evinlo

EVINLO EXPLAINERS

Stress, explained

How Evinlo reads your waking day in 15-minute steps and shows when your heart rate at rest sat above your own usual level, without ever turning stress into a score.

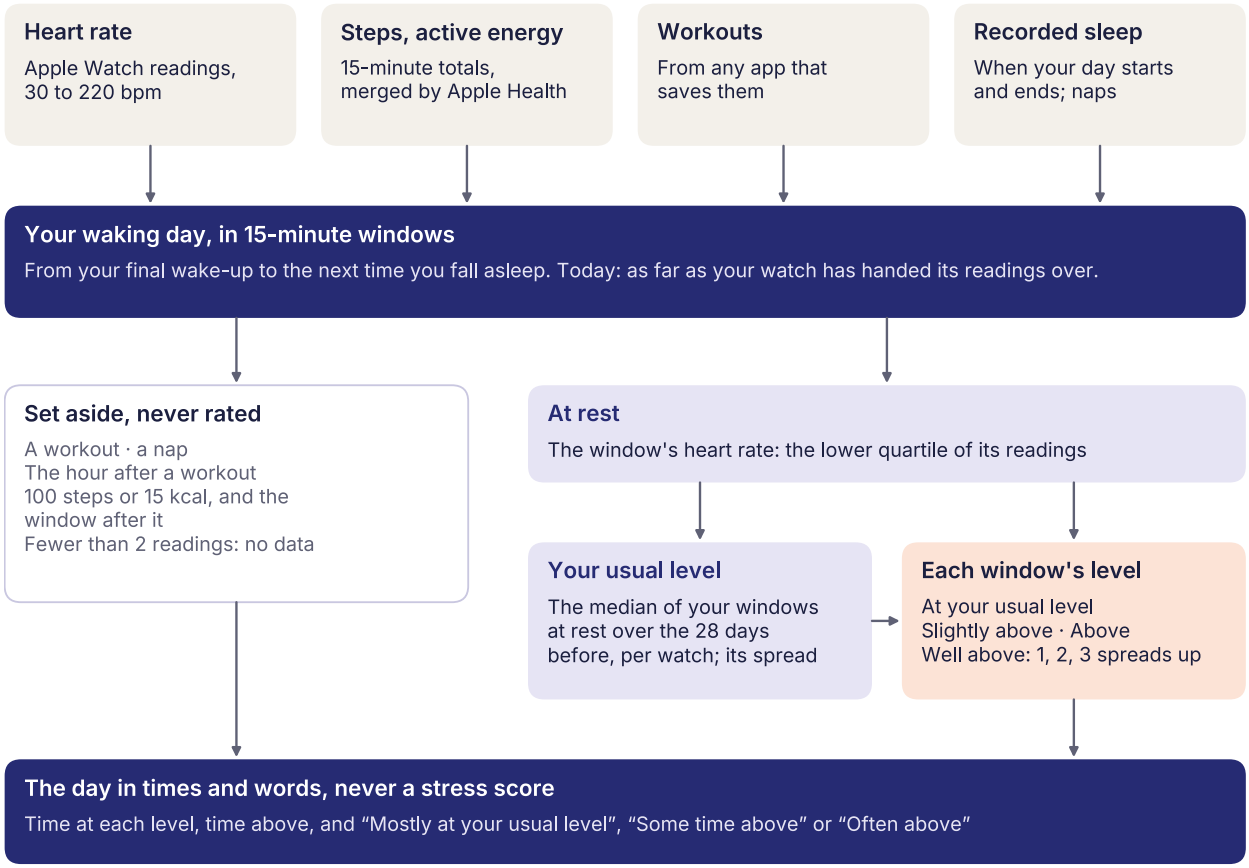


ALGORITHM
Stress 1.0.0

WRITTEN
October 2026

The one-minute version

Stress in Evinlo means **physiological stress**: stretches of your waking day when your heart rate **at rest** sat above your own usual daytime level. It does not measure emotions, and it cannot tell excitement from worry. The page is called **Recovery and stress** because it shows both: the time above your usual level, and the stretches back at it.



How a day becomes the Recovery and stress page. Every window of 15 minutes is either set aside or read at rest; a window at rest is compared with your own usual level and gets one of four levels; the day is told in times and words.

IN SHORT

- **Only at rest.** Movement, workouts, naps and the time after them are set aside, never rated and never filled in.
- **Against your own usual level.** The middle of your heart rate at rest over the 28 days before, kept per watch.
- **Four levels, counted in time.** At your usual level, slightly above, above and well above. Only “Above” and “Well above” count as time above.
- **Words, never a number.** “Mostly at your usual level”, “Some time above” or “Often above”. There is no stress score.
- **Never “stressed”.** Evinlo says what your heart rate did, not how you felt, and sends no stress notification.

