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Science 411

4 fundamentals, 1 big takeaway, and 1 practical application

Effects of voluntary slow breathing on heart rate and heart rate variability: A systematic review and a meta-analysis

4 FUNDAMENTALS

1. Essential Background Material

This systematic review and meta-analysis examined the effects of slow breathing on heart rate variability, a key marker of overall health and wellness.

Slow breathing has been used for millennia to reduce stress and improve physical and mental health. However, its underlying mechanisms are actually poorly understood.

In general, **we think most of the benefits come from stimulation of the vagus nerve**, the primary nerve of the parasympathetic (rest-and-digest) nervous system.

Heart rate variability (HRV) is a way to measure this vagal activity. Thus, if slow breathing works through the vagus nerve, it should be detectable via HRV.

And, of course, we know that HRV has been used in a ton of studies on slow breathing. However, this information has not been synthesized to examine how slow breathing impacts HRV at different time intervals across experiments.

This study filled that gap by generating a systematic review and meta-analysis on the impact of slow breathing on HRV at three time intervals.

1. During the practice (which they label DURING),
2. Immediately after one session (IM-AFTER1),
3. After a multi-session intervention (AFTER-INT).

2. What Did this Research Do?

The authors collected studies of voluntary slow breathing that measured HRV at one of the three time intervals mentioned above.

IMPORTANT

The introduction provided one of the best descriptions of the various HRV parameters I've read. It's too much to include, but here are the key takeaways: RMSSD and LF power can be used as a marker of vagal activity for the "DURING" measurements. For IM-AFTER1 (immediately after) and AFTER-INT (after multiple sessions), only RMSSD can be used. These latter two measurement times can be considered baseline vagal activity.

For each study, they calculated the risk of bias. They then used the Hedges' g score to evaluate the overall changes due to slow breathing.

According to the authors, if the Hedges' score is positive, the slow breathing group had higher HRV than the control group. Moreover, there are pre-defined g-value thresholds to see if the effects are "small," "medium," or "large."

223 studies were included in the analysis:

- 172 for DURING
- 16 for IM-AFTER1
- 49 for AFTER-INT

3. What Were the Major Findings?

Like almost all breathing studies, the risk of bias was high in most of the 223 included papers. Nonetheless, the results were encouraging.

For DURING:

- There was a "medium" effect size for RMSSD (g = 0.53)
- There was a "large" effect size for LF (g = 1.49)

This indicates that, across the 172 studies included for DURING, **slow breathing significantly increased cardiac vagal activity during the breathing practice.**

For IM-AFTER1:

- There was a "small" effect for RMSSD.

This indicates that, immediately after the practice, vagal activity is still increased, but not as significantly as during the exercise (this is expected).

For AFTER-INT:

- There was a "small" effect for RMSSD (but larger than for IM-AFTER1)
- The Hedges' g score for AFTER-INT = 0.32 and IM-AFTER1 = 0.14.

This indicates that long-term practice increases baseline vagal activity.

4. Why Do These Results Matter?

Across all time points considered, slow breathing increased cardiac vagal tone. This supports the notion that the vagus nerve is the underlying mechanism behind the benefits of slow breathing.

Because the parasympathetic nervous system is critical in many chronic and acute diseases, **these results "encourage" the use of slow breathing in health-related settings. It's cheap, easy, and basically has no adverse side effects.**

1 BIG TAKEAWAY

Slow breathing works through activation of the vagus nerve, and consistent practice of slow breathing improves overall cardiac vagal tone, which could be highly beneficial in many health conditions.

1 PRACTICAL APPLICATION

Because there were 223 studies with different protocols, we cannot provide explicit guidance from this paper. But, in general, slow breathing protocols are performed using a pace of 4 to 7 breaths per minute (6 bpm is most common) using a slightly longer exhale than inhale.

The most straightforward application is to perform slow breathing at 6 breaths per minute using a 4-second inhale and a 6-second exhale. Do this for at least 10 minutes daily to improve vagal tone both immediately and over the long run.