REVIEW ARTICLE

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Stress reduction interventions for rural medical professionals – a narrative review

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Abstract

Introduction and Objective. Occupational stress and burnout affect over 70% of physicians globally, with rural practitioners facing additional stressors such as professional isolation, excessive workloads, and systemic under-resourcing. The aim of the review is to evaluate evidence on selected non-pharmacological stress-reduction interventions: meditation, mindfulness, yoga, progressive muscle relaxation (PMR), and breathing exercises, as practical strategies for rural medical professionals.

Review Methods. A structured narrative review was conducted using PubMed and Embase for English- and Polish-language publications (2010–2025). Grey literature from recognized health institutions was also consulted. Sources were selected based on credibility, relevance, and clarity.

Brief description of the state of knowledge. The reviewed interventions reduce perceived stress, anxiety, and depression, and induce physiological effects, including lower heart rate and blood pressure, and lower cortisol. Mindfulness-based stress reduction showed moderate to large effects and improved quality of life. PMR proved effective regardless of session duration, suiting time-constrained clinicians. Breathing exercises, including cyclic sighing and diaphragmatic breathing, produced relief within five minutes. Yoga delivered both physiological and psychological benefits, though evidence for diagnosed anxiety disorders remains limited. Immersive technologies (VR/AR) may broaden access by eliminating travel barriers.

Summary. Non-pharmacological interventions offer safe, accessible, evidence-supported strategies for managing occupational stress among rural physicians. Methodological heterogeneity, however, limits firm conclusions; standardized large-scale randomized controlled trials with long-term follow-up are needed.

Key words

mindfulness, yoga, burnout, meditation, occupational stress, breathing exercises, relaxation techniques, rural health services, mind-body therapies, stress immunity

INTRODUCTION AND OBJECTIVE

The medical profession is widely recognized as one of the most demanding and stressful occupations globally. Occupational stress and burnout represent a pervasive challenge among physicians, with prevalence reported to be as high as over 70% among medical doctors [1, 2]. This alarming figure underscores the systemic nature of the problem, one that extends well beyond individual coping capacity and reflects deeply embedded structural conditions within healthcare systems [3]

Stress is a physiological and psychological reaction of the body to certain difficult situations [4, 5]. Everyone experiences stress; it is an integral part of our lives. On the one hand, transient stress can motivate us to act, avoid danger, or simply keep us alert. On the other hand, continuous stress without the proper chance to relax can have severe negative effects on both our physical and mental health [6].

Prolonged stress disrupts the body's homeostasis and causes damage to many systems. A major cause of this homeostatic instability is the disruption of the hypothalamic-pituitary-adrenal (HPA) axis and the subsequently elevated cortisol levels, and chronically increased cortisol levels resulting in suppression of the immune system. Stress promotes sympathetic nervous system activity, with the related increases in heart rate and blood pressure significantly elevating the risk of cardiovascular disease. Acute and chronic stress also affect the musculoskeletal system (for example, muscle wasting, exacerbated musculoskeletal tension), the reproductive system (impaired ovarian function and reduced testosterone levels in men), as well as the gastrointestinal system (decreased nutrient absorption, alterations in gut microbiota). Furthermore, it is widely accepted that chronic stress contributes substantially to the development of various mental health disorders. Individuals seeking to reduce stress do not always choose healthy solutions; some resort to alcohol and nicotine abuse, gambling, eating disorders, or other substance use disorders [5].

The consequences of chronic occupational stress among physicians are multidimensional and far-reaching. Periods of prolonged occupational stress are the main driver of burnout. At the individual level, burnout has been associated with lower career satisfaction [7], higher absenteeism, greater

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probability of premature departure from the profession, and increased risk of interpersonal difficulties [2, 3]. At the clinical level, burnout has been linked to a significantly greater risk of medical errors, including medication errors and diagnostic failures, as well as suboptimal patient-centrered attitudes [2]. Burnout has also been found to be an independent predictor of self-reported major medical errors, even after controlling for personal and professional factors [7]. At the organizational level, consequences include reduced productivity, increased risk of unnecessary procedures, and substantial direct and indirect medical costs [2, 7]. Physician burnout and its association with suicidality have also been questioned [8]. Beyond burnout, occupational stress in medical professionals has been associated with anxiety and depression [9]. A survey of National Health Service staff found that 61% of healthcare workers reported feeling stressed all or most of the time [10].

While these challenges affect the medical profession broadly, physicians practicing in rural, remote, and regional settings face a distinct and compounded set of stressors. As demonstrated by Coumans and Ciller [11] in a mixed-methods systematic review of the experiences of 11,130 rural physicians across 10 countries, burnout emerged as the most prevalent stress-related outcome in rural practice. Rural practitioners frequently contend with excessive workloads, geographic and professional isolation, blurred work-life boundaries, inadequate remuneration, limited career progression, and systemic under-resourcing. These pressures are further compounded by the absence of specialist support, restricted collegial networks, housing constraints, and limited career opportunities for physicians' partners [12]. In some contexts, professional isolation and inadequate institutional support have been associated with depressive symptoms, anxiety, and, in severe cases, contemplation of suicide [12, 13].

Given the convergence of these pressures, there is an urgent need to identify effective stress-reduction strategies tailored to the unique realities of rural medical practice. A growing body of evidence supports psychosocial and behavioural interventions, including cognitive-behavioural approaches, mindfulness-based programmes, and relaxation techniques as means of reducing occupational stress and burnout in medical professionals [2, 14, 15]. There is therefore growing interest in non-pharmacological techniques as viable adjuncts to pharmacotherapy and psychotherapy, including yoga, muscle relaxation, meditation, mindfulness, and breathing exercises.

The aim of this review is to provide a comprehensive overview of selected non-pharmacological methods of stress reduction (yoga, progressive muscle relaxation, meditation, mindfulness, and breathing exercises) that may serve as evidence-based strategies for rural physicians, evaluating their impact on both the physiological and psychological aspects of stress response.

MATERIALS AND METHOD

A structured search of PubMed and Embase was conducted from March – August 2026. Searches were limited to publications in English and Polish, published between 2010 – 2026. The search strategy was designed to combine three key elements: stress, the selected nonpharmacological interventions as well as the target population. The specific search string used for PubMed was: *(stress) AND ('yoga' OR 'progressive muscle relaxation' OR 'meditation' OR 'mindfulness' OR 'breathing exercise*'* OR "breathing technique*' OR 'relaxation') AND ('physician*' OR 'doctor*' OR 'nurse*' OR 'medical student*' OR 'healthcare' OR 'health care' OR 'medical staff'). A corresponding syntax was adapted for the Embase database. The combined search initially identified 3,723 records. After the removal of 1,139 duplicates, 2,584 records underwent title/abstract screening. Most records were excluded at this stage, with 87 full texts being assessed for eligibility. Ultimately, 36 studies met the inclusion criteria and were included in the narrative synthesis. A simplified PRISMA flow diagram summarizing these numbers is provided as Figure 1.

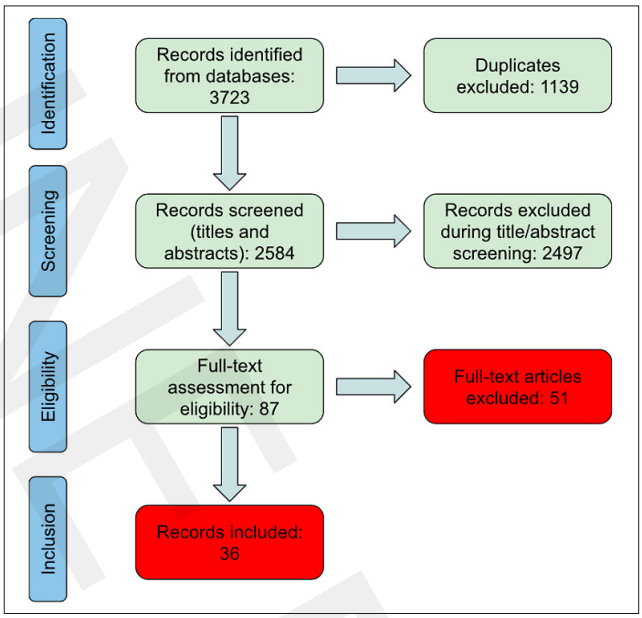

Figure 1. Simplified PRISMA flow chart for study selection

Inclusion criteria were: studies involving adult healthcare professionals or closely related populations (e.g., medical students, nurses) reporting psychological or physiological stress outcomes; randomized controlled trials (RCTs), quasi-experimental studies, and observational studies. Exclusion criteria were: studies without primary data (narrative reviews, opinion pieces), paediatric populations, and non-healthcare populations.