What goes in

What	Where it comes from	What Evinlo uses it for
Heart rate	Apple Watch only; readings from 30 to 220 bpm	The heart rate at rest of each 15-minute window
Whether a reading was taken in motion	Apple Watch tags each reading	Readings in motion are left out of a window's value; many of them mark the window as movement
Steps and active energy	Apple Health's totals per 15 minutes, which merge your iPhone and your watch	Telling movement from rest
Workouts	Any app that saves workouts to Apple Health	Setting a workout and the time after it aside
Recorded sleep	The night and its naps, from the sleep area	When your waking day starts and ends; naps are set aside

Evinlo never adds up what several devices counted: two devices counting the same steps would look like twice the movement. Everything about a day depends on that day's own data, so a day that is over keeps its facts.

What stress does **not** use: heart rate variability by day (too sparse on most watches, and where it is dense it mostly repeats the heart rate), caffeine, alcohol, State of Mind, mindful sessions, resting heart rate, sleeping heart rate and Readiness. No setting and no answer moves your day.

Why there is no stress score

A daily stress number would mostly follow the day's overall heart-rate level rather than what happened in it. It would rise with movement, fall with how much of the day could be read, and wobble for most of the day. In a study of 1,002 people over five days, the heart rate during self-reported high stress was only a few beats higher than without stress (Smets et al., 2018). In 781 students over three months, a wrist device's stress measure showed very weak to no association with self-reported stress for most of them (Siepe et al., 2025).

So Evinlo shows what the data supports: **when** your heart rate at rest was above your usual level, **for how long**, and **how much** of the day could be read.

How it works, step by step

Step 1: your waking day, in windows

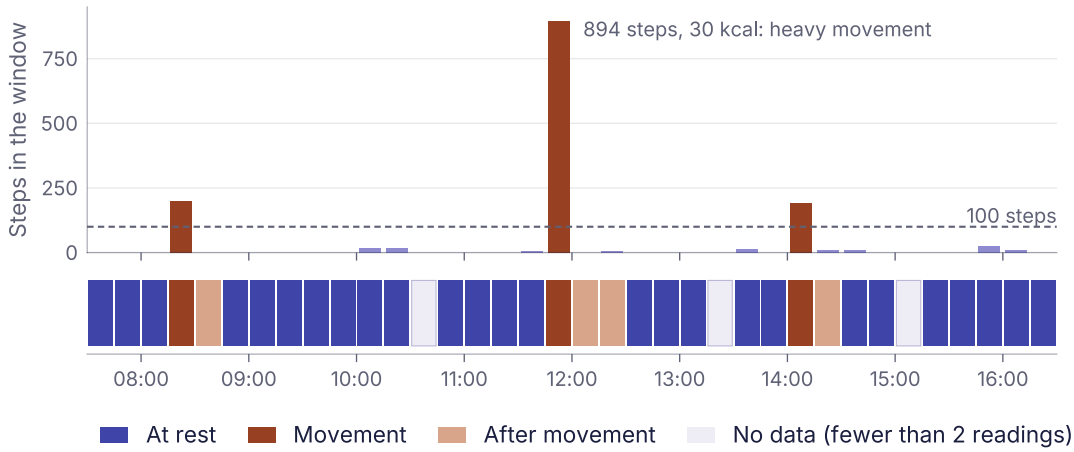
- **The day** runs from your final wake-up to the next time you fall asleep. Where a night was not recorded, the day starts at your usual wake-up time (the median of the usable nights of the 14 days before) and, for an earlier day, ends at your usual time of falling asleep. Without any such night it runs from 07:00 to 23:00. The page says which of the three it is.

- **Today stays open.** It is read as far as your watch has handed its readings over, so it ends, for now, with the last window that holds a reading. Today's readings arrive in batches; this keeps a gap from appearing that fills in minutes later.
- **Windows** are 15 minutes long and start on quarter hours. Only whole windows exist: Maya woke at 07:29, so her first window starts at 07:30. An earlier day shorter than two hours has none.

Step 2: what is set aside

Each window gets one **basis**, the reason it is read or set aside: the first row of this table that applies. A window that is set aside is never rated and never filled in.

Order	Basis	Rule
1	Workout	The window overlaps a workout by at least a second
2	Asleep	It overlaps a nap you recorded during the day
3	After a workout	It starts less than 60 minutes after a workout ended
4	Movement	100 steps or more, or 15 kcal of active energy or more, or at least two readings taken in motion that make up at least half of its readings
5	After movement	The window after a movement window; the two windows after heavy movement (400 steps or 40 kcal)
6	No data	Fewer than 2 readings
7	At rest	Everything else



Maya's waking day so far, from 07:30 to 16:30: 36 windows. The bars are the steps of each window; the row below is each window's basis. Three windows held 100 steps or more. The one at 11:45 held 894 steps and 30 kcal, heavy movement, so the two windows after it are set aside too.

On Maya's day, 3 windows were movement and 4 more followed one. Three windows had fewer than two readings: no data. The other 26 were at rest.

