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Effectiveness of Pranayama techniques in reducing anxiety levels among school teachers in India

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Abstract
Background: School teachers in India face significant occupational stress and anxiety due to increasing workloads, administrative pressures, and evolving educational demands. Pranayama, an ancient yogic breathing practice, has shown promise as a cost-effective intervention for managing anxiety.
Objective: This study aims to evaluate the effectiveness of pranayama techniques in reducing anxiety levels among school teachers in India.
Methods: A randomized controlled trial was conducted with 120 school teachers (ages 28-55) from urban and semi-urban schools across three Indian cities. Participants were randomly assigned to either an intervention group (n=60) receiving 45-minute pranayama sessions five days per week for eight weeks, or a control group (n=60) maintaining regular activities. Anxiety levels were measured using the Hamilton Anxiety Rating Scale (HAM-A) and the State-Trait Anxiety Inventory (STAI) at baseline, four weeks, and eight weeks.
Results: The intervention group showed significant reduction in anxiety scores compared to the control group ($p<0.001$). Mean HAM-A scores decreased from 21.4±4.2 at baseline to 12.8±3.6 at eight weeks in the intervention group, while control group scores remained relatively stable (20.8±4.0 to 19.2±3.8). Effect size (Cohen's d) was 1.84, indicating a large treatment effect.
Conclusion: Pranayama techniques demonstrate significant effectiveness in reducing anxiety levels among school teachers. These findings support the integration of pranayama into school wellness programs as a practical, accessible intervention for occupational stress management.

Keywords: Pranayama, anxiety, school teachers, yoga, stress management, India, breathing exercises

Introduction
Background
The teaching profession in India is increasingly recognized as a high-stress occupation. Teachers face multifaceted challenges including large class sizes, curriculum demands, parental expectations, administrative burdens, and limited resources. According to recent surveys, approximately 60-70% of Indian teachers report experiencing moderate to high levels of occupational stress, with anxiety being one of the most prevalent mental health concerns.
Anxiety among teachers not only affects their personal well-being but also impacts classroom effectiveness, student outcomes, and overall educational quality. Traditional interventions such as counseling and pharmacological treatments face barriers including stigma, accessibility, and cost constraints in the Indian context.

Pranayama: An Overview
Pranayama, derived from Sanskrit words "prana" (life force) and "ayama" (extension), refers to yogic breathing techniques that have been practiced in India for millennia. The practice involves conscious regulation of breath through specific techniques including:
- Nadi Shodhana (alternate nostril breathing)
- Bhramari (humming bee breath)
- Ujjayi (victorious breath)
- Bhastrika (bellows breath)
- Anulom Vilom (alternate breathing without retention)

Physiologically, pranayama influences the autonomic nervous system, particularly enhancing parasympathetic activity, which promotes relaxation and reduces stress response. Research suggests that regular pranayama practice modulates the hypothalamic-pituitary-adrenal (HPA) axis, reduces cortisol levels, and increases gamma-aminobutyric acid (GABA) activity in the brain.

Rationale and Research Gap
While several studies have examined pranayama's effects on anxiety in clinical populations, limited research has specifically focused on school teachers in India. This demographic represents a unique population experiencing occupation-specific stressors within a cultural context where yoga and pranayama are traditionally rooted. Understanding pranayama's effectiveness in this group could inform scalable, culturally appropriate workplace wellness interventions.

Research Objectives
Primary Objective: To evaluate the effectiveness of an eight-week pranayama intervention in reducing anxiety levels among school teachers in India.
Secondary Objectives
- To compare anxiety reduction between different pranayama techniques
- To assess the sustainability of anxiety reduction at follow-up
- To identify demographic factors associated with treatment response
- To evaluate participant adherence and acceptability of the intervention

Literature Review
1. Occupational Stress Among Teachers
Teaching is globally recognized as a stressful profession, with teachers experiencing higher rates of anxiety,

depression, and burnout compared to other occupational groups. In the Indian context, specific stressors include

Systemic Factors: Large student-teacher ratios (often 40:1 or higher), inadequate infrastructure, frequent policy changes, and examination-focused curricula create chronic pressure on teachers.

Social Factors: Teachers face high expectations from parents, society, and administrators while often receiving limited social recognition or compensation commensurate with their responsibilities.

Professional Factors: Increasing administrative duties, continuous professional development requirements, and integration of technology without adequate training contribute to role overload. “Studies conducted across Indian states report that 45-65% of teachers experience significant anxiety symptoms, with higher prevalence among female teachers and those in urban settings. Consequences include reduced job satisfaction, increased absenteeism, and negative impacts on teaching quality.

2. Pranayama and Anxiety: Existing Evidence

A growing body of research supports pranayama's anxiolytic effects:

Neurobiological Mechanisms: Neuroimaging studies demonstrate that pranayama practice increases activity in brain regions associated with emotional regulation, including the prefrontal cortex and anterior cingulate cortex, while reducing amygdala hyperactivity. Pranayama also influences neurotransmitter systems, particularly increasing GABA and serotonin availability.

Physiological Effects: Controlled breathing techniques shift autonomic balance toward parasympathetic dominance, evidenced by increased heart rate variability (HRV), reduced blood pressure, and decreased cortisol levels. These physiological changes directly counteract the stress response underlying anxiety symptoms.

Clinical Evidence: Meta-analyses of randomized controlled trials indicate moderate to large effect sizes for pranayama interventions in reducing anxiety across various populations. However, most studies have focused on clinical samples with diagnosed anxiety disorders rather than occupational stress-related anxiety in healthy populations.

3. Gaps in Current Research

Despite promising findings, several limitations exist in the current literature

- **Population specificity:** Few studies target occupational groups like teachers
- **Cultural context:** Limited research conducted within Indian educational settings
- **Intervention standardization:** Wide variation in pranayama protocols makes comparison difficult
- **Long-term outcomes:** Most studies assess immediate post-intervention effects without follow-up
- Mechanism exploration: Need for more research on which specific pranayama techniques are most effective for anxiety

This study addresses these gaps by implementing a standardized pranayama protocol specifically designed for school teachers in India.

Methodology

1. Study Design

This study employed a randomized controlled trial (RCT) design with parallel groups. The study was conducted between August 2024 and February 2025, spanning one academic year to capture typical occupational stress patterns among teachers.

Ethical approval was obtained from the Institutional Ethics Committee of [Institutional name]. Written informed consent was obtained from all participants, and the study was registered with the Clinical Trials Registry of India (CTRI).

2. Participants

Inclusion Criteria

- Employed as full-time school teachers in CBSE/ICSE/State Board schools
- Age 25-60 years
- Teaching experience of at least two years
- HAM-A score =14 (indicating mild to moderate anxiety)
- Ability to attend regular intervention sessions
- No prior regular pranayama or yoga practice (defined as <1 session per month in the past 6 months)

Exclusion Criteria

- Diagnosed psychiatric disorders requiring medication
- Current use of anxiolytic or antidepressant medications
- Severe cardiovascular or respiratory conditions
- Pregnancy
- Active substance abuse
- Current participation in other stress management interventions

3. Sample Size

Sample size was calculated based on expected anxiety score reduction. Assuming a mean difference of 5 points on HAM-A scale with standard deviation of 6, alpha of 0.05, and power of 80%, the required sample size was 48 per group. Accounting for 20% attrition, 60 participants per group (total n=120) were recruited.

4. Recruitment and Randomization

Participants were recruited through advertisements in schools across Delhi, Mumbai, and Bangalore. Teachers expressing interest underwent screening assessments. Those meeting eligibility criteria were assigned unique identification numbers and randomized using computer-generated random number sequences with 1:1 allocation ratio. Randomization was stratified by city and gender to ensure balanced groups.

An independent researcher not involved in outcome assessment performed the randomization and maintained allocation concealment using sealed, opaque envelopes opened only after baseline assessment completion.

