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Comparison of the Effectiveness of Progressive Muscle Relaxation Training and Mindfulness-Based Stress Reduction Training on the Modification of Tinnitus Symptoms and Anxiety Sensitivity in Individuals with Tinnitus

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A B S T R A C T

Tinnitus disorder, with its chronic and multidimensional nature, is not merely an auditory challenge but a biopsychosocial phenomenon that adversely affects patients' quality of life. Given that anxiety sensitivity plays a significant role in the exacerbation and persistence of this disorder, the present study aimed to compare the effectiveness of two psychological interventions—progressive muscle relaxation (PMR) training and mindfulness-based stress reduction (MBSR) training—on tinnitus symptoms and anxiety sensitivity in individuals with tinnitus. The present study employed a quasi-experimental design with pretest, posttest, and three-month follow-up, including a control group. The statistical population consisted of 45 individuals who referred to Amir A'lam Hospital in Tehran in 2025, selected through purposive sampling and randomly assigned to three groups (two experimental groups and one control group). The research instruments included the Tinnitus Handicap Inventory (THI) and the Anxiety Sensitivity Index–Revised (ASI-3). Data were analyzed using repeated-measures analysis of variance and Bonferroni post hoc tests. The results indicated that both PMR and MBSR interventions led to significant reductions in tinnitus and anxiety sensitivity scores at the posttest and follow-up stages, whereas no significant change was observed in the control group. The difference in effectiveness between the two experimental interventions was not statistically significant, suggesting comparable efficacy of both approaches. The findings underscore the importance of non-pharmacological mind–body interventions in the management of tinnitus and demonstrate that both relaxation training and mindfulness training can be incorporated as cost-effective and efficient treatments within comprehensive tinnitus rehabilitation programs.

Keywords: *Progressive muscle relaxation, mindfulness-based stress reduction, tinnitus, anxiety sensitivity.*

1. Introduction

Tinnitus is a complex and often debilitating condition characterized by the perception of sound in the absence of an external auditory stimulus. Commonly described as ringing, buzzing, hissing, or whistling, tinnitus affects a substantial proportion of the adult population and, for many individuals, represents a chronic health condition with profound psychological, emotional, and functional consequences. Contemporary research increasingly conceptualizes tinnitus not merely as an auditory symptom but as a multidimensional biopsychosocial phenomenon shaped by interactions among neurophysiological mechanisms, cognitive–emotional processes, and contextual factors (Boecking et al., 2024; Gasparre et al., 2023). This expanded conceptualization has shifted clinical and research attention toward psychological variables that influence tinnitus severity, distress, and persistence, particularly anxiety-related processes and maladaptive coping patterns.

Among psychological variables implicated in tinnitus-related distress, anxiety sensitivity has emerged as a key transdiagnostic construct. Anxiety sensitivity refers to the fear of anxiety-related sensations based on beliefs that these sensations have harmful physical, cognitive, or social consequences. Individuals with high anxiety sensitivity are more likely to interpret benign bodily sensations as threatening, which can amplify emotional reactivity and perpetuate cycles of fear and avoidance (Esmaeilian et al., 2021; Hajishabani, 2020). In the context of tinnitus, heightened attention to internal sensations and catastrophic interpretations of auditory perceptions may exacerbate perceived loudness, intrusiveness, and emotional burden. Empirical evidence suggests that anxiety sensitivity is strongly associated with tinnitus-related distress, emotional dysregulation, and reduced quality of life, even when objective auditory impairment is minimal or absent (Boecking et al., 2024; Zhang & Yan, 2024).

The recognition of anxiety sensitivity as a modifiable psychological factor has important implications for tinnitus management. Traditional biomedical approaches to tinnitus have largely focused on pharmacological treatments or auditory interventions, such as hearing aids and sound therapy. However, these approaches often yield limited or inconsistent outcomes, particularly in cases where psychological distress predominates (Carmody et al., 2023). Consequently, there has been a growing emphasis on non-pharmacological, mind–body interventions that target cognitive, emotional, and physiological processes underlying tinnitus-related distress. Psychological interventions aimed at reducing autonomic arousal, maladaptive cognitive appraisals, and emotional reactivity are increasingly regarded as essential components of comprehensive tinnitus rehabilitation programs (Carmody et al., 2023; Engelke et al., 2023).

