

# **Comparative effect of paced and unpaced breathing on heart rate variability in individuals with combat injury**

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## **Abstract**

**Background:** Respiration is a crucial determinant of autonomic balance and heart rate variability (HRV). The comparative effect of paced versus unpaced breathing on HRV has never been explored in veterans with combat-related traumatic injury (CRTI).

**Objective:** To examine the effect of paced versus unpaced breathing in veterans with combat-related traumatic injury (CRTI).

**Methods:** This was an observational cohort study using the data from the first follow-up of the ArmeD SerVices TrAuma Rehabilitation OutComE (ADVANCE) study, UK. We

compared paced and unpaced breathing in a random sample of 100 participants with CRTI (Afghanistan 2003-2014) recruited into the ADVANCE study. HRV was recorded using a single-lead ECG. HRV data was acquired during a five-minute unpaced breathing followed immediately by five minutes of paced breathing (six cycles per minute) among fully-rested and supine participants. HRV was reported using time-domain (root mean square of successive differences, RMSSD), frequency-domain (low frequency, LF; high frequency, HF), and non-linear (Sample Entropy) measures. The agreement between HRV during paced and unpaced breathing protocol was examined using the Bland-Altman analysis.

**Results:** The mean age of the participants was  $36.5 \pm 4.6$  years. Resting respiratory rate was significantly higher with unpaced versus paced breathing ( $13.4 \pm 3.4$  vs  $7.6 \pm 2.0$  /minute;  $p < 0.001$ ) respectively. Resting mean heart rate and RMSSD were found to be significantly higher with paced breathing compared to unpaced breathing ( $p < 0.001$ ). Paced breathing significantly increased median LF power as compared to unpaced breathing ( $p < 0.001$ ). No significant difference was found in the absolute power of HF between the two breathing protocols. The Bland-Altman analysis revealed poor agreement between HRV values during paced and unpaced breathing conditions with wide limits of agreement.

**Conclusion:** Slow-paced breathing leads to higher HRV than unpaced breathing and could overestimate resting 'natural-state' HRV.

**Keywords:** combat-injury; breathing; resonance frequency; military; heart rate variability