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Comparison of Progressive Muscle Relaxation and Deep Breathing Exercises for Stress Reduction in Older Adults: A Quasi-Experimental Study

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Abstract

Background: Stress is a common psychological problem among older adults and may negatively affect physical health, emotional well-being, and quality of life. Progressive Muscle Relaxation (PMR) and Deep Breathing Exercise (DBE) are non-pharmacological interventions frequently used to promote relaxation and reduce psychological distress.
Objective: To compare the effects of PMR and DBE on perceived stress among institutionalized older adults.
Methods: This quasi-experimental study employed a two-group pretest-posttest design. Thirty older adults residing at Balai Pelayanan Sosial Tresna Werdha Budi Luhur, Yogyakarta, Indonesia, were recruited using purposive sampling and allocated to a PMR group (n=15) or a DBE group (n=15). Both interventions were conducted twice weekly for three weeks. Stress levels were assessed using the Perceived Stress Scale-10 (PSS-10). Within-group changes were analyzed using paired sample t-tests, whereas between-group differences were analyzed using an independent sample t-test.
Results: Both groups demonstrated significant reductions in stress scores following the intervention period. Mean PSS-10 scores in the PMR group decreased from 15.60±3.02 to 11.20±1.32 (mean reduction=4.40 points; p<0.001). In the DBE group, mean scores decreased from 15.00±2.07 to 11.00±2.07 (mean reduction=4.00 points; p<0.001). No statistically significant difference was observed between groups (t=0.315; df=28; p=0.755).
Conclusion: PMR and DBE were both associated with significant reductions in perceived stress among institutionalized older adults. No significant difference in effectiveness was observed between the two interventions.

Keywords
aged; breathing exercises; muscle relaxation; psychological stress; residential facilities

Introduction

Population aging has become a major global demographic phenomenon with significant implications for healthcare systems, social services, and public health policies. Improvements in healthcare, nutrition, and socioeconomic conditions have contributed to increased life expectancy, resulting in a growing proportion of older adults worldwide. Although increased longevity reflects advances in public health, aging is frequently accompanied by various physiological, psychological, and social challenges that may negatively affect overall well-being. Among these challenges, psychological stress represents an important concern because of its association with impaired physical health, emotional instability, reduced quality of life, and increased healthcare utilization.[1,2]

Stress is generally defined as an individual's physiological and psychological response to internal or external demands perceived as exceeding available coping resources. In older adults, stress may arise from multiple age-related factors, including declining physical function, chronic diseases, loss of independence, bereavement, social isolation, reduced economic productivity, and diminished social participation. Persistent exposure to stress can activate the hypothalamic-pituitary-adrenal axis and sympathetic nervous system, resulting in increased secretion of cortisol and catecholamines. Chronic activation of these physiological pathways has been associated with impaired immune function, cardiovascular disorders, sleep disturbances, anxiety, depression, and accelerated biological aging.[3,4]

Mental health problems among older adults have become increasingly prevalent worldwide. The World Health Organization reported that approximately one in seven individuals aged 60 years and older experiences a mental health disorder, while many others experience psychological distress that remains undetected and untreated.[2] In Indonesia, the growing number of older adults has been accompanied by increasing psychosocial challenges associated with aging, including loneliness, reduced family support, chronic illness, and decreased social engagement.[5] Consequently, effective and accessible interventions are required to support mental well-being and healthy aging.

The burden of stress may be particularly pronounced among institutionalized older adults residing in long-term residential care facilities. Compared with community-dwelling older adults, residents of social care institutions frequently experience separation from family members, adaptation to new living environments, reduced autonomy, and limited opportunities for meaningful social interaction. These circumstances may increase vulnerability to loneliness, emotional distress, and psychological stress. Previous studies have reported higher levels of psychological distress, depression, and reduced quality of life among institutionalized older adults compared with those living independently in the community.[6,7] Therefore, stress management interventions targeting this population are of substantial clinical and public health importance.