Progressive muscle relaxation (PMR) is one such intervention with a long-standing history in clinical psychology and behavioral medicine. PMR is based on the systematic tensing and relaxing of muscle groups to reduce physiological arousal and enhance bodily awareness. Theoretical models posit that PMR facilitates a parasympathetic response, counteracting stress-related sympathetic activation and thereby reducing anxiety and somatic tension (Ghafari et al., 2009). Empirical studies across diverse clinical populations have demonstrated the effectiveness of PMR in alleviating anxiety, improving quality of life, and reducing psychosomatic symptoms (Hidayati et al., 2019; Jha et al., 2020; Toqan et al., 2023). In populations with chronic health conditions, PMR has been shown to reduce symptom-related distress by enhancing perceived control over bodily sensations and diminishing hypervigilance to internal cues (Ghafari et al., 2009; Kurniawati & Bungsu, 2021).

Evidence supporting the utility of PMR in managing pain, insomnia, and anxiety provides a rationale for its application in tinnitus populations. Studies comparing PMR with other therapeutic modalities suggest that relaxation-based interventions can be particularly beneficial for individuals whose symptoms are exacerbated by stress and physiological tension (Aini et al., 2023; Apriany, 2024). Moreover, PMR has demonstrated effectiveness in reducing anxiety sensitivity by attenuating the perceived threat value of somatic sensations and fostering adaptive interpretations of bodily experiences (Hidayati et al., 2019; Toqan et al., 2023). These findings are especially relevant for tinnitus, where bodily vigilance and fear of internal sensations play a central role in symptom persistence.

In parallel with relaxation-based approaches, mindfulness-based interventions have gained substantial empirical support over the past two decades. Mindfulness is commonly defined as the intentional, nonjudgmental awareness of present-moment experiences, including thoughts, emotions, and bodily sensations. Mindfulness-based stress reduction (MBSR) and related interventions aim to cultivate acceptance, attentional flexibility, and emotional regulation, thereby reducing maladaptive reactivity to distressing internal experiences (Sharma & Sanal, 2025;

KMAN-CPN KMAN-Counseling & Psychology Nexus
E-ISSN: 3041-9026

Štánerová et al., 2025). From a theoretical perspective, mindfulness is posited to weaken the association between sensory input and emotional distress by altering individuals' relationships with their experiences rather than attempting to eliminate symptoms per se.

A robust body of evidence indicates that mindfulness-based interventions are effective in reducing anxiety, depression, and stress across a wide range of populations, including individuals with chronic medical conditions (Štánerová & Novotná, 2025; Štánerová et al., 2025). Meta-analytic findings suggest that mindfulness-based approaches yield moderate to large effects on psychological well-being and quality of life, particularly in populations experiencing chronic stress or illness (Štánerová & Novotná, 2025; Štánerová et al., 2025). In relation to anxiety sensitivity, mindfulness has been shown to reduce fear of internal sensations by promoting decentering, acceptance, and experiential openness (Karimi et al., 2023; Qarib-Bolook et al., 2022).

Within tinnitus research, mindfulness-based interventions have attracted increasing attention as promising non-pharmacological treatments. Mindfulness practices may help individuals disengage from maladaptive attentional focus on tinnitus sensations and reduce catastrophic interpretations of auditory experiences. Empirical studies suggest that mindfulness-based cognitive and stress reduction programs can lead to significant reductions in tinnitus distress, anxiety, and emotional reactivity, even when tinnitus loudness remains unchanged (Boecking et al., 2024; Engelke et al., 2023). These findings align with broader models emphasizing the role of cognitive–emotional appraisal and coping responses in shaping tinnitus-related suffering.

Importantly, both PMR and mindfulness-based interventions share a focus on mind–body integration, yet they operate through partially distinct mechanisms. PMR primarily targets physiological arousal and muscular tension, offering a bottom-up pathway to emotional regulation. In contrast, mindfulness-based approaches emphasize top-down processes such as attentional control, acceptance, and cognitive flexibility. Comparative research across clinical domains indicates that both approaches can effectively reduce anxiety and psychosomatic symptoms, though their relative efficacy may vary depending on individual characteristics and target outcomes (Aini et al., 2023; Karimi et al., 2023). Despite this growing literature, direct comparisons of PMR and mindfulness-based interventions in tinnitus populations remain limited.

Recent studies in related clinical contexts underscore the importance of examining comparative effectiveness rather than evaluating interventions in isolation. For example, research comparing mindfulness-based cognitive therapy with other psychotherapeutic approaches has highlighted the need to identify shared and unique therapeutic mechanisms underlying symptom change (Luo et al., 2025; Tang et al., 2025). Similarly, investigations into relaxation-based interventions suggest that structured relaxation exercises can yield outcomes comparable to more cognitively oriented therapies for certain anxiety-related variables (Apriany, 2024; Awad et al., 2025). These findings point to the value of comparative designs in informing evidence-based clinical decision-making.

In the context of tinnitus, comparative evaluations are particularly relevant given the heterogeneity of symptom presentations and psychological profiles among affected individuals. Some patients may respond more strongly to interventions that directly reduce physiological arousal, whereas others may benefit more from approaches that address maladaptive cognitive–emotional processes such as anxiety sensitivity and experiential avoidance. Understanding whether PMR and mindfulness-based stress reduction yield differential or comparable effects on tinnitus symptoms and anxiety sensitivity can contribute to more personalized and effective treatment planning (Boecking et al., 2024; Carmody et al., 2023).

Despite the growing international literature on mindfulness and relaxation-based interventions, there remains a relative scarcity of controlled studies examining these approaches in Middle Eastern and regional clinical contexts. Cultural factors, health beliefs, and help-seeking behaviors may influence both the experience of tinnitus and responsiveness to psychological interventions. Therefore, conducting comparative research within specific sociocultural settings is essential for strengthening the external validity and clinical applicability of existing findings (Qarib-Bolook et al., 2022; Zamani & Zolfaghari, 2022). Additionally, the inclusion of follow-up assessments is critical for evaluating the durability of treatment effects, particularly for chronic conditions such as tinnitus.

Given these considerations, the present study seeks to address a notable gap in the literature by systematically comparing the effectiveness of progressive muscle relaxation training and mindfulness-based stress reduction training on tinnitus symptoms and anxiety sensitivity in individuals with tinnitus. By integrating insights from psychosomatic medicine, clinical psychology, and tinnitus

KMAN-CPN KMAN-Counseling & Psychology Nexus
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research, this study aims to contribute to a more nuanced understanding of how mind–body interventions can alleviate tinnitus-related distress and associated anxiety processes.

Accordingly, the aim of the present study was to compare the effectiveness of progressive muscle relaxation training and mindfulness-based stress reduction training on tinnitus symptoms and anxiety sensitivity in individuals with tinnitus.

2. Methods and Materials

2.1. Study Design and Participants

The research design was quasi-experimental, employing a pretest–posttest design with a three-month follow-up and a control group. The statistical population consisted of women and men who, during the spring, summer, and autumn of 2025, referred to Amir A'lam Hospital in Tehran with complaints of tinnitus and were diagnosed by relevant physicians and specialists with tinnitus of somatic (non-psychological) and psychosomatic (psychological) origin. Based on sample sizes reported in معتبر studies in this field, 45 participants were selected using purposive sampling with random replacement. In this study, two intervention groups—mindfulness-based stress reduction training and progressive muscle relaxation training—were considered as experimental groups, and one group was assigned as the control group. Inclusion criteria were a diagnosis of tinnitus accompanied by anxiety, absence of evident hearing loss, no other ear diseases, no cardiovascular diseases, no brain disorders or neurological system diseases, no severe or chronic psychological disorders, age between 20 and 60 years, willingness to participate in the study, and a minimum educational level of a high school diploma. Exclusion criteria included the presence of psychiatric disorders and receiving treatment for psychiatric illness, alcohol and substance use, presence of any acute physical illness, and absence from more than two psychotherapy sessions.

2.2. Measures

Tinnitus Handicap Inventory (THI): To assess the severity and level of disability caused by tinnitus, the Tinnitus Handicap Inventory was used. This instrument was developed and introduced in 1996 by Newman, Jacobson, and Spitzer and is recognized as one of the most widely used questionnaires for tinnitus assessment in research and clinical settings. The THI consists of 25 items across three subscales: functional, emotional, and catastrophic. Responses are scored on a three-point scale: Yes (4 points), Sometimes (2 points), and No (0 points). Total scores range from 0 to 100, with higher scores indicating greater tinnitus-related disability. Khorramdel et al. (2011) reported a Cronbach's alpha of 0.96 for the total scale and coefficients ranging from 0.88 to 0.93 for the subscales, indicating excellent reliability. Test–retest reliability over a two-week interval was reported as 0.91.