Two reviewers independently screened titles and abstracts; disagreements were resolved by consensus. Although a formal risk-of-bias assessment was not performed, study design, sample size, and presence of active control groups in the study characteristics table were recorded to aid interpretation

RESULTS

Meditation. According to the American Psychological Association [16], meditation is a state of extended contemplation or reflection, aimed at achieving focused attention, an altered state of consciousness, or self-insight. Contemporary meditation has evolved beyond spiritual practice to address personal well-being and stress reduction. Its forms include body-centreed meditation (body scanning),

contemplation, emotion-centred meditation, transcendental (mantra) meditation, movement-based meditation, visual-based meditation, and mindfulness meditation.

To evaluate the efficacy of meditation programmes, including their role in improving stress-related outcomes, Goyal et al. [17] conducted a systematic review in 2014, which found moderate evidence that mindfulness meditation interventions can decrease anxiety, depression, and pain, with low evidence for reducing stress and improving mental health-related quality of life. However, no significant superiority was found of meditation over pharmacological therapy or physical exercise. These findings were later confirmed by Seekircher et al. [18], who also found no advantage of meditation over conventional psychotherapy. Evidence regarding meditation's impact on positive mental health dimensions, such as positive affect and overall well-being, remained weak or insufficient.

The clinical effectiveness of meditation is further supported by studies analyzing objective physiological evidence. For example, Fox et al. [19] conducted a meta-analysis assessing whether meditation practice could be associated with neuroanatomical alterations. They discovered that meditation exercises are consistently linked with changes in eight brain regions. These include areas responsible for meta-awareness (frontopolar cortex), body awareness (both sensory cortices and insula), and the process of memory consolidation and reconsolidation (hippocampus). Also, structures activated during intra- and inter-hemispheric communication (superior longitudinal fasciculus and corpus callosum) and areas important for self- and emotion regulation (orbitofrontal cortex and anterior and mid-cingulate) had morphological alterations.

More recent evidence from the physician population strengthens the clinical relevance of meditation. In a randomized, single-blind exploratory trial among 64 hospital physicians in France, Banjac et al. [20] compared a brief, guided 15-minute meditative relaxation session with an unguided rest condition. Both interventions produced significant reductions in blood pressure, heart rate, and self-reported stress. However, guided practice was rated more favourably, with higher satisfaction scores and greater perceived relaxation. These results suggest that even short, structured meditative pauses can be realistically integrated into physicians' workdays and may offer a practical, acceptable strategy for managing acute stress.

Mindfulness. Mindfulness is a form of meditation involving deliberate, non-judgmental awareness of one's surroundings and internal states [21]. It is a component of various therapeutic interventions, including mindfulness-based cognitive behavioural therapy (MBCT), mindfulness-based stress reduction (MBSR), and mindfulness meditation.

A 2022 systematic review examining the impact of mindfulness-based interventions on the mental health of physicians and nurses found that such interventions can significantly reduce stress, anxiety, and depression in healthcare workers, with some studies reporting improvements in overall well-being, fatigue, and sleep quality [22]. However, therapeutic benefits were not uniform across all analyzed studies, reflecting the heterogeneity of study designs.

Recognizing that clinicians often cannot commit to lengthy weekly meditation sessions, Sarazine et al. [23] examined whether a single four-hour mindfulness workshop could support the wellbeing of nurses. The intervention produced short-term reductions in perceived stress and emotional exhaustion, with some improvements persisting for six months. Although the study was conducted in nursing populations rather than physicians, it illustrates that even brief, workshop-style mindfulness formats may offer practical benefits in clinical environments.

Recent physician-specific evidence reinforces these findings. A 2026 meta-analysis demonstrated that structured mindfulness curricula, professional coaching, and peer-support programmes lead to meaningful reductions in emotional exhaustion and depersonalization, while simultaneously improving personal accomplishment [14].

These results align with recent trials demonstrating the feasibility of mindfulness interventions in physician training. For example, Purdie et al. [24] conducted a randomized clinical trial among paediatric resident physicians, comparing hybrid delivery of mindfulness meditation through both in-person sessions and digital formats. The study found that participation in Mindful Awareness Practices (MAPs) led to significant reductions in emotional exhaustion and perceived stress, with benefits observed across both delivery modes. Importantly, the hybrid design highlighted that mindfulness can be successfully integrated into demanding residency schedules, offering flexibility for clinicians with limited time or access to traditional programmes. Although intervention formats varied, the overall impact suggests that mindfulness can be adapted to diverse clinical environments and remains effective even when delivered digitally.

Khoury et al. [25] found that MBSR demonstrates a moderate-to-large effect on reducing perceived stress, anxiety, depression, and general psychological distress, while also positively affecting quality of life and compassion – maintaining efficacy even against active control groups. A 2024 meta-analysis further confirmed that stress management interventions including mindfulness techniques produce a significant, moderate reduction in cortisol levels, with mindfulness and relaxation-based interventions outperforming both talking therapies and mind-body training in attenuating cortisol [26].

Yoga. Yoga, an ancient mind-body discipline, is widely used today as a therapeutic practice aimed at improving both physical and psychological well-being. Modern yoga typically integrates breathing techniques *(pranayama),* physical postures *(asanas),* and meditative elements *(dhyana).* Physiological studies show that yoga practice can reduce cortisol levels, resting blood pressure, and heart rate, supporting its role as a stress-modulating intervention. Cramer et al. [27] examined whether current evidence supports yoga's anxiolytic effects. Preliminary evidence indicates that yoga reduces anxiety compared to no-treatment groups; however, these findings applied only to individuals with sub-clinically elevated anxiety, or those diagnosed by non-standardized methods. Given its favourable safety profile [28], yoga can be used as a potentially beneficial way of reducing anxiety levels in some individuals.

Zhang et al. [29] confirmed that physical relaxation methods, including yoga, progressive muscle relaxation, and massage therapy are effective in reducing occupational stress in healthcare professionals compared to non-intervention controls.

Table 1. Comparative synthesis of non-pharmacological stress reduction interventions and their applicability in medical practice

Intervention	Key effects	Applicability	Limitations and research considerations
Meditation	Reduces stress, anxiety, depression and pain [14], induces neuroanatomical changes [19], 15-min guided meditative relaxation lowers BP, HR and stress in physicians [21].	No equipment required; feasible as brief (15-min) sessions during clinical work with high completion [21], scalable via telehealth; suitable for time-constrained rural physicians.	No clear superiority over pharmacotherapy or exercise [14], single-centre physician trials preliminary [21], rural-specific data lacking
Mindfulness	Reduces perceived stress, anxiety, depression and emotional exhaustion [18, 24], lowers cortisol [25], improves MBI domains in physicians [15].	Adaptable to brief workshops [23] and multi-week curricula, digital peer-support and online coaching formats feasible [22], scalable for geographically isolated clinicians.	Heterogeneous programme content and duration; high attrition in some long-term follow-ups (>60% at 6 months) [23], most physician trials urban/academic.
Yoga	Reduces anxiety and stress; improves quality of life and professional fulfillment; lowers cortisol, BP and HR [26, 27, 28, 30].	Safe and adaptable; online/remote delivery validated among physicians; can be scaled for rural clinicians without in-person classes.	Large variability across yoga styles [27], limited physician-specific randomized trials [30], small sample sizes
PMR	Reduces stress, anxiety and depression [33], lowers physiological stress markers [32], reduces stress indicators, improves sleep and workplace well-being in clinical staff [34, 35].	Flexible session length [31], requires no equipment or specialist facilitator; easily implemented in low-resource rural settings; synergistic with other techniques [32].	Many studies quasi-experimental or pre-post with small samples [34], short durations [35], more randomized, adequately powered physician trials needed.
Breathing exercises	Reduce anxiety and negative affect [38], increase parasympathetic activity and HRV [37], 5-min sessions produce measurable stress reduction [39], ASIP shows reduced daily and next-day stress in physicians [40].	Extremely time-efficient [36], requires no equipment; fits demanding clinical schedules; digital/app-based delivery feasible in rural settings; VR can augment breathing protocols where available [41, 42, 43].	No universal optimal protocol [38], long-term effects and comparative efficacy across techniques unclear; need standardized protocols for physician populations.

PMR – progressive muscle relaxation; BP – blood pressure; HR – heart rate; MBI – Maslach Burnout Inventory; ASIP – Anti-Stress Intervention Among Physicians; VR – virtual reality,; HRV – heart rate variability.

A randomized clinical trial evaluating Sudarshan Kriya Yoga (SKY), a structured breathing-and-meditation protocol, found significantly lower depression, anxiety, and stress scores among physicians compared to controls, alongside improved professional fulfillment [30]. A complementary study showed that an online SKY programme reduced burnout and insomnia in a multinational cohort of physicians, highlighting its practicality in settings where time and resources are limited.

These findings suggest that yoga-based interventions may be particularly suitable for clinicians working in high stress or resource constrained environments.

