- Mind and body

Why do we usually sleep at night? What happens when we don't sleep?

The Witness · 27 Jun 2024 · 7 · KARINE SCHEUERMAIER, ALISON BENTLEY, DALE RAE, FRANCESCO XAVIER GOMEZ-OLIVE CASAS, GOSIA LIPINSKA, JONATHAN DAVY, JOSHUA DAVIMES, NOMATHEMBA CHANDIWANA AND

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Recent sleep research breakthroughs

DAN DENIS

Twenty-six years. That is roughly how much of our lives are spent asleep. During the past decade, there has been a surge of interest from researchers in the nature and function of sleep. New experimental models coupled with advances in technology and analytics are giving us a deeper look inside the sleeping brain. Here are some of the recent breakthroughs in the science of sleep.

LUCID DREAMING

No longer on the fringes, the neuroscientific study of dreaming has now become mainstream.

U.S. researchers in a 2017 study woke their participants up at regular intervals during the night and asked them what was going through their minds prior to the alarm call. Sometimes participants couldn't recall any dreaming. The study team then looked at what was happening in the participant's brain moments before waking. Participants' recall of dream content was associated with increased activity in the posterior hot zone, an area of the brain closely linked to conscious awareness. Researchers could predict the presence or absence of dream experiences by monitoring this zone in real time.

Another development in the study of dreams is research into lucid dreams, in which you are aware that you are dreaming. A 2021 study established two-way communication between a dreamer and a researcher. In this experiment, participants signalled to the researcher that they were dreaming by moving their eyes in a pre-agreed pattern.

The researcher read out maths problems (what is eight minus six?). The dreamer could respond to this question with eye movements. The dreamers were accurate, indicating they had access to high-level cognitive functions. The researchers used poly-somnography, which monitors bodily functions such as breathing and brain activity during sleep, to confirm that the participants were asleep.

OUR BRAIN REPLAYS MEMORIES WHILE WE SLEEP

This year marks the centenary of the first demonstration that sleep improves our memory. However, a 2023 review of recent research has shown that memories formed during the day get reactivated while we are sleeping. Researchers discovered this using machine learning techniques to "decode" the contents of the sleeping brain.

A 2021 study found that training algorithms to distinguish between different memories while awake makes it possible to see the same neural patterns re-emerge in the sleeping brain. Another study, also in 2021, found that the more times these patterns re-emerge during sleep, the greater the benefit to memory. Research has also shown that sleep restructures our memories to form more cohesive narratives and helps us find solutions to problems. Science is showing that sleeping on it really does help.

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for a third of our lives and there are many restorative processes going on during sleep that are needed to stay healthy.

Why do we usually sleep at night? What happens when we don't sleep? NADINE DREYER asks some experts about this essential part of our lives.

WHY DO WE NEED SLEEP AND WHY DO WE SLEEP BETTER AT NIGHT?

We sleep for a third of our lives, yet it is only when we cannot sleep or when we experience poor quality sleep that we really start noticing it.

During sleep, our muscle activity drops, our breathing slows down, and our heart rate and blood pressure decrease. At the same time our brain actively clears toxins, which cause neurodegenerative diseases.

It also consolidates memories, wiping out "useless" ones during deep sleep, known as slow wave sleep.

All this allows us to start afresh the following day.

Our lives are organised around our sleep-wake schedule. As we're a diurnal species, our master clock in the brain, which maintains many of our 24-hour rhythms, schedules our period of activity with daylight, and our period of rest with the night.

In some other animals, like rodents, evolutionary pressure has pushed those species to become nocturnal, which allows them to scurry and feed outside the view of their diurnal (daytime) or crepuscular (twilight) predators.

Not sleeping at the right time has been associated with poor health. Some of the side-effects are poorer cognitive performance, lower energy and worse mental health.

There's also a higher risk of developing neurodegenerative diseases such as Alzheimer's and a higher risk of developing high blood pressure and diabetes. During the Covid-19 ed sleep happens, we will start complaining: "I haven't slept enough", or "I slept really badly last night".

Such ruptures include those induced by specific sleep disorders like sleep apnoea or insomnia. Sleep apnoea leads to unconscious sleep interruptions due to upper airways obstruction and can lead to hypertension and a risk of diabetes.

Research in rural Mpumalanga province found that one out of three older adults had moderate to severe sleep apnoea and this was associated with a higher risk of cardiovascular disease. Yet there is no treatment in the public health system for this common sleep disorder.

Sleep health inequity in South Africa is also driven by socioeconomic status.

A recent study on sleep in men and women living in the Khayelitsha in the Western Cape showed that poor sleep quality was associated with fear of falling asleep in a violent environment. Sleep was disturbed by strange noises, fear of attacks and dreams about past trauma.

ELECTRONIC DEVICES MAKE IT DIFFICULT TO SLEEP

Even though our biology is meant to make us sleep at night, several societal and technological changes have progressively decreased our sleep opportunity.

Our sleep timing is controlled by our master circadian clock. This clock is highly sensitive to light, so exposure to bright light and blue light such as that emitted from electronic devices such as smartphones shifts our bedtime to a later time.

In our recently published study of adolescent sleep in Nigeria, adolescents in urban areas slept less and sleep quality was worse. Sleep duration was shorter, due to bedtimes being later, but waking times times. This helps us sleep at the best time with respect to our master clock's rhythm. This in turn helps ensure a consolidated bout of sleep.

• Aim for an average of seven to nine hours of sleep each night.

• Avoid watching screens one hour before normal bedtime. If this is unavoidable, choose the lowest brightness and add the orange night screen setting. Rather read a book under a bedside light.

• Get outdoor light during the day to strengthen the master clock's circadian (near 24-hour) rhythm.

• Do some physical activity once a day. This helps build sleep pressure and also strengthens the master clock's rhythms.

• Avoid alcohol before bedtime as it is associated with disrupted sleep, as are caffeine and stimulants.

• Try to sleep in a quiet, cool and dark or dimly lit environment.

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• Jonathan Davy is a senior lecturer, Rhodes University.
• Joshua Davimes is a senior lecturer in anatomical sciences, Wits.
• Nomathemba Chandiwana is principal scientist at Ezintsha, Wits.
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polar disorder and schizophrenia. The more severe the sleep and circadian disruptions are, the worse a person's mood, risk of relapse and mental health treatment outcomes are.

But despite evidence showing this link, why it exists remains largely unknown. This is what research conducted by myself and my colleagues sought to understand.

We found that sleep and circadian rhythm disruptions appear to trigger or worsen a range of mental disorders, including bipolar disorder and depression. We also uncovered some of the specific biological mechanisms which may underpin this link.

Our review assessed all research published in the past 10 years on different mental disorders, including depression, anxiety and psychosis. We mainly focused on adolescents and young adults.

We found that the majority of young people diagnosed with a mental health condition also had sleep problems such as insomnia (trouble falling asleep and staying asleep), delayed sleep timing, and worsened daytime alertness. We also found that one-third of people with bipolar disorder (and other mental disorders) had a disrupted circadian rhythm, where they go to sleep and wake up later than usual.

Our study also pinpointed some of the mechanisms that may explain the link between sleep problems and mental health disorders. Among these mechanisms are an increased vulnerability at the genetic or molecular level to circadian rhythm disruption.

We also found that some participants experienced changes in their brain activity caused by chemical signalling problems that can affect sleep and mood levels. Inappropriate light exposure (getting too little natural daylight or too much artificial light at night) and eating too late in the extend into adulthood.

Adolescence is not only a particularly vulnerable time for developing mental disorders. It's also a time when sleep and circadian rhythms change. Adolescents often sleep later, due to a delay in their circadian rhythm caused by their development, but have to wake up early due to school. As a consequence, they often experience shorter sleep than needed, which can further worsen their mental health.

Our review highlights how important it is to pay attention to circadian rhythm disruptions in young people, especially when it comes to risk of certain mental health problems. Our review also highlights the need to consider sleep and circadian problems when someone experiences mental health problems. By addressing such problems, it may be possible to improve one's mental health.

SLEEP AND CIRCADIAN INTERVENTIONS

At the moment, treatments for sleep problems (such as insomnia) involve cognitive behavioural therapy and sleep restriction. These focus on improving sleep, while mental health problems due to circadian rhythm disruption are not directly addressed.

Our review highlighted treatments that may help improve mood and sleep quality and align circadian rhythms. This included timing medication intake, exposure to natural daylight (and reducing night-time light) as well as eating and being physically active during the day. More research will be needed, however, to better understand the benefits of these treatments.

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PHOTOS: UNSPLASH

Sleep is as essential to our health as food and water. It is important to a number of brain functions, including how nerve cells communicate with each other. We sleep for a third of our lives and there are many restorative processes going on during sleep that are needed to stay healthy.

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Not sleeping at the right time has been associated with poor health. Some of the side-effects are poorer cognitive performance, lower energy and worse mental health.

There’s also a higher risk of developing neurodegenerative diseases such as Alzheimer’s and a higher risk of developing high blood pressure and diabetes. During the Covid-19 pandemic and the strictest lockdown, South Africans rated their sleep quality as poorer, with more insomnia symptoms. These were associated with worse levels of depression and anxiety.

WHAT HAPPENS WHEN WE DON’T SLEEP?

Sleep is a state of vulnerability where a “rest and digest” state dominates over the “fight and flight” state when we are awake.

Our early sleep “scans” the environment before allowing us to dive into deeper stages of sleep. When a rupture in this consolidated sleep happens, we will start complaining: “I haven’t slept enough”, or “I slept really badly last night”.

Such ruptures include those induced by specific sleep disorders like sleep apnoea or insomnia. Sleep apnoea leads to unconscious sleep interruptions due to upper airways obstruction and can lead to hypertension and a risk of diabetes.

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In our recently published study of adolescent sleep in Nigeria, adolescents in urban areas slept less and sleep quality was worse. Sleep duration was shorter, due to bedtimes being later, but waking times in the morning similar to those of adolescents in rural areas. The use of electronic devices at night by urban Nigerian adolescents was associated with shorter sleep duration.

This is one example of a growing body of research that highlights the negative consequences of nocturnal tech use on sleep.

WHAT ARE KEY HABITS TO HELP PEOPLE SLEEP BETTER?

The most important habit is to take sleep as seriously as a healthy diet and regular exercise. We advise the following.

• Keep regular wake times and bedtimes. This helps us sleep at the best time with respect to our master clock’s rhythm. This in turn helps ensure a consolidated bout of sleep.
• Aim for an average of seven to nine hours of sleep each night.
• Avoid watching screens one hour before normal bedtime. If this is unavoidable, choose the lowest brightness and add the orange night screen setting. Rather read a book under a bedside light.
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