Given the multifactorial nature of stress in older adults, non-pharmacological interventions have gained increasing attention as safe and cost-effective management strategies. Such interventions are particularly valuable in geriatric populations because they minimize the risk of medication-related adverse effects while promoting self-management and psychological resilience. Among the available approaches, Progressive Muscle Relaxation (PMR) and Deep Breathing Exercise (DBE) are commonly used because of their simplicity, feasibility, and physiological benefits.[8,9]

PMR is a structured relaxation technique originally developed by Jacobson that involves systematic contraction and relaxation of specific muscle groups throughout the body. This intervention aims to reduce muscular tension, increase awareness of bodily sensations, and induce a state of physical and psychological relaxation. Physiologically, PMR is believed to suppress excessive sympathetic nervous system activity while enhancing parasympathetic responses, thereby reducing physiological manifestations of stress. Previous studies have demonstrated beneficial effects of PMR on stress, anxiety, sleep quality, emotional regulation, and overall psychological well-being across various populations, including older adults.[10,11]

DBE is another widely used relaxation technique that emphasizes slow, controlled diaphragmatic breathing. Through modulation of respiratory rhythm and stimulation of vagal activity, DBE may reduce autonomic arousal, improve oxygen utilization, and facilitate emotional regulation. Controlled breathing has been shown to decrease physiological responses associated with stress, including elevated heart rate, blood pressure, and sympathetic nervous system activation. Furthermore, DBE is easy to perform, requires no specialized equipment, and can be implemented safely among older adults with diverse functional capacities.[12,13,14]

Although substantial evidence supports the effectiveness of PMR and DBE individually, important knowledge gaps remain. Most previous studies have investigated these interventions separately rather than directly comparing their effects within the same population. Furthermore, findings regarding their relative effectiveness remain inconsistent. Some studies suggest that PMR may produce greater reductions in stress because it simultaneously addresses physical tension and psychological relaxation, whereas others report comparable outcomes between muscle relaxation and breathing-based interventions.[15,16,17] As a result, healthcare professionals often lack clear evidence regarding which intervention should be prioritized when designing stress management programs for older adults.

Another limitation of the existing literature is the relatively small number of studies involving institutionalized older adults. Most available evidence originates from community-dwelling populations, limiting the applicability of findings to residential care settings where psychosocial stressors may differ substantially. Considering the increasing number of older adults residing in institutional care facilities and the growing emphasis on non-pharmacological approaches to mental health management, further investigation is warranted to identify practical and effective interventions for stress reduction in this population. [6,7,18]

Based on these considerations, this study aimed to compare the effects of PMR and DBE on stress levels among older adults residing at Balai Pelayanan Sosial Tresna Werdha Budi Luhur, Yogyakarta. It was hypothesized that both interventions would significantly reduce perceived stress levels, while PMR would demonstrate a greater reduction in stress scores than DBE because of its combined effects on muscular relaxation and autonomic regulation. The findings are expected to contribute evidence supporting physiotherapy-based stress management strategies for institutionalized older adults.

Methods

This study employed a quasi-experimental two-group pretest-posttest design to compare the effects of Progressive Muscle Relaxation (PMR) and Deep Breathing Exercise (DBE) on stress levels among older adults. The study was conducted at Balai Pelayanan Sosial Tresna Werdha Budi Luhur, Bantul, Yogyakarta, Indonesia, from January to February 2026. A quasi-experimental approach was selected because random allocation was not performed, and participant assignment was determined according to institutional feasibility and intervention scheduling requirements.

The study population consisted of older adults residing at Balai Pelayanan Sosial Tresna Werdha Budi Luhur. Participant recruitment was conducted using purposive sampling. Preliminary screening identified 37 residents who met the initial age criterion and were assessed for eligibility.[19] Following screening procedures, 30 participants fulfilled the study requirements and were enrolled. Seven individuals were excluded because they did not meet the study eligibility requirements or declined participation. Detailed exclusion categories were not reported in the original dataset and therefore could not be further classified.

Participants were eligible if they were aged 60 years or older, resided at the institution during the study period, demonstrated moderate to severe stress levels based on the Perceived Stress Scale-10 (PSS-10), were able to communicate effectively, and agreed to participate in the study. Individuals presenting with acute illness, severe cognitive impairment, severe communication difficulties, or conditions preventing completion of the intervention protocol were excluded.

