

How Slow Breathing Alters Brain Circuits to Crush Anxiety

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STORY AT-A-GLANCE

- › Research has identified a brain circuit involving the anterior cingulate cortex, pons and medulla that links slow breathing to reduced anxiety. Activating this circuit in mice led to slower breathing and decreased anxiety, while shutting it off increased stress and breathing rates
- › The discovery of this brain circuit provides a neurological basis for practices like yoga and mindfulness
- › Another study found that torso stiffness, a common stress response, limits venous return and cardiac output, exacerbating anxiety symptoms. Aerobic exercise and proper breathing reduce torso stiffness, improve circulation and prevent negative effects on your cardiopulmonary system
- › Understanding the biomechanics of how the body responds to anxiety is helpful for developing holistic treatment strategies. Techniques that promote muscle relaxation and enhance circulation, such as aerobic exercise and controlled breathing, are useful for anxiety treatment plans
- › By addressing both the neurological and physical aspects of anxiety, it allows for a more comprehensive approach to managing anxiety. This includes integrating breathing techniques and physical exercise to alleviate symptoms and promote overall well-being

Anxiety disorders are a group of mental health conditions characterized by persistent and excessive fear, worry and apprehension. You might experience symptoms such as restlessness, rapid heartbeat, difficulty concentrating and an overwhelming sense of

dread. If left untreated, anxiety disorders significantly impair your daily functioning and quality of life.

These disorders are marked by intense emotional and physical responses. You may find yourself having panic attacks, avoiding social situations or grappling with obsessive thoughts. Common signs include constant nervousness, irritability and fatigue, which interfere with your work, relationships and overall well-being. Should anxiety remain unaddressed, it often leads to severe consequences like depression, substance abuse or chronic health issues.

Recent research from *Frontiers in Public Health*¹ reveals that from 1992 to 2021, the global number of anxiety disorder cases surged by 73.44%, with age-standardized incidence rates increasing by 21.17%. Among the BRICS nations (Brazil, Russian Federation, India, China and South Africa), India saw the most dramatic rise, experiencing a 113.3% increase, while China exhibited the smallest growth at 2.79%.

Brazil and South Africa also reported significant changes, reflecting diverse socio-economic factors across these countries. These statistics highlight a troubling upward trend in anxiety disorders, emphasizing the need for targeted mental health interventions.

If you or someone you know is struggling with anxiety, it's important to recognize the broader impact of these disorders. Anxiety not only affects individuals but also imposes substantial social and economic burdens on society. Challenges in maintaining employment, sustaining relationships and managing daily tasks are common.

Additionally, the increased incidence of anxiety contributes to higher health care costs and reduced productivity, underscoring the urgent need for comprehensive public health strategies to address this growing concern. Simple natural solutions, like slow breathing, offer a holistic option for anxiety relief.

Underlying Causes of Anxiety Disorders

Anxiety disorders are often exacerbated by a variety of risk factors, including genetic predisposition, environmental stressors and personal history of trauma. Conventional treatments, such as **selective serotonin reuptake inhibitors (SSRIs)** and benzodiazepines, are commonly prescribed but come with significant drawbacks. These medications lead to side effects like drowsiness, dizziness, and dependency, which may not address the root causes of anxiety.

Additionally, the effectiveness of these drugs varies greatly among individuals, leaving some without adequate relief. Underlying causes of anxiety disorders include imbalances in brain chemistry, particularly involving neurotransmitters like serotonin and dopamine, which play a role in mood regulation. Chronic stress and poor coping mechanisms also contribute to the development of anxiety disorders.

Furthermore, lifestyle factors such as lack of physical activity, poor diet and inadequate sleep exacerbate symptoms. These elements create a challenging environment for mental health, often leading to a cycle of anxiety that is difficult to break. The progression from these underlying causes to full-blown anxiety disorder involves a cascade of physiological and psychological changes.

Imbalances in neurotransmitters disrupt normal brain function, leading to heightened emotional responses and difficulty managing stress. Chronic stress alters the brain's structure and function, particularly in areas responsible for emotion regulation, such as the amygdala and prefrontal cortex. This results in a heightened state of alertness and anxiety, making it difficult for individuals to relax or feel at ease.

Diagnosing anxiety disorder is problematic due to the subjective nature of symptoms and the overlap with other mental health conditions. Many individuals don't seek help until symptoms become severe, leading to delayed diagnosis and treatment.

Additionally, the reliance on self-reported symptoms results in misdiagnosis, as individuals may not accurately convey the severity or nature of their anxiety, leading to inappropriate treatment plans that fail to address the specific needs of the patient.

The complexity of anxiety disorder diagnosis is further compounded by the lack of definitive biological markers. Unlike some physical health conditions, anxiety disorders do not have clear-cut diagnostic tests, making it challenging for health care providers to confirm a diagnosis.

This reliance on clinical judgment and patient history sometimes results in inconsistent or inaccurate diagnoses. As a result, individuals experience prolonged periods of untreated anxiety, which significantly impacts their quality of life.

How Intentional Slow Breathing Helps Manage Anxiety

A recent news article highlighted groundbreaking research conducted by neuroscientists at the Salk Institute. This study sought to identify and understand the specific brain circuits responsible for the voluntary control of breathing and their link to emotional and behavioral states.²

By exploring these neural pathways, researchers aimed to uncover how conscious breathing techniques influence mental well-being and offer new therapeutic avenues for anxiety-related disorders.

Published in *Nature Neuroscience*, the research focused on the intricate connection between different regions of the brain that regulate breathing patterns.³ Scientists discovered a dedicated circuit encompassing the anterior cingulate cortex, the pons and the medulla. This circuit plays a role in coordinating breathing with your emotional states.⁴

To explore this, experiments were conducted on mice, where activating this neural pathway resulted in slower breathing rates and reduced signs of anxiety. Conversely, inhibiting the circuit led to increased stress levels in the animals.⁵

One of the key findings of the study is the identification of how messages from the pons inhibit activity in the medulla, leading to a decrease in breathing rates.⁶ This interaction allows for the voluntary slowing of breath, which is often practiced in relaxation techniques like yoga and mindfulness.

The ability to control breathing through this circuit demonstrates a direct neurological basis for the calming effects observed in these practices.⁷ The researchers emphasized that this discovery bridges the gap between conscious breathing exercises and their impact on the brain's emotional centers.

By understanding the specific roles of the anterior cingulate cortex and its connections to the pons and medulla, scientists better comprehend how intentional breath control modulates stress responses.⁸ This insight not only validates traditional practices but also opens the door to developing targeted treatments for anxiety and panic disorders.

The Importance of Proper Breathing for Mental Health

The study's experiments also revealed that when the cortex-pons-medulla circuit was artificially activated in mice, the animals exhibited fewer signs of anxiety and breathed more slowly.⁹ This suggests that stimulating this pathway could be a viable strategy for reducing anxiety symptoms in humans. The ability to consciously regulate breathing through this neural circuit highlights the intricate link between our physiological processes and emotional states.¹⁰

By directly influencing the neural mechanisms that control breathing, treatments that provide relief from anxiety without the side effects associated with conventional medications could be developed.

This research underscores the importance of breathing in maintaining mental health. Humans have long used slow breathing techniques to regulate emotions, often without fully understanding the underlying neurological processes.¹¹ The discovery of this specific brain circuit provides a concrete explanation for why these practices are effective, emphasizing the role of the brain in coordinating breath with our emotional and behavioral states.¹²

Moreover, the study highlights the complexity of the brain's role in managing stress and anxiety. The coordinated activity between the anterior cingulate cortex, pons and medulla demonstrates how higher brain regions interact with lower brainstem areas to

maintain emotional balance.¹³ This intricate relationship is essential for adapting to different emotional states and managing stress effectively.

In summary, the identification of the cortex-pons-medulla circuit marks a significant advancement in our understanding of how breathing influences mental well-being. By unraveling the specific neural pathways involved, this research provides a solid foundation for developing innovative treatments for anxiety and stress-related disorders.¹⁴

As scientists continue to explore these connections, the potential for new therapeutic strategies that harness the power of controlled breathing becomes increasingly promising.

The Role of Torso Stiffness in Anxiety and Its Impact on Circulation

In further exploration of how physical changes affect mental health, a narrative review explored how the stiffness of your torso — essentially how rigid your upper body is — influences feelings of anxiety and the way blood circulates through your body.¹⁵

The researchers aimed to understand if the way we hold our bodies affects our mental state and overall physical health. By examining the connection between muscle tension in the torso and anxiety levels, the study sought to uncover new methods to alleviate anxiety through physical adjustments.

The study focused on individuals who experience chronic anxiety and examined how their muscle tension in the torso area impacts their blood flow. Torso stiffness, which refers to the tightness or rigidity in the muscles around the upper body, was found to be a common stress response.

When people are anxious, their bodies often tense up, particularly in the torso, which restricts blood flow back to the heart and decrease the amount of blood the heart pumps out with each beat. This limitation leads to reduced oxygen and nutrient delivery

to vital organs, contributing to the physical symptoms of anxiety such as rapid heart rate and shortness of breath.

One of the key findings was that aerobic exercise, which includes activities like swimming or cycling, significantly reduces torso stiffness. Aerobic exercise helps by increasing heart rate and promoting better blood circulation throughout your body. When the muscles in your torso become less tense and more relaxed, blood flows more freely, enhancing your body's ability to respond to stress.

Exercise Combined with Breathing Techniques Benefit Anxiety

Additionally, the study found that controlled breathing techniques, when combined with aerobic exercise, further help reduce muscle tension and improve circulation. This combination not only helps in lowering anxiety but also supports overall cardiovascular health.

The researchers also highlighted that this approach of combining aerobic exercise with proper breathing techniques prevents negative effects on the cardiopulmonary system, which includes your heart and lungs. By maintaining flexibility in your torso muscles and ensuring efficient blood flow, individuals avoid the strain that often accompanies chronic anxiety.

Improved circulation means that your body more effectively manages and recovers from stress, reducing the long-term impact on heart and lung health.

Understanding the biomechanics of how your body responds to anxiety is key for developing effective treatment strategies. The study emphasized that by addressing physical factors like muscle tension and blood flow, health care providers offer more comprehensive care for individuals struggling with anxiety.

Integrating techniques that promote muscle relaxation and enhance circulation, such as aerobic exercise and controlled breathing, into anxiety treatment plans provides both immediate and lasting relief from symptoms.

Furthermore, the study explored the specific biological mechanisms behind these findings. When your torso muscles are tense, they create physical barriers that make it harder for blood to return to your heart. This creates a cycle where reduced circulation leads to increased stress on your heart to pump blood, thereby exacerbating feelings of anxiety.

By engaging in aerobic exercise, your heart becomes more efficient at pumping blood, and the increased movement helps to loosen the muscles in your torso. Controlled breathing, on the other hand, activates the parasympathetic nervous system – the part of your nervous system responsible for relaxation and recovery – thereby counteracting the fight-or-flight response that contributes to anxiety.

The combination of aerobic exercise and proper breathing enhances your body's ability to maintain optimal muscle function and blood flow. Improved **heart rate variability** (HRV), which is a measure of the variation in time between each heartbeat, is another benefit observed in the study. Higher HRV is associated with better stress resilience and cardiovascular health, indicating that your body is better equipped to handle stressors effectively.

Solutions for Managing Anxiety at Its Root

Anxiety often stems from how you breathe and how your brain controls that process. By addressing these fundamental aspects, you significantly reduce anxiety and improve your overall well-being.

- 1. Breathe through your nose** – Breathing through your nose ensures that the air is properly filtered, warmed and humidified before reaching your lungs. This not only enhances oxygen uptake but also regulates **carbon dioxide levels**, which are important for calming your nervous system. Next time you feel anxious, focus on taking slow breaths in through your nose.
- 2. Adopt horizontal breathing** – Instead of taking deep, vertical breaths that trigger the stress response, practice **horizontal breathing**. This means expanding your

ribcage sideways rather than lifting your chest upwards. Horizontal breathing promotes relaxation by avoiding the activation of stress pathways in your nervous system.

- 3. Breathe less and more lightly** – Rapid breaths increase anxiety levels by over-oxygenating your body and depleting carbon dioxide. Aim to breathe less frequently and more gently. This balance helps maintain optimal carbon dioxide levels, which are essential for calming your brain and reducing stress hormones like cortisol.
- 4. Integrate controlled breathing practices** – Consistently practicing controlled breathing exercises rewires your brain's response to stress. Techniques like alternate nostril breathing or the Buteyko method encourage slow, deliberate breaths that activate your parasympathetic nervous system, fostering a state of calm and enhancing your ability to manage anxiety effectively.

Sources and References

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- ³ [Nature Neuroscience November 19, 2024, 27, 2455-2465](#)
- ¹⁵ [Front Sports Act Living. 2024 Nov 1;6:1487862](#)