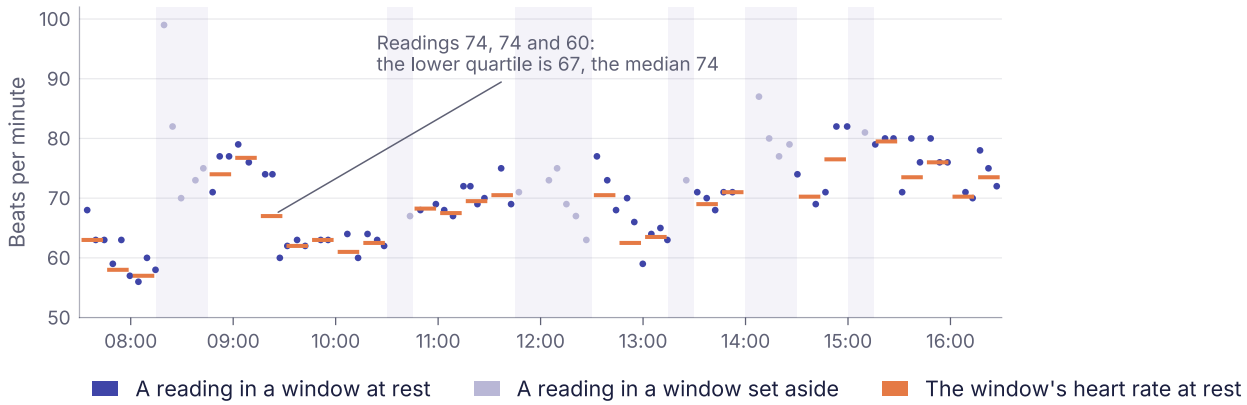
After a workout, until the heart rate has settled. Heart rate stays raised for hours after harder exercise (Stanley et al., 2013). From the second hour on, a window at rest stays set aside until the first one that reads at your usual level; that window and the later ones are rated. Movement in between does not end the wait, a later workout starts it again, and after four hours everything is rated.

Without any steps and active energy in Apple Health for the day, nothing is rated: rest cannot be told from movement.

Step 3: the heart rate at rest of a window

A window at rest needs at least two readings from Apple Watch. Its value is the **lower quartile** of those readings, the value a quarter of the way up from the lowest, not their median. Three reasons:

- a watch that reads rarely reads while you are still,
- a watch that reads often also catches the short walk inside a window,
- and a heart rate raised at rest raises every reading, the low ones too.



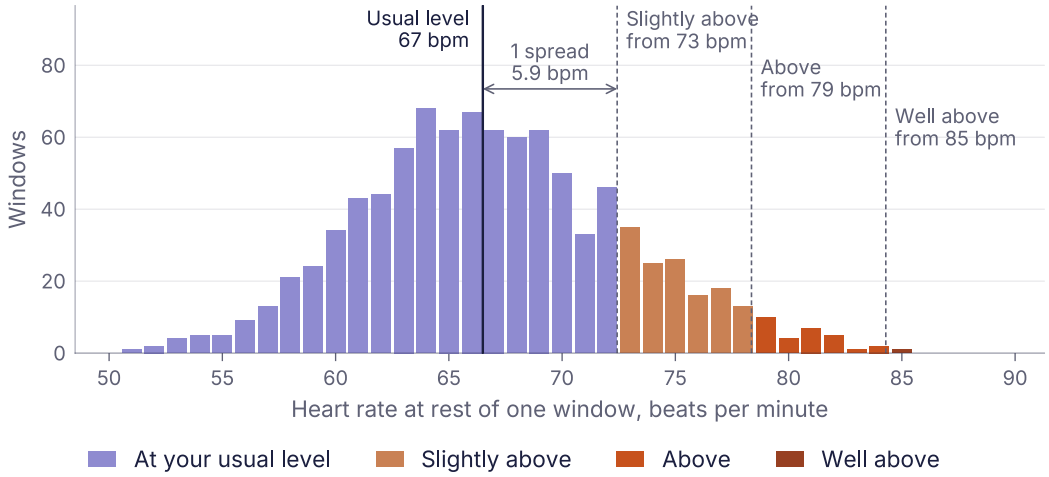
Maya's heart-rate readings from 07:30 to 16:30, and the value of each window at rest. Shaded windows are set aside; their readings count for nothing. In the window at 09:15 one low reading pulls the value down: a heart rate that is truly raised at rest would raise that one too.

Take Maya's window at 09:15. Her watch read 74, 74 and 60. The lower quartile is 67 bpm, while the median 74 would have followed the two higher readings. Readings that the watch tagged as taken in motion never enter the value.

Step 4: your usual level

Your **usual level** is your own daytime heart rate at rest:

- **The pool:** the windows at rest of the 28 days before the day, without the windows in the four hours after a workout, and without days that lack movement data. A day counts when it gives at least 12 such windows (three hours).
- **Per watch.** A window is only ever compared with windows of the same watch generation, the model of watch that Apple Health records with each reading. A watch of another generation starts again; nothing is merged or shifted between watches.
- **The centre** is the median of the pool. **The spread** is 1.4826 × the median absolute deviation (a robust cousin of the standard deviation), never below 1.4826 × 3 bpm (4 bpm while the level is early).
- **How much is needed:** no levels before 7 such days, an early reading from 7 to 13, established from 14.
- **No look-ahead.** The day itself and later days never enter its level.