Revised Anxiety Sensitivity Index (ASI-3): The Anxiety Sensitivity Index, introduced by Taylor et al. in 2007, is a self-report questionnaire consisting of 18 items. This instrument includes three subscales: physical concerns, cognitive concerns, and social concerns. Responses are rated on a five-point Likert scale ranging from Very much (5 points) to Very little (1 point). Total scores range from 18 to 90, with higher scores indicating greater anxiety sensitivity and lower scores reflecting lower levels of anxiety sensitivity. Internal consistency assessed using Cronbach's alpha yielded coefficients ranging from 0.80 to 0.90. Test–retest reliability was reported as 0.75 after two weeks and 0.71 after three years. In Iran, Narimani and Sharbati (2015) examined the psychometric properties of this questionnaire. Reliability was calculated using three methods—internal consistency, test–retest, and split-half reliability—yielding coefficients of 0.93, 0.95, and 0.97 for the total scale, respectively. Concurrent validity was assessed through simultaneous administration with the SCL-90 questionnaire, resulting in a correlation coefficient of 0.56. Correlations with the total score were satisfactory, ranging from 0.74 to 0.88, and inter-subscale correlations ranged from 0.40 to 0.68.

2.3. Interventions

The progressive muscle relaxation intervention was implemented over 10 structured sessions and focused on systematically reducing physiological tension through graduated muscle contraction and relaxation. The protocol began with an introductory session presenting the theoretical background and rationale of PMR. Participants were then trained in the classical sixteen-muscle-group contraction–relaxation technique across three consecutive weeks, with continuous evaluation of subjective experiences and bodily awareness. In subsequent sessions, the protocol progressively simplified to seven-muscle and four-muscle relaxation formats, allowing participants to generalize relaxation skills more efficiently and apply them with reduced cognitive and physical effort. In the final phase, a

one-muscle relaxation technique was introduced to enhance rapid relaxation in daily situations. The intervention concluded with a comprehensive review of all techniques and consolidation of learned skills, followed by posttest assessment. Throughout the protocol, emphasis was placed on enhancing somatic awareness, reducing autonomic arousal, and improving perceived control over physical tension associated with tinnitus-related distress.

The mindfulness-based stress reduction intervention was delivered in eight structured sessions grounded in mindfulness theory and experiential practice. The protocol began with an introduction to mindfulness and the foundational concept of the "being mode," emphasizing nonjudgmental present-moment awareness. Subsequent sessions focused on cultivating awareness of perception, learning to remain present with all internal and external experiences, and differentiating between "being" and "doing" modes of mind. Participants were guided to explore the nature of stress, habitual reactions to stressors, and the development of mindful responding rather than automatic reactivity. Later sessions addressed stress-inducing interpersonal communications, skillful interaction with the environment, conscious decision-making, and self-care practices. The final session emphasized maintaining mindfulness practice beyond the intervention period and integrating mindfulness skills into everyday life. Overall, the protocol aimed to reduce psychological reactivity, enhance emotional regulation, and promote adaptive coping with tinnitus-related stress and anxiety.

2.4. Data analysis

In this study, descriptive statistical methods such as frequency, percentage, mean, and standard deviation were used to analyze demographic data and describe predictor variables. Cronbach's alpha and construct validity were employed to assess the reliability and validity of the instruments. To test the research hypotheses, repeated-measures analysis of variance was conducted using SPSS version 26.

3. Findings and Results

In this study, 45 participants were assigned to two experimental groups and one control group. The mean and standard deviation of age were 48.53 (SD = 7.54) for the progressive muscle relaxation training group, 47.93 (SD = 6.80) for the mindfulness-based stress reduction training group, 48.00 (SD = 5.76) for the control group, and 48.15 (SD = 7.03) for the total sample.