After eligibility assessment, participants were allocated into two intervention groups consisting of 15 participants each. Fifteen participants received PMR, while fifteen participants received DBE. Because the study utilized a quasi-experimental design, randomization procedures were not implemented. Allocation was performed according to institutional feasibility and intervention scheduling considerations while maintaining balanced group sizes.

Stress level was measured using the Indonesian version of the PSS-10 developed by Cohen et al. 1 The instrument consists of ten items scored on a five-point Likert scale ranging from 0 (never) to 4 (very often), with total scores ranging from 0 to 40. Higher scores indicate greater perceived stress. Four positively worded items are reverse scored before calculation of the final score. Previous studies have reported acceptable psychometric properties for the PSS-10, with Cronbach's alpha values ranging from 0.78 to 0.91 internationally and approximately 0.93 in Indonesian populations.[20] The PSS-10 was selected because it is widely used, simple to administer, and appropriate for assessing perceived stress among older adults.

Baseline assessments were performed before intervention and included demographic characteristics and stress measurements. Age and sex were recorded for all participants. Stress levels were measured before intervention initiation (pretest) and immediately after completion of the intervention period (posttest).

Participants assigned to the PMR group received a structured muscle relaxation program based on Jacobson's relaxation principles. The intervention involved sequential contraction and relaxation of major muscle groups throughout the body. Participants were instructed to contract each muscle group for approximately 5–10 seconds followed by relaxation for approximately 10–20 seconds. The intervention was conducted twice weekly for three consecutive weeks. Each session lasted approximately 20–30 minutes and consisted of three to four complete relaxation cycles under direct supervision.

Participants assigned to the DBE group received a standardized breathing exercise program emphasizing slow diaphragmatic breathing. During each session, participants were instructed to sit comfortably in an upright position, inhale slowly through the nose, briefly hold the breath, and exhale slowly through the mouth. Breathing cycles were repeated continuously under supervision throughout the intervention session. The intervention was administered twice weekly for three weeks with a duration of approximately 20–30 minutes per session. The overall treatment frequency and duration were matched to the PMR group to ensure comparability of intervention exposure.

Both interventions were delivered and supervised by the principal investigator, an undergraduate physiotherapy student, under the supervision of licensed physiotherapy educators. Intervention sessions were conducted within the institutional environment using standardized instructions.[21] To promote consistency of intervention delivery, attendance was recorded during each session

and all participants completed the planned intervention protocol. Additional fidelity monitoring procedures were not reported in the original study.

Ethical approval was obtained prior to commencement of data collection, and all participants provided informed consent before participation. Documentation of ethical clearance was available in the study appendices. However, the ethical approval number was not reported in the original research record and therefore could not be included in the present manuscript.[22]

Data were analyzed using IBM SPSS Statistics software. Descriptive statistics were used to summarize participant characteristics and outcome measures. Continuous variables were presented as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages.

Prior to inferential analysis, assumptions for parametric testing were evaluated. Normality was assessed using the Shapiro-Wilk test because the sample size was fewer than 50 participants. Homogeneity of variance between groups was examined using Levene's test. Because all variables demonstrated normal distribution and homogeneous variance, parametric statistical analyses were applied.

Within-group differences between pretest and posttest stress scores were analyzed using paired sample t-tests. Between-group differences were analyzed using an independent sample t-test. Statistical significance was established at $p<0.05$. The independent sample t-test produced a t-value of 0.315 with 28 degrees of freedom and a p-value of 0.755. Effect size estimates, confidence intervals, post hoc power analysis, and adjusted analyses such as analysis of covariance (ANCOVA) or mixed repeated-measures analysis of variance were not reported in the original dataset and therefore could not be calculated reliably without access to the complete raw data. These analyses are recommended for future investigations.

