On Oura ring data

Intro: I have had an Oura ring for just over a year now, and I thought I would post some lessons learned, and show some data. Until now I haven’t looked at the medium/long term trends, and I only regularly checked the app for the first monthFootnote1. I am most interested in looking at sleep quality and resting heart rate as a measure of fitness.

Relevant terms and data pointsFootnote2:

* Sleep score (0-100): An Oura calculated score capturing total sleep quality, using various parametersFootnote3.
* Readiness score (0-100): An Oura calculated value for readiness, analogous to sleep score, with different contributing parametersFootnote4.
* Resting heart rate (bpm): Average resting heart rate whilst sleeping. For me this is ~43bpm but for the population it is 50-60bpm, and within a given individuals range lower is always betterFootnote5.
* Heart rate variability balance: Average waking hour heart rate variability (HRV), where HRV measures the difference in timing of your heart beats. The science of HRV is complex but the general claim is that a high HRV indicates a well-rested state. Moment to moment the true demands on the heart fluctuate, and ideally the heart fluctuates in tandem. Somewhat counterintuitively, a tightly fixed heart rate is a sign of fatigue.
* Deep sleep time (min): Associated with physical repair/growth. Deep sleep is good.
* REM sleep time (min): Rapid eye movement, associated with memory, learning and creativity. REM sleep is good.
* Total sleep time (min): Self-explanatory.

More on resting heart rate: There are genetic differences as some people have larger stroke volumes (~bigger hearts) giving lower resting heart rates and lower max heart rates, and vice versa. For reference my max heart rate is ~182bpm, which is on the low side for my age/fitness level. Some elite athletes have max heart rates of 210bpm and resting heart rates of ~30bpm, which indicates insane aerobic capacity. Given the genetic variance the important thing is to be slowly bringing down your resting heart rate over time (or at least not seeing it massively increase as you age) and to be improving your power output or speed at higher heart rates. You shouldn’t be trying to increase your max heart rate, or claiming “elite health status” for winning the genetic lottery for having a large stroke volume causing a low resting HR.

On sleep score: Subjectively sleep score correlates with next day cognitive function and work capacity, but to me a 95-sleep score feels no better than 85. Sleep score has no correlation with next day HRV balanceFootnote6 and next night resting HR, and I’m not sure that the Oura team could say that a 95-sleep score leads to better X where X is a future measured variable.

On to my personal takeaways:

* Your consistent caffeine intake negatively affects sleep, but it is single day increases in caffeine that have a more pronounced effect.
* Coffee (which is not just bitter caffeine water) is much worse than tea or “pure” caffeine.
* You really can physically outwork a massive caffeine intake.
* Low carb dinners improve sleep, as does earlier last mealtime.
* The best way to get a great sleep score on a given day is to have a poor sleep the night before. Lower caffeine, lower stress, and meal timing and composition also help, in descending order of impact.
* Oura really can catch illnesses before you do.

The last point is the most interesting, and the one that needs data – not just an explanation – to know. See plots below.

A graph showing a line

AI-generated content may be incorrect.

*Resting HR with illness/alcohol*

A graph with blue lines

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*HRV Balance with illness/alcohol*

A graph of a graph

AI-generated content may be incorrect.

*Readiness Score with illness/alcohol*

By the eyeball test we can see that periods of higher alcohol intake negatively affect resting HR, HRV balance and readiness, as does illness. I can also say that for both periods my Oura was giving me poor readiness scores prior to me feeling ill, although I failed to act on it. I can also say that after the July 2024 ill period I got back to training too quickly and remember failing easy workouts on the bike, which you can see in the post-illness massive drop in HRV balance. Or that at least is my explanation. Also note that whilst the coloured bands seem to negatively affect the measures, the charts are not fully explained by them. There are short and long-term trends not due to illness or alcohol. They are also not due to exercise.

Regarding exercise data, I did look at the activity balance metric but unfortunately the Oura app doesn’t seem to pull in all Strava data consistently, and I can’t be bothered getting it from the Strava API as I’m guessing that the short-term effects of cardio are drowned out by the illness and alcohol effects. Also, periods of exercise heroics will decrease HRV balance.

