ECRONICON OPEN ACCESS

EC NEUROLOGY

Research Article

Prolonged Oral Vibratory Breathing (EVOP): A Narrative Review of its Mechanisms, Psychophysiological Effects, and Clinical Applications

Solarte A[1]*, Sanabria K[2] and Alzate J[3]

[1]*Medicine Faculty, Universidad de la Costa, Bogotá, Colombia*

[2]*SER Clinic, Bogotá, Colombia*

[3]*Medicine Faculty, Universidad Nacional de Colombia, Bogotá, Colombia*

***Corresponding Author**: Solarte A, Medicine Faculty, Universidad de la Costa, Bogotá, Colombia.

Received: July 24, 2025; **Published:** August 18, 2025

Abstract

Introduction: Prolonged Oral Vibratory Breathing (EVOP), part of the Solarte Psychoneuroimmunotherapy Technique, is a controlled breathing exercise combining prolonged exhalation with vocal vibration. Rooted in contemplative Eastern practices, it is hypothesized that EVOP stimulates the vagus nerve, promoting autonomic self-regulation with benefits across physical, mental, and emotional domains.

Objective: To critically review the scientific evidence regarding the physiological mechanisms, psychophysiological effects, and clinical applications of the EVOP technique, in order to establish its value as a complementary therapeutic tool.

Methods: A narrative review was conducted using comprehensive searches across PubMed, Embase, PsycINFO, and the Cochrane Library, with no language or date restrictions. Included studies were experimental, observational, and theoretical, focusing on variables such as heart rate variability (HRV), autonomic balance, cardiorespiratory synchronization, and emotional modulation. Due to heterogeneity, a qualitative synthesis was performed.

Results: EVOP activates vagal pathways via dual modulation-top-down (voluntary cortical control) and bottom-up (sensory afferents)-resulting in increased HRV, blood pressure reduction (~-5.6 mmHg systolic), and acute and chronic anxiety reduction. It enhances cardiorespiratory coherence, induces calm-alert states, improves sleep quality, and alleviates mild depressive symptoms. Clinical benefits have also been observed in asthma, COPD, dysautonomia, epilepsy, and cardiovascular rehabilitation.

Discussion: EVOP produces measurable systemic effects on autonomic and emotional regulation, supported by robust physiological mechanisms. Regular practice induces lasting increases in vagal tone and executive function. While few studies have investigated EVOP under its specific name, analogous techniques (e.g., bhramari, resonance breathing) provide strong indirect evidence. Success depends on patient education, gradual implementation, and adherence.

Keywords: *Vagus Nerve Stimulation; Heart Rate Variability; Breathing Exercises; Psychophysiology; Mind-Body Therapies*

Introduction

The Solarte Technique of Psychoneuroimmunotherapy (PNIT), known as Prolonged Oral Vibratory Breathing (EVOP, for its acronym in Spanish), is a controlled breathing exercise designed to harness the therapeutic effects of respiratory modulation on the body and mind. Eastern contemplative practices (meditation, yoga pranayama, etc.) have demonstrated physical, mental, and cognitive benefits partially attributed to controlled breathing [1]. Particularly, slow breathing patterns featuring prolonged exhalation are considered essential in explaining these improvements via shifts in autonomic balance [1]. EVOP is framed within this context, proposing that prolonged exhalation combined with vocal vibration stimulates the vagal nerve, activating self-regulatory health mechanisms. The following presents a scientific review of the EVOP technique, detailing its mechanisms of action, physiological/psychological effects, documented clinical applications, protocol for implementation, limitations, and a clinical guide for healthcare professionals interested in its integration. All statements are supported by evidence from recent and relevant scientific studies.

Methods

The methodology of this narrative review was based on a comprehensive search and analysis of the existing scientific literature to explore the concept and therapeutic application of Prolonged Oral Vibratory Breathing (EVOP), also known as the Solarte Technique of Psychoneuroimmunotherapy (PNIT). This review included relevant studies published in peer-reviewed journals that examined the mechanisms of action, physiological and psychological effects, and clinical applications of EVOP. Studies included were predominantly experimental, observational, and theoretical in nature, addressing various aspects such as autonomic nervous system balance, heart rate variability, and cardiorespiratory synchronization, as well as the modulation of cognitive and emotional states.

Eligible studies involved human participants of any age and health condition, with particular attention to populations experiencing anxiety disorders, stress-related conditions, sleep disturbances, respiratory disorders, neurological conditions, and cardiovascular diseases. EVOP interventions, characterized by slow, controlled exhalations combined with oral vibration (sound humming), were compared with other breathing techniques, placebo interventions, or standard medical treatments. Primary outcomes assessed included physiological markers like heart rate variability, autonomic balance, and blood pressure; secondary outcomes included psychological measures such as anxiety, stress perception, and cognitive performance.

Electronic searches were conducted using databases including PubMed, Medline, Embase, PsycINFO, and Cochrane Library, without language or date restrictions. Reference lists of selected articles and relevant systematic reviews were also examined to identify additional eligible studies.

Study selection involved a two-stage process where initially titles and abstracts were screened independently by two reviewers to identify potential inclusions. Subsequently, full texts were reviewed for final inclusion decisions, with discrepancies resolved by discussion or consultation with a third reviewer. Data extraction and management were performed using standardized forms, capturing study characteristics, participant details, intervention descriptions, outcome measures, and main findings.

Critical appraisal of the included studies was performed using validated tools appropriate for each study design, such as the Newcastle-Ottawa Scale for observational studies and the Cochrane Risk of Bias tool for randomized controlled trials. Efforts were made to manage potential biases through transparent reporting, and assessments were conducted independently by two reviewers.

Due to the heterogeneous nature of the included studies, a narrative synthesis was performed, summarizing and interpreting findings qualitatively rather than quantitatively. Results were organized thematically according to mechanisms of action, physiological and psychological effects, clinical applications, and protocol descriptions of EVOP.

Results

EVOP mechanisms of action

Vagal stimulation and interoceptive pathways

EVOP induces slow, prolonged exhalation accompanied by vocal vibration (similar to certain pranayama practices such as bhramari or OM chanting). This breathing pattern modulates the two-way interoceptive pathway: on one hand, a top-down modulation through cortical voluntary control of breathing, and on the other, a bottom-up modulation via vagal afferent signals ascending from the organs toward the brain.

In the top-down pathway, the conscious decision to breathe slowly and deeply (with prolonged exhalation) activates prefrontal cortical circuits which, through their efferent projections, increase vagus nerve activity [1]. This "phasic" vagal stimulation immediately enhances heart rate variability (HRV), reduces heart rate, and lowers blood pressure [1]. Additionally, it inhibits sympathetic activity and the hypothalamic-pituitary-adrenal (HPA) axis (reducing stress hormone release), activates cholinergic anti-inflammatory pathways, and improves cognitive executive control via central autonomic nervous system projections [1].