Results

The participant flow from eligibility assessment to final analysis is presented in Figure 1. Of the 37 participants assessed for eligibility, 7 were excluded because they did not meet the inclusion criteria or declined participation. The remaining 30 participants were allocated equally to the Progressive Muscle Relaxation (PMR) group (n = 15) and the Deep Breathing Exercise (DBE) group (n = 15). All participants received and completed their allocated interventions, and all participants were included in the final analysis, with 15 participants analyzed in each group.

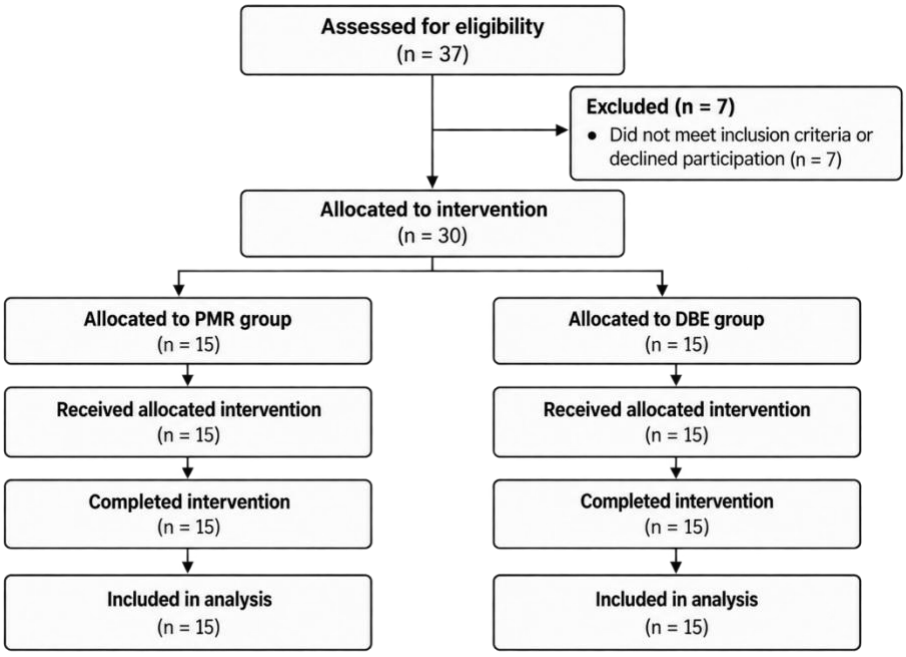

Figure 1. Participant Flow and Group Allocation

Before evaluating intervention outcomes, baseline participant characteristics were examined to assess comparability between groups. As presented in Table 1, both intervention groups demonstrated identical distributions of age categories and sex. These findings indicate that the groups were demographically comparable prior to intervention, thereby reducing the likelihood that observed outcome differences were attributable to baseline demographic variation.

Table 1. Baseline Characteristics of Participants

Characteristic	PMR (n=15)	DBE (n=15)	Total (n=30)
Age Category, n (%)			
60–64 years	3 (20.0)	3 (20.0)	6 (20.0)
65–69 years	4 (26.7)	4 (26.7)	8 (26.7)
70–74 years	3 (20.0)	3 (20.0)	6 (20.0)
75–79 years	5 (33.3)	5 (33.3)	10 (33.3)
Sex, n (%)			
Male	5 (33.3)	5 (33.3)	10 (33.3)
Female	10 (66.7)	10 (66.7)	20 (66.7)

The majority of participants were female (66.7%), while the largest age category was 75–79 years (33.3%). Because both intervention groups demonstrated identical demographic distributions, baseline demographic characteristics were considered comparable.

Prior to inferential analysis, assumptions for parametric testing were evaluated using the Shapiro-Wilk test for normality and Levene's test for homogeneity of variance. All variables satisfied the assumptions for parametric analysis (all p>0.05); therefore, paired sample t-tests and independent sample t-tests were subsequently applied.[23]

The effectiveness of PMR in reducing perceived stress was evaluated by comparing pre-intervention and post-intervention PSS-10 scores. Descriptive statistics for the PMR group are presented in Table 2.

