

# Measuring Heart Rate Variability

## Foundations of Heart Rate Variability

### Short-term measurements

1-5 minutes

Easy  
Repeatable  
Trend-able  
Actionable



### Long-term measurements

> 5 minutes – usually hours (24hrs)

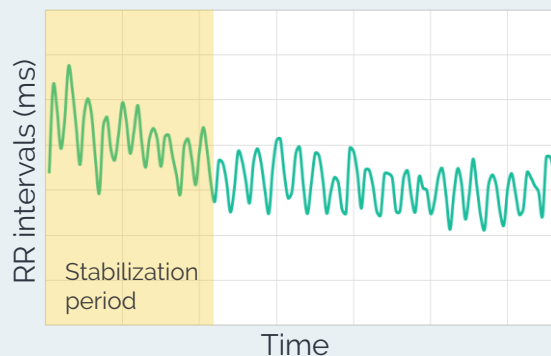
Can help determine what parts of the day produce more stress  
Used to practice live biofeedback  
Serves as warning for impending catastrophe  
Used to gather short-term snippets

## Short-term Measurement Durations

- ✓ 1 minute is minimum valid sample
- 🏆 5 minutes is considered the “gold standard” for short-term readings
- Shorter readings are more sensitive to anomalies
- Longer readings are more forgiving to artifacts but increase likelihood of introducing human factors

### Pre-reading “stabilization”

Let heart rate level out before recording HRV



### Why Baseline?

What is your “normal”? Readings taken in isolation are less meaningful  
Readings taken over multiple days reduces chance of a single measurement skewing results

### How often to measure?

**Ideal** - every day (missing days may miss key events)  
**Minimum** - 4 days per week (3 for elite athletes)  
**Better** - 5+ days per week  
↑ frequency = ↑ confidence = better trend accuracy and predictability

### When to measure?

HRV measurements taken at rest are most recommended because they have been heavily researched, are practically proven, and are easily trend-able

**HRV naturally changes throughout the day** due to internal processes and external/internal stressors. Measuring first thing in the morning eliminates many variables for more consistency.

**Ideal** – Measure first thing upon waking from longest sleep (within 30 minutes)

**Practical** - Measure during a rest time that is most consistent for your schedule (shift schedules or travel)

★ Consistency is key to taking meaningful measurements!!

# Measuring Positions & Breathing

## Foundations of Heart Rate Variability

### Resting vs. Non-resting Measurements

HRV measurements can be taken at rest or while active but measurements taken at rest are most recommended since they have been heavily researched, are practically proven, and easily trend-able

### Measuring Positions at Rest – *Consistency is Key!*

#### Supine / Laying

Most repeatable  
Consistent for longer readings  
Most Parasympathetic activation

- ✓ Recommended when resting HR is above 50 bpm



#### Sitting

Repeatable with care  
More accessible throughout the day  
More difficult for longer readings

Back supported vs. unsupported

- ✓ Recommended when resting HR is below 50 bpm while lying



#### Resting Squat

Repeatable with care  
Accessible anywhere  
More stress on the system  
Less researched



- ✓ Recommended only if you have a truly easy, resting squat

#### Standing / Orthostatic

Repeatable with extreme care  
Easiest to do anywhere  
Most stress on the system

- ✓ Least recommended unless testing orthostatic intentionally
- ✓ Not recommended for longer duration



Back angle while sitting can affect HRV because of structural stress

- ✓ Be conscious of back angle and choose an easily repeatable position



### Breathing Patterns During Measurement

Breathing patterns can artificially influence HRV  
Slower breathing elicits strong ANS activation

#### "Readiness/Daily" Reading

- Recommend to not use paced breathing
- If you do use guided breathing during then only use "natural" breathing pace

#### Meditation/Live Biofeedback Reading

- Paced breathing is recommended
- Slow, deep diaphragmatic breathing
- Resonance breathing

# Measurement Devices

## Foundations of Heart Rate Variability

### Device accuracy is extremely important when measuring HRV!

An inaccurate device will provide an inaccurate and invalid HRV value



## Passive Electric vs. PPG Heart Rate Monitors

**Passive Electric** - Passively receives electrical signals produced by heart contractions and transmits data

### Types of Electrical Passive HR monitors

- ECG/EKG (electrocardiogram) - 3-12 leads; detects full QRS complex
- Chest strap - 1-2 leads and detects RRs
- Custom combos - usually detects RRs
- Handheld - 2 leads and detects RRs

**Practical Tip: Moisten sensor and secure snugly but comfortably for best contact and least chance of movement artifacts**



### Pros

- ✓ Proven more accurate under many conditions
- ✓ Accessible
- ✓ Less chance of limb movement artifacts
- ✓ Compatible with many wireless transmitting protocols

### Cons

- Requires skin preparation & more time
- Signal noise when not at rest due to core movement
- Loss of skin contact can produce high-amplitude signal fluctuations that appear as extra beats
- Less convenient for certain people (smaller women or men with chest hair)

**PPG (PhotoPlethysmoGraph) sensor** - Measures the relative amount of blood flow through tissue using a photoelectric transducer

### Types of PPG HR monitors

- Finger
- Ear
- Wrist

**Practical Tip: Consider/check circulation, pressure, placement on skin, and limb position**

### Pros

- ✓ Accessible
- ✓ Less preparation > more convenient
- ✓ Compatible with many wireless transmitting protocols

### Cons

- Not extensively proven for accuracy
- Not good for people with bad circulation, certain skin colors, or fidgety people
- More sensitive to signal artifacts from:
  - Limb position relative to heart
  - Line interference
  - Ambient light or external light interference
  - Sensor movement
  - Blood volume discrepancies
  - Pressure
- More difficult and less accurate for longer readings

If a device measures HR, that does not mean it measures HRV

Even if a device transmits RR intervals, those RRs might be estimated, altered, or smoothed