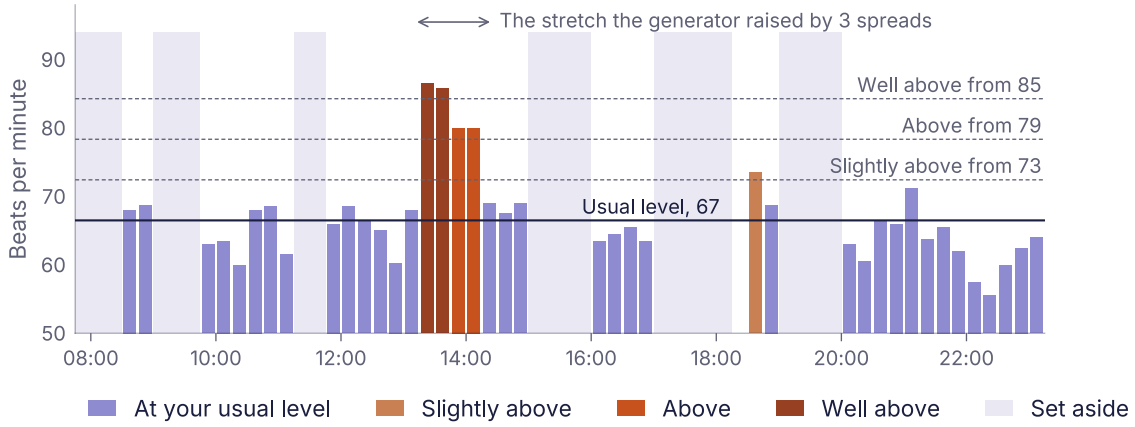
Maya's 935 windows at rest from 27 of the 28 days before 13 October. Their median is her usual level; each dashed line is one more spread above it. The colour of a bar is the level a window of that heart rate gets.

For Maya on 13 October that is 935 windows from 27 of the 28 days. Their median is 66.5 bpm, their median absolute deviation 4 bpm, so one spread is 5.9 bpm. The page shows her usual level as 67 bpm, in whole beats, and where each level starts, rounded up: slightly above from 73 bpm, above from 79 bpm and well above from 85 bpm.

Step 5: four levels

Distance from your usual level	Level
below 1 spread	At your usual level
1 to below 2 spreads	Slightly above
2 to below 3 spreads	Above
3 spreads or more	Well above

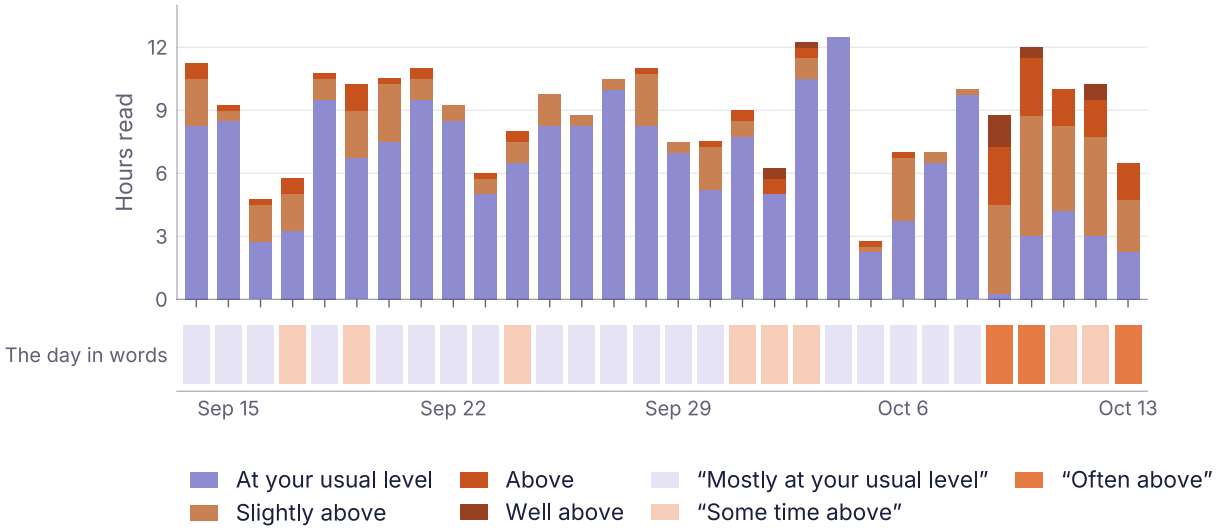
The levels are one-sided: a heart rate below your usual level is at your usual level. **Slightly above** is shown and never counted as time above. Standing instead of sitting adds a few beats on average (van de Ven et al., 2025); with the smallest spread, "Above" starts about nine beats above your usual level, beyond that.



A whole day of Maya with a raised stretch (Thursday 8 October). The generator raised her heart rate at rest by three spreads from 13:13 to 14:23. Evinlo read four windows in a row above her usual level, from 13:15 to 14:15. The bar height is each window's heart rate at rest, its colour the level.

Step 6: the day in times and words

- **Times.** The time at each level, the time read, what was set aside and why, and the gaps. They always add up to the time you were awake.
- **A stretch above your usual level:** two or more windows in a row above or well above.
- **The time above** counts a window above your usual level only when it is part of a stretch or holds at least three readings. A single window of two readings can be a whole level off; it stays on the timeline and is not counted.
- **The day in words**, from 8 rated windows: **“Often above”** when the time above is at least a quarter of the rated time and at least an hour; **“Some time above”** when there is a stretch, or the time above is at least a tenth of the rated time and at least half an hour; otherwise **“Mostly at your usual level”**. A day whose own watch has no level yet has no words.
- **Stretches at your usual level:** four or more windows in a row at your usual level (an hour).
- **Your usual time above:** the median time above of the whole days among the 28 before that have words, once 14 of them do. An earlier day is compared with it in five steps: under 15 minutes apart is “about your usual”, 45 minutes or more is “much” more or less, anything between “a little”. Today is never compared: part of a day against a whole day says nothing.
- **Above now** (today only): the last two windows are above your usual level, and the last one ended half an hour ago at most. The page then asks “Time for a short pause?”.
- **Little coverage:** a whole day read for less than a quarter of its waking time keeps its words and says so.



The 30 days up to 13 October of Maya in a tense week: on the last five days the generator raised her heart rate at rest by 1.5 spreads all day. Each bar is the time read that day, by level (the last one is the day so far); the row below is the day in words.

In the tense week, 3 of the 5 days read “Often above” and the other two “Some time above”. The week moves her usual level only a little, from 67 to 68 bpm, and “Slightly above” starts at 75 bpm instead of 73: the usual level follows you slowly. A tense month would move it further, and the page says so.

A worked example

Meet **Maya**, the synthetic person of every explainer: the app's generator made her nights and days, and no part of her comes from a real person. She wears her watch day and night, apart from a short charge. It is **Tuesday, 13 October 2026, at 16:30**, the moment of the screenshots in the next section.

Her day so far

Maya woke at 07:29. By 16:30 her day holds 36 windows, 9 hr. This is how they divide:



Maya's waking day so far, by what each window was read as. The parts add up to her 9 hours awake.

She spent 4 hr 45 min at her usual level, 1 hr 30 min slightly above and 15 min above. Another 1 hr 45 min were set aside for movement and the windows after it, and 45 min had fewer than two readings. So Evinlo could read 6 hr 30 min of her 9 hr awake, or 72%.

Her usual level rests on 27 of the last 28 days: a median of 66.5 bpm and a spread of 5.9 bpm. So each level starts at

$$66.5 + 1 \times 5.93 = 72.4 \qquad 66.5 + 2 \times 5.93 = 78.4 \qquad 66.5 + 3 \times 5.93 = 84.3$$

and the page rounds those up to 73, 79 and 85 bpm.

One window above her usual level. At 15:15 her watch read 79, 80, 80. The lower quartile is 79.5 bpm:

$$z = \frac{79.5 - 66.5}{5.93} = 2.19$$

That is 2.19 spreads above her usual level: **Above**. The window stands alone, so it is not a stretch, but it holds 3 readings, so it counts: **15 min above so far**.

The day in words. She has 26 rated windows, more than the 8 that words need. Her 15 min above are 3.8% of the rated time, far from a tenth, and there is no stretch: **"Mostly at your usual level so far"**. Over a whole day she is usually about 15 min above; today is not compared with that, because the day is not over.

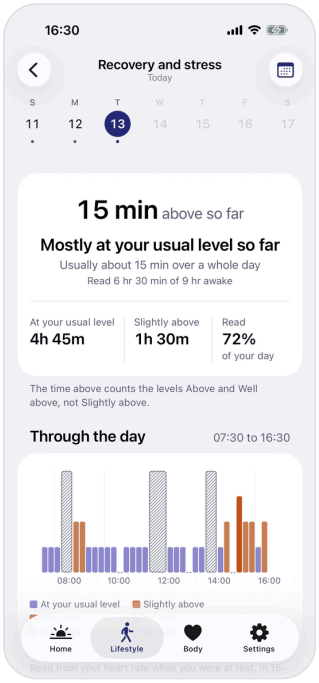
A day with a raised stretch

Now keep Maya's nights and let the generator raise her heart rate at rest by three spreads, for 45 to 90 minutes, on about four days in ten. On Thursday 8 October that stretch ran from 13:13 to 14:23.

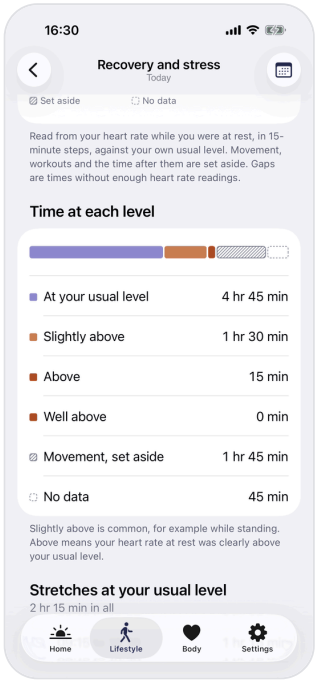
Her first window started at 07:45. Evinlo read 10 hr of 15 hr 30 min awake. Four windows in a row read above or well above, 86.5, 85.75, 80, 80 bpm: a stretch from 13:15 to 14:15, so **1 hr above**. That is 10% of her rated time, short of the quarter "Often above" needs, and the stretch makes it **"Some time above"**. On her whole days she is usually 30 min above, so the page says "A little more than your usual 30 min". The edges of the raised stretch fall into windows whose lower quartile stayed at her usual level, which is why Evinlo reads an hour of a stretch that lasted seventy minutes.

