Hearts are Important
That little, 11-ounce organ in your chest pumps thousands of gallons of blood through your system daily. It should be no surprise that measuring exactly how your heart is doing can lend great insight into your overall health.

Every one of our 100,000 daily heartbeats is a potential data point used to understand our well-being. For most wearable companies, monitoring a fraction of those heartbeats is enough. Using only basic sensors to record PPG, the metric for organ activity, the average wearable device can only capture heart rates during moderate activity. Additionally, the signal captured is only binary, not obtaining any information other than if the beat occurred.

This is where Biostrap soars above the competition. Our clinical-grade PPG sensors allow the Biostrap unit to gather comprehensive data on how your heart is pumping—not stopping at only counting heartbeats. Monitoring each heartbeat for 29 different parameters, the Biostrap can analyze heart data against the information from the last 24 hours.

But rather than jumping into the values of Biostrap, it’s important for everyone to understand how healthy their heart is. So we’ve built out a guide to do just that. Focusing on Resting Heart Rate and Heart Rate Variability, we’ll break down how to measure how your heart is performing.

About Biostrap:
Biostrap is the most advanced, machine learning platform on the market. With two devices, Biostrap is able to gather twice as much data and recognize over 130+ repetitious activities.

Our clinical-quality PPG sensors make tracking resting heart rate, heart rate variability, and sleep metrics easier and more accurate than ever.
Heart Rate Variability

Each time our heart beats we live a little longer.
There is no better measure of our overall mortality than heart health. And there are few better indicators of heart health than heart rate variability (HRV).

Heart rate variability is the interval between heartbeats—the duration of the R–R interval—and how those intervals vary over time. If your heartbeats were doughnuts, then the interval between each beat would be the doughnut hole. Are each of these doughnut holes the same size? Or are some larger than others? Smaller? The measure of these ‘doughnut holes’, and how they compare in size to the ones that precede or follow them, is the measure of heart rate variability.

A variable heart rate is a normal, health response to changes in our bodies and environment including breathing, exercise, stress, blood flow, and any metabolic changes.

It’s counterintuitive. One might think that the steadier the heartbeat and the more fixed the intervals, the better off we are. But HRV is an indicator of a flexible, resilient heart. A healthy heart at rest actually has greater variability.

How Does it Work
Healthy people at rest have normal periodic variation in heartbeat intervals. Reduced HRV is a marker of reduced vagal activity and waning health.

Allostasis is our bodies’ response to stress and the method by which we return to balance or homeostasis. HRV is a marker of robust allostasis, our bodies’ ability to bounce back.

Over time, repeated stressors increase our allostatic load and can diminish our health. Allostatic Load has been called the ‘wear and tear’ on the body over time.

What is a normal HRV level?
How can we measure HRV, and when should we be worried? What IS normal when it comes to our heart? There is currently no standardized scale of normalcy for HRV. And as with resting heart rate (BPM) or blood pressure, demographics impact what’s ‘normal’.

HRV also naturally decreases with age, perhaps a function of allostatic load or perhaps just a reflection of wear and tear. The resting heart (beats per minute) remains the same but HRV analysis shows diminished variability.

What affects HRV?
HRV is sensitive to acute stress, including daily work stress such as making complex decisions, or public speaking. Daily worry, lingering impact of PTSD, medication all can decrease HRV. So can stress or illness.

The beauty of our bodies is that our most essential functions, breathing, heartbeat, blood flow, digestion, take no thought whatsoever. Our autonomic nervous system (ANS) controls our breathing, our heartbeat, our digestion, without our lifting a finger. NS is comprised of two independent systems, the sympathetic nervous system (fight-or-flight response) and our parasympathetic nervous system which occurs at rest. These two systems work together to help us attain homeostasis (balance). It’s an elaborately choreographed danced wherein each part of the whole functions, or malfunctions, together. HRV is a function of the parasympathetic system.

Even when our heart rate appears steady there can be considerable variance between each beat.
HRV and Overtraining

Each time our heart beats we live a little longer.

Every athlete wants to be faster, stronger, better. How do they improve? Training. Elite and amateur athletes alike carefully calibrate their training program to ensure constant progress. But is there a limit?

One of the most amazing things about the human body is our ability to become stronger as needed. Let’s say you’re asked to carry a large boulder from point A to point B. It’s so heavy that you can barely lift it. When you reach point B, arms quivering, you drop it with a relieved grunt. The next day it may seem even harder to carry the same stone. Your arm and leg muscles are sore. But keep this up daily, and guess what? Within a week, the rock won’t seem as heavy. You’ll lift it easily. You’ll walk more quickly. Your muscles have gotten stronger from training. Now you’re ready for a heavier rock.

What if, though, on the second day they handed you a rock double the weight? And then extended the distance you had to carry it? You would falter. Become discouraged. Risk injury. You couldn’t finish the task, and definitely would not become stronger. Overtraining occurs when our activity exceeds our ability to recover from the activity. It can derail even elite athletes. Because the treatment for overtraining is prolonged rest (weeks or months), preventing overtraining should be a goal of any training regime. And measuring heart rate variability can help.