5. Intervention

Intervention Group: Participants received a structured pranayama program conducted by certified yoga instructors

with minimum 5 years of experience. The intervention consisted of

Duration: 45-minute sessions, five days per week, for eight weeks (total: 40 sessions) Pranayama Techniques Taught:

1. **Weeks 1-2: Foundation and breathing awareness**

- Diaphragmatic breathing (10 minutes)
- Nadi Shodhana/Anulom Vilom (15 minutes)
- Bhramari (10 minutes)

2. **Weeks 3-6: Practice intensification**

- Extended Nadi Shodhana practice (20 minutes)
- Bhramari with variations (15 minutes)
- Introduction of Ujjayi (10 minutes)

3. **Weeks 7-8: Integration and autonomy**

- Self-paced practice with instructor guidance
- Development of personal practice routines
- All techniques practiced in balanced proportion Each session included:
- Opening relaxation (5 minutes)
- Pranayama practice (30 minutes)
- Closing meditation and breath awareness (10 minutes)

Sessions were conducted in school premises during after-school hours or weekends to maximize accessibility. Participants also received illustrated practice guides and were encouraged to practice 15 minutes daily at home. Adherence was tracked through daily practice logs.

Control Group: Participants continued their regular daily activities without any specific intervention. They were offered the pranayama program free of cost after study completion as compensation for participation. Control group participants were contacted weekly for retention and completed all assessment protocols on the same schedule as the intervention group.

6. Outcome Measures Primary Outcome

Hamilton Anxiety Rating Scale (HAM-A): A clinician-administered 14-item scale assessing anxiety severity. Each item is rated 0-4, with total scores ranging from 0-56. Scores of 14-17 indicate mild anxiety, 18-24 moderate anxiety, and =25 severe anxiety. HAM-A has demonstrated excellent reliability (a=0.790.86) and validity in diverse populations.

Secondary Outcomes

State-Trait Anxiety Inventory (STAI): A 40-item self-report questionnaire with two subscales:

- **STAI-S (State Anxiety):** Measures current anxiety levels (20 items)
- **STAI-T (Trait Anxiety):** Measures general anxiety tendency (20 items)

Scores range from 20-80 per subscale, with higher scores indicating greater anxiety. STAI is widely validated with high internal consistency (a=0.86-0.95).

Additional Assessments

- **Heart Rate Variability (HRV):** Measured using portable ECG devices during 10-minute resting periods as an objective physiological marker of autonomic function
- **Perceived Stress Scale (PSS-10):** 10-item questionnaire assessing stress perception over the past month
- **Quality of Life (WHO-QOL BREF):** Brief version assessing physical, psychological, social, and environmental domains
- **Adherence and Acceptability:** Practice logs, session attendance records, and post-intervention satisfaction surveys

7. Assessment Schedule

- **Baseline (Week 0):** Before randomization
- **Mid-intervention (Week 4):** During active intervention phase
- **Post-intervention (Week 8):** Immediately after intervention completion
- **Follow-up (Week 16):** Eight weeks post-intervention to assess sustainability

All assessments were conducted by trained research assistants blinded to group allocation. HAM-A assessments were administered by clinical psychologists unaware of participant group assignment.

8. Data Analysis

Data were analyzed using SPSS version 26.0 and R statistical software. Analysis followed intention-totreat principles, with all randomized participants included regardless of intervention adherence.

Descriptive Statistics: Means, standard deviations, frequencies, and percentages were calculated for demographic and outcome variables.

Primary Analysis: Mixed-model repeated measures ANOVA examined between-group differences in HAM-A scores across time points, with baseline scores as covariates. Post-hoc pairwise comparisons used Bonferroni correction.

Secondary Analyses

- Independent t-tests compared groups on secondary outcomes at each time point
- Within-group changes analyzed using paired t-tests
- Effect sizes calculated using Cohen's d
- Linear regression identified demographic predictors of treatment response
- Subgroup analyses examined effects across gender, age groups, and teaching experience

Missing Data: Multiple imputation with 20 iterations addressed missing data, assuming missing at random (MAR) mechanism.

Statistical Significance: Two-tailed tests with a=0.05 were used for all analyses.

Results

1. Participant Flow and Characteristics

Of 186 teachers screened, 120 met eligibility criteria and were randomized (60 intervention, 60 control). Figure 1 presents the CONSORT flow diagram showing participant progression through the study.

Attrition: At eight weeks, 114 participants completed post-intervention assessment (95% retention rate): 57 in intervention group (95%) and 57 in control group (95%). At 16-week follow-up, 108 participants (90%) provided data. Reasons for dropout included relocation (n=4), time constraints (n=5), and loss to follow-up (n=3). No significant differences in baseline characteristics were found between completers and non-completers.

Baseline Characteristics: Table 1 presents demographic and clinical characteristics by group. Groups were well-matched on all variables (all p > 0.05):

Characteristic	Intervention (n=60)	Control (n=60)	p-value
Age (years), mean ± SD	38.4 ± 8.2	37.9 ± 7.8	0.73
Gender, n (%)			0.68
Female	42 (70%)	44 (73.3%)	
Male	18 (30%)	16 (26.7%)	
Teaching experience (years)	11.6 ± 6.4	11.2 ± 6.1	0.72
Education level, n (%)			0.82
Bachelor’s	18 (30%)	20 (33.3%)	
Master’s	38 (63.3%)	36 (60%)	
Doctoral	4 (6.7%)	4 (6.7%)	
School type, n (%)			0.91
Government	24 (40%)	25 (41.7%)	
Private	36 (60%)	35 (58.3%)	
Baseline HAM-A score	21.4 ± 4.2	20.8 ± 4.0	0.43
Baseline STAI-S score	52.8 ± 8.4	51.9 ± 7.9	0.54
Baseline STAI-T score	48.6 ± 7.2	48.1 ± 6.8	0.69

2. Primary Outcome: HAM-A Anxiety Scores

Between-Group Comparison: Mixed-model ANOVA revealed significant group × time interaction (F (2,224) = 89.42, p<0.001, partial? ²=0.44), indicating differential change patterns between groups.

Table 2: presents HAM-A scores at each assessment point

Time Point	Intervention Group	Control Group	Mean Difference	p-value	Cohen’s d
Baseline	21.4 ± 4.2	20.8 ± 4.0	0.6	0.43	0.15
Week 4	16.2 ± 3.8	20.1 ± 3.9	-3.9	<0.001	1.01
Week 8	12.8 ± 3.6	19.2 ± 3.8	-6.4	<0.001	1.84
Week 16	13.9 ± 3.7	19.4 ± 4.1	-5.5	<0.001	1.56

Within-Group Changes

- **Intervention group:** Significant reduction from baseline to week 8 (mean change: -8.6, 95% CI: -9.8 to -7.4, p<0.001), representing 40.2% decrease in anxiety scores

- **Control group:** Minimal change from baseline to week 8 (mean change: -1.6, 95% CI: -2.4 to -0.8, *p* =0.002), representing 7.7% decrease

Effect Size: Cohen's d of 1.84 at week 8 indicates a large treatment effect. The Number Needed to Treat (NNT) for achieving clinically significant anxiety reduction (=50% reduction in HAM-A score) was 2.8, meaning approximately 3 teachers need to receive the intervention for one additional teacher to achieve clinically meaningful improvement.

Sustainability: At 16-week follow-up, the intervention group maintained significant anxiety reduction compared to baseline (mean change: -7.5, p<0.001), though scores increased slightly from week 8 (mean increase: 1.1, *p* =0.04). This suggests good sustainability of treatment effects.

3. Secondary Outcomes

State-Trait Anxiety Inventory (STAI): Both STAI subscales showed significant between-group differences at weeks 4, 8, and 16 (all p<0.001):

Measure	Baseline	Week 8	Within-Group Change	Cohen’s d
Intervention	52.8 ± 8.4	38.2 ± 6.9	-14.6 (p<0.001)	1.68
Control	51.9 ± 7.9	49.1 ± 7.6	-2.8 (*p* =0.008)	0.36
STAI-T Intervention	48.6 ± 7.2	39.4 ± 6.4	-9.2 (p<0.001)	1.32
Control	48.1 ± 6.8	46.8 ± 6.9	-1.3 (*p* =0.12)	0.19

Heart Rate Variability (HRV)

The intervention group showed significant increases in HRV parameters indicating improved autonomic function:

- RMSSD increased from 28.4±8.2 ms at baseline to 42.6±10.4 ms at week 8 (p<0.001)
- High-frequency power increased by 48% (p<0.001)
- Low-frequency/high-frequency ratio decreased from 2.8±0.6 to 1.9±0.4 (p<0.001) Control group showed no significant changes in HRV parameters (all p>0.3).

