) study of moderate quality.[88]

Following an extensive assessment, five (5) studies[73,74,76,79,88] found a substantial decline in levels of stress among elderlies, general adults, unemployed individuals, male automotive workers, and caregivers, respectively, at the posttest stage compared to pretest in groups receiving PMR alongside relaxation therapy (RT): music, physical exercise and laughter therapy, stress control (SC), counseling services (CS), and DB, respectively, highlighting the significant efficacy of this integrated approach in alleviating stress. Furthermore, three (3) other studies[76,77,79] strengthen these findings, indicating a significant reduction in stress outcomes among nursing students, unemployed individuals, and male automotive workers at the posttest phase in groups where PMR was administered in conjunction with cognitive behavioral therapy (CBT), CS, and DB, respectively, when compared to the control group.

In terms of anxiety outcomes, four (4) studies[73,74,76,78] reported a substantial reduction in levels of anxiety among elderlies, general adults, unemployed individuals, and caregivers, respectively, in the posttest as compared to the pretest in groups receiving a combination of PMR with RT: music, physical exercise and laughter therapy, SC, CS, and stress management skills (SMS), respectively. Besides, three (3) further papers[76–78] found a substantial reduction in depressive outcomes among unemployed individuals, nursing students, and caregivers at posttest in the group receiving PMR paired with CS, CBT, and SMS, respectively, when compared to the control group. However, one (1) study[79] contradicted the dominant discoveries, presenting a lack of significant decrease in levels of anxiety among male automotive workers at posttest compared to pretest, and also when compared with the control group, in the group that received PMR combined with DB, indicating the need for a more comprehensive investigation of this therapeutic approach.

When analyzing depression outcomes, reports from three (3) studies[73,76,78] revealed a significant reduction in levels of depression among elderlies, unemployed individuals, and caregivers, respectively, at the posttest compared to the pretest within the group that received PMR in combination with RT: music, physical exercise and laughter therapy, CS, and SMS, respectively. Along with the previous findings, another two (2) studies[76,78] have reported a substantial reduction in depressive outcomes among unemployed individuals, and caregivers, respectively, at the posttest stage in the group that got PMR integrated with CS, and SMS, respectively, when compared to the control group. Two (2) studies,[74,79] however, deviated from the majority of outcomes, presenting no significant decrease in symptoms of

depression among general adults and male automotive workers, respectively, at posttest compared to pretest in the group receiving PMR alongside SC, and DB, respectively, and also when compared with the control group. Unexpectedly, one (1) study[78] found a significant increase in levels of depression among adults in the wait-list control group at posttest, where no interventions were provided. It is a finding that warrants additional investigation to determine the underlying causes, and therefore highlighting the need for further studies.

Overall, for the PMR combined with other intervention studies, the Cohen's *d* effect sizes are ranging from d=0.40 to d=2.24 for stress, signifying an impact spectrum spanning from small to large. Similarly, the effect sizes for anxiety, falling between d=0.15 and d=2.10, indicate a spectrum from small to large impact. In the case of depression, the range of d=0.27 to d=0.74 suggests a small-to-medium effect size. The effect sizes for each study are displayed in Table 3.

## Discussion

This paper presents a systematic literature review on the efficacy of Progressive Muscle Relaxation (PMR) in adults for stress, anxiety, and depression. Our review identified 46 studies, from sixteen (16) countries, covering 3402 total sample. This review is a pioneering endeavor in that it is the first to systematically assembled and report findings relating to the efficacy of PMR and PMR combined with other interventions among general adult, thus contributing to the current body of knowledge. Furthermore, this review is notable for its comprehensive approach, providing studies employing Randomized Controlled Trial (RCT) and Quasi-Experimental Design (QED) research designs. As a result, it provides a thorough view of the many approaches used to examine the efficacy of PMR. This comprehensive approach not only broadens the spectrum of evidence reviewed but also allows for the analysis of a diverse variety of study designs, resulting in a deeper comprehension of PMR's conceivable effect. Besides, this review attempted to look at the impact of PMR as a stand-alone intervention as well as those that explore PMR in combination with other interventions. By presenting in this way, this review promotes a broad knowledge of PMR's efficacy in various therapeutic conditions by offering evidence from both methods. The comparison of PMR itself versus PMR paired with various interventions may aid in identifying potential synergistic benefits, directing future study and potential therapeutic application.

Based on the outcome measures, overall, PMR has been demonstrated to be beneficial in reducing stress, anxiety, and depression in adults. When PMR is combined with other interventions, the combined techniques have also consistently exhibited enhanced efficacy, particularly for stress (n=10) and anxiety (n=9). There are a total of 24 studies that support PMR's efficacy in reducing stress, 21 studies in reducing anxiety, and 11 studies in reducing depression, either on its own or in combination with other interventions.