What you see in the app

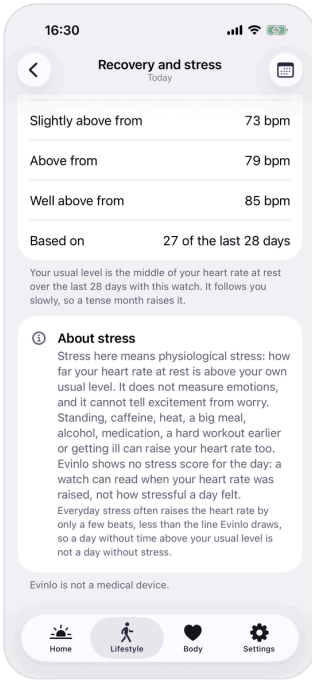
Screenshots of the app's synthetic data mode at 16:30 on Tuesday 13 October. Top: Maya's ordinary day. Bottom: a whole earlier day with a raised stretch in the morning, the tense week (1 hr 45 min above so far), and a new person in the first week.



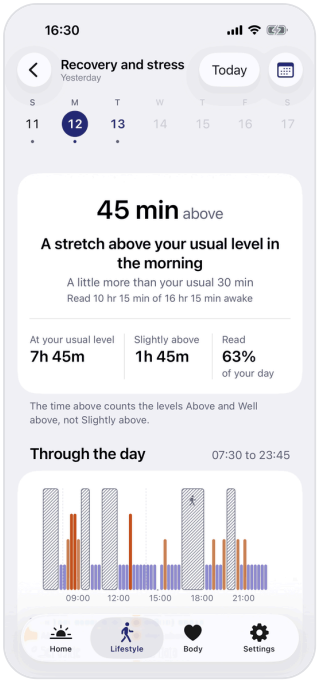
15 min above so far: "Mostly at your usual level so far".



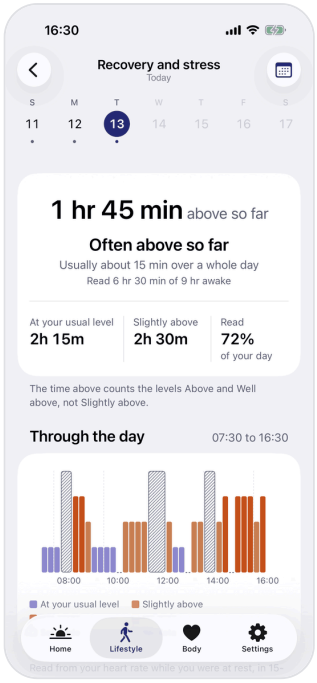
Time at each level, adding up to her 9 hours awake.



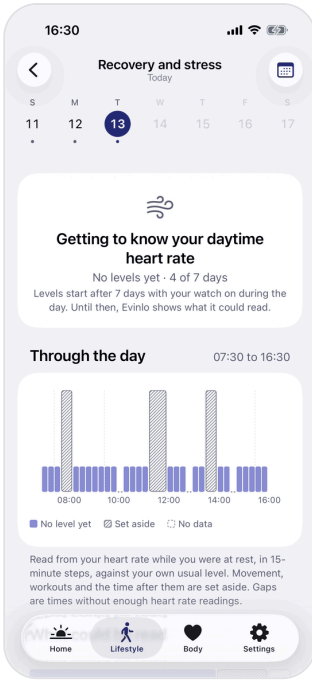
Her usual level and where each level starts.



A whole earlier day, with a stretch in the morning.



The tense week: "Often above so far".



The first week: no levels yet.

The chart draws every window: a bar at its level, hatched where it was set aside, empty where there was no data. Today's page may add one calm idea under "What you can do", such as "Time for a short pause?" or "Settled again". It names a measurement, never a mood.

Honest limits

- **A day without time above is not a day without stress.** Everyday stress often raises the heart rate by less than the line Evinlo draws. That is why the lowest level is named for the measurement and not "calm".
- **What reads above is often not stress.** Posture, food, caffeine, heat, medication, a hard workout earlier or getting ill all raise the heart rate at rest. Posture cannot be seen at all: a standing desk can read "Slightly above" for hours, which is why that level never counts.
- **Much of a day cannot be read.** On the synthetic person, about half of the waking windows of an ordinary day can be rated, about seven in ten of a day at a desk. What limits whether a raised stretch is seen is coverage, not the line: of a clear stretch of 45 to 90 minutes, about six windows in ten can be rated, so such a day reads as something other than "Mostly at your usual level" on about two days in three.
- **Right after a workout, a raised heart rate stays unseen** until it has once read at your usual level.
- **A watch reads rarely.** One window often rests on two or three readings, which is why a lone window of two readings is not counted.
- **Your usual level follows you.** A tense week moves it by little, a tense month moves it more.
- **Without Apple Watch, or without steps and active energy, nothing is rated.** Evinlo never says that your watch was not worn; it says what was recorded.
- **Evinlo is not a medical device.** It never says that you are stressed, and it sends no stress notification.

