Aura Total Sleep System

Wake-up light & REM sleep tracker

Use ballistocardiography to measure and understand your sleep
The Withings Aura® Sleep Sensor uses ballistocardiography to measure variations induced by respiration rate, heart beats and the body’s movements during the night. It does this with clinical accuracy to analyze the structure of your sleep, as well as the presence in the bed and the number of wake-ups per night.

This analysis enables the Withings Aura® to:
• Differentiate an awake state from a sleep state - the periods in the bed sleeping - and awake.
• Measure the different sleep phases of your night.

The Withings Aura® will use the properties of red light to increase your melatonin, hormonal secretion that is named the “sleep hormone,” for its ability to induce sleep.

The Withings Aura® will use the measurements from the sleep sensor to wake you at the best moment of your sleep cycle so that you wake up refreshed. It will provide you an overview of your cardiovascular fitness and how well you recovered from stress and exercise by measuring your full-night resting heart rate.

The Withings Aura® bedside device will also track your environment’s temperature, luminosity and sound level to provide you with comprehensive insights to improve your sleep quality.
Withings® has developed the Withings Aura® Total Sleep System, a highly-innovative line of products that offer the unique ability to track sleep patterns and improve sleep quality in the bedroom.

The Withings Aura® Total Sleep System has two different parts. The first is a dock that emits light and sound gradually along with sensors that measure temperature, luminosity and sound levels. The second is a pneumatic sensor under the mattress. This sensor measures heart rate, respiratory rate and body movements. This data, analyzed using the algorithm developed by Withings®, provides analysis close to polysomnography - the gold standard for sleep monitoring. The established practice of polysomnography differs greatly, however, in that it involves wearing multiple electrophysiological sensors during the night, and therefore analysis is both costly and uncomfortable.

Why do I have to track my sleep?

Sleep is something that you spend one third of your life doing. It is a vital bodily function, like breathing or digestion. It plays an important role in learning, memorization and adaptability. It is also essential to your overall well-being[1]. Sleep enables us to recover from physical and psychological fatigue accumulated during the day[2]. But attaining your sleep quota can be difficult. The ability to sleep properly also decreases with age. In addition, environments in developed countries disturb your circadian rhythm and sleep[3]. This is due to excess heat, luminosity and noise[4]. Worse still, lack of sleep has been identified as a risk factor for several disorders such as high blood pressure and obesity[5,6].

The sleep phases

A night’s sleep is divided into two parts called NREM for Non-Rapid Eye Movement and REM for Rapid Eye Movement, also called «paradoxical sleep» during which we dream. The night begins with light sleep during which we are neither fully asleep nor fully awake. Body movements are infrequent and dreams may occur giving the feeling of being awake. We are sleeping but a small noise could easily wake us.

Deep sleep involves full body immobility. There is very little brain activity or reaction to external stimuli. Heart rate and breathing rate are slow and regular; the face is expressionless. Deep sleep phases are crucial times for the body to regenerate from physical tiredness.

In REM sleep, your face moves and is expressive. Although your eyelids are closed, your eyes move rapidly under the lids, indicating intense brain activity and dreaming. This stage allows a person to recover from psychological fatigue and stress. It is common to wake up suddenly in the morning at the end of a phase of REM sleep.
Dive into the science behind Withings Aura®

1. Discover how the Withings Aura® will help you to fall asleep and wake up

The Withings Aura® fall-asleep system emits a red light to help secrete melatonin and facilitate sleep[7]. Melatonin - also called the sleep hormone - is known to regulate our biological temporal rhythms. The rate of melatonin in the blood increases two or three hours before sunset. The red-light emissions can be accompanied by music and “colored” sounds[8] that have already proven their effectiveness in relaxing the mind and inducing quality sleep[9].

The wake-up system analyzes the best moment to wake you at the best time of your sleep cycle with a blue light that increases gradually to decrease melatonin production[10]. Exposure to light in the morning is known to help you wake up.

2. Discover how the Withings Aura® will help you to understand your sleep and improve your lifestyle habits

The Withings Aura® will provide you with a complete analysis of your night as soon as you wake up. Sleep duration, number of awakenings, but also sleep phase durations are useful insights to better understand your sleep. Furthermore, luminosity, noise and temperature sensors will help you to identify the causes of your sleep disorders. The World Health Organization recommends that sound levels should not be above 30 dba[11] in the bedroom and to sleep in a surrounding environment of around 18°C (64.4 °F) in temperature.

3. Use of ballistocardiography by the Withings Aura®

Sleep cycles have several specific patterns. For example, during REM sleep, the heart rate and respiratory rate increase and vary. Body movements concentrate around REM sleep, a period occurring on average every 90 to 100 minutes among adults[12]. During other phases, the deeper the sleep, the rarer the body movements and the lower the heart rate.

The Withings Aura® measures variations induced by respiratory rate, heart beats and body movements during the night to analyze sleep structure[13] as well as presence in the bed and number of awakenings per night. These measurements enable the Withings Aura® to differentiate between wakefulness and sleep, and periods in bed asleep and not asleep. It is also able to measure the time it takes you to fall asleep.

The method we use is called ballistocardiography. Each time the heart beats, the blood's acceleration generates a mechanical impulse that can be measured by the pneumatic sensor. This technique has already proven its effectiveness for the measurement of cardiac variability during clinical studies[14]. Similarly, several studies have showed the effectiveness of measuring heart rate variability to detect different sleep phases[15,16]. Ballistocardiography enables measurement of resting heart rate all through the night. This new measurement provides information about cardiovascular fitness[17].
Effectiveness of Withings Aura® Total Sleep System programs were evaluated using a validation research protocol designed by the “Centre du Sommeil de l’Hôtel-Dieu”, a sleep clinic in Paris, France. The study was conducted in 2006 on a group of men and women with no known sleep disorders.

The research protocol measured objective and subjective sleep quality for the entire group for 96 monitored reference nights without using the Withings Aura® programs, and 96 monitored test nights using both the fall-asleep and wake-up programs. Sleep and wake-up were measured prior, during and after the Withings Aura® programs using actimetry, sleep agendas, Spiegel scale, Stanford scale and Vis-Morgen scale. The results of the scientific study show significant improvement in sleep quality and morning energy when using the Withings Aura® programs. Notably, 79% of participants observed improvement in Morning Energy & Total Sleep Quality, and 74% of participants observed improvement in Clarity in the Morning when using the Withings Aura® programs.

Withings® worked with the University of Mannheim’s Otorhinolaryngology Teaching Hospital to develop and validate the sleep stage and sleep duration algorithms of the Withings Aura® Smart Sleep System’s sensor. The university’s sleep lab was used in 2014 to collect reference polysomnography recordings on 30 subjects. The sleep analysis from the polysomnography recordings of the 30 subjects was compared with the stages of sleep and sleep duration estimated by the Withings Aura® Sleep Sensor for the same patients and nights. Withings Aura® sleep analysis was found to agree well with the polysomnography (PSG) results in terms of the whole night’s division between sleep stages. A correlation coefficient of \( r = 0.81 \) for relative sleep stage duration was obtained with high statistical significance \((p<0.01)\). A mean difference of 10.7% was observed across the sleep duration of each subject’s night between polysomnography analysis and the Aura sleep sensor analysis. These results indicate that the Aura sleep analysis agrees well with polysomnography recordings with regards to the distinction between wakefulness and sleep. Precision and recall also demonstrate reliability of the Withings Aura® Sensor for recognizing wakefulness.

Good agreement has been observed between the Withings Aura® Total Sleep Sensor and polysomnography recordings, especially taking into account the variability observed in agreement between polysomnography scorers. Various research studies have shown that agreement in sleep stage assignment varies significantly between polysomnography scorers. For instance, Norman et. al. (2000) measured a mean agreement between scorers of 76% on subjects with no sleep-related complaints or sleep pathologies, the most favorable category of subjects. The accuracy of the Withings Aura® was assessed by Cohen’s kappa coefficient \( (0.41) \). It shows good correlation between Withings Aura® measurements and the gold standard[18].
Withings Aura® Total Sleep System: How to?

1. Place the sensor under your mattress
2. Sleep
3. Get a result

Understand your sleep
- Track your sleep stages
- Measure your environments (T°, sound, noise)
- Track your number of awake, night duration
- Analyze your night
- Measure your resting heart rate

Improve your sleep
- Sleep induced program, melatonin, sleep hormone
- Wake-up system, best moment of the cycle, wake up gradually
- Personalized insight

Improve your health
- Sleep enables us to recover from physical and psychological fatigue accumulated during the day
- The lack of sleep has been identified as a risk factor for several disorders as high blood pressure or obesity

Bibliography


Aura works with Spotify & Nest

Nest and Aura join forces for optimal comfort
With Spotify and Aura, wake up to the light you need and the music you love