Table 2. PSS-10 Scores Before and After Progressive Muscle Relaxation

Variable	Minimum	Maximum	Mean ± SD
Pre-test	12	21	15.60 ± 3.019
Post-test	9	13	11.20 ± 1.320

As shown in Table 2, participants receiving PMR demonstrated a reduction in mean stress scores from 15.60 to 11.20, corresponding to an average decrease of 4.40 points. This finding suggests an improvement in perceived stress following completion of the intervention program.

To determine whether the observed reduction was statistically significant, a paired sample t-test was performed. The results are presented in Table 3.

Table 3. Within-Group Comparison of Stress Scores in the PMR Group

Comparison	Mean Reduction	p-value
Pre-test vs Post-test	4.40	<0.001

The analysis demonstrated a statistically significant reduction in stress levels following PMR intervention (p<0.001), indicating that participants reported lower stress scores after the intervention period compared with baseline measurements.[24]

A similar analysis was conducted to evaluate the effectiveness of DBE. Descriptive outcomes for the DBE group are presented in Table 4.

Table 4. PSS-10 Scores Before and After Deep Breathing Exercise

Variable	Minimum	Maximum	Mean ± SD
Pre-test	12	18	15.00 ± 2.070
Post-test	8	15	11.00 ± 2.070

Participants receiving DBE also demonstrated a reduction in stress scores after the intervention period. Mean PSS-10 scores decreased from 15.00 to 11.00, representing an average reduction of 4.00 points.
The statistical significance of these changes was assessed using a paired sample t-test and is presented in Table 5.

Table 5. Within-Group Comparison of Stress Scores in the DBE Group

Comparison	Mean Reduction	p-value
Pre-test vs Post-test	4.00	<0.001

The paired sample t-test demonstrated a statistically significant reduction in stress levels following DBE intervention (p<0.001), suggesting that the breathing exercise program was associated with improved stress outcomes among participants.[24]

The primary objective of this study was to compare the effectiveness of PMR and DBE in reducing perceived stress among older adults. Therefore, a between-group analysis was conducted to determine whether one intervention produced greater improvement than the other. The results are presented in Table 6.

Table 6. Between-Group Comparison of Intervention Effects

Variable	PMR	DBE
Mean reduction in PSS-10 score	4.40	4.00

Statistical Test	Value
t	0.315
df	28
p-value	0.755

Although PMR demonstrated a slightly greater mean reduction in stress scores than DBE, the difference between interventions was not statistically significant (t=0.315; df=28; p=0.755). These findings indicate that both PMR and DBE were associated with reductions in perceived stress and that neither intervention demonstrated superiority over the other within the present study population.[25]

From a practical perspective, both interventions produced reductions of approximately four points on the PSS-10 within a three-week intervention period. While PMR resulted in a marginally greater numerical improvement, the absence of a statistically significant between-group difference suggests that both interventions may provide comparable benefits for stress management among institutionalized older adults.

Effect size estimates, confidence intervals, post hoc power analysis, and adjusted analyses such as analysis of covariance were not reported in the original dataset and therefore could not be presented in the current study.[26]

Discussion

This study compared the effects of Progressive Muscle Relaxation (PMR) and Deep Breathing Exercise (DBE) on perceived stress among institutionalized older adults. The findings demonstrated that both interventions were associated with significant reductions in stress levels following a three-week intervention period. Participants receiving PMR experienced a mean reduction of 4.40 points on the Perceived Stress Scale-10 (PSS-10), whereas participants receiving DBE demonstrated a mean reduction of 4.00 points. However, no statistically significant difference was observed between groups, indicating that both interventions produced comparable improvements in perceived stress among older adults residing in a long-term care facility.

The significant reduction in stress observed following PMR is consistent with previous evidence supporting relaxation-based interventions for psychological health among older adults. PMR is designed to reduce muscular tension through systematic cycles of contraction and relaxation, thereby facilitating both physical and psychological relaxation. From a physiological perspective, PMR is believed to suppress excessive sympathetic nervous system activity while enhancing parasympathetic responses. This autonomic

modulation may reduce physiological manifestations of stress, including elevated muscle tension, increased heart rate, and heightened emotional arousal. Previous studies have reported beneficial effects of PMR on stress, anxiety, sleep quality, and emotional well-being across diverse populations, including older adults.[10,11] The present findings therefore support the growing body of evidence suggesting that PMR may serve as a practical non-pharmacological intervention for stress management in geriatric populations.

The magnitude of stress reduction observed in the PMR group may also be clinically meaningful. Participants experienced an average reduction of 4.40 points, corresponding to approximately 28% improvement relative to baseline stress levels. Although an established minimal clinically important difference for the PSS-10 among institutionalized older adults has not yet been determined, a reduction of this magnitude suggests a meaningful improvement in perceived stress. Lower stress levels may contribute to improved emotional regulation, sleep quality, social engagement, and overall quality of life, all of which are important determinants of healthy aging.[3,4] Consequently, the benefits of PMR may extend beyond simple reductions in questionnaire scores and may support broader psychosocial well-being.

Participants receiving DBE likewise demonstrated a statistically significant reduction in stress levels following intervention. This finding is consistent with previous studies indicating that breathing-based interventions can effectively reduce psychological distress through autonomic regulation. DBE emphasizes slow and controlled diaphragmatic breathing, which may stimulate vagal activity, reduce sympathetic activation, and improve physiological regulation of stress responses. Previous investigations have reported improvements in stress, anxiety, and emotional well-being following structured breathing exercises.[12,13,14,27] The present findings therefore reinforce existing evidence supporting the role of DBE as a simple and accessible intervention for psychological stress management among older adults.

An important practical advantage of DBE is its simplicity. Unlike some exercise-based interventions that require specific equipment, substantial physical effort, or extensive supervision, DBE can be performed in various settings and may be adapted to individuals with different levels of physical function.[28] This characteristic is particularly relevant for institutionalized older adults, many of whom experience mobility limitations, chronic health conditions, or reduced exercise tolerance. As a result, DBE may represent a feasible strategy for routine stress management within residential care facilities and community-based geriatric programs.[29]

One of the most important findings of the present study is the absence of a statistically significant difference between PMR and DBE. Although PMR demonstrated a slightly larger reduction in stress scores than DBE, the difference was not statistically significant. This result suggests that both interventions may influence similar physiological pathways despite employing different therapeutic approaches. PMR primarily targets muscular tension and bodily awareness, whereas DBE focuses on respiratory regulation and autonomic modulation. Nevertheless, both interventions ultimately promote parasympathetic activation and reduce sympathetic arousal, which may explain their comparable effectiveness in reducing perceived stress.[9,12,13]

The absence of superiority of one intervention over the other is consistent with previous studies reporting comparable outcomes among various relaxation-based interventions. Some authors have suggested that PMR may provide greater benefits because it simultaneously addresses physical tension and cognitive relaxation processes.[11] However, other investigations have reported that breathing-based interventions produce similar reductions in stress and anxiety.[16,17] Taken together, these findings suggest that intervention effectiveness may depend on participant characteristics, intervention dosage, environmental context, and outcome measures rather than the specific relaxation technique employed.

The present findings should also be interpreted within the context of the study population. All participants resided within the same social care institution and were exposed to similar environmental conditions and psychosocial stressors. Institutionalized older adults often experience challenges related to loneliness, separation from family members, reduced autonomy, and adaptation to communal living environments.[6,7] These circumstances may contribute to elevated stress levels irrespective of underlying physical health status. Both PMR and DBE may have helped participants cope with these stressors by promoting relaxation and improving psychological self-regulation, thereby producing similar therapeutic outcomes.

Several methodological limitations should be considered when interpreting these findings. First, the study employed a quasi-experimental design without random allocation. Although demographic characteristics appeared comparable between groups, the possibility of selection bias cannot be completely excluded.[30] Second, no non-intervention control group was included. Consequently, it is not possible to determine the extent to which observed improvements resulted exclusively from the interventions rather than from natural adaptation, increased social interaction, or attention received during participation in the study. Third, the relatively small sample size may have reduced statistical power to detect subtle differences between interventions. Although the observed between-group difference was small, the possibility of a Type II error cannot be entirely excluded. Future studies should therefore employ larger sample sizes and more robust statistical approaches to strengthen causal inference and comparative effectiveness evaluation.[31]

Despite these limitations, the study possesses several strengths. It directly compared two commonly used non-pharmacological interventions within the same population, utilized a standardized stress assessment instrument, achieved complete participant retention, and focused on institutionalized older adults, a population that remains underrepresented in stress management research. These strengths contribute valuable evidence regarding feasible physiotherapy-based approaches for supporting mental health among older adults living in residential care facilities.

From a clinical perspective, the findings support the integration of both PMR and DBE into geriatric physiotherapy and health promotion programs. Because neither intervention demonstrated superiority, healthcare providers may select interventions based on individual preferences, functional abilities, available resources, and clinical objectives. PMR may be particularly suitable for individuals presenting with prominent muscular tension, whereas DBE may be preferable for those requiring a simpler and less physically demanding intervention. Future research should incorporate randomized controlled designs, larger and more diverse populations, longer follow-up periods, objective physiological outcomes, effect size estimation, and adjusted statistical analyses to further clarify the comparative effectiveness of these interventions.

Conclusion

This study compared the effects of Progressive Muscle Relaxation (PMR) and Deep Breathing Exercise (DBE) on perceived stress among institutionalized older adults. Both interventions were associated with significant reductions in Perceived Stress Scale-10 (PSS-10) scores following a three-week intervention period. Participants receiving PMR demonstrated a mean reduction of 4.40 points, whereas participants receiving DBE demonstrated a mean reduction of 4.00 points. However, no statistically significant difference was observed between groups ($t=0.315$; $df=28$; $p=0.755$), indicating that neither intervention demonstrated superiority over the other in reducing perceived stress among older adults residing in a social care institution.

The findings suggest that PMR and DBE may both represent feasible non-pharmacological approaches for stress management among institutionalized older adults. Given their comparable outcomes, intervention selection may be guided by participant preferences, physical capabilities, clinical needs, and available resources within the care setting.[32]

Study Limitations

Several limitations should be considered when interpreting the findings of this study. First, the study employed a quasi-experimental design without random allocation, which may have introduced selection bias despite comparable baseline demographic characteristics between groups.[33] Second, the absence of a non-intervention control group limits the ability to determine whether observed improvements were attributable exclusively to the interventions or were partially influenced by other contextual factors. Third, the relatively small sample size may have reduced statistical power to detect subtle differences between interventions. Finally, effect size estimates, confidence intervals, and adjusted statistical analyses were not available in the original dataset, limiting interpretation of the magnitude and precision of intervention effects.

Clinical Implications

The findings support the incorporation of PMR and DBE into geriatric physiotherapy and health promotion programs within residential care facilities. Both interventions are relatively simple, low-cost, non-invasive, and feasible to implement among older adults with varying functional capacities.[34] PMR may be particularly appropriate for individuals experiencing prominent muscular tension, whereas DBE may be advantageous for individuals requiring a simpler intervention with minimal physical demand. Because neither intervention demonstrated superiority, healthcare professionals may select either approach according to patient characteristics, therapeutic goals, and resource availability.

Future research should employ randomized controlled trial designs, larger and more diverse samples, longer follow-up periods, objective physiological outcome measures, and more comprehensive statistical analyses to further clarify the comparative effectiveness and long-term benefits of PMR and DBE in older adult populations.

Author Contributions

Putri Dwi Arianty Ikhwan: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Visualization, Writing – Original Draft.
Muhammad Irfan: Conceptualization, Methodology, Validation, Supervision, Project Administration, Writing – Review and Editing.
Fitri Yani: Validation, Methodology, Critical Review, Writing – Review and Editing.

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Conflict of Interest Statement

The authors declare no conflicts of interest related to this study.

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Ethics Statement

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical clearance was obtained before data collection, and all participants provided written informed consent prior to participation. The ethical approval number should be added according to the official ethics committee approval document.

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