For the experts

Version

`StressAlgorithm.version` is **1.0.0**. Every day carries it (`StressDay.algorithmVersion`). A change to any rule or parameter below is a new version, made through a proposal and a replay (`docs/scoring.md`, “Changing an algorithm”).

Every parameter

Parameter (`StressParameters.v1`)	Value	What it does
`windowMinutes`; `minimumReadings`	15; 2	Window length; usable readings a window needs for a value
`plausibleHeartRate`	30…220 bpm	Readings outside are dropped
`valueQuantile`	0.25	The window’s value is this quantile of its usable readings
`movementSteps`; `movementEnergy`	100 steps; 15 kcal	A window with either is movement
`heavySteps`; `heavyEnergy`	400 steps; 40 kcal	Heavy movement
`bufferWindows`; `heavyBufferWindows`	1; 2	Windows set aside after movement; after heavy movement
`afterWorkoutMinimumMinutes`	60	Always set aside after a workout ends
`afterWorkoutMaximumMinutes`	240	Settling ends; also the hours after a workout left out of the pool
`settleZ`	1.0	The first window below this distance ends the settling
`referenceDays`; `referenceDayMinimumWindows`	28; 12	The days a usual level looks back on; windows a day must give
`provisionalDays`; `establishedDays`	7; 14	Days for an early and an established level
`spreadFloorEstablished`; `spreadFloorProvisional`	3.0; 4.0 bpm	The smallest median absolute deviation, before × 1.4826
`slightlyAboveZ`; `aboveZ`; `wellAboveZ`	1; 2; 3	Where each level starts, in spreads
`patternMinimumWindows`	8	Rated windows the words need
`stretchWindows`; `usualStretchWindows`	2; 4	A stretch above; a stretch at your usual level
`countedSingleWindowMinimumReadings`	3	Readings a lone window above needs to count
`someTimeAboveShare`; `someTimeAboveMinutes`	0.10; 30	“Some time above” without a stretch
`oftenAboveShare`; `oftenAboveMinutes`	0.25; 60	“Often above”
`usualDays`; `usualMinimumDays`	28; 14	The usual time above: days looked back on; days with words it needs
`historyDays`	30	Days of the chart
`aboveNowFreshMinutes`	30	“Above now”: the last window ended at most this long ago

Parameter (`StressParameters.v1`)	Value	What it does
`minimumDayMinutes`	120	An earlier day shorter than this has no windows
`noHeartRateAfterMinutes`	120	Today says “no heart rate” only after this long
`watchLookbackDays`	14	Days without any watch reading before “No heart rate found”
`usualClockNights`	14	Days behind the usual wake-up and sleep times
`assumedWakeHour`; `assumedSleepHour`	07:00; 23:00	The day without any recorded night
`assumedDayHours`	16	The length an open day is drawn at without a plan (drawing only)
`movementDataMinimumWindows`	8	Windows with a heart rate before “Evinlo can’t see your movement”
`UsualComparison.timeAboveAboutMinutes`; `timeAboveWellMinutes`	15; 45	The five steps of a day’s time above against the usual (`UsualComparison.timeAbove`)

Formulas

The value of a window, from its usable readings sorted $x_0 \le \ldots \le x_{n-1}$, $n \ge 2$, with $p = 0.25\,(n-1)$:

$$v = x_{\lfloor p \rfloor} + \left(p - \lfloor p \rfloor\right)\left(x_{\lfloor p \rfloor + 1} - x_{\lfloor p \rfloor}\right)$$

The usual level of watch generation g, from the pool P_g of the 28 days before, with floor f (3 bpm established, 4 early):

$$c = \operatorname{median}(P_g), \qquad s = 1.4826 \times \max\left(\operatorname{median}_{x \in P_g}|x - c|,\ f\right), \qquad z = \frac{v - c}{s}$$

The page shows $\operatorname{round}(c)$ and $\lceil c + ks \rceil$ for $k = 1, 2, 3$. With A the counted windows above and R the rated windows of a day ($R \ge 8$), each 15 minutes:

$$\text{Often above: } \frac{A}{R} \ge 0.25 \text{ and } 15A \ge 60 \qquad \text{Some time above: a stretch, or } \frac{A}{R} \ge 0.10 \text{ and } 15A \ge 30$$

The order of operations

1. **Sleep** (stage A of the day pipeline) gives the night windows: onset, final wake-up and naps of every day needed, and today’s suggested bedtime.
2. **The waking days** (`WakingDay.bounds`): the day and each day behind it, from those night windows only.
3. **The facts of each day** (`StressEngine.facts`): the windows, their readings, value and 15-minute totals, and the basis of each window. They depend on the day’s own samples only; a day’s facts are final from the start of the day after the next and are then kept in the feature cache (kind `stressday`).
4. **The usual level** of every watch generation from the facts of the 28 days before (`StressEngine.references`).
5. **The day** (`StressEngine.day`): each window rated against its own watch’s usual level, the settling after workouts, stretches, time above, words, the state, “above now” and the usual level as shown. The page shows its levels.
6. **The history stage:** the facts of the 57 days before; each earlier day of the chart and of the last 28 worked out the same way; the usual time above from the final ones (`StressEngine.usualTimeAbove`); the day again with it; the 30 summaries of the chart.