Simultaneously, the bottom-up pathway is activated by vagal afferents triggered by the respiratory pattern itself: slow exhalation with vibration is sensed by baroreceptors, chemoreceptors, and pulmonary mechanoreceptors, whose signals ascend to the brainstem and limbic system indicating a calm and safe state [1]. These afferent signals reflexively increase efferent vagal tone (forming a "relaxation loop"), consolidating a physiological rest-and-digest state (parasympathetic dominance) [1].

In summary, EVOP's slow, prolonged breathing directly (top-down) and indirectly (bottom-up) activates the vagus nerve, modulating interoception. Voluntary regulation of internal bodily signals combines with sensory feedback from the body [2,3], restoring autonomic balance.

Heart rate variability and cardiorespiratory coherence

A key indicator of this vagal activation is increased heart rate variability (HRV) observed with EVOP. Prolonged exhalation and slow respiratory rhythm (~6 breaths per minute) synchronize heart-rate oscillations with respiration (respiratory sinus arrhythmia phenomenon) [4]. This functions as intrinsic biofeedback: during extended exhalation, vagal activity reduces heart rate, and during inhalation slightly increases it, creating greater RR-interval variation amplitude indicative of parasympathetic dominance [1]. Theoretical studies suggest slow respiratory patterns with prolonged exhalation constitute "respiratory vagal stimulation," explaining multiple mind-body practice effects [1]. Indeed, resonance breathing techniques (breathing at the resonance frequency ~0.1 Hz) consistently increase HRV and promote optimal heart-breathing coupling [4].

In EVOP, oral vibration during exhalation potentially adds sensory stimuli: resonant sound stimulates mechanoreceptors in the upper airway and ear (auricular branch of the vagus nerve), reinforcing vagal afferent signals. Moreover, exhaling with humming (as in bhramari) significantly increases nitric oxide (NO) production in the paranasal sinuses [5]. Nasal nitric oxide, upon entering lower airways, induces vasodilation and bronchodilation, enhancing pulmonary oxygenation [5]. This combined effect of elevated NO and cardiorespiratory synchrony not only optimizes gas exchange but also signals physiological safety to the brain, triggering vagal reflexes consolidating relaxation [1].

Synchronization of brain waves

Slow respiratory changes also influence rhythmic brain activity. Slow breathing exercises modulate cortical neuronal oscillations, promoting patterns associated with states of calm alertness. EEG studies of subjects breathing at 6 breaths/min show increased alpha-wave (8-12 Hz) power and decreased theta-wave (4-7 Hz) power [3], consistent with a relaxed yet alert state. This cortical "tuning" may result from neuronal rhythm entrainment by respiratory rhythm. Respiratory neuroscience research suggests breathing generates slow oscillations that synchronize activity across extensive cortical regions with underlying respiratory rhythm [6].

A hypothesis posits that EVOP breathing, by stabilizing cardiorespiratory and vagal dynamics, promotes coherence across systems (heart, respiration, brain), reflected in more organized brain waves. In other words, prolonged vibratory breathing may act as an internal metronome aligning autonomic nervous system fluctuations with those of the central nervous system. This mechanism could explain why many individuals report mental clarity and tranquility after several minutes of EVOP: the brain receives predictable rhythmic signals (baroreceptive and mechanical) promoting neuronal synchrony and reducing stress-related "noise." Thus, from a neurophysiological perspective, EVOP modulates descending (voluntary efferent) and ascending (vagal afferent) interoceptive pathways, stimulating the vagus nerve and harmonizing heart rhythm, respiratory rhythm, and cortical activity [1,3].

Physiological and psychological effects

Autonomic balance (ANS)

The most immediate impact of EVOP is marked activation of the parasympathetic nervous system with corresponding sympathetic inhibition. During the practice, decreased heart rate and blood pressure are observed, along with increased heart rate variability (HRV), reflecting heightened vagal tone [1]. In controlled studies, slow breathing training (e.g. 20 minutes/day at 6 breaths/minute) produced, after a few weeks, significant increases in HRV indices such as SDNN, pNN50, and total spectral power [4], along with reductions in sympathetic tone. Even single sessions of slow, deep breathing acutely increase the high-frequency (HF) component of HRV-a direct index of cardiac vagal influence-in both young and older adults, simultaneously reducing acute anxiety responses [7].

This strengthening of the "vagal brake" has multiple systemic effects:

- Slowing sinus node activity and prolonging diastole improves myocardial perfusion and reduces cardiovascular load.
- Sympathetic inhibition leads to reduced catecholamine and cortisol release, promoting physiological relaxation.

Some studies report that after weeks of slow breathing practice, there is significant reduction in perceived stress levels and markers of adrenal axis activation [1]. Furthermore, baroreflex sensitivity increases, improving blood pressure stability. A meta-analysis on hypertensive patients found slow breathing programs (≤10 breaths/min, ≥5 minutes daily for ≥4 weeks) achieved modest but significant reductions in blood pressure (~-5.6 mmHg systolic, -3 mmHg diastolic) [8], an effect attributed to restored autonomic balance and cardiovascular reflexes.

Collectively, EVOP supports autonomic homeostasis, promoting parasympathetic predominance resulting in relative bradycardia, reduced blood pressure variability, higher HRV, and a metabolic resting state. Regular practice can induce long-lasting tonic changes, elevating basal vagal tone and improving ANS resilience to chronic stress [4].

Emotional regulation and stress

EVOP exerts notable psychological effects, particularly in anxiety reduction and stress management. Sustained vagal activation transmits signals to the brain that counteract excessive emotional reactivity. Studies demonstrate that slow breathing techniques increase feelings of comfort, relaxation, and calm, while reducing anxiety, tension, and perceived stress indicators [3,4]. For example, a single session of deep abdominal breathing acutely reduced state anxiety (psychological inventories) in older adults and increased cardiac vagal tone [7].

Neurophysiologically, heightened vagal activity inhibits limbic circuits related to fear/anxiety responses (e.g. amygdala) and activates prefrontal areas involved in emotional regulation [4]. Greater vagal tone correlates with better prefrontal emotional control (neurovisceral integration theory), facilitating calm responses to stressful stimuli. EVOP also tends to decrease physiological arousal levels (e.g. skin conductance, muscle tension), breaking the positive feedback loop between physical symptoms and anxiety.

Indeed, resonance breathing training for 4 weeks significantly reduced anxiety and depression scores, mediated by vagal pathways modulating stress-related brain nuclei (locus coeruleus, hypothalamic-pituitary-adrenal axis) and emotional cortical regions (orbitofrontal cortex, insula, hippocampus) [4]. In PTSD patients, breathing and yoga interventions reduced re-experiencing and hypervigilance symptoms, aligning with slow breathing's capacity to induce somatic safety states.

In short, EVOP acts as a physiological "brake" on stress: activating the natural calming system (ventral vagus) and reducing acute stress neuroendocrine cascades, enhancing emotional self-regulation and reducing anxiety, panic, and tension symptoms [3,7].

Attention, cognition, and mental state

Beyond relaxation, EVOP practice may improve certain cognitive functions and mood. Cardiorespiratory synchronization and reduced mental noise promote a state of quiet alertness, optimizing sustained attention and mental clarity. Slow breathing studies reported increased subjective vigilance and vigor, alongside decreased mental confusion [3]. Neurologically, increased alpha-wave activity is consistent with relaxed attention, facilitating cognitive focus.

In neuropsychological tests, daily breathing training at 6 breaths/min over several weeks improved executive function and attention performance in young adults, evidenced by improved Trail-Making Test A/B scores after 4 weeks [4]. Increased vagal tone and reduced stress free cognitive resources previously monopolized by anxiety. Additionally, slow breathing enhances frontal cerebral perfusion and can synchronize neuronal rhythms, facilitating efficient neural communication.

Another benefit is mood improvement: reducing chronic stress activation leads practitioners to experience fewer depressive symptoms. A meta-analysis indicated slow breathing interventions lowered depression and anger-hostility scores on psychometric scales [3]. This antidepressant effect may be explained through vagal modulation of the locus coeruleus, reducing norepinephrine overproduction, and possibly affecting serotonin levels via vagal reflexes from the nucleus tractus solitarius.

Although EVOP is not a primary treatment for major depression, it can be a valuable adjunct, temporarily improving mood and motivation through the invigorating sense of calm typically induced. Cardiovascularly, these psychophysiological changes are beneficial: reduced stress and better emotional regulation associate with decreased long-term risks of arrhythmia, metabolic syndrome, and cardiovascular events.

In conclusion, EVOP contributes to an optimal psychophysiological state: calm yet alert, emotionally balanced, with enhanced attentional capacity and possibly discreet improvements in executive functions and working memory, especially when regularly integrated into daily routines [4].

Cardiovascular health

Given EVOP's strong impact on autonomic balance, cardiovascular repercussions are significant. High sustained vagal tone correlates with reduced systemic inflammation, better recovery post-exercise, and decreased risk of malignant arrhythmias. Regular slow breathing practice reduces blood pressure in mildly hypertensive subjects (~5 mmHg clinically relevant reduction) [8], reducing myocardial workload.

Elevated HRV induced by EVOP is a positive prognostic marker in cardiology, as lower HRV associates with poorer outcomes in myocardial infarction and heart failure. Hence, raising HRV could improve cardiovascular protection by increasing autonomic flexibility. Studies in coronary and heart failure patients found diaphragmatic slow breathing training increased HF HRV and improved exercise tolerance.

Additionally, slow breathing reduces supraventricular arrhythmias: vagal respiratory maneuvers can decrease tachycardia or extrasystoles related to elevated sympathetic tone. EVOP, though not replacing conventional cardiovascular treatments, can complement cardiac rehabilitation programs to manage stress responses (e.g., breathing exercises prior to situations triggering anxiety-induced angina or arrhythmias).

Summarily, EVOP provides cardiovascular benefits:

(a) Improved baseline hemodynamics (lower pulse and BP),

(b) Enhanced vagal reserve (crucial for arrhythmia control and reflex response),

(c) Possible anti-inflammatory effects via vagal pathways (modulating proinflammatory cytokine release), and

(d) Improved quality of life by reducing anxiety-related palpitations (See figure 1 and 2) [9].

These effects support integrating breathing techniques like EVOP into comprehensive cardiovascular health approaches [4,8].

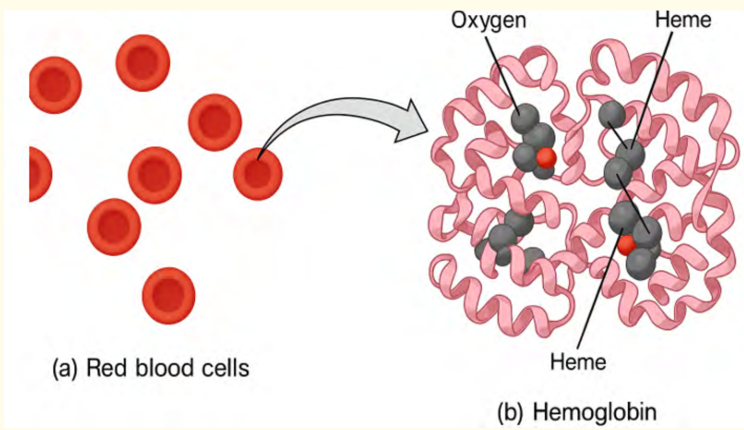

***Figure 1:** Hemoglobin is the protein within red blood cells responsible for transporting oxygen to cells and carbon dioxide to the lungs, composed of four subunits [9].*

Clinical applications of EVOP

The EVOP technique has been explored-or theoretically proposed-as a complementary therapeutic tool in diverse pathologies, leveraging its effects on the autonomic nervous system, emotional regulation, and respiratory function. Below are detailed primary clinical applications supported by scientific evidence:

- **Anxiety and stress disorders:** The efficacy of slow breathing in anxiety is well-documented. EVOP, similar to other diaphragmatic breathing techniques, can acutely reduce situational anxiety and, with regular practice, decrease baseline anxiety. Clinical trials demonstrate that respiratory exercises improve generalized anxiety and chronic stress by reducing sympathetic hyperactivity. For example, a study reported that daily slow breathing practice (12 minutes) significantly decreased anxiety levels (measured by state-anxiety scales), an effect comparable to traditional relaxation interventions [7]. Systematic reviews conclude that respiratory control techniques improve individuals' "psychophysiological flexibility," increasing stress tolerance and reducing panic and worry symptoms [3]. Similar pranayamas to EVOP have improved PTSD symptoms, likely by enhancing parasympathetic tone [10]. Thus, EVOP can be integrated into psychology/psychiatry settings as an emotional-regulation technique, helping patients manage acute anxiety episodes and chronic stress symptoms [4,7].

