

Voluntary regulated breathing practices for stress and anxiety reduction: A systematic review of the published literature

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Background and Aims

Voluntary regulated breathing practices such as diaphragmatic or pranayama-based approaches are established stress-reduction tools.

To better understand the efficacy of different breathing practices among different populations, we identified and provide a narrative review of existing literature presenting empirically-evaluated, breathing-based interventions for stress or anxiety.

Results

- **29 studies** were identified, including 20 RCTs and 9 single-arm, pre-post, non-randomized studies, comprising:
 - 2257 total participants
 - Overall mean age 35.6 years, 49.6% female
- Most commonly applied breathing practices were:
 - Deep, diaphragmatic, or other slow breathing
 - Alternate nostril breathing (slow pace)
 - Fast breathing

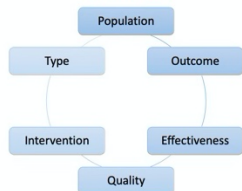
Main Findings

- Breathing practices **significantly reduced stress/anxiety** in:
 - **22 of the 29 interventions**
 - **All interventions among high-anxiety adults, healthy adults, youth**
- All effective interventions included some form of **slow breathing**
- Breathing practices were **not effective** when they lacked:
 - Slow breathing
 - Multiple sessions
 - Guided training
 - Practice time
- Simulated-stress/threat interventions were **rarely effective**.

Methods

- **PRISMA guidelines** were followed
- **Databases searched:** PubMed, Science Direct, reference-mined select key articles
- **Inclusion criteria:**
 - **Study type:** RCTs, prospective clinical studies
 - **Intervention:** Any voluntary regulated breathing practice** done on its own
 - **Outcomes:** Psychometric measures of stress or anxiety
 - **Populations:**
 - Clinical and non-clinical stress/anxiety
 - Ages $\geq 1y$
 - Any geographic location
 - Published in English language
- **Exclusion criteria:**
 - Breath combined with other interventions (e.g., yoga, meditation, tai chi, etc.)
 - Biofeedback-modified guidance
 - O₂- or CO₂-modified air
 - External breath manipulation / regulation
 - Physiologic stress/anxiety metrics only
- **Data extraction:** Conducted independently by two authors
- **Study quality:**
 - CLEAR-NPT for RCTs
 - NHLBI tool for other clinical studies

Synthesis

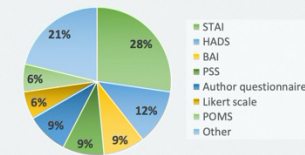


** Voluntary regulated breathing practice defined as any voluntary, regulated manipulation or control of the breath

Study Characteristics

Study Type	Stress Metric	Populations				
		High-Anxiety (n=4)	Clinical (n=13)	Simulated stress (n=4)	Healthy Adults (n=3)	Youth (n=5)
RCTs	1 st	8	3			
	2 nd	6	3			
Non-Randomized	1 st	6	0			
	2 nd	2	1			

Stress/Anxiety Outcome Metrics



	Positive		Null/Negative	
	Single Sessions*	Multiple Sessions*	Single Sessions*	Multiple Sessions*
High-Anxiety	Clark 1985	Chen 2017*		
	Clark 1990*	Serafim 2018*		
Other Clinical	Cieck 2017*	Han 1996	Biggs 2003*	Thomas 2017
	Hayruva 2012*	Dhruva 2012	Jefferson 2010	
	Sureka 2014	Valenza 2014*	Boaviagem 2017*	
	Marshall 2014*	Chanandrabu 2019*		
Simulated Stress		McCaul 1979	Holmes 1978	
			Sakakibara 1996	
			Kamath 2017*	
Healthy Adults		Gupta 2010*		
		Bhimani 2011*		
		Schmalzi 2018*		
Youth	Khng 2017*	Busch 2012*		
	Hunt 2018	Sellakumar 2015*		
		Hakked 2017		

Legend: * Stress was primary outcome. Bolded studies = RCTs.

Effective interventions INCLUDED:

- Multiple practice sessions
- Guided training
- Slow breathing
- Long-term (individual or guided) practice

Ineffective interventions LACKED: