Why Do We Sleep And How Can We Sleep Better?

Leslie Alan Horvitz
Photo:
lesliehorvitz.com

12-17-2024 ~ *Sleep is a biological necessity, but it remains a mysterious phenomenon we don't fully understand.*

We spend about a third of our lives sleeping. But do we know why we do it? Is it for biological, psychological, or evolutionary reasons? Much research has based its findings on what happens when we don't sleep enough. The effects of sleeplessness aren't difficult to pinpoint. Still, apart from a scientific consensus that sleep is essential to several brain functions and plays some kind of "housekeeping role," scientists have yet to determine why.

As contended by the National Institute of Neurological Disorders and Stroke, an arm of the National Institutes of Health and the nation's leading funder of brain research, "its biological purpose remains a mystery."

Several theories have been advanced to explain sleep. Although these theories may be valid, none offer a complete explanation.

Why We Sleep: Many Theories
According to a theory proposed by the National Library of Medicine, sleep is essential for energy conservation. This is because our metabolic rate drops during sleep, resulting in daily energy savings of up to 15 percent. This theory argues that sleep was an evolutionary development, reducing energy use during those times—mainly at night—when it was less practical to hunt for food. On the other

hand, sleep left our ancestors more vulnerable to predators.

Likewise, the restorative theory argues that sleep is necessary for the body to undertake improvements and regrowth, including muscle repair, protein synthesis, tissue growth, and hormone release. Some sleep researchers have hypothesized that without enough sleep, the brain may not be able to clear toxins effectively.

Still, a 2024 study published in Nature Neuroscience suggests this theory could be wrong. The study found that the clearance and movement of fluid in the brains of mice were markedly *reduced* during sleep. However, this was considered only indirect evidence.

A third theory focuses on brain plasticity—the ability of the brain to change and repair itself. Sleep allows the brain's glymphatic system—or waste clearance system—to remove toxins from the brain that build up during the day. This lets the neurons, or nerve cells, reorganize to ensure proper brain function during waking hours.

According to Harvard Medical School's Division of Sleep Medicine, "…brain plasticity is not entirely understood, but its connection to sleep has several critical implications. It is becoming clear, for example, that sleep plays a critical role in brain development in infants and young children. Infants spend about 13 to 14 hours per day sleeping, and about half of that time is spent in REM sleep, the stage in which most dreams occur."

The synaptic homeostasis theory focuses on the brain's consolidating and culling functions during sleep. While we sleep, the memories we need to preserve are converted from short-term to long-term, a process involving heightened activity in the hippocampus. Those that are irrelevant or unnecessary are discarded—a nightly decluttering operation.

The number of synapses increases during the day due to activity. Synapses are the gaps where neurons meet and use chemicals to send signals through the nervous system. If allowed to accumulate, the brain would become overloaded, like a computer's hard drive running out of memory, making it necessary to prune the unnecessary synapses. Numerous studies supporting this theory show a pattern of synapses in experimental animals shrinking during sleep and expanding during wakefulness.

A 2024 study published in Science by György Buzsáki, professor of neuroscience at New York University, focuses on sudden and powerful high-frequency brain waves known as “sharp wave ripples,” produced by the firing of many thousands of neurons within milliseconds of one another. They are “like a fireworks show in the brain,” said Wannan Yang, a doctoral student in Buzsáki’s lab. The sharp wave ripples fire when the mammalian brain rests, whether during a break between tasks or sleep. They are known to be involved in consolidating and storing memories.

The new research shows that they’re also involved in selecting and “tagging” the high-priority memories, which are replayed in sleep while ignoring those without priority. Scientists believe resting and sleeping are vital to consolidating and retaining information. If you sleep all the time, you won’t be able to form new memories. But if you stay awake all the time, you won’t form them, either. “If you just run one algorithm, you will never learn anything,” Buzsáki said. “You have to have interruptions.”

