



What Is Heart Rate Variability (HRV) and How Can It Indicate Stress and Wellbeing?

Over the past few years, HRV has gained popularity as an indicator of stress and general wellbeing. Once measured in medical facilities through ECG machines or dedicated heart rate monitors, HRV can now be measured using mobile devices thanks to advanced PPG technologies. But what exactly is HRV, how is it linked to stress, and why should it matter to payers and providers?

What is HRV?

In contrast to what is often believed, a healthy heart does not beat at regular intervals as does a metronome; rather, there are actually slight variations in the time intervals between beat to beat. In other words, if your heart rate is 60 beats per minute, the time between each beat wouldn't be consistent or identical. While one interval might be 1.03 seconds, another might be .55 seconds. These intervals are also known as R-R intervals, and the variations between them are measured by the Heart Rate Variability (HRV) metric.

How is HRV linked to stress?

Heart rate variability reflects the functions of the Autonomic Nervous System (ANS), the system responsible for helping your body respond to stress by stimulating your “fight or flight” response and then helping your body proceed to calm down by restoring a state of “rest and digest.”

The autonomic nervous system is divided into the sympathetic nervous system and the parasympathetic nervous system. The sympathetic system is a network of nerves that prime your body for action when encountering a situation perceived as frightening or **stressful**. It prepares you to “fight or flight” by **causing your heart rate and respiration rate to increase** so you can get more energy and oxygen to fuel a rapid response to the danger, causing your pupils to dilate, and triggering an increase of blood flow to the muscles that you might need to run or fight, etc.

On the other hand, the parasympathetic nervous system stimulates your body’s “rest and digest” response. When your body is not under threat, the parasympathetic system helps your body relax and preserve energy by doing things like **lowering your heart rate**, constricting your pupils, increasing your rate of digestion, and more.

These two complementary systems – the sympathetic and parasympathetic systems – offset one another, and it is the balance between them that helps your body respond efficiently to life’s changing demands and alternate between “fight or flight” and “rest and digest” modes – whether to handle a poor night of sleep, a car accelerating towards you on the road, or the birth of a child. Your ability to switch between these modes in response to stimuli reflects how resilient you are to stress and can be assessed through your heart rate variability.

How is HRV measured?

There are several ways to evaluate HRV, including **time domain**, **frequency domain**, and **non-linear** methods.

Time Domain Analysis

Time Domain Analysis refers to statistical analyses used to quantify the variation in interbeat intervals over time. One of the simplest time-domain analysis parameters is the standard deviation of the NN interval (R-R intervals filtered for any noise that would make the data unreliable), also known as SDNN. When HRV is large and irregular, the SDNN value increases, generally indicating that your body is rapidly adjusting to environmental changes. Therefore, SDNN is an index of physiological resilience against stress.

Other time domain parameters used to measure HRV include rMSSD, pNN50, and more.

Frequency Domain Analysis

Heart rate (HR) oscillations can be divided into different frequency bands (ranges), including ultra-low-frequency (ULF), very-low-frequency (VLF), low-frequency (LF), and high-frequency (HF). **Research** has identified certain frequency bands that tend to correlate with certain physiological phenomena like activity within different parts of the ANS.

Frequency Domain Analysis is a complex analysis technique that shows how much of a signal lies within one or more of these frequency bands, which can then be used to infer activity in certain ANS branches. Specifically, high frequency bands tend to correlate with activity in the parasympathetic branch and low frequency with activity in the sympathetic branch.

What can HRV indicate about a person's health?

HRV helps to **signal imbalances in the autonomic nervous system**. By becoming aware of these imbalances, you can:

- Detect underlying sleep disorders and heart issues
- Identify chronic stress or mental health issues
- Flag health risks associated with reduced HRV, including arrhythmias, heart attack, heart failure, early death, and sudden cardiac death
- Better **predict morbidity risk** from common mental (e.g., stress, depression, anxiety, PTSD) and physical disorders (e.g., inflammation, chronic pain, diabetes, concussion, asthma, insomnia, fatigue)

How can patients or clients use HRV to improve wellness?

- **Identify stress triggers and improve emotional regulation**– patients or clients can track their nervous system’s response to emotions, thoughts, feelings and environmental stimuli.
- **Get feedback on lifestyle adjustment or new habits** – HRV measurements provide feedback about a person’s lifestyle and can help inspire taking steps toward a healthier life. When implementing lifestyle changes, like meditating regularly, improving sleep, eating a healthier diet, and exercising more, a person may notice changes in their HRV.
- **Adjust athletic training regimens** – athletes may track HRV to adjust their training programs. They can learn when the body is being overworked, which often results in a drop in HRV, and can learn how fast they recover. High levels of HRV generally indicate aerobic and general fitness as well as greater resilience to stress.

What’s a normal HRV range?

HRV is a highly individual metric, influenced by factors like age, height, sex, circadian rhythm and more. Generally speaking, a normal SDNN value is above 50. However, the best way to determine a normal HRV range is to track it over time and establish a baseline with a health professional.

Can people improve their HRV?

Studies show that certain lifestyle changes can help improve HRV. These include:

- Regularly **exercising**
- Getting more **sleep**
- **Breathing** exercises
- Drinking less **alcohol**
- Eating a **healthier diet**

Empower anyone to measure HRV using their smartphone camera

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