No other area reads stress. The pipeline works stress out for the last 12 months; an older day says “Older than 12 months”.

Edge cases

State	When	What the page says
Day not started	Today, while the night still counts as in progress	“Your day hasn’t started yet.”
No heart rate found	No Apple Watch heart rate on the day or in the 14 days before it	What it found, never “needs Apple Watch”: a missing watch and heart rate it may not read look the same
Evinlo can’t see your movement	Heart rate in 8 windows or more, and no steps and no active energy	That it needs steps and active energy
No heart rate	No reading in the day’s windows; today only two hours after the day began	“No heart rate from your watch yet today.”
No levels yet	The day’s watch has fewer than 7 days behind its level; on a new watch “Getting to know your new watch”	“No levels yet · 4 of 7 days”
Too early, too little read	Fewer than 8 rated windows	“Too early to say”, “Too little could be read”

Also settled by the rules: on the day a watch changes, the old watch’s windows keep their levels and the day has no words; windows start on quarter hours of Unix time, so a clock change only adds or removes an hour of windows; a nap starts no buffer; a workout that ended before the day still counts for the hour and the settling after it.

Where it lives in the code

Paths under `Packages/EvinloKit/Sources/EvinloAlgorithms/` unless they say otherwise.

What	Where
Parameters, version, the engine’s entry points	`Contract/StressContract.swift`
The waking day; windows on quarter hours	`Stress/WakingDayLayout.swift`, `Stress/StressWindowGrid.swift`
Readings, a window’s value, what is set aside	`Stress/StressWindowReadings.swift`, `Stress/StressFactsBuilder.swift`
Your usual level; levels and settling	`Stress/StressReferenceBuilder.swift`, `Stress/StressWindowRating.swift`
Stretches, time above, words; states	`Stress/StressDaySummaryRules.swift`, `Stress/StressDayBuilder.swift`
Watch changes, final days, the usual time above	`Stress/StressEngine+Days.swift`
The stress stages of the day pipeline	`Pipeline/DayPipeline+Stress.swift`
The day as the app reads it; the words on screen	`Packages/EvinloKit/Sources/EvinloModels/Stress.swift`; `App/Evinlo/Data/Wording/StressWording.swift`

How it is checked

The evaluation tool (`Tools/EvinloEval`) replays the day pipeline day by day, without look-ahead, on synthetic people and on a developer's own Apple Health export, and judges these guardrails:

Guardrail	Rule
ST-H1 to H3	Two evaluations give identical days; nothing is read past the replay moment; a day worked out from the 28 days behind its level alone is the same day
ST-H4, H5	No rated window lies in a workout, the hour after one or a nap, holds movement or follows a movement window; no level without 7 days of the window's own watch, no words from fewer than 8 rated windows
ST-H6, H7	A day's times add up to its waking time, its windows follow each other without gap or overlap; a final day does not change when later days are added
ST-W1 to W8	Bands for a person's own data, reviewed, never a failure: windows rated, windows above, days "Mostly at your usual level"; movement must not leak into the levels; a change of watch; how often the level sits on its smallest spread; days with words; days read for less than a quarter
ST-S1, S2, S4	A calm synthetic person: at most 6% of rated windows above, 1.5% well above, 25% slightly above or more; at least 65% of days "Mostly at your usual level", at most 2% "Often above"
ST-S3	Inside a raised stretch of three spreads at least 80% of rated windows read above; of two spreads at least 50% above and 90% slightly above or more
ST-S5 to S9	A desk day and a very active day can be read; a new watch that reads higher has no level for 7 days and is then not read as time above; three of the five days of a tense week read as such, and the week moves the usual level by less than half a spread; without movement data nothing is rated; a new person has no level before the eighth day

On the synthetic person, about 3% of the rated windows of calm people read above their usual level and about one in six slightly above or more; eight to nine in ten of their days read "Mostly at your usual level". Inside a raised stretch of three spreads, nine in ten rated windows read above. Every figure and number of this explainer comes from `evinlo-eval export` on synthetic people, and the readings behind a window from `evinlo-eval synthesize` of the same person.

References

- Smets et al., *npj Digital Medicine* 1:67, 2018: heart rate in self-reported high stress, 1,002 people over five days.
- Siepe et al., *Journal of Psychopathology and Clinical Science*, 2025: a wrist device's stress measure against self-reported stress, 781 students over three months.
- van de Ven et al., *Psychophysiology* 62, 2025: how much standing adds to the heart rate.
- Stanley et al., *Sports Medicine* 43, 2013: heart rate stays raised for hours after exercise.
- Verkuil et al., *Annals of Behavioral Medicine* 50(5), 2016: heart rate variability falls beyond what movement explains while people worry.
- Apple's documentation: Apple Watch reads the heart rate during the day "when you're still" and tags each reading with whether it was taken in motion.
- The complete reference for every rule: docs/scoring.md, "Stress (v1)".

Spotted something unclear or wrong, or want to improve a rule? Evinlo is open source, and every rule can be changed through a proposal and a replay. Start at **evinlo.com/contribute**.