- **Depression and mental wellbeing:** Although less studied than anxiety, breathing techniques also hold promise for mild to moderate depression. By alleviating chronic stress activation and improving emotional regulation, EVOP can improve mood states. Open studies with HRV biofeedback (involving guided slow breathing) in major depression patients reported reduced depressive symptoms and increased positive affect after weeks of training, suggesting a role of increased vagal tone in modulating reward and stress circuits [11]. Resonance breathing reportedly reduces depressive symptoms via vagal effects on cerebral areas (amygdala hyperactivity reduction and noradrenaline normalization) [4]. Although EVOP alone is not a depression treatment, it can serve as a self-care technique for momentary negative mood mitigation. More research is required for severe depression or bipolar disorders, but its safety suggests integrative potential with supervision.
- **Insomnia and sleep disorders:** EVOP is suitable for primary insomnia and stress/anxiety-related secondary insomnia. Difficulty initiating or maintaining sleep often relates to physiological hyperarousal (sympathetic hyperactivation, high cortisol levels, ruminative thoughts). Slow breathing before bedtime can induce relaxation responses. A perspective published in Frontiers in Psychiatry highlights deep-breathing techniques as promising interventions for reducing autonomic hyperactivation in insomnia [12]. Practicing slow breathing (15 minutes) at bedtime decreases heart rate and increases nocturnal HRV, correlating with reduced sleep latency and nighttime awakenings [12]. EVOP, by adding vibration, can amplify relaxation sensations. Recommendations include EVOP performed in bed, lights off, performing 4-8 slow vibratory breathing cycles before transitioning to silent breathing, promoting sleep onset.
- **Respiratory disorders (Asthma, COPD):** EVOP, paradoxically beneficial in obstructive respiratory diseases, is supported by evidence showing respiratory exercises with prolonged exhalation and vocal vibration as complementary asthma therapy. A controlled clinical trial in asthmatic children demonstrated significant symptom control improvement and quality-of-life enhancements with bhramari pranayama and "OM" chanting (15 min/day, 12 weeks), compared to standard treatment alone, noting decreased nocturnal wheezing, reduced rescue inhaler use, and reduced airway inflammation (FeNO) [13]. Proposed mechanisms include endogenous nitric oxide increases (bronchodilator effect), improved diaphragmatic recruitment, and anxiety reduction. Thus, EVOP (similar to prolonged bhramari) can be advised for daily practice, enhancing bronchodilation and relaxation states. In COPD, prolonged exhalation techniques (e.g. pursed-lip breathing) improve oxygenation by preventing airway collapse. EVOP adds vibratory stimulus, potentially mobilizing bronchial secretions (like Flutter devices) and exercising expiratory muscles. A systematic Cochrane review concluded respiratory exercises significantly improve exercise capacity in COPD, albeit variable impacts on dyspnea and quality-of-life [14]. EVOP could provide mindfulness and anxiety reduction, helping lengthen effective exhalation. Caution is advised in advanced hypercapnic COPD patients to avoid excessive CO_2 retention.
- **Neurological disorders (Epilepsy, dysautonomia):** Vagal stimulation, an accepted neurological therapy (electrical vagal nerve stimulation for refractory epilepsy), suggests EVOP's potential as a non-invasive vagal stimulator. Epileptic patients often have lower parasympathetic tone, predisposing seizure occurrence. A hypothesis paper in *Epilepsy and Behavior* proposed slow breathing could elevate seizure thresholds by raising vagal tone, inhibiting pathological neuronal synchronization [10]. Case reports indicated reduced epileptic activity with regular pranayama. EVOP may particularly aid stress-related reflex epilepsies, complementing conventional treatments. Dysautonomia's (POTS, post-COVID dysautonomia) benefit from respiratory training. Biofeedback HRV

programs, improving vagal tone, demonstrated symptom relief and orthostatic tolerance improvement [15]. EVOP, applied daily, can similarly stabilize autonomic function and reduce symptomatic severity (dizziness, palpitations, vasovagal syncope).

- **Other areas:** EVOP may aid conditions involving autonomic imbalance, anxiety, or respiratory dysfunction, such as functional gastrointestinal disorders (irritable bowel syndrome), chronic pain, fibromyalgia, and attention-deficit/hyperactivity disorder (ADHD). Preliminary studies indicate slow breathing may slightly enhance sleep quality and reduce pain perception in fibromyalgia, potentially reducing central sensitization. Breathing exercises, including vibratory techniques (e.g. "bee humming"), are informally used to calm hyperactive children and improve attention in mind-body school interventions.

Condition	Reported Benefits of EVOP	Evidence (References)	Predominant Mechanism
Anxiety and Stress Disorders	Reduced anxiety symptoms, decreased stress reactivity, enhanced emotional control.	[1,12,16]	Vagal activation, cortisol reduction, cardiorespiratory synchronization.
Depression and Mental Wellbeing	Improved depressive moods, reduced physiological stress, improved emotional regulation.	[17-19]	Amygdala inhibition, HPA axis modulation, increased vagal tone.
Insomnia and Sleep Disorders	Reduced sleep latency, fewer nocturnal awakenings, improved sleep quality.	[20,21]	Increased HRV, autonomic relaxation.
Respiratory Disorders (Asthma, COPD)	Improved respiratory control, decreased dyspnea, increased exhaled nitric oxide, reduced bronchial inflammation.	[22,23]	Increased exhaled NO, inflammation reduction, ventilation stabilization.
Neurological Disorders (Epilepsy, Dysautonomia)	Reduced epileptic seizures, stabilized autonomic function, improved orthostatic tolerance.	[10,24]	Autonomic modulation, increased seizure threshold, enhanced baroreceptor control.
Cardiovascular Health	Reduced blood pressure, increased HRV, lower sympathetic load.	[19,25]	Enhanced baroreflex control, reduced sympathetic tone, improved cardiovascular efficiency.
Chronic Pain and Fibromyalgia	Reduced pain perception, decreased central sensitization, muscular relaxation.	[21,26]	Reduced central sensitization, modulation of descending pain system, parasympathetic activation.

Table 1: *Clinical applications of EVOP, evidence and proposed mechanisms.*

Application protocol for the EVOP technique

Preparation and posture

To practice EVOP, a quiet environment is recommended, with the patient adopting a comfortable posture facilitating diaphragmatic breathing. Ideally, they should sit with a straight yet relaxed back (for instance, on a chair with lumbar support or in the sukhasana meditation posture, if flexibility allows) [27]. Alternatively, the technique can be practiced lying down (supine), particularly in relaxation contexts or before sleep. However, a seated position promotes greater conscious awareness during waking hours.

It is advisable to loosen tight clothing around the abdomen and chest to avoid restricting breathing movements. Before starting, explain to the patient in simple terms: "Breathe deeply in through your nose, then release the air very slowly while vibrating your lips, like imitating the sound of a small horse (or, for children, a train)".

A practical demonstration is beneficial to clarify any doubts. To facilitate diaphragmatic breathing, instruct the patient to place one hand on their abdomen and the other on their chest; upon inhalation, the abdominal hand should move more than the chest hand. The jaw and tongue should remain relaxed, with loose and mobile lips during the vibrating exhalation (See figure 2).