Perceived Stress Scale (PSS-10)

Intervention group: baseline 24.6±4.8 to week 8 17.2±4.2 (change: -7.4, p<0.001)

Control group: baseline 24.1±4.6 to week 8 23.2±4.5 (change: -0.9, p =0.18) Between-group difference at week 8: $p<0.001$, Cohen's d=1.42

Quality of Life (WHO-QOL BREF)
Significant improvements were observed in the intervention group across all domains:

- Physical health: +12.4% ($p<0.001$)
- Psychological health: +18.6% ($p<0.001$)
- Social relationships: +9.8% (p =0.002)
- Environmental: +7.2% (p =0.01)

Control group showed no significant changes in any QOL domain (all $p>0.2$).

4. Intervention Adherence and Acceptability
Attendance: Mean session attendance was 36.4 out of 40 sessions (91%), with 83% of participants attending =32 sessions (=80% adherence threshold).

Home Practice: Average reported home practice was 4.2 days per week, with mean duration of 16.8 minutes per session. Practice frequency was positively correlated with anxiety reduction (r=0.42, $p<0.001$).

Acceptability: Post-intervention satisfaction survey (5-point Likert scale, 5=highly satisfied):

- Overall satisfaction: 4.6±0.5
- Ease of learning techniques: 4.4±0.6
- Perceived benefit: 4.7±0.5
- Likelihood to continue practice: 4.5±0.6
- Likelihood to recommend to colleagues: 4.8±0.4

Adverse Events: No serious adverse events were reported. Minor side effects included temporary lightheadedness (n=3, resolved with practice modification) and mild headache (n=2, resolved spontaneously).

5. Subgroup Analyses
Gender: Both male and female teachers showed significant anxiety reduction, with no significant gender × treatment interaction (p =0.31), suggesting similar effectiveness across genders.

Age Groups: Participants were categorized as younger (<40 years, n=68) and older (=40 years, n=52). Both groups benefited significantly, though younger teachers showed slightly greater reduction (interaction p =0.04), possibly due to higher initial anxiety levels and greater intervention adherence.

Teaching Experience: Teachers with <10 years experience (n=52) and =10 years experience (n=68) both showed significant improvements with no significant interaction (p =0.22).

School Type: Government school teachers (n=49) and private school teachers (n=71) showed comparable anxiety reduction (interaction p =0.18), indicating effectiveness across different educational settings.

Baseline Anxiety Severity: Participants with higher baseline anxiety (HAM-A =22, n=54) showed greater absolute reduction but similar percentage reduction compared to those with lower baseline anxiety (HAM-A <22, n=66), suggesting effectiveness across the anxiety spectrum.

6. Predictors of Treatment Response
Multiple linear regression identified predictors of anxiety reduction (defined as change in HAM-A from baseline to week 8):
Significant predictors

- **Session attendance (β=0.38, p<0.001):** Higher attendance associated with greater reduction
- **Home practice frequency (β=0.31, *p* =0.002):** More frequent home practice predicted better outcomes
- **Baseline anxiety severity (β=0.26, *p* =0.01):** Higher initial anxiety associated with greater absolute reduction
- **Age (β=-0.18, *p* =0.04):** Younger age slightly associated with greater reduction

Non-significant predictors: gender (p =0.42), teaching experience (p =0.36), education level (p =0.51), school type (p =0.28)
The model explained 42% of variance in treatment response (adjusted R^2=0.42, $F(7,109)$ =13.6, $p<0.001$).

Discussion
1. Principal Findings
This randomized controlled trial demonstrates that an eight-week pranayama intervention significantly reduces anxiety levels among school teachers in India. The intervention group showed a 40% reduction in anxiety scores compared to 8% in the control group, with a large effect size (Cohen's d=1.84) indicating robust clinical significance. These effects were sustained at eight-week follow-up and were accompanied by improvements in physiological stress markers, perceived stress, and quality of life.

2. Interpretation and Mechanisms
The observed anxiety reduction can be understood through multiple mechanisms:

- **Neurophysiological Mechanisms:** Pranayama practices directly influence the autonomic nervous system. The significant increase in HRV observed in the intervention group indicates enhanced parasympathetic activity and improved autonomic flexibility. This shift counteracts the sympathetic hyperactivity characteristic of anxiety states. Additionally, controlled breathing stimulates vagal nerve activity, which has widespread anxiolytic effects through vagal-brain connections.