A 2024 report in Current Biology underscores the relationship between learning and a good night’s sleep, but from a different perspective: the changes in how brain cells are connected. Some synapses are in brain regions associated with learning and memory, and sleep deprivation hurts these synapses.

Theories explaining these connections have primarily been based on the belief that synapses are identical. However, Seth Grant, a neuroscientist at the University of Edinburgh, and his team and others have found that synapses are surprisingly diverse in structure, the composition of proteins in the neurons surrounding them, and the types of neurotransmitters they use to send signals. Grant and his team call the set of synapses the “synaptome.” In mice studies, the researchers allowed one group to get about six hours of sleep while prodding the second group to keep them awake. Although the total number of synapses remained constant in both groups, the diversity of subtypes fell in the sleep-deprived mice, especially in areas of the brain associated with learning and memory: the cortex and hippocampus.

Quality sleep can also improve emotional well-being. Activity during sleep increases in certain parts of the brain—especially the amygdala, which is involved in emotional regulation and the response to fear. Research suggests that sleep deprivation causes the amygdala to overreact, heightening stress and anxiety,

even when there is no fearful stimulus.

Similarly, sleep heightens activity in the striatum, which has several decision-making functions such as motor control, emotion, habit formation, and reward. Sleep also heightens activity in the insula, which some investigators believe "provides an awareness of the physical self as a feeling (sentient) entity, which may constitute a basis of selfhood."

Other theories emphasize the importance of sleep in maintaining normal health. Weight, for instance, is maintained because sleep has a pronounced effect on hunger hormones. Sleep increases leptin, making you feel sated after a meal, and decreases ghrelin, heightening appetite. This theory may explain why sleep deprivation is associated with an increase in obesity.

Sleep may also benefit the immune system. This is because, during sleep, the body produces cytokines—proteins that fight infection and inflammation—and antibodies that promote immunity. That may explain why—at least in some instances—a good night's sleep can mitigate colds and fevers.

Research has yielded evidence that sleep may help ward off dementia by providing a nightly shower for the brain, washing away the cellular waste accumulated during the day. This includes sticky clumps in the brain called plaques—amyloid deposits that build up during the day and that, in large quantities, have been linked to the development of Alzheimer's. Research has found that adults aged 65 to 85 already have plaques in their brains; the less sleep they get, the more amyloid is present, and the worse their cognition is.

"Is lack of sleep sufficient to cause dementia? Probably not by itself alone," said Dr. Sudha Seshadri, the founding director of the Glenn Biggs Institute for Alzheimer's and Neurodegenerative Diseases at the University of Texas Health Science Center at San Antonio. "But it seems to definitely be a risk factor for increasing the risk of dementia, and perhaps also the speed of decline."

Sleep problems may also be an early sign of dementia—specifically Lewy body dementia and Parkinson's disease dementia. Such conditions may disrupt rapid eye movement (REM) sleep, causing people to act out physically in dreams.

However, too *much* sleep (nine hours or more) also appears to be linked to an increased risk for dementia. This might mean that other factors like depression,

diabetes, or cardiovascular problems could be implicated.

A 2024 study led by Joseph Dzierzewski, senior vice president of research and scientific affairs at the National Sleep Foundation, showed that a good night's sleep could also lower feelings of loneliness. The study showed that of 2,297 adults in the United States, those who had seven to nine hours of sleep a night reported improvement in social relationships. The study indicated that younger adults were more likely to benefit than older adults, although researchers are uncertain why. Poor sleep may appear to contribute to feelings of loneliness because it adversely affects mood and leads to social withdrawal and lower self-esteem.

Evolutionary or adaptive theory argues that human inactivity during sleep helps us survive. If we remain stationary, we'll stay out of trouble, especially when we're vulnerable. Our ancestors survived by staying more or less still and avoiding accidents in the dark. Some experts take issue with this theory, contending that if survival were at stake, we'd be much better off if we were conscious and able to react to emergencies.

The Anatomy of Sleep

Several structures within the brain are involved