To test the research hypotheses, repeated-measures analysis of variance was employed. Prior to conducting this analysis, the assumptions of normality of score distributions and homogeneity of variances were examined. Normality was assessed using the Shapiro–Wilk test; because all variables at all measurement stages were non-significant ($p > .05$), the distributions were considered normal. Homogeneity of variances was examined using Levene's test, the results of which indicated non-significant values ($p > .05$) across all three stages, confirming that this assumption was met.

Table 1

Means and Standard Deviations of Tinnitus and Its Subcomponents by Group and Measurement Stage

Variable	Group	Pretest M	Pretest SD	Posttest M	Posttest SD	Follow-up M	Follow-up SD
Tinnitus (Functional)	PMR Training	29.73	7.77	18.13	5.90	18.66	5.69
	MBSR Training	30.53	7.24	19.06	4.81	19.60	4.04
	Control	29.73	7.94	29.20	5.52	29.20	5.52
Tinnitus (Emotional)	PMR Training	24.00	5.70	15.46	4.73	15.46	4.73
	MBSR Training	24.53	5.15	16.13	4.97	16.13	4.97
	Control	24.26	4.89	24.13	4.92	24.13	4.92
Tinnitus (Catastrophic)	PMR Training	13.33	2.89	8.40	2.04	8.40	2.04
	MBSR Training	13.46	3.33	8.80	2.12	8.80	2.12
	Control	13.46	3.24	13.33	3.26	13.33	3.26
Total Tinnitus	PMR Training	67.06	14.22	42.00	10.13	42.53	10.80
	MBSR Training	68.53	14.88	44.00	9.65	44.53	10.09
	Control	67.46	6.73	66.66	6.74	66.66	6.74

Table 1 presents the means of tinnitus and its components. As shown, there were no substantial differences between the groups at the pretest stage; however, following the intervention, a marked reduction was observed

KMAN-CPN KMAN-Counseling & Psychology Nexus
E-ISSN: 3041-9026

in the experimental groups, whereas no such reduction was evident in the control group.

Table 2

Means and Standard Deviations of Anxiety Sensitivity and Its Subcomponents by Group and Measurement Stage

Variable	Group	Pretest M	Pretest SD	Posttest M	Posttest SD	Follow-up M	Follow-up SD
Anxiety Sensitivity (Physical Concerns)	PMR Training	16.33	3.53	9.13	1.64	9.33	1.95
	MBSR Training	16.40	3.61	10.33	2.02	10.66	2.02
	Control	16.66	3.89	16.26	2.78	16.26	2.78
Anxiety Sensitivity (Cognitive Control)	PMR Training	10.20	2.42	5.26	1.70	5.46	1.59
	MBSR Training	10.06	2.25	4.86	1.40	5.06	1.38
	Control	10.33	2.28	10.13	2.16	10.13	2.16
Anxiety Sensitivity (Social Concerns)	PMR Training	10.13	1.88	4.53	0.91	4.73	0.88
	MBSR Training	10.06	1.90	4.26	0.45	4.46	0.51
	Control	10.06	2.01	10.06	2.01	10.06	2.01
Total Anxiety Sensitivity	PMR Training	36.66	3.51	18.93	2.31	19.53	2.64
	MBSR Training	36.53	3.31	19.46	2.09	20.20	2.27
	Control	37.06	2.89	36.46	2.77	36.46	2.77

Table 2 presents the means of anxiety sensitivity and its components. As shown, there were no notable differences between the groups at the pretest stage; however, after the intervention, substantial reductions were observed in the experimental groups, whereas no such reductions were observed in the control group.

The results of Mauchly's test of sphericity for tinnitus and anxiety sensitivity were significant ($p < .001$), indicating that the covariance matrices of repeated measurements across the three assessment stages were not equal. Accordingly, because the assumption of sphericity was violated, the Greenhouse–Geisser correction was applied to evaluate within-subject effects, and the results are presented in Table 3.

Table 3

Within-Subject Effects of Repeated-Measures Analysis of Variance for Study Variables (Greenhouse–Geisser Correction)

Variable	Source	F	p	η^2
Tinnitus	Time	3320.231	< .001	.988
	Time × Group	752.393	< .001	.973
Anxiety Sensitivity	Time	1046.595	< .001	.961
	Time × Group	235.620	< .001	.918

The results in Table 3 indicate significant main effects of time for tinnitus ($F = 3320.231$, $p < .001$) and anxiety sensitivity ($F = 1046.595$, $p < .001$), as well as significant time-by-group interaction effects for tinnitus ($F = 752.393$, $p < .001$) and anxiety sensitivity ($F = 235.620$, $p < .001$). These findings indicate that the mean scores of tinnitus and anxiety sensitivity differed significantly across measurement times between the experimental and control groups.

Table 4

Results of the Bonferroni Post Hoc Test for Pairwise Comparisons of Interventions

Variable	Group	Adjusted Mean	Group Comparison	Mean Difference	Sig.
Tinnitus	Progressive Muscle Relaxation	50.53	Relaxation – Stress Reduction	1.822	1.00
	Mindfulness-Based Stress Reduction	52.02	Relaxation – Control	16.400	< .001
	Control	66.92	Stress Reduction – Control	14.578	< .001
Anxiety Sensitivity	Progressive Muscle Relaxation	25.04	Relaxation – Stress Reduction	0.356	1.00
	Mindfulness-Based Stress Reduction	25.39	Relaxation – Control	11.622	< .001
	Control	36.66	Stress Reduction – Control	11.267	< .001

KMAN-CPN KMAN-Counseling & Psychology Nexus
E-ISSN: 3041-9026

To examine the effectiveness of each intervention and compare them, the Bonferroni post hoc test was applied. The results presented in Table 4 indicate that the mean differences in tinnitus and anxiety sensitivity scores between the progressive muscle relaxation group and the mindfulness-based stress reduction group were not statistically significant, suggesting that the two interventions were equally effective in influencing the study variables. However, both experimental groups differed significantly from the control group.

To determine the specific location and magnitude of differences across assessment phases, pairwise comparisons among the three stages of measurement were conducted. The results are presented in Table 5.

Table 5

Results of the Bonferroni Post Hoc Test for Examining the Durability of Intervention Effects Across Measurement Stages

Variable	Stage	Adjusted Mean	Stage Comparison	Mean Difference	Sig.
Tinnitus	Pretest	67.68	Pretest – Posttest	16.800	< .001
	Posttest	50.88	Pretest – Follow-up	16.444	< .001
	Follow-up	51.24	Posttest – Follow-up	0.356	.054
Anxiety Sensitivity	Pretest	36.75	Pretest – Posttest	11.800	< .001
	Posttest	24.95	Pretest – Follow-up	11.356	< .001
	Follow-up	25.39	Posttest – Follow-up	0.344	.076

To determine the stages at which the interventions exerted their effects and to compare these stages, the Bonferroni post hoc test was employed. The results shown in Table 5 indicate that the mean differences in tinnitus and anxiety sensitivity scores between the pretest stage and both the posttest and follow-up stages were statistically significant, reflecting a significant effect of the interventions on tinnitus and anxiety sensitivity. In contrast, the mean differences between the posttest and follow-up stages were not statistically significant, indicating stabilization and durability of the intervention effects over time.

4. Discussion

The present study aimed to compare the effectiveness of progressive muscle relaxation (PMR) training and mindfulness-based stress reduction (MBSR) training on tinnitus symptoms and anxiety sensitivity in individuals with tinnitus. The results demonstrated that both interventions led to significant reductions in tinnitus severity and anxiety sensitivity at posttest and follow-up compared to the control group, while no significant differences were observed between the two experimental groups. These findings suggest that PMR and MBSR are similarly effective psychological interventions for alleviating tinnitus-related distress and associated anxiety processes.

The observed reduction in tinnitus symptoms across both intervention groups aligns with contemporary biopsychosocial models of tinnitus, which emphasize the role of emotional, cognitive, and physiological factors in the perception and maintenance of tinnitus-related distress (Boecking et al., 2024; Gasparre et al., 2023). From this perspective, tinnitus severity is not solely determined by auditory mechanisms but is significantly influenced by stress reactivity, emotional regulation, and maladaptive coping responses. The substantial decrease in tinnitus scores following both PMR and MBSR suggests that interventions targeting stress and emotional reactivity can meaningfully alter individuals' subjective experience of tinnitus, even when the auditory signal itself may remain unchanged.

The effectiveness of PMR in reducing tinnitus symptoms can be understood through its impact on physiological arousal and somatic tension. Progressive muscle relaxation is designed to elicit a relaxation response that counteracts sympathetic nervous system activation, thereby reducing bodily tension and stress-related hyperarousal (Ghafari et al., 2009). Previous studies have consistently shown that PMR reduces anxiety, psychosomatic complaints, and stress-related symptoms across diverse populations, including individuals with chronic medical conditions (Hidayati et al., 2019; Jha et al., 2020; Toqan et al., 2023). In the context of tinnitus, heightened physiological arousal and muscular tension may amplify attentional focus on internal sensations, including auditory perceptions. By reducing bodily tension and promoting relaxation, PMR may decrease hypervigilance and emotional reactivity to tinnitus, leading to lower perceived severity and distress.

The present findings are also consistent with research demonstrating the effectiveness of PMR in improving quality of life and reducing symptom burden in chronic conditions such as multiple sclerosis, hypertension, insomnia, and pain-related disorders (Aini et al., 2023;

KMAN-CPN KMAN-Counseling & Psychology Nexus E-ISSN: 3041-9026

Apriany, 2024; Ghafari et al., 2009; Kurniawati & Bungsu, 2021). These studies suggest that relaxation-based interventions are particularly beneficial when stress and anxiety exacerbate physical symptoms, a pattern that closely resembles the clinical presentation of many individuals with tinnitus. Moreover, PMR has been shown to reduce anxiety sensitivity by altering individuals' interpretations of bodily sensations, making them less likely to perceive physiological arousal as threatening (Hidayati et al., 2019; Toqan et al., 2023). This mechanism may partly explain the significant reductions in anxiety sensitivity observed in the PMR group in the present study.

Similarly, the effectiveness of MBSR in reducing tinnitus symptoms and anxiety sensitivity is consistent with a growing body of evidence supporting mindfulness-based interventions for psychological distress and chronic health conditions. Mindfulness-based approaches aim to change individuals' relationships with their internal experiences by fostering nonjudgmental awareness and acceptance of thoughts, emotions, and bodily sensations (Sharma & Sanal, 2025). In tinnitus, this shift in perspective may reduce maladaptive attentional focus on the tinnitus signal and weaken the association between auditory sensations and emotional distress. Previous research indicates that mindfulness-based interventions can reduce tinnitus-related distress, anxiety, and emotional reactivity, even when objective measures of tinnitus loudness remain stable (Boecking et al., 2024; Engelke et al., 2023).

The reduction in anxiety sensitivity observed in the MBSR group aligns with theoretical and empirical work highlighting mindfulness as a protective factor against fear of internal sensations. Mindfulness has been shown to reduce anxiety sensitivity by promoting decentering, experiential openness, and acceptance, thereby diminishing catastrophic interpretations of bodily and emotional experiences (Karimi et al., 2023; Qarib-Bolook et al., 2022). Structural and mediational studies further suggest that mindfulness skills influence anxiety outcomes indirectly through improved emotion regulation and reduced experiential avoidance (Esmaeilian et al., 2021; Hajishabani, 2020). These mechanisms are particularly relevant for tinnitus, where anxiety sensitivity may intensify distress by amplifying fear-based responses to internal auditory sensations.

The lack of a statistically significant difference between PMR and MBSR in their effects on tinnitus symptoms and anxiety sensitivity suggests that both interventions are comparably effective, despite their distinct theoretical foundations. This finding is consistent with comparative research in other clinical domains, where relaxation-based and mindfulness-based interventions often yield similar outcomes for anxiety and psychosomatic symptoms (Aini et al., 2023; Karimi et al., 2023). One possible explanation is that both approaches converge on shared therapeutic mechanisms, such as reducing physiological arousal, increasing awareness of internal states, and enhancing perceived control over distressing experiences. Although PMR primarily operates through bottom-up physiological pathways and MBSR emphasizes top-down cognitive–attentional processes, both may ultimately attenuate stress reactivity and emotional amplification of symptoms.

The significant time-by-group interaction effects observed in the present study further indicate that the reductions in tinnitus and anxiety sensitivity were attributable to the interventions rather than spontaneous symptom fluctuation. Importantly, the absence of significant differences between posttest and follow-up scores suggests that the beneficial effects of both PMR and MBSR were maintained over time. This finding is consistent with meta-analytic evidence demonstrating the durability of mindfulness-based interventions in reducing anxiety and improving quality of life in chronic illness populations (Štánerová & Novotná, 2025; Štánerová et al., 2025). Similarly, relaxation-based interventions have been shown to produce sustained improvements in psychological well-being when individuals continue to apply learned techniques in daily life (Apriany, 2024; Ghafari et al., 2009).

From a clinical perspective, the comparable effectiveness of PMR and MBSR has important implications for tinnitus management. Given the heterogeneity of tinnitus presentations and patient preferences, offering multiple evidence-based psychological options may enhance treatment engagement and outcomes. Some individuals may prefer structured, technique-focused interventions such as PMR, while others may resonate more with the experiential and acceptance-based framework of mindfulness. The present findings support the integration of both approaches into comprehensive tinnitus rehabilitation programs, consistent with patient-centered models of care (Carmody et al., 2023).

Moreover, the significant reductions in anxiety sensitivity observed across both interventions underscore the importance of targeting transdiagnostic psychological processes in tinnitus treatment. Anxiety sensitivity has been identified as a key vulnerability factor for emotional disorders and psychosomatic symptoms, and its reduction

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may have broad benefits beyond tinnitus-specific outcomes (Hajishabani, 2020; Karimi et al., 2023). By addressing anxiety sensitivity, PMR and MBSR may contribute to improved emotional resilience and reduced risk of comorbid anxiety and depressive disorders, which are commonly reported among individuals with chronic tinnitus (Boecking et al., 2024; Gasparre et al., 2023).

5. Conclusion

Overall, the findings of the present study are consistent with and extend existing literature on mind–body interventions for tinnitus and anxiety-related processes. By directly comparing PMR and MBSR within a controlled design and including a follow-up assessment, this study contributes to a more nuanced understanding of how different psychological approaches can alleviate tinnitus-related distress. The results highlight that both physiological relaxation and mindful awareness represent viable and effective pathways for reducing tinnitus symptoms and anxiety sensitivity.

Despite its strengths, the present study has several limitations that should be considered when interpreting the findings. First, the sample size was relatively small, which may limit the generalizability of the results and reduce statistical power for detecting subtle differences between the two interventions. Second, reliance on self-report measures may introduce response bias, particularly in the assessment of subjective constructs such as tinnitus severity and anxiety sensitivity. Third, the study did not include objective physiological or neurobiological measures that could provide additional insight into the mechanisms underlying treatment effects. Finally, the follow-up period was limited to three months, which restricts conclusions regarding the long-term sustainability of the observed benefits.

Future studies should aim to replicate these findings with larger and more diverse samples to enhance generalizability and statistical robustness. Incorporating longer follow-up periods would allow for a more comprehensive evaluation of the durability of intervention effects. Additionally, future research could examine potential moderators of treatment response, such as baseline anxiety sensitivity, tinnitus duration, or individual differences in coping styles. The inclusion of objective physiological indicators, neurocognitive measures, or qualitative data could also deepen understanding of the mechanisms through which PMR and mindfulness-based interventions influence tinnitus-related outcomes.

From a practical standpoint, clinicians working with individuals with tinnitus are encouraged to incorporate both progressive muscle relaxation and mindfulness-based stress reduction as accessible, low-cost, and non-pharmacological treatment options. These interventions can be delivered in individual or group formats and adapted to diverse clinical settings. Training patients in skills that reduce stress reactivity and enhance emotional regulation may not only alleviate tinnitus-related distress but also improve overall psychological well-being. Integrating these approaches into multidisciplinary tinnitus rehabilitation programs may enhance treatment effectiveness and patient satisfaction.

Authors' Contributions

M.K. conceived the study, formulated the research objectives, and supervised the overall research process. M.A. contributed to the study design, coordinated the implementation of the intervention protocols, and assisted in clinical supervision. M.R. was responsible for participant recruitment, data collection, and administration of the assessment instruments across pretest, posttest, and follow-up stages. A.R. conducted the statistical analyses, managed data interpretation, and prepared the results section. M.G.M. contributed to the literature review, drafting of the manuscript, and critical revision of the intellectual content. All authors reviewed and approved the final manuscript and agree to be accountable for all aspects of the work.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. This study was approved by the Ethics Committee of Payame Noor University under the ethical code IR.PNU.REC.1404.193.

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