On Skewness:

A group of graphs with different colors

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*Histograms of relevant params*

I would have guessed that the two scores skew lower. What this means is that for the occasional terrible night’s sleep there is not a counterbalancing amazing night’s sleep. No matter how much you try you cannot make up for a poor night’s sleep (of say ~40 sleep score) with a night of 120 sleep score. I would also guess that HRV balance, deep sleep, and REM sleep also skew left, and that resting HR skews right, using the same logic.

We can see however that deep and REM sleep are symmetrical in shape. Not only that, my REM data is normally distributed.

A graph of a graph

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*QQ plots of deep and REM sleep*

Something else I would not have guessed is the very weak correlation between deep and REM sleep.

A diagram of a sleep

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*REM deep sleep scatterhisto*

For a given deep sleep value REM can fluctuate by ~3x, and for a given REM value deep sleep can fluctuate by ~2x. You cannot say that X total sleep time will give you Y REM sleep and Z deep sleep! I would not have guessed this.

More to follow.

Footnote1 I think it does a poor job of calling out weeklong trends and general out of the norm behaviour. It overly focuses on last night’s values and isn’t opiniated enough when it thinks you are coming down with something or needing to stay rested.

Footnote2 If you are an Oura user you can view and download a csv of your data from the Oura website. I pulled it from the API.

Footnote3 Total sleep time, deep sleep time, REM sleep time, efficiency, latency, restfulness

Footnote4 activity balance, body temperature, HRV balance, previous day activity, previous night, recovery index, resting heart rate, sleep balance

Footnote5 Unless it’s so low that you in danger of having a heart attack in the middle of the night, which was a worry in the glory days of EPO use in professional cycling, where the (unsubstantiated) rumour had cyclists supposedly getting up in the middle of the night to ride their bikes to get their heart rate up to stop their blood become haemoglobin custard.

Footnote6 HRV balance is heavily correlated to prior night resting heart rate, unsurprisingly.

Some predictions:

* Before even looking at the data I have some predictions. I would guess that the two scores skew lower. What this means is that for the occasional terrible night’s sleep there is not a counterbalancing amazing night’s sleep. No matter how much you try you cannot make up for a poor nights sleep (of say ~40 sleep score) with a night of 120 sleep score.
* I also guess that HRV balance also skews left, and that resting HR skews right, using the same logic.
* I’m guessing that there is this abstract thing called ‘good sleep’, and that deep and REM sleep are well correlated. Bad sleep lowers both, good sleep increases both.
* Sleep score is the best predictor of next day HRV balance.

*Note: One of these predictions is wrong, can you guess?*

On the data:

Let’s start with histograms for all params. I have doubled up the graphs where sensible.

A group of graphs with different colors

AI-generated content may be incorrect.By the eyeball test it looks like my guesses were correct on skewness. Looking at the REM and deep sleep chart it’s interesting that Deep sleep is more consistent. REM sleep varies more. The lack of skew on both is somewhat surprising to me.

Let’s see how correlated REM is to deep sleep:

A diagram of a sleep

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By the eyeball test it is surprising how weakly correlated they are. For a given deep sleep value REM can fluctuate by ~3x, and for a given REM value deep sleep can fluctuate by ~2x. You cannot say that X total sleep time will give you Y REM sleep and Z deep sleep! My guess was wrong.

Is prior night resting heart rate a good predictor of next day HRV balance?

A diagram of a graph

AI-generated content may be incorrect.

Yes. Also note there is something suspicious going on with the HRV balance metric where it is creating clean vertical distributions around certain numbers. You can see this clearly at a HRV balance of 82.

Is Sleep score a superior predictor of next day HRV balance vs the individual sleep score components?

[SUMMARISE R2 values]

Can two weeks of beyond normal cardio bring down resting HR? Also was it enough to bring down HRV balance?

Over the space of 12 days in December (05/12 – 16/12) I did 24 hours of cardio, followed by 11 days of zero exercise. What happened to resting HR and HRV balance over this time?

On illness and drinking:

* I was ill 12/01/2025 to 24/01/2025.
* I was on holiday 19/12/2024 to 03/01/2025
* I was travelling 05/07/2024 to 23/07/2024
* I was ill 9/07/2024 to 23/07/2024

Lessons:

* Of course, caffeine negatively affects sleep, but it is increases in caffeine that have a more pronounced effect.
* Coffee (which is not just bitter caffeine water) is much worse than tea or “pure” caffeine.
* You really can physically outwork a massive caffeine intake.
* Low carb dinners improve sleep, as does earlier last mealtime.
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