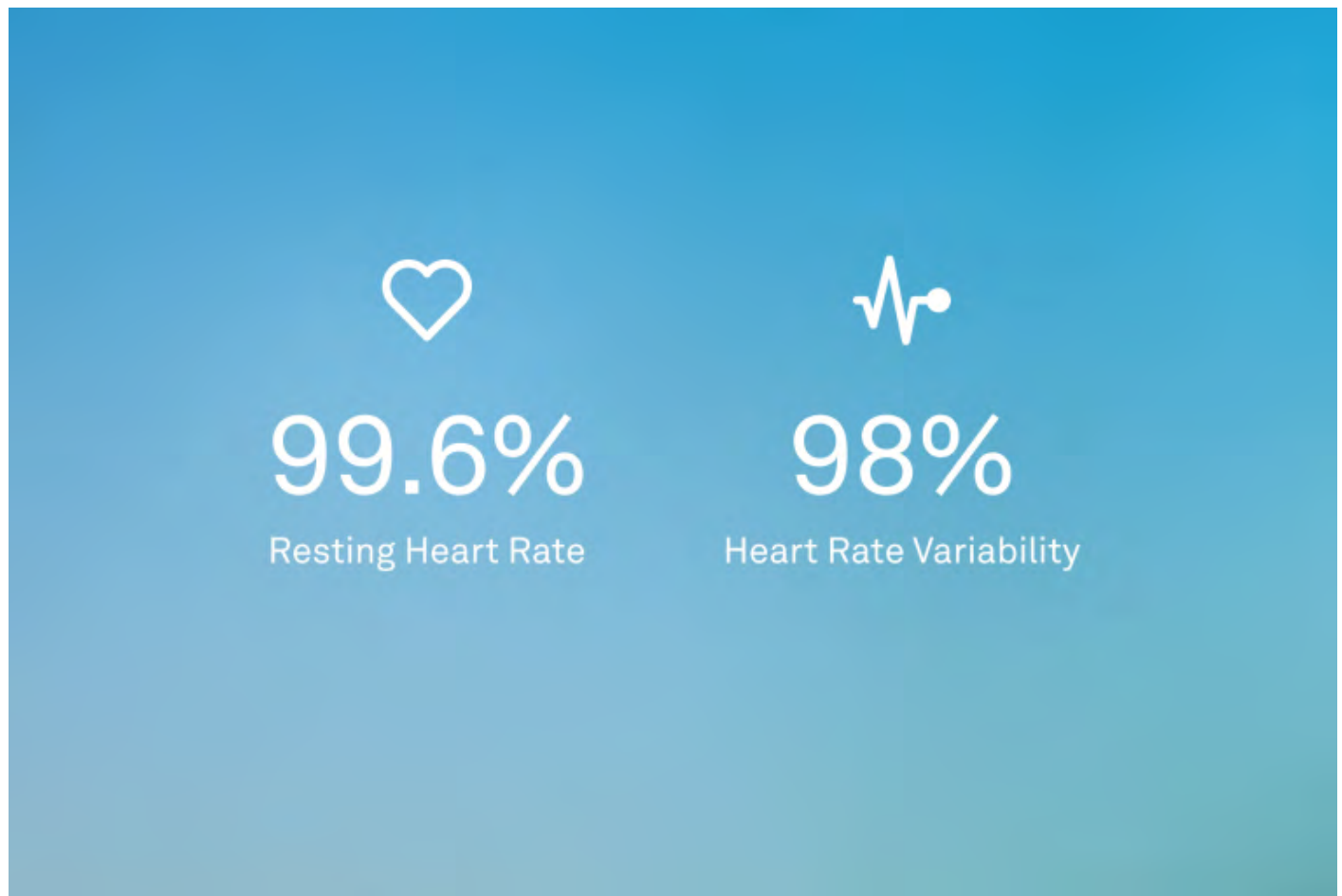


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How Accurate Are Oura's Heart Rate & HRV Measurements?



Author: Oura Team | January 9, 2020



Oura is always looking for ways to prioritize and communicate accuracy. As a result, we're excited to share new research by our science team to continue to validate our sensors against industry standard tools.

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What Are The Details?

In a study of 49 healthy subjects, the Oura ring was shown to be:

- A valid tool for measuring average nighttime resting heart rate (RHR) & variability (HRV)
- A highly accurate means of assessing body signals and long-term health behavior

Let's dig into the data.

Oura's Average Nighttime Values Correspond Near-Perfect with ECG

When comparing Oura's average nighttime RHR and HRV to a medical-grade ECG device, the results showed a near-perfect correlation for RHR ($r^2 = 0.996$) and extremely high squared correlation for HRV ($r^2 = 0.980$).

If you're not familiar with r squared (r^2), it is a commonly used way to assess how well two values correspond. It ranges from 0 to 1 where 0 means there's no correlation while 1 means the two variables are completely in sync.

Because both of these r^2 are very close to 1, it means that the values in the Oura app are at the top of the accuracy range and correspond nearly perfectly with ECG values, the gold standard for measuring heart rate.

Here's where you can find these metrics within the app:

BOOM!