Muscle relaxation exercises. Progressive Muscle Relaxation (PMR), involves the alternate tensing and releasing of specific muscle groups, utilizing both 'top-down' neurological processing (conscious control from the CNS) and 'bottom-up' processing (pro-prioceptive feedback) [31]. According to Toussaint et al. [32], PMR decreases perceived stress and anxiety while also increasing physiological relaxation, as evidenced by reduced phasic electrodermal activity, an effect not observed with deep breathing techniques alone.

A comprehensive 2024 systematic review confirmed that PMR reduces stress, anxiety, and depression in adult populations [33]. Importantly, PMR demonstrates a synergistic effect when combined with other stress-reducing methods (breathing exercises, music therapy, guided imagery, or psychoeducation), yielding significantly greater reductions in perceived stress and anxiety than standalone PMR. Furthermore, the duration of PMR sessions (ranging from 5 – 37 minutes) and their frequency did not substantially affect positive mental health outcomes, underscoring the method's flexibility and accessibility.

Direct evidence from clinical staff further supports PMR's applicability. A quasi-experimental study in Indonesia found substantial reductions in nurses' occupational stress scores after one week of daily PMR sessions [34]. Similarly, a pre-post study among physicians and nurses working in a COVID-19 mobile cabin hospital reported significant reductions in anxiety and improved sleep quality following a seven-day PMR protocol [35].

Relaxation techniques combining deep breathing with PMR have shown additional benefits in cardiovascular disease and hypertension management, with combined protocols reducing blood pressure more effectively than rest alone [36]. Collectively, these findings indicate PMR as a practical, low-cost intervention that can be readily implemented in medical environments, including rural or resource-limited settings.

Breathing exercises. Breathing exercises consist of consciously performing inhalation and exhalation cycles according to a specific pattern while maintaining a defined body position. Techniques used for stress reduction include diaphragmatic (deep) breathing, 'sighing' (deep inhalations followed by prolonged exhalations), 'box breathing' (equal lengths of inhalation, breath-hold, and exhalation), and 'cyclic hyperventilation with retention' (deep intense inhalations with short exhalations) [37]. Although uncontrolled hyperventilation is associated with panic attacks, controlled cyclic hyperventilation has demonstrated benefits for stress reduction.

Balban et al. [37] demonstrated that as few as five minutes per day of sighing, box breathing, or cyclic hyperventilation techniques can increase perceived positive emotions while reducing anxiety and negative affect. Compared to mindfulness meditation, these breathing techniques showed a more prominent increase in positive affect, with comparable reductions in anxiety. Cyclic sighing emerged as the most effective technique for mood improvement. Physiological studies further support these outcomes: slow breathing (4 – 10 breaths per minute) enhances parasympathetic activity, improves ventilation efficiency, and increases heart rate variability [38]. Magnon et al. [39] found that a single five-minute session of deep slow breathing significantly reduced perceived anxiety.

Recent physician focused trials provide compelling evidence for the feasibility of breathing interventions in

clinical practice. The Anti-Stress Intervention Among Physicians (ASIP) study evaluated two short, digitally supported breathing techniques among 76 resident physicians and found significant reductions in daily stress levels and anticipated next-day stress [40]. Breath-focused components of Mindful Awareness Practices (MAPs) have also been shown to improve stress and well-being in paediatric residents [24]. Together, these findings indicate that breathing-based interventions are both physiologically effective and practical for physicians, even within demanding clinical schedules.

DISCUSSION

The continuous rise of chronic stress and anxiety in the modern world has prompted growing interest in non-pharmacological management strategies. A multidimensional approach to healthcare, integrating both physical and psychological well-being, can lead to better clinical outcomes, as research demonstrates that methods improving personal well-being also exert measurable physiological effects [36].

Current literature confirms that meditation is a safe and effective adjunctive method of stress reduction, supported by neuroimaging evidence of associated brain morphological alterations [19]. Although meditation reduces anxiety, depression, stress, and pain [17] and outperforms placebo, evidence for its superiority over other established therapies remains inconclusive. Meditation does not appear to have a consistent positive impact on positive mental health dimensions, and therefore should complement rather than replace conventional interventions.

A randomized trial among hospital doctors demonstrated that even a brief, guided 15-minute meditative relaxation session can lower blood pressure, heart rate, and perceived stress, with high acceptability among participants [20]. While the guided session did not outperform unguided rest on most physiological outcomes, physicians reported greater satisfaction with the guided practice, an important consideration for clinicians, particularly those in rural settings who may struggle to maintain regular anti-stress routines.

Progressive muscle relaxation remains one of the most practically applicable and evidence-supported stress reduction techniques. The physiological impact of PMR on somatic parameters related to the stress response has been well documented, highlighting its potential role as a supportive therapy for cardiovascular diseases, such as arterial hypertension [36]. Moreover, its psychological effectiveness is evident, PMR significantly reduces stress, anxiety, and depression in individuals [33]. Crucially, PMR yields these benefits regardless of session duration, making it particularly suitable for time-constrained healthcare environments. Evidence from healthcare professionals reinforces this applicability: daily PMR sessions produced substantial reductions in occupational stress among nurses within a single week [34], while a structured seven-day protocol alleviated anxiety and improved sleep among physicians and nurses working in a COVID-19 field hospital [35]. These findings highlight PMR's practicality, requiring no specialized equipment, minimal training, and can be implemented even in resource-limited rural settings.

Mindfulness-based interventions have similarly demonstrated broad benefits, including reductions in perceived stress, anxiety, depression, and emotional exhaustion [22, 23, 24]. Physician-focused trials show that structured mindfulness interventions can reduces stress symptoms [14]. Additional randomized studies report reductions in stress-related indicators among paediatric residents following MAPs training [24]. These findings are particularly relevant for rural physicians, who often face heightened emotional strain and limited institutional support.

Breathing exercises offer a wide array of evidence-based techniques sharing the common goal of reducing stress and anxiety. Research confirms that these exercises are an effective non-pharmacological approach for promoting mental health, by reducing self-reported stress, anxiety and depressive symptoms [37, 39]. Their most compelling advantage in clinical settings is time efficiency: a single five-minute session can produce significant short-term reductions in perceived stress and anxiety, with some methods, such as cyclic sighing, outperforming mindfulness meditation in mood improvement [37]. These psychological benefits are reinforced by well-documented physiological changes. Physician-specific data further strengthen this conclusion. The ASIP study demonstrated that brief, digitally supported breathing exercises significantly reduced daily stress and anticipated next-day stress among resident physicians [40].

While the overall data regarding the use of the described non-pharmacological methods of stress reduction are highly promising, a major limitation lies in the difficulty of interpreting and comparing studies within this field due to diverse and inconsistent definitions of stress-reduction techniques, high methodological heterogeneity, and variable operationalization of perceived stress, anxiety, and well-being. The 2026 meta-analysis by Khan et al. [14] illustrates this challenge: although structured individual-focused interventions consistently improved burnout outcomes, the underlying studies differed considerably in design, duration, and intervention type. Future research should prioritize standardized, randomized controlled trials with large cohorts and long term follow-ups. Until such research is available, the described methods should be regarded as safe, additional tools for improving personal well-being and managing stress.

Emerging technology may provide rural physicians with novel and effective stress management tools. Mobile applications supporting general well-being are becoming increasingly accessible, offering a wide range of resources that can be utilized regardless of geographic location. Virtual Reality (VR) and Augmented Reality (AR) interventions have shown encouraging results in hospital staff, reducing acute stress, anxiety, and burnout while improving mood [41]. Physiological markers, such as heart rate, heart rate variability, and blood pressure, also improve following VR-based relaxation [42]. A synthesis focused specifically on hospital-based healthcare workers highlighted VR's potential role in resilience training and burnout prevention [43]. These technologies may be particularly advantageous for rural clinicians, offering immersive stress-relief experiences without the need for travel or in-person sessions. Most VR studies to date have been conducted in hospital environments rather than rural clinics, underscoring the need for targetted research in rural physician populations. However, the current body of research examining the efficacy of such interventions remains limited, and it therefore appears both

timely and scientifically justified to plan and conduct future studies specifically designed to evaluate the effectiveness of immersive technologies as supportive tools for stress reduction among physicians practicing in rural areas.

CONCLUSIONS

Current evidence confirms that meditation, yoga, mindfulness, breathing techniques, and muscle relaxation exercises can be effectively used as adjunctive methods of stress reduction, exerting measurable effects on both physiological parameters of stress and psychologically perceived stress and anxiety. These non-pharmacological interventions are particularly relevant for rural physicians, who face a distinctive and compounded set of occupational stressors, yet frequently lack access to conventional support resources. Their practical accessibility, favourable safety profiles, and time efficiency – especially in the case of breathing exercises and PMR – make them well-suited for integration into rural healthcare settings. Research in this area is rapidly developing; however, significant methodological heterogeneity persists and more standardized, large-scale studies are essential to establish robust evidence-based recommendations.

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