Recovery

How do we build strength? When we exercise, our muscles contract. This stress and effort cause microtrauma to our muscle tissue. Our bodies repair this damage by fusing together new muscle fibers. As the fibers thicken, our muscles grow. But this repair process doesn’t happen while we exercise. It happens when we rest.

Recovery is a period of rest between intervals of exertion. It is essential to building strength.

The Science and The Symptoms

Overtrained athletes are susceptible to infection, especially in the respiratory tract. They have higher markers of oxidative stress. Disturbed sleep. They are fatigued. Often apathetic or depressed. They lose their appetite. They may have signs of systemic inflammation. The most significant symptom is unexplained underperformance.

It’s a complicated assessment. Fatigue, for example, is both a cause of, and a symptom of, overtraining. Mood dysregulation is a symptom of overtraining, but can also be a factor. Pain, poor sleep, respiratory distress can each be a cause, or a symptom, of overtraining. Because of the multi-causal nature, it is important to develop a healthy baseline and monitor biomarkers for deviation before overreaching segues into overtraining.

Though overtraining has been deeply studied, there is no fixed definition and the exact process is not understood. Theories include low muscle glycogen, central fatigue hypotheses, glutamine hypothesis, oxidative stress, hypothalamic hypothesis, cytokine hypothesis.

What affects HRV?

Measuring HRV and identifying patterns help athletes maximize performance but avoid overtraining. Measuring HRV daily can help an athlete identify decreases and adjust training. In one study “a reduced HRV was seen soon after awakening in overtrained athletes, suggesting increased sympathetic tone.” Research indicates that negative effects of overtraining on the automatic system is reversible. The cure? Rest.

A study of heart rate variability in middle-distance runners found that HRV was a better tool than resting heart rate to evaluate cumulative fatigue.
Another study determined that HRV was a reliable marker in differentiating between international and national level soccer players. A 4 year study of elite Nordic skiers found that “HRV was significantly lower in fatigued athletes. This research supports HRV as a key tool to optimize individual training profiles.

Avoiding Overtraining

Even 15 years ago researchers struggled with the difficulty of measuring biomarkers to assess overtraining.

Wearable tech has brought the sports lab into the home. Athletes can now measure sleep, blood oxygen saturation, SpO2, respiration, heart rate and heart rate variability with a single device. An analysis of these values, and the trends or patterns, helps athletes modulate training, avoid overtraining, promote recovery (the micro tears which regular exercise engenders) and prevent or recover from injury.

Overtraining can be a serious issue that takes months to recover from and can compromise an athlete's performance.

Optimal training is training designed specifically for an individual athlete, tailored to his or her abilities and aerobic capacity. Research shows that long term changes in HRV (> 4 weeks) are a reliable indicator of physiological adaptation in athletes. Understanding their unique individual HRV fingerprint can help athletes adjust training and maximize performance.

Cardio fitness is so significant that the American Heart Association recommends that it be measured as a ‘fifth vital sign’, alongside blood pressure, pulse rate, temperature, and respiration. Heart rate variability (HRV) has traditionally been used to evaluate cardiovascular and metabolic health. Athletes are now harnessing its power to set training regimes, evaluate progress, and avoid overtraining. Recovery is an essential component of any training regime. Routine measurement of HRV helps athletes stay in the growing zone, and out of the slowing zone.

Resting Heart Rate

The Basics of RHR

Our hearts beat slowest when we are at rest. The number of beats per minute when a body is still called your resting heart rate (RHR). This is the optimal measure risk factor for cardiovascular mortality, doctors recommend it be measured often. An increase of 20 beats per minute is associated with heightened mortality (risk of death), even within the normal range.

The normal range is 60 to 100 beats per minute. Unless you are an elite athlete, an RHR of less than 60 beats (bradycardia) can signify a serious health condition. Beats over 100 (up to 400 beats per minute) are called tachycardia. This can also be serious.

Our RHR is regulated by the sinus node, which generates electrical impulses to regulate our heart. Regular exercise improves the heart’s efficiency. Superbly conditioned individuals have lower RHR, usually 40 to 60 beats per minute (BPM).
What factors affect RHR?
Numerous factors affect RHR, which is why regular measurement is key. Fitness, activity, gender, age, size, disease, and stress can impact your RHR, as will transient circumstances such as room temperature, body position, medications or caffeine. Recent research shows heart rate also has a genetic component.

Measuring your Resting Heart Rate
Traditionally the amateur athlete or health enthusiast measured his heart beat with two fingers and simple math. Wearables like Biostrap now enables us to get accurate easy accountings of our RHR over time. This lets us track the impact of our health, including the relative success of exercise or other interventions we’ve undertaken. French mathematician Blaise Pascal said, “The heart has its reasons of which reason knows nothing.” From a biological perspective, that’s no longer true. Health researchers now have an increased understanding of what a healthy heart looks, sounds and acts like. And the more we learn, the more we understand that RHR is a fundamental marker of health that we can, and should measure at home.