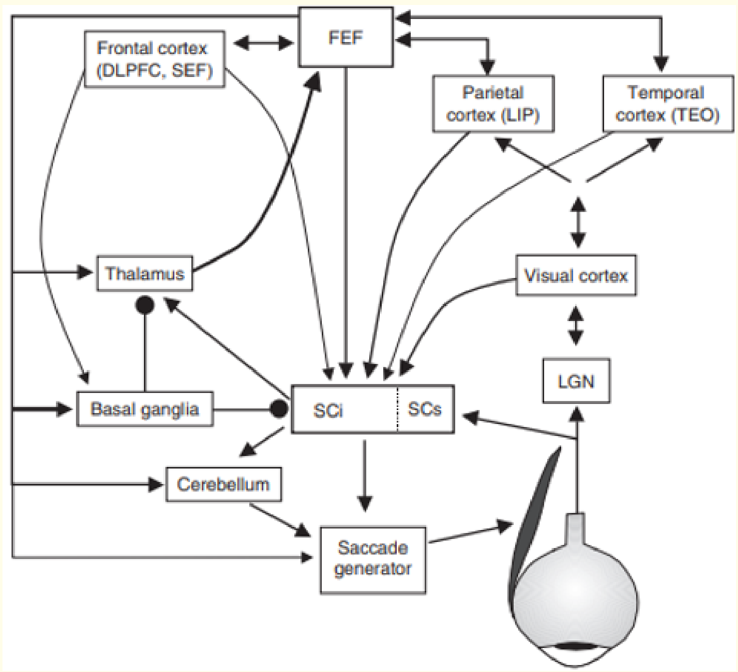

Figure 2: *Diagram of cerebral structures and anatomical routes involved in eye movement. Visual stimuli from the retina transmit to the lateral geniculate nucleus (LGN) and other regions. The LGN transmits visual signals to the primary visual cortex, further processed in temporal and parietal areas. The Frontal Eye Field (FEF) connects with frontal lobe regions like the Dorsolateral Prefrontal Cortex (DLPFC). The FEF influences saccades production through projections to intermediate layers of the superior colliculus (SCi), basal ganglia, cerebellum, and other brainstem nuclei. Adapted from [28].*

Breathing cycle and vibration technique

EVOP consists of a respiratory cycle emphasizing prolonged, vibratory exhalation. A basic cycle includes:

1. Slow, silent nasal inhalation (~4-5 seconds) (filling first the abdomen, then slightly the chest without forcing maximal inhalation).
2. Brief pause (1 second) after inhalation (optional, to prevent feelings of breathlessness).
3. Prolonged oral exhalation with vibration (~6-15 seconds): Patient slowly exhales while making a humming or lip-vibrating sound.
   - If lip vibration is difficult, advise gently pressing index fingers near upper molars toward lips, easing vibration [27].
   - The sound should be comfortably deep and steadily sustained until the lungs feel comfortably empty (at least twice the inhalation duration; typically inhalation: exhalation ≈ 1:2 or 1:3 ratio).

4. Pause (~1 second) after exhalation (post-expiratory apnea, natural pause after complete exhalation).

5. Repeat cycle starting again with a calm nasal inhalation.

Throughout practice, instruct patients to focus attention on air sensations and vibration, using this as a meditative anchor to prevent mind wandering (See figure 3).

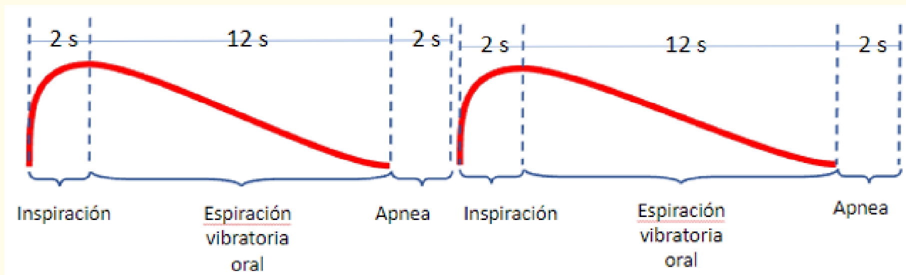

Figure 3: *Schematic representation of the inhalation-exhalation-apnea cycle in EVOP, with approximate timings.*

A typical EVOP respiratory rhythm is around 4-6 breaths per minute (rpm), corresponding to a total cycle of ~10-15 seconds (approximately 0.1 Hz, the cardiorespiratory resonance frequency) [4]. Initially, shorter proportions (e.g. inhale 3s, exhale 6s) may be adopted, gradually lengthening exhalation as comfort and pulmonary capacity improve. The goal is prolonged exhalation without discomfort-eliciting a pleasant, internal "massage" sensation rather than breathlessness.

The sound intensity should be moderate: "Audible only to yourself, not the next room".

If humming with closed mouth ("mmm") induces nasal or ear discomfort, a slightly open-mouth variant ("om" or gentle humming with slightly parted lips) may be used to reduce Eustachian tube pressure.

Duration and practice frequency

Evidence suggests relatively brief, frequent EVOP sessions yield significant benefits. Clinical studies have employed sessions from 5-20 minutes to achieve therapeutic effects [4,27]. In PNIT-Solarte technique, around 10 minutes per session (~50-60 respiratory cycles at 6 rpm) is recommended, sufficiently activating the vagus nerve and eliciting measurable HRV and mental state changes. For beginners, even 5 minutes (about 30 cycles) induce appreciable relaxation. Clinical contexts often advise beginning with 5-10 minutes twice daily (morning and evening), potentially extending to 15-20 minutes as preferred. Consistency is key-daily practice for at least 4 weeks shows objective stress and cognition improvement [4]. After an initial 4-8 weeks, symptom improvement can be re-evaluated to consider integrating EVOP as a lifestyle practice.

Additionally, EVOP may be practiced situationally: 1-3 minutes during acute needs (anxiety episodes, intense pain, stressful situations). Even brief sessions quickly activate vagal responses, preventing panic escalation [7].

Adaptations for specific conditions

- **Asthma or COPD patients:** Ensure slow nasal inhalation (avoiding reflex bronchoconstriction). Initially, patients uncomfortable with vocal vibration due to cough may first practice pursed-lip exhalation, gradually incorporating soft humming as airway stability improves. EVOP is contraindicated during severe acute exacerbations.

- **Anxiety/panic:** Emphasize prolonged exhalation rather than deep inhalation (preventing hyperventilation). Counting (e.g. inhale counting to 4, exhale counting to 8) assists rhythm maintenance. Gentle vibration often aids anxiety distraction and natural exhalation prolongation.
- **Insomnia:** Advise practice lying down in bed, eyes closed. Five-minute EVOP sessions followed by quiet breathing can facilitate sleep transition. If chanting "OM" is mentally stimulating (religious connotations or mental activation), encourage gentle humming ("mmm").
- **Orthostatic dysautonomia:** Recommend sitting or supine positions (preventing dizziness). Measure heart rate pre/post EVOP to reinforce technique confidence, eventually integrating gradual physical exercises to enhance vascular reflexes.
- **Children:** Adapt language playfully ("breathe like a bee"). Shorter sessions (2-5 minutes), focusing on enjoyment and tactile vibration sensation.
- **Elderly or hearing-impaired individuals:** Ensure tactile vibration perception (placing hands on throat or chest). May prefer slightly higher humming tones due to hearing difficulties.

In all scenarios, instruct patients to avoid generating muscular tension; any discomfort should prompt technique reassessment and rest.

Integration with other techniques

EVOP may combine with additional relaxation elements:

- Nasal inhalation optimizing nitric oxide release and airway humidification [5].
- Traditional bhramari technique (covering ears, slightly tilting chin) enhancing internal vibration perception in meditative contexts.
- Synchronizing vibratory exhalation with imagery or simple vowel mantras for mental relaxation.

Encourage patients to maintain a practice diary, noting daily session durations and anxiety/stress levels before and after sessions (0-10 scale). Such logs aid adherence, effectiveness monitoring, and patient motivation through visible progress.

