Beyond distraction? The effect of slow deep breathing on pain

Hassan Jafari, Johan Vlaeyen, Omer Van den Bergh, Ilse Van Diest
Health Psychology, University of Leuven (KU Leuven)

Introduction:
If you are in pain, would a breathing technique provide some sort of pain relieve? More specifically, can slow deep breathing generate an analgesic effect? And if so, what is the mechanisms behind the respiratory hypoalgesia? During a long time these questions have been the object of several clinical [3,5,6] and more recently experimental studies [1,2,4]. Most clinical studies report on an effect of slow deep breathing on pain, and more recently, experimental studies have started bringing forward possible mechanisms behind the breathing-induced hypoalgesia. A number of psychological (e.g. distraction and attention) and physiological mechanisms (e.g. parasympathetic vagal tone) could explain the possible analgesic effect of slow deep breathing.

Study Questions:
Q1 Does attention/distraction caused by instructed breathing reduce pain?
Q2 Can slow breathing (6 breaths per min) produce analgesic effects beyond those produced by attentional focus or distraction?
Q3 Do variations in inspiratory/expiratory ratio (i/e ratio) during slow breathing influence the effect of respiration on pain?

Design:
Forty eight healthy individuals, 35 female (73%), with mean age of 22.5 ± 3 participated in this study. After baseline recording, the participants’ breathing were paced during four blocks of respiration in a counterbalanced order. ECG, respiration, continuous blood pressure and pain intensity (VAS) were recorded.

Respiration manipulation

| Q1 | Spontaneous breathing |
| Q2 | Paced spontaneous breathing |
| Q3 | Slow Deep B. (low i/e ratio) |
| Q4 | Slow Deep B. (high i/e ratio) |

Pain Intervention

| 1. Spont B | 2. Paced B in nature | 3. 50% low i/e ratio | 4. 50% high i/e ratio |

The thermal stimuli consisted of three temperatures of 1, 2 and 3 degree Celsius above the pain threshold of each participant. Every intensity was applied four times in every single breathing condition in a random order. The stimulus duration was five seconds and the inter-stimulus interval varied randomly between 35 to 45 seconds.

Results:
Effect of respiration on pain:

- a. Instructed breathing of any kind reduced subject’s pain level beyond spontaneous breathing.
- b. Increase in pain through rising temperatures were less steep for the instructed breathing patterns compared to spontaneous Breathing.
- c. Low i/e ratio slow deep breathing could more effectively reduce the subjective pain beyond paced spontaneous breathing when the pain stimuli was stronger.

Effect of respiration on heart rate variability (HRV):

- Measures of HRV (SDNN, RMSSD, HF power, LF power) in slow deep breathing significantly differed from spontaneous breathing. Slower breathing increased HRV.
- Distraction (paced vs non-paced breathing) does not show any effect on HRV measures.

Effect of heart rate variability (HRV) on pain:

None of the HRV measures could significantly explain the change in pain rating for all the three degrees above threshold. (p-value, RMSSD = 0.20, interaction effect = 0.15)

Discussion:

1. Both psychological and physiological mechanisms could play a role in respiratory-hypoalgesia. Instructed breathing, in any frequency or pattern, reduces pain to some extent in contrast to non-manipulated breathing.
2. Slow deep breathing can reduce pain beyond the effect of distraction.
3. HRV can not explain the mediation model for the effect of respiration on pain.
4. Further investigation is required to find the underlying mechanism of respiratory-induced hypoalgesia.

References: