Int J Clin Exp Physiol. 2024;11(1):47-48.
https://www.ijcep.org

Heart Rate Variability Biofeedback: Using Slow-Paced Breathing as a Window to Improved Health and Autonomic Regulation

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NEWS

Heart Rate Variability (HRV) is considered as an index of autonomic nervous system function. A higher vagally mediated HRV (vmHRV) is known to be associated with higher life expectancy, greater cognitive flexibility and resilience to stress and is a relevant marker positively related to health, well-being and self-regulation.[1] In the recent years, HRV Biofeedback (HRVB) paired with slow-paced breathing has garnered attention as a promising non-pharmacological intervention with potential benefits in conditions such as stress management and in disorders like depression, anxiety, cardiovascular diseases and musculoskeletal pain disorders.[1]

Biofeedback is a process by which a patient learns how to change physiological activity for the purposes of improving health and performance.[2] This is done by measuring the exact physiological activity under consideration, for example, brain wave patterns, muscle activity, heart function, breathing patterns and skin temperature. The information is rapidly fed back or presented to the user in an easily understood, intuitive format that allows near real-time adjustment to changes in the target physiological activity. Over time, these desired changes in physiological activity can be achieved without the continued use of an instrument.

HRVB is based on providing feedback of heart rate on a beat-to-beat basis during slow breathing maneuvers. The participant try to maximize Respiratory Sinus Arrhythmia (RSA) by creating a sine wave like curve of peaks and valleys and matches RSA to heart rate patterns, thus maximizing HRV via Feedback.[3] During HRVB, the amplitude of heart rate oscillations grows to many times the amplitude at rest, while the pattern becomes simple and sinusoidal. This is due to the temporal coherence of phases between respiratory, blood pressure and cardiac oscillations, at the specific resonant frequency. The mechanism for this effect lies in a confluence of processes: (i) Phase relationships between heart rate oscillations and breathing at specific frequencies (ii) Phase relationships between heart rate and blood pressure oscillations at specific frequencies (iii) Activity of the baroreflex (iv) Resonance characteristics of the cardiovascular system. During slow-paced breathing there is no temporal delay in respiratory and cardiac oscillation hence resulting in high and regular vmHRV.[4]

Some of the benefits from HRVB include the efficiency of gas exchange, cardiovascular benefits, improvements in exercise performance, reduction of oxidative stress and inflammation, central benefits such as enhanced cognition, meditation effects and reduction of anxiety and pain perception.[4]

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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DOI: 10.5530/ijcep.2024.11.1.8

VIEWS

HRV Biofeedback: A Peek into the Old and a Vision for the Future

Interestingly, the concept of slow-paced breathing is a cornerstone of the ancient practice of pranayama, one of the eight limbs of yoga. Pranayama has been known to impact health by harmonizing the body's physiological functions such as autonomic regulation, respiratory efficiency and cardiovascular functions. The integration of such research-backed techniques into modern healthcare strategies can provide a comprehensive approach in improving the overall health outcomes.

Recent advances in Artificial Intelligence (AI)-based applications for biofeedback have revolutionized the accessibility and effectiveness of HRV biofeedback. AI-driven apps can provide real-time feedback and personalized training programs, making biofeedback more user-friendly and accessible to a broader population. These applications empower individuals to take control of their health by providing tools to monitor and improve their physiological states through biofeedback training.HRV biofeedback using slow-paced breathing represents a significant advancement in autonomic regulation and behavioural therapy. Its simplicity, effectiveness and broad applicability make it a valuable tool in both clinical and everyday settings.

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Received: 02-01-2024;
Revised: 27-02-2024;
Accepted: 14-03-2024.