



Review Article

Review of Heart Rate Variability Biofeedback: Intervention to relieve Stress

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Abstract

Depression is prevailing and captivating millions of individuals across the globe. There are numerous stressors and triggers that can induce depressive symptoms or anxiety in individuals of all ages. This exponential growth in depressed and distressed members of society may lead to a massive loss of productive individuals. It is a general practice to prescribe drugs to treat such psychological concerns, but acquiring these medications frequently may affect the body's metabolism. Alternative interventions that can replace or minimize the use of drugs are needed. Heart rate variability biofeedback (HRVB) is a practical approach to treating stress and depression. This article intends to represent an overview of HRVB, its effectiveness, and its side effects so that it can be compared to the medications prescribed.

Keywords

Heart rate variability, Biofeedback, Stress, Depression.



Introduction

World Health Organization has stated that depression is among the most prevalent psychological concern, afflicting around 265 million individuals of different age groups worldwide¹. Mood disorder, decreased interest, sleep disruption, diminished desire to eat, decelerated thinking, and dearth of vitality have all been regarded as possible factors associated with the onset and tenacity of many other illnesses: people experiencing depression seem to be more likely to have addiction issues, personality issues, or other psychiatric conditions like distress, and anxious behavior^{2,3}. People with chronic illnesses were more likely to exhibit comorbidities with depression, according to a global study involving 245,404 persons from 60 nations⁴. Furthermore, depressed symptoms are frequently linked to poor health outcomes and resistance to drugs and therapies. They are frequently coexisting with severe health concerns such as type 2 diabetes, absenteeism, and senile dementia⁵⁻⁷. Anxiety and depression are also linked to an increased risk of heart problems. People with cardiovascular disorders are likelier to have concomitant depression⁸⁻¹⁰.

Heart rate variability (HRV), an assessment of the change in the time between every pulse, is a critical sign of the function of the autonomous nervous system and a powerful determinant of clinical incidence and death. Higher variability shows the autonomic nervous system's capacity for self-regulation. Because more serious complications are strongly related to decreased HRV and decreased HRV itself appears to be associated with the likelihood of incidence of depression, this measure could be employed as a prognostic and predictive biomarker of distress and anxiety¹¹⁻¹³.

HRV research led to the development of HRV Biofeedback (HRVB), a non-invasive therapeutic method aimed at enhancing heart rate oscillations through real-time feedback and slow breathing exercises¹³. This approach was formulated to solve difficulties with HRV regulation discovered while treating depression. Prior studies have shown that HRVB enhances HRV as evaluated by SDNN (the standard deviation of NN intervals), high-frequency power (HF), and the low-frequency power/high-frequency power ratio (LF/HF). Each of these biological markers has been linked to reduced depressed symptoms¹⁴.

Heart rate variability biofeedback (HRVB) has received much attention in recent decades for treating various diseases and enhancing productivity. Because asthmatic and digestive problems appear to adapt to this type of cardio-respiratory feedback exercise, the question of plausible causes becomes more pertinent. The most widely accepted way is that the homeostasis of the baroreceptor is strengthened¹⁵.

In the 1990s, researchers experimented with a type of cardio-respiratory therapy known as HRVB. HRV has a complicated structure that is sometimes considered "unstable," containing multiple overlapping oscillation frequencies that are non-linearly connected. Some of the activities in this pattern are triggered by pre-defined reflexes, while others have a modulatory function and are influenced by other autonomic pathways¹⁶. Negative feedback loops help preserve allostatic stability while permitting sensitivity to external needs. The magnitude of heart rate oscillations increases to several times at rest during HRV biofeedback, while the waveform becomes simple and sinusoidal. This trend is observed in practically everybody and is often achieved



in a brief moment, even in those who have never been subjected to the procedure before^{15,16}.

HRVB has been shown in multiple studies to reduce physical and psychological symptoms while enhancing wellbeing¹⁷. In an arbitrary meta-analysis investigating the efficacy of HRVB on psychological distress symptoms, Goessl et al.¹⁸ discovered that HRVB is a beneficial and effective strategy for reducing anxiety and stress. Lehrer et al. published a systematic and meta-analytic review on the effectiveness of HRVB and/or paced breathing on a variety of psychological signs and symptoms, cognitive functioning, and intricate behavioral patterns. HRVB and timed breathing had a minor but substantial influence on depression, according to the researchers¹⁹.

Factors related to HRV

Respiratory Sinus Arrhythmia

Respiratory Sinus Arrhythmia (RSA) is a change in heart rate (HR) due to ventilation, with HR rising while inspiration and falling with expiration. It plays a key role in managing to breathe, ensuring that the volume of blood going to the lungs is maximal when the lungs have the most oxygen. This link is critical for respiratory illness and physical and psychological performance that necessitates more oxygen to the working body and brain. Gaseous exchange efficiency is highest when ventilation and heart rate oscillations are completely in synchrony²⁰.

The neuronal control of RSA seems to be another significant component of psychological concerns and neuroscience. The vagus nerve mediates this neuronal control, a key autonomic nerve activated during tranquil and relaxing times and inhibited during stressful times. The magnitude of peak-to-trough heart rate

fluctuations that occur with every breath can be used to calculate the quantity of RSA. Healthy people have a higher range of changes (in beats per minute) than individuals suffering from diseases. Young people have a better amplitude of changes, and those with optimal aerobic capacity have a larger amplitude of changes. It is lower in stress, wrath, and despair, as well as a variety of physical illnesses, from cardiovascular disease to infections²⁰.

The Baroreflex

The baroreflex is another modulatory reflex strongly enhanced by HRVB (BR). The BR establishes the circumstances for resonant consequences of breathing which result in substantial RSA variations. It perceives blood pressure fluctuations using stretch receptors in the carotid artery and aorta. When baroreceptors detect a rise in BP, the BRs trigger an immediate decline in HR, followed by a physical decline in BP due to less blood flows through the vascular system²¹.

Why HRV Biofeedback?

HRVB promotes a variety of homeostatic 'negative feedback loops' explicitly. Because HRVB stimulates both the baroreflex and the RSA, as well as increases parasympathetic activity, there is the possibility that HRVB will help with emotional control. There are grounds to assume that HRVB enhances gaseous exchange capabilities that help manage respiratory disease and other breathing problems due to the obvious in-phase interaction between breathing and heart rate. There are grounds to think it helps manage blood pressure as it activates the BR. It's possible that stimulating the vagus nerve will result in the sense of calm and well-being^{19,22}. The bolstering of conceptual and physiological underpinnings over the past few years has helped clarify the connections between the brain and the heart that Claude Bernard proposed over 150 years ago.



Autonomic regulation of the circulatory system and cerebral arousal interact with one another. Therefore, changing one will impact the other, which could last for a while²³. More recently, advantages have been observed in patients with acute stress disorder, urging those under stress to employ HRV-BFB training to enhance their health, well-being, or competence.

The effectiveness of HRVB with wearable technology on self-reported stress is confirmed by a recent meta-analysis from Goessl et al.²⁴. However, due to a dearth of studies in this area, only eight studies examined signs of stress as an end parameter for healthy persons. In their evaluation of the effectiveness of general biofeedback training on psychophysiological outcomes of stress, De Witte et al.²⁵ underline the need for additional research that takes into account both psychological and physiological characteristics of stress.

It is worth noting that HRV biofeedback is not a measurement tool to observe breathing rate. Rather it is an intervention in which the subject learns to control and optimize breathing patterns and heart rate variability²⁶.

Possible Side Effects of HRV Biofeedback

HRVB's distinctive effects have piqued interest, maybe as a result of these impacts. Each year, the number of HRVB research published has increased significantly. It's crucial to explain HRVB's potential negative effects. In most cases, these are minor quibbles. When people initially start slow breathing, it's usual for them to hyperventilate slightly as the increased depth of breathing adapts to the slower speed. The apprentice is especially told to inhale at a low pace in the conventional protocol, particularly in response to drowsiness symptoms, which are frequently the first hyperventilation symptoms to

appear. Another potential negative effect arises in those who have recurrent cardiac arrhythmias¹⁹.

Conclusion

Alternate medicine is a futuristic approach, and it is for the benefit of mankind. We, as living beings, are vulnerable to psychosocial stresses and other linked comorbidities. And prefer taking medications for all the issues and concerns. Heart rate variability is a great alternative and an effective intervention to cope with stress and depressive symptoms. Trained and certified clinical professionals are needed to turn the tables upside down.

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