Limitations and Contraindications

Evidence limitations: Although EVOP and related techniques have growing scientific backing, there remain gaps in the literature. Many applications are inferred by analogy from studies of slow breathing or pranayamas in general, since the "EVOP" method under that specific name has not always been investigated in controlled trials. Much of the evidence is indirect (for example, using bhramari pranayama in yoga or HRV biofeedback in clinical settings). Further targeted clinical research on EVOP/PNIT (Solarte technique) is needed to establish optimal pathology-specific protocols and to quantify its effects on various health outcomes. Moreover, most available studies feature small sample sizes or relatively short durations. Therefore, results should be extrapolated with caution. Not all patients respond equally: factors such as prior familiarity with relaxation techniques, the severity of underlying disease, and adherence will influence the magnitude of observed benefits.

Practical limitations: Long-term adherence may suffer if patients do not perceive immediate results or find it tedious to set aside daily practice time. It is therefore essential to motivate patients, set realistic expectations (substantial effects often emerge after several weeks), and integrate the practice into their daily routine to ensure sustainability. Additionally, EVOP demands a minimum level of cognitive function and cooperation: patients with severe cognitive impairment, acute confusion, or certain intellectual disabilities may be unable to understand or perform the technique correctly; in such cases, simpler alternatives (or passive vagal stimulation) should be considered. Similarly, in individuals with psychiatric disorders that provoke aversion to bodily focus (for example, certain severe trauma cases that trigger anxiety when closing the eyes and noticing internal sensations), the approach must be gradual and highly sensitive to the patient's comfort.

Clinically observed immediate effects of EVOP application:

1. Sensation of calm and tranquility (parasympathetic activation).
2. Alterations in body temperature, possibly linked to acetylcholine and dopamine release.
3. Perception of increased brightness and spatial expansiveness at the end of practice, attributable to improved oxygenation of the occipital region/visual cortex.
4. Reduction in pain perception among patients with painful conditions (analgesic effect).
5. Mental clarity, with enhancement of executive functions and focused attention (prefrontal cortex activation).

Contraindications: Slow breathing with prolonged exhalation is generally safe for most individuals. However, the following relative contraindications and precautions apply:

- **Severe bradycardia or symptomatic hypotension:** Because EVOP increases vagal tone, individuals with marked bradycardia (e.g. < 50 bpm with dizziness) or very low blood pressure could theoretically experience exacerbated parameters. In patients with intrinsic pacemaker dysfunction (sick sinus syndrome) or uncontrolled advanced AV block, close monitoring is recommended during practice, as vagal stimulation may worsen cardiac pauses. Practically, one watches for presyncope symptoms during breathing; if these occur, the technique should be halted.
- **Decompensated heart failure or acute pulmonary edema:** Although slow breathing can improve hemodynamics in heart failure, during an acute episode the patient will be dyspneic and unable to coordinate prolonged breaths. Stabilization is required first; once euvolemic and compensated, the technique can be introduced gradually.
- **Severe COPD with hypercapnia:** In CO_2-retaining patients, excessively slow and deep breathing can transiently worsen retention by reducing minute ventilation too much. However, rapid shallow breathing is a greater threat in COPD; properly applied EVOP tends to improve alveolar ventilation by promoting more complete lung emptying. Nonetheless, in end-stage COPD at risk of respiratory failure, any change in breathing pattern must be supervised by a respiratory physiotherapist. The patient's tolerance should not be exceeded, and practice should cease if headache (a sign of hypercapnia) develops.
- **Asthma exacerbation or acute attack:** During acute bronchospasm, patients often struggle to exhale; forcing a controlled pattern may increase respiratory muscle fatigue. In such acute cases, appropriate bronchodilator therapy is the priority. EVOP may be reintroduced during recovery to help normalize breathing patterns but should not replace primary management of a severe attack.
- **Recent abdominal or thoracic surgery:** Vocal vibrations during exhalation may cause discomfort or traction on surgical sites in the immediate postoperative period. It is advisable to wait for initial healing (first 1-2 weeks) before performing strong humming. Simple breathing exercises (without humming) are indicated early to prevent atelectasis. Once the surgeon approves, EVOP may aid rehabilitation (for example, improving vagal function post-vagotomy).
- **Otorhinolaryngological issues:** Individuals with middle ear infections or severe sinusitis may find the increased pressure from mouth-closed humming uncomfortable. If pain occurs, patients should open the mouth slightly during exhalation or postpone the technique until after resolution of the infection. In chronic sinusitis, increased nitric oxide production from humming may be beneficial, but extreme congestion may impede sound production; in such cases, waiting for partial decongestion is advisable.
- **Acute psychiatric disorders:** In patients experiencing psychotic, manic, or intensely paranoid episodes, introducing a breathing technique may be unfeasible or foster mistrust. Psychiatric stabilization should precede EVOP, which may then be integrated into rehabilitation if the patient is receptive.

- **Very young children:** Children under approximately four years old are unlikely to follow complex instructions. Instead, playful blowing games to prolong exhalation and simple vowel sounds can lay the groundwork until they are ready for formal EVOP.
- **High-risk pregnancy:** No specific contraindication exists for slow breathing during pregnancy-in fact, it is beneficial for birth preparation. However, in complications such as severe preeclampsia or cervical incompetence requiring strict bed rest, any new activity should be approved by an obstetrician. Seated EVOP is generally safe, as it does not involve physical exertion or prolonged apnea, but always subject to medical clearance.

Overall, EVOP carries minimal risk. Reported adverse effects are typically mild and transient-slight dizziness or tingling from inadvertent hyperventilation when breathing too quickly instead of slowly; this resolves by restoring a truly slow, deep pattern. Another possible effect is drowsiness or marked relaxation (which in many contexts is desired), but patients should avoid practicing in situations requiring sustained high concentration-such as operating heavy machinery-until they understand their individual response. Unlike anxiolytic medications, EVOP does not induce dependence or dangerous systemic effects, giving it a highly favorable risk-benefit profile when appropriately indicated.

Absolute contraindications: There are virtually no scenarios in which slow breathing with prolonged exhalation is completely forbidden, except when a patient cannot manage their airway voluntarily (unconsciousness, coma), as the technique requires active participation. Even patients with a tracheostomy may adapt the method (humming through the phonatory tube). Thus, rather than absolute contraindications, clinical judgment should guide the adaptation of EVOP to each patient and its avoidance only in clearly inappropriate circumstances (acute hemodynamic instability, acute respiratory distress, etc.).

In summary, EVOP is very safe, but clinicians must assess each patient individually. Progressive introduction of the technique, close monitoring of initial tolerance, and thorough instruction minimize risks. Patients should always be reminded to listen to their bodies: if discomfort arises, they must stop and consult their therapist for adjustments.

Clinical guide for the application of EVOP

Below is a practical guide aimed at healthcare professionals (physicians, physiotherapists, psychologists) who wish to implement Prolonged Oral Vibratory Breathing (EVOP) in various clinical settings. This guide summarizes, in a schematic and easy-to-reference format, the instructional steps, pathology-specific considerations, and follow-up recommendations:

Steps to teach EVOP to the patient:

1. **Initial explanation:** Inform the patient what EVOP is and why it may help them. For example: "This is a breathing technique that activates the body's main calming nerve (the vagus nerve) through slow exhalations with lip vibration; it will help calm your nervous system, improve your breathing, and help you manage stress more effectively [1,3]". Adapt your language to the patient's educational level, using simple metaphors if helpful (e.g., "we'll breathe like a bee softly humming" for children).

2. **Demonstration by the clinician:** Show the patient how to perform a full EVOP breath. If possible, do it together at first. Say: "Watch me: I inhale slowly through my nose (4 seconds)… now I exhale with my lips closed, making a 'mmmm' sound (10 seconds)…" It's important the patient hears the tone and observes the timing. Then invite them to try. Gently correct any mistakes (e.g., if they exhale too forcefully rather than prolonging, remind them: "slower, as if you were humming a lullaby").

3. **Posture and relaxation:** Ensure the patient is seated comfortably. Guide a brief muscle-relaxation sequence if they seem tense (e.g. loosen shoulders and neck). Suggest closing their eyes if they feel comfortable, to facilitate inward focus.

4. **Guided practice:** Use a soft voice initially to pace the breath: "Inhale… 2…3… (pause)… exhale with sound… 2…3…4…5…6…7…8…" Perform 5-10 cycles together. You may use a timer or a respiratory-metronome app if preferred, but often verbal cues followed by the patient's internal rhythm suffice. Watch for signs of difficulty: if the patient yawns or gasps on the inhale, they may have over-prolonged the exhale-adjust by shortening it slightly. If they feel lightheaded, stop, allow normal breathing, then resume more gently (they may have hyperventilated out of nervousness).

5. **Immediate feedback:** After a few minutes, ask how they feel:

   a. "Did you feel the vibration?"
   b. "Was the pace comfortable?"
   c. "Did you notice any changes in your body (warmth, tingling, relaxation)?"

Reinforce positives: "Excellent-you really lengthened your exhale, which is exactly what we want to boost your heart-rate variability [7]. The more you practice, the more natural it will become".

If there's room for improvement, offer tips: "Try making a slightly deeper sound so your sinuses vibrate more-that releases nitric oxide and helps your breathing [5]".

6. **Prescribing home practice:** Collaborate with the patient on a realistic plan. For example: "Do this every morning when you wake up and every evening before bed. Start with 5 minutes each time for the first week, then increase to 10 minutes [27]. I'll give you a handout (or video) with the instructions to remind you". Advise integrating practice into an existing routine (e.g., after brushing teeth or during an afternoon break) to build a habit. If the patient has a smartphone, they can use guided-breathing or coherence-training apps set to 6 breaths per minute with a "humming" soundtrack-though this is optional.
7. **Teaching situational use:** Especially for anxiety or stress, emphasize that isolated EVOP breaths can be used in crisis moments. For example: "If you have a panic attack, remember: sit or stand, focus on your breath, and do five slow humming exhales. This sends a 'no danger' signal to your brain and can abort the panic response [7]. Even a couple of breaths can make a difference". Run through an imagined trigger scenario so the patient can visualize using the technique in real time.
8. **Follow-up and reinforcement:** At subsequent visits, ask specifically about EVOP practice. Review any practice log if they're keeping one. If adherence is low, explore barriers: lack of time, forgetfulness, technical doubts, or feeling it's "not doing anything." Boost motivation by sharing objective data when possible (e.g., measure their heart rate before and after a session to show it dropped from 85 to 70 bpm). Adjust the prescription as needed: some patients may find 10 minutes at once tedious-suggest 5 min in the morning + 5 min in the evening; others may want more challenge-invite them to try 15 minutes straight. Tailor it individually.
9. **Multidisciplinary integration:** Inform the rest of the care team that the patient is using this technique so everyone can support it. For instance, nurses can remind hospitalized patients to practice; respiratory physiotherapists can include it in exercise sessions; psychologists can combine it with cognitive therapy ("when your worry hits 8/10, use the breaths you learned to bring it down"). A coordinated approach increases the likelihood of success.
10. **Documenting outcomes:** Record EVOP-related changes in the clinical chart. For example: "Reported anxiety reduction, sleeps 7 h/night (previously 5h), office BP 120/80 mm Hg (previously 140/90) after one month of vagal breathing practice" [8]. This not only aids follow-up but also provides persuasive evidence for future patients ("I've had people who reduced their palpitations and improved their blood pressure with this technique-this could help you too").

Pathology-specific considerations

- **Family medicine/primary care:** EVOP can be taught in a brief visit to address stress, tension-type headache, early insomnia, or as an adjunct for mild hypertension before escalating medication [8]. Having printed brochures or resources is useful. Community workshops demonstrating EVOP and other relaxation methods can also be effective.
- **Cardiology:** Integrate EVOP into cardiac rehabilitation programs, especially for post-infarction patients with anxiety or those with hypertension. Monitoring heart rate and blood pressure before and after breathing exercises can reinforce benefits. Clarify that EVOP complements but does not replace medication. Some cardiologists use heart-rate coherence biofeedback devices; patients can synchronize their humming breaths to the device's pacing.
- **Pulmonology:** In pulmonary rehabilitation (COPD, pulmonary fibrosis), include EVOP as part of respiratory muscle training. Combine with incentive-spirometry exercises, ensuring exhalations do not become too prolonged if oxygen saturation drops. For asthma, teach EVOP during stable-state visits so the patient has the skill for respiratory stress situations.
- **Mental health/psychology:** EVOP fits well within mindfulness and anxiety-management therapies. In cognitive-behavioral therapy for panic, after psychoeducation on bodily sensations, train slow breathing (often 4-7-8 or similar); EVOP is a humming-sound variant. In group stress-management workshops, dedicating the first 10 minutes to collective EVOP practice helps focus attention and induce relaxation. Vigilance is essential for complex PTSD, as intense inward focus may trigger traumatic memories; progression should be very gradual and tolerance-adapted. From a social-cognition perspective, mirror neurons confer additional group benefits: they facilitate understanding others' actions and emotions, enhancing social learning and internalization of well-being [29,30]. Clinically, Dr. Armando observes that patients often imitate the improvements they witness in peers during group practice. Important: in complex PTSD, advance extremely gradually to avoid trauma activation.
- **Neurology:** Although evidence is emergent, EVOP may be considered for migraine prevention (leveraging its vascular-relaxant effect) or recurrent neurocardiogenic syncope (training controlled vagal responses). In refractory epilepsy, if the patient consents, EVOP can be added to promote relaxation alongside standard therapies [10]. Document any changes in seizure frequency, even if anecdotal, to enrich the field's knowledge.
- **Physiotherapy and therapeutic yoga:** Respiratory-trained physiotherapists can incorporate EVOP into mobilization sessions, especially for patients with chronic musculoskeletal pain, where breathing aids muscle release. Yoga therapists in clinical settings may relabel bhramari as EVOP to emphasize its scientific basis-always observing pranayama precautions and individualizing intensity.