There is a consistent trend in this review that emerges where the majority of studies using Jacobson's Progressive Muscle Relaxation (PMR) exercise show that it is beneficial in reducing stress, anxiety, and depression in adults, whether used in its original form[18] or as adapted by later research.[35,37,55,63,70,90] In our review, we discovered that when people engaged in PMR exercises on their own in private spaces, the lengths of the sessions varied, with the lowest session lasting 5 minutes[45] and the longest lasting 28 minutes.[54,61] When combining with other interventions or variables, the shortest duration becomes 15 minutes,[74] while the longest is 37 minutes.[85] In our analysis, we observed that the duration of the PMR exercises, whether shorter or longer, did not significantly influence the outcome measures. Our study shows that there was a pervasive pattern of decreasing mental health outcomes across time. Moreover, our findings show that the regularity, whether daily or only a few days a week, does not significantly change the outcomes when analyzing the frequency of PMR implementation. Regardless of the exact frequency of PMR sessions, the overall trend in the majority of studies consistently demonstrates a reduction in outcome measures.

When delving deeper into individual outcome measures, for stress, one (1) study[59] found no significant reduction in stress level when compared to the control group at posttest. For anxiety, there are five (5) studies[34,49,51,79,81] reported no reduction in anxiety at the posttest. Interestingly, there are two (2) studies[42,50] that show a significant reduction of anxiety in the control group which calls for more research to uncover the underlying causes. Lastly, the majority of the studies on depression involved elderly people and those who looked after patients and senior citizens. There are three studies[59,74,79] revealed no significant reduction compared to control groups. Alarmingly, one study[78] even indicated an increase in depression levels post-intervention of a wait-list control group.

For the record, we found an interesting pattern in our thorough review. It seems that statistically insignificant results tend to occur when PMR is explored in the context of a general adult population, without defining or focusing on specific subgroups.[59,74,81] This recurring trend of non-significant results in wider adult populations raises the possibility that the efficacy of PMR may depend on particular demographic, psychographic, or clinical traits that are unusually absent from a generalized group. However, it does not reduce PMR's potential benefit in specific therapeutic applications, where its efficacy can be clearly seen. Future studies should investigate the efficacy of PMR in specific demographics or under predetermined circumstances to identify where its advantages are most noticeable.

When measuring the efficacy of PMR combined with other interventions versus PMR as a standalone relaxation technique, there are two (2) studies in this review[66,68] that found combining PMR with other variables to be more effective compared to the PMR training alone in their respective study. Korkut, Ülker, Çidem, Şahin[66] found combining PMR with nature sound to be more effective in reducing anxiety among the nursing students, while Robb[68] highlighted that combination of PMR with music to be more effective in reducing anxiety among the university students compared to PMR alone.

Because of its diverse approach, PMR and its combination with other therapies appear to be viable interventions for stress, anxiety, and depression in adults. Combining PMR with different interventions may simultaneously access several relaxing mechanisms. Moreover, additional interventions might concentrate on other psychological or physiological aspects in addition to PMR, which can only alleviate muscular tension and relaxation. Compared to employing PMR alone, this holistic approach may provide a more comprehensive course of relaxation that potentially results in increased efficacy. With the assistance of an increasing amount of evidence and research,[66,74,76,79] these interventions provide an approachable and well-researched way to manage stress, anxiety, and depression.

There is certain limitation to the current review that could be addressed in future research. First, while this research provides invaluable findings, it is crucial to highlight that due to limited resource, it only included studies in English from English-language databases. This linguistic and database limitation may unintentionally exclude important studies published in different languages or databases. Future reviews may thereby strengthen the extent of coverage and generalizability of data by including papers in other languages and expanding the search to non-English databases. This will ensure a more thorough understanding of the efficacy of PMR among adults for stress, anxiety, and depression in varied cultural and language areas.

## Conclusion

In conclusion, there has been large amount of evidence that supports the efficacy of PMR in reducing stress, anxiety, and depression among adults. Studies also shows that PMR combined with other interventions are more effective compared when applied by itself. Given these findings, researchers could find it beneficial to consider combining or integrating PMR with other interventions to enhance its potential in reducing stress, anxiety, and depression. Future research could also expand on the current review's findings by incorporating a more targeted goal such as focusing PMR interventions among the wider working population, rather than to mostly health care workers, which may further refine our knowledge of PMR's potential advantages and appropriate implementation in diverse circumstances.

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