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Heart Rate

Near-Perfect Fit with ECG
 $r^2 = 0.996$

HRV

Very High Fit with ECG
 $r^2 = 0.980$

And here's what those results look like in the raw data:

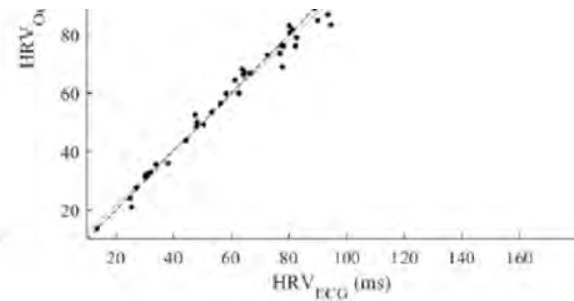
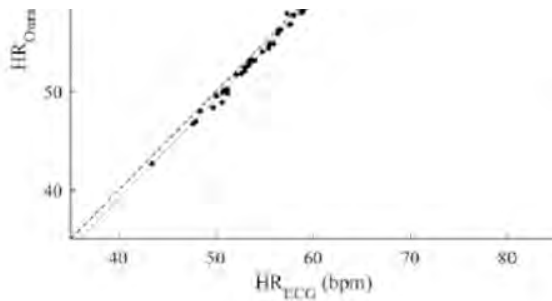
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Oura's Nighttime RHR and HRV Graphs Show Very High Agreement with ECG

In addition to the single score you get for RHR or HRV, Oura also provides a graph of your data throughout the night. These graphs are made up of tons of data points that each represent a 5-minute segment of your data, connected over time.

When you compare these segments to ECG data for individual nights, the agreement between these 5-minute segments is high for both RHR and HRV but shows more higher variation than the nightly values, depending on the individual.

Here's where you can find this data within the app in your RHR and HRV graphs for the night:

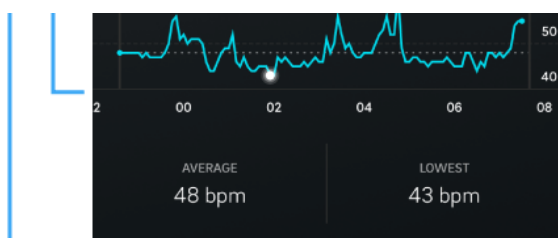
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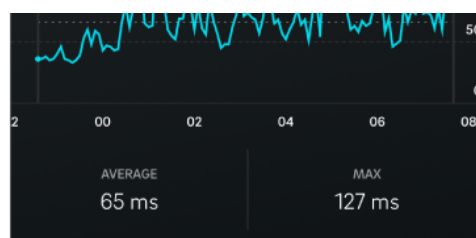
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HR Graph

$r^2 = 0.923$ for user with high agreement with ECG



HRV Graph

$r^2 = 0.922$ for user with high agreement with ECG

And here's how those values look within the raw data when you look at the variability between different types of individuals whose data is more or less likely to match when you compare Oura and ECG.

For example, for **an individual with high agreement**, the relationship between these 5-minute segments is very high for both RHR ($r^2 = 0.923$) and HRV ($r^2 = 0.922$). How can you tell? The graphs look nearly identical between the values from Oura (PPG) and ECG:

BOOM!

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with high agreement

The $r^2=0.923$ indicates PPG values correspond extremely well with the ECG values.

with high agreement

The $r^2=0.922$ indicates PPG values correspond extremely well with the ECG values

For an individual with typical agreement, the results are similar but show more variation. This is the case for the average Oura user. The agreement varies from person to person and night to night. Overall, the relationship shows very strong alignment between ECG and Oura (PPG) values for 5-minute segments for both RHR ($r^2 = 0.918$) and HRV ($r^2 = 0.827$).

Once again, the graphs look extremely similar:

INDIVIDUAL WITH TYPICAL AGREEMENT

Nighttime heart rate measured with the Oura ring and ECG

One night of data from an individual with typical agreement

The $r^2=0.918$ indicates PPG values correspond extremely well with the ECG values.

Nighttime HRV measured with the Oura ring and ECG

One night of data from an individual with typical agreement

The $r^2=0.827$ indicates PPG values correspond well with the ECG values

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CHIEF SCIENTIST, HANNU KINNUNEN, WHO LED THE STUDY.

“Think about it for a second: we compared a 4-gram smart ring with a medical grade ECG device and saw how well it holds up. This level of accuracy opens up new possibilities for understanding what state your body is in.”

Despite the ring’s capability to track even the smallest changes, Hannu Kinnunen wants to remind everyone that it’s the big picture that counts: *“It’s not enough to know that your heart rate is, say, 52 bpm with zero-point-something accuracy. What’s meaningful is that Oura lets you see cause and effect: you start exercising and your HR drops by 5 bpm, or you get sick and your HRV drops by half and your HR jumps by 10 bpm. That’s why accuracy in the long term becomes meaningful.”*

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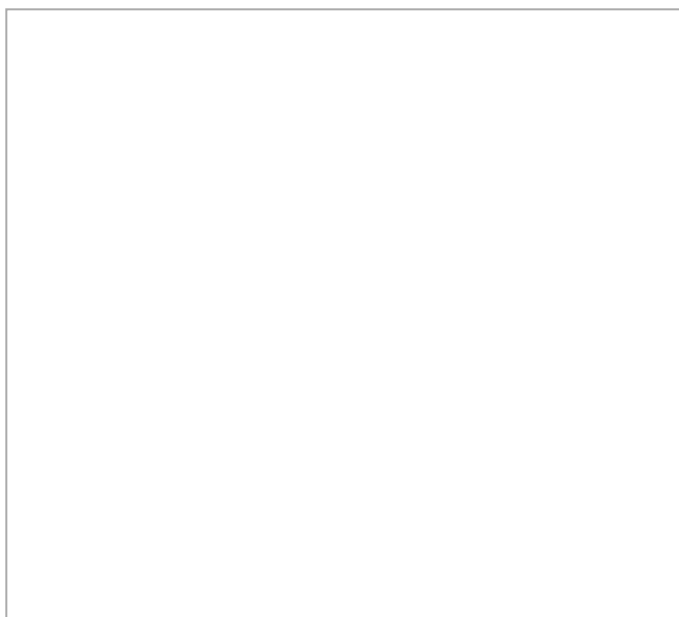
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