Follow-up of outcomes

The review recommends periodic evaluation of:

- Target symptoms of the pathology (e.g. anxiety/depression scores, monthly migraine days, blood pressure, asthma control scores [13]).
- Easy-to-measure physiological parameters: Resting heart rate and blood pressure in clinic (expected to decrease after weeks of practice [8]), and heart-rate variability indices (e.g. RMSSD or HF) if equipment is available.
- Adherence: Days per week practiced, average minutes per session (use logs or apps).
- Patient satisfaction: Ask if they find the technique useful, notice well-being changes, and plan to continue.

If after approximately eight weeks there are no improvements or perceived benefits, re-evaluate the technique (correct execution? alternative approaches?). Often, tweaking details or combining with another intervention enhances effectiveness.

Ethical Aspects and Consent

Clarify that EVOP is a complementary, evidence-based, low-risk intervention. Obtain the patient's informed consent and active collaboration-it is a skill they perform, not something done to them. Empower the patient by emphasizing they are learning a physiologically backed self-care tool.

Conclusion

Prolonged Oral Vibratory Breathing (the Solarte PNIT Technique) is an accessible, virtually cost-free tool underpinned by solid neurophysiological principles for modulating the autonomic nervous system. When correctly applied, it can deliver benefits across multiple health domains-from stress and anxiety reduction [7] and improved respiratory function in COPD/asthma [13] to support in cardiovascular rehabilitation [8]. This guide aims to facilitate its integration into daily clinical practice, promoting an integrative health approach where mind-body techniques like EVOP complement conventional medical treatments to enhance patient quality of life.

Bibliography

1. Gerritsen RJS and Band GPH. "Breath of life: the respiratory vagal stimulation model of contemplative activity". *Frontiers in Human Neuroscience* 12 (2018): 397.

2. Kjaer TW., *et al*. "Increased dopamine tone during meditation-induced change of consciousness". *Brain Research. Cognitive Brain Research* 13.2 (2002): 255-259.

3. Zaccaro A., *et al*. "How breath-control can change your life: a systematic review on psycho-physiological correlates of slow breathing". *Frontiers in Human Neuroscience* 12 (2018): 353.

4. Chaitanya S., *et al*. "Effect of resonance breathing on heart rate variability and cognitive functions in young adults: a randomised controlled study". *Cureus* 14.2 (2022): e22187.

5. Trivedi G., *et al*. "Humming (Simple bhramari pranayama) as a stress buster: a Holter-based study to analyze heart rate variability (HRV) parameters during bhramari, physical activity, emotional stress, and sleep". *Cureus* 15.4 (2023): e37527.

6. Heck DH., *et al*. "Breathing as a fundamental rhythm of brain function". *Frontiers in Neural Circuits* 10 (2016): 115.

7. Magnon V., *et al*. "Benefits from one session of deep and slow breathing on vagal tone and anxiety in young and older adults". *Scientific Reports* 11.1 (2021): 19267.

8. Chaddha A., *et al*. "Device and non-device-guided slow breathing to reduce blood pressure: A systematic review and meta-analysis". *Complementary Therapies in Medicine* 45 (2019): 179-184.

9. Clark MA., *et al*. "39.4 Transport of Gases in Human Bodily Fluids - Biology 2e". OpenStax OpenStax (2018).

10. Yuen AWC and Sander JW. "Can slow breathing exercises improve seizure control in people with refractory epilepsy? A hypothesis". *Epilepsy and Behavior* 18.4 (2010): 331-334.

11. Kral TRA., *et al*. "Slower respiration rate is associated with higher self-reported well-being after wellness training". *Scientific Reports* 13.1 (2023): 15953.

12. Jerath R., *et al*. "Self-regulation of breathing as an adjunctive treatment of insomnia". *Frontiers in Psychiatry* 9 (2018): 780.

13. Yadav R., *et al*. "Efficacy of Bhramari pranayama and Om chanting on asthma control, quality of life, and airway inflammation in asthmatic children: an open-label randomized controlled trial". *Journal of Asthma* 61.3 (2024): 249-259.

14. Yancey JR and Chaffee D. "The role of breathing exercises in the treatment of COPD". *American Family Physician* 89.1 (2014): 15-16.

15. Vallabhajosyula S and Duggirala S. "Investigating the impact of electrocardiography biofeedback on POTS symptom management". *Journal of Emerging Investigators* (2023).

16. Balban MY., *et al*. "Brief structured respiration practices enhance mood and reduce physiological arousal". *Cell Reports Medicine* 4.1 (2023): 100895.

17. Arakaki X., *et al*. "The connection between heart rate variability (HRV), neurological health, and cognition: A literature review". *Frontiers in Neuroscience* 17 (2023): 1055445.

18. Streeter CC., *et al*. "Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder". *Medical Hypotheses* 78.5 (2012): 571-579.

19. Laborde S., *et al*. "The effect of slow-paced breathing on stress management in adolescents with intellectual disability". *Journal of Intellectual Disability Research* 61.6 (2017): 560-567.

20. Ma X., *et al*. "The effect of diaphragmatic breathing on attention, negative affect and stress in healthy adults". *Frontiers in Psychology* 8 (2017): 874.

21. Busch V., *et al*. "The effect of deep and slow breathing on pain perception, autonomic activity, and mood processing--an experimental study". *Pain Medicine (Malden, Mass.)* 13.2 (2012): 215-228.

22. Telles S and Naveen K. "Voluntary breath regulation in yoga: Its relevance and physiological effects" (2008).

23. Sengupta P. "Health impacts of yoga and pranayama: a state-of-the-art review". *International Journal of Preventive Medicine* 3.7 (2012): 444-458.

24. Porges SW. "The polyvagal perspective". *Biological Psychology* 74.2 (2007): 116-143.

25. Bradley RT., *et al*. "The coherent heart heart-brain interactions, psychophysiological coherence, and the emergence of system-wide order". *Integral Review* 5.2 (2009): 10-115.

26. Brown RP and Gerbarg PL. "Yoga breathing, meditation, and longevity". *Annals of the New York Academy of Sciences* 1172 (2009): 54-62.

27. Mooventhan A and Khode V. "Effect of Bhramari pranayama and OM chanting on pulmonary function in healthy individuals: A prospective randomized control trial". *International Journal of Yoga* 7.2 (2014): 104-110.

28. Frontal Eye Fields. ResearchGate (2025).

29. Zambrano DB and Ávila CC. "Las neuronas espejo y su incidencia en el aprendizaje". *RES NON VERBA: Revista Científica* 11.1 (2021): 54-72.

30. Jacob P. "What do mirror neurons contribute to human social cognition?" *Mind and Language* 23.2 (2008): 190-223.

Volume 17 Issue 9 September 2025