- **Neurochemical Pathways:** Research suggests pranayama increases GABA levels in the brain, similar to anxiolytic medications but without associated side effects. The practice may also modulate the HPA axis, reducing cortisol hypersecretion associated with chronic stress and anxiety.

- **Psychological Mechanisms:** Beyond biological pathways, pranayama provides teachers with practical coping skills, enhancing self-efficacy in managing stress. The mindful awareness component of pranayama practice may disrupt rumination patterns common in anxiety, while regular practice establishes a sense of routine and control.

- **Contextual Factors:** The cultural familiarity and social acceptability of yoga practices in India may have enhanced engagement and reduced stigma compared to Western stress management interventions. Group sessions provided social support and normalized stress experiences among teachers.

3. Comparison with Existing Literature

Our findings align with and extend previous research. Meta-analyses report moderate to large effect sizes for yoga and breathing interventions on anxiety, typically ranging from d=0.6 to 1.2. Our effect size (d=1.84) exceeds most previous studies, possibly due to:

- Population specificity: Teachers may be particularly receptive to accessible, non-pharmacological interventions they can implement in school settings
- Intervention intensity: Our protocol (5 sessions weekly) was more intensive than many previous studies
- Cultural congruence: Pranayama's cultural roots in India may enhance acceptability and adherence
- Methodological rigor: Standardized protocols, blinded assessment, and high retention rates strengthened effect detection

Previous studies in Indian populations have shown promising results with pranayama for various conditions, but few have specifically targeted occupational anxiety in teachers. Our study fills this gap and demonstrates effectiveness in a real-world educational context.

4. Clinical and Practical Implications

Scalability: Pranayama interventions are highly scalable and cost-effective. Once teachers learn the techniques, they can practice independently without ongoing professional support or expensive equipment. Schools can incorporate brief pranayama sessions into daily schedules or staff wellness programs.

Preventive Approach: Rather than waiting for anxiety to reach clinical severity requiring specialized treatment, pranayama offers a preventive approach accessible to all teachers. Regular practice may prevent anxiety escalation and associated burnout.

Workplace Integration: The intervention’s feasibility in school settings makes it attractive for institutional adoption. Schools could offer regular pranayama classes, create dedicated practice spaces, or integrate brief practices into staff meetings or beginning-of-day routines.

Broader Applications: While this study focused on anxiety, teachers reported additional benefits including improved sleep, better emotional regulation with students, and enhanced overall well-being. These secondary benefits support broader mental health and professional functioning.
Policy Considerations: Results suggest that educational policies promoting teacher wellness should consider evidence-based practices like pranayama. Government initiatives could provide training for certified instructors in schools or include pranayama in teacher training curricula.

5. Strengths and Limitations Strengths:

- Rigorous RCT design with adequate power and randomization
- Blinded outcome assessment reducing detection bias
- Multiple validated outcome measures including objective physiological markers
- High adherence and retention rates (>90%)
- Standardized intervention protocol enhancing replicability
- Culturally appropriate intervention in the target population
- Adequate follow-up period assessing sustainability

Limitations

- **Single-blind design:** Participants were aware of their group assignment, potentially introducing expectation effects, though blinded assessment mitigates this concern
- **Geographic limitation:** Study conducted in three major cities; generalizability to rural or smaller urban areas requires investigation
- **Selection bias:** Teachers volunteering for a pranayama study may differ from the general teaching population in motivation or health consciousness
- **Lack of active control:** Control group received no intervention; comparison with an active control (e.g., general wellness education) would strengthen conclusions about pranayama-specific effects
- **Short-term follow-up:** Sixteen-week follow-up, while showing sustained effects, does not address long-term (>6 months) sustainability
- **Self-reported home practice:** Reliance on self-reported practice logs may introduce recall bias
- **Mechanism exploration:** While HRV provides physiological insights, the study did not measure neurochemical markers or conduct neuroimaging to fully elucidate mechanisms

6. Future Research Directions

Building on these findings, future research should:

- **Long-term studies:** Investigate whether anxiety reduction persists beyond six months and identify factors supporting sustained practice
- **Dose-response relationships:** Examine optimal practice frequency, duration, and intensity
- **Comparative effectiveness:** Compare different pranayama techniques to identify most effective practices for anxiety
- **Mechanism studies:** Employ neuroimaging and comprehensive biomarker assessment to clarify underlying mechanisms
- **Cost-effectiveness analysis:** Evaluate economic benefits considering reduced absenteeism, healthcare utilization, and improved teaching effectiveness
- **Dismantling studies:** Determine active components (e.g., breathing regulation vs. mindfulness vs. group support)
- **Rural populations:** Extend research to rural schools with different stressor profiles and resource availability
- **Technology integration:** Explore mobile apps or online platforms for supporting home practice and reaching broader populations

- **Implementation science:** Study optimal methods for integrating pranayama into school wellness programs at scale
- **Student outcomes:** Investigate whether teacher anxiety reduction translates to improved student outcomes, classroom climate, and educational quality

Conclusion

This randomized controlled trial provides robust evidence that pranayama techniques effectively reduce anxiety among school teachers in India. The intervention demonstrated large effect sizes, high acceptability, excellent safety profile, and sustained benefits at follow-up. Given the accessibility, cultural appropriateness, and cost-effectiveness of pranayama, these findings support its integration into comprehensive teacher wellness programs.

School teachers face substantial occupational stress that affects both personal well-being and professional effectiveness. Pranayama offers a practical, evidence-based tool for managing anxiety that teachers can implement independently. Educational institutions, policymakers, and public health professionals should consider pranayama as a valuable component of holistic approaches to supporting teacher mental health.

By investing in teacher wellness through accessible interventions like pranayama, educational systems can simultaneously support workforce health and enhance the quality of education delivered to students. Future research should focus on optimizing implementation, understanding mechanisms, and evaluating long-term outcomes to maximize the public health impact of this promising intervention.

References

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (5th ed.). Arlington, VA: American Psychiatric Publishing, 2013.
2. Brown RP, Gerbarg PL. Yoga breathing, meditation, and longevity. Annals of the New York Academy of Sciences,2009:1172(1):54-62.
3. Butzer B, LoRusso A, Shin SH, Khalsa SBS. Evaluation of yoga for preventing adolescent substance use risk factors in a middle school setting: A preliminary group-randomized controlled trial. Journal of Youth and Adolescence,2017:46(3):603-632.
4. Chandra S, Jaiswal AK, Singh R, Jha D, Mittal AP. Mental health and estimation of stress in teachers: A comparative study between government and private primary school teachers of Lucknow city. Industrial Psychiatry Journal,2017:26(2):177-181.
5. Cramer H, Lauche R, Anheyer D, Pilkington K, de Manincor M, Dobos G, *et al*. Yoga for anxiety: A systematic review and meta-analysis of randomized controlled trials. Depression and Anxiety,2018:35(9):830-843.
6. Ganpat TS, Nagendra HR, Selvi V. Efficacy of yoga on occupational stress among teachers: A randomized controlled trial. Journal of Education and Health Promotion,2021:10:140.
7. Gerritsen RJS, Band GPH. Breath of life: The respiratory vagal stimulation model of contemplative activity. Frontiers in Human Neuroscience,2018:12:397.
8. Gururaja D, Harano K, Toyotake I, Kobayashi H. Effect of yoga on mental health: Comparative study between young and senior subjects in Japan. International Journal of Yoga,2011:4(1):7-12.
9. Hamilton M. The assessment of anxiety states by rating. British Journal of Medical Psychology,1959:32(1):50-55.
10. Jayawardena R, Ranasinghe P, Ranawaka H, Gamage N, Dissanayake D, Misra A. Exploring the therapeutic benefits of pranayama (yogic breathing): A systematic review. Journal of Integrative and Complementary Medicine,2020:26(12):1091-1102.
11. Jerath R, Crawford MW, Barnes VA, Harden K. Self-regulation of breathing as a primary treatment for anxiety. Applied Psychophysiology and Biofeedback,2015:40(2):107-115.
12. Kauts A, Sharma N. Effect of yoga on academic performance in relation to stress. International Journal of Yoga,2009:2(1):39-43.
13. Kuppusamy M, Kamaldeen D, Pitani R, Amaldas J, Shanmugam P. Effects of yoga breathing practice on heart rate variability in healthy adolescents: A randomized controlled trial. Integrative Medicine Research,2018:7(1):28-32.
14. Ma X, Yue ZQ, Gong ZQ, Zhang H, Duan NY, Shi YT, *et al*. The effect of diaphragmatic breathing on attention, negative affect and stress in healthy adults. Frontiers in Psychology,2017:8:874.
15. Maharana S, Sharma M. Prevalence of stress among school teachers: A systematic review. Indian Journal of Occupational and Environmental Medicine,2020:24(3):170-175.
16. Nagendra HR, Kumar V, Mukherjee S. Cognitive behavior evaluation based on physiological parameters among young healthy subjects with yoga as intervention. Computational and Mathematical Methods in Medicine, 2015.
17. Narasimhan L, Nagarathna R, Nagendra HR. Effect of integrated yogic practices on positive and negative emotions in healthy adults. International Journal of Yoga,2011:4(1):13-19.
18. National Council of Educational Research and Training. Status of School Education in India. New Delhi: NCERT, 2019.
19. Pascoe MC, Thompson DR, Ski CF. Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis. Psychoneuroendocrinology,2017:86:152-168.
20. Pramanik T, Sharma HO, Mishra S, Mishra A, Prajapati R, Singh S. Immediate effect of slow pace bhastrika pranayama on blood pressure and heart rate. Journal of Alternative and Complementary Medicine,2009:15(3):293-295.
21. Reddy KJ, Menon KR, Thattil A. Academic stress and its sources among university students. Biomedical and Pharmacology Journal,2018:11(1):531-537.
22. Riley KE, Park CL. How does yoga reduce stress? A systematic review of mechanisms of change and guide to future inquiry. Health Psychology Review,2015:9(3):379-396.
23. Saoji AA, Raghavendra BR, Manjunath NK. Effects of yogic breath regulation: A narrative review of scientific evidence. Journal of Ayurveda and Integrative Medicine,2019:10(1):50-58.

24. Sengupta P. Health impacts of yoga and pranayama: A state-of-the-art review. International Journal of Preventive Medicine,2012:3(7):444-458.
25. Sharma VK, Trakroo M, Subramaniam V, Rajajeyakumar M, Bhavanani AB, Sahai A. Effect of fast and slow pranayama on perceived stress and cardiovascular parameters in young health-care students. International Journal of Yoga,2013:6(2):104-110.
26. Shirley D, Bethel MW, Irving D. Restorative yoga: A psychophysiological analysis. Journal of Bodywork and Movement Therapies,2010:14(1):50-56.
27. Spielberger CD, Gorsuch RL, Lushene R, Vagg PR, Jacobs GA. Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press, 1983.
28. Streeter CC, Gerbarg PL, Saper RB, Ciraulo DA, Brown RP. Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. Medical Hypotheses,2012:78(5):571-579.
29. Telles S, Singh N, Balkrishna A. Managing mental health disorders resulting from trauma through yoga: A review. Depression Research and Treatment, 2012.
30. Thirthalli J, Naveen GH, Rao MG, Varambally S, Christopher R, Gangadhar BN. Cortisol and antidepressant effects of yoga. Indian Journal of Psychiatry,2013:55(Suppl 3):S405-S408.
31. Tyagi A, Cohen M. Yoga and heart rate variability: A comprehensive review of the literature. International Journal of Yoga,2016:9(2):97-113.
32. UNESCO. Global Education Monitoring Report 2020: Inclusion and Education. Paris: UNESCO, 2020.
33. Varambally S, Gangadhar BN. Current status of yoga in mental health services. International Review of Psychiatry,2016:28(3):233-235.
34. Vedamurthachar A, Janakiramaiah N, Hegde JM, Shetty TK, Subbakrishna DK, Sureshbabu SV, *et al*. Antidepressant efficacy and hormonal effects of Sudarshana Kriya Yoga (SKY) in alcohol dependent individuals. Journal of Affective Disorders,2006:94(1-3):249-253.
35. Wahbeh H, Elsas SM, Oken BS. Mind-body interventions: Applications in neurology. Neurology,2008:70(24):2321-2328.
36. World Health Organization. WHOQOL-BREF: Introduction, Administration, Scoring and Generic Version of the Assessment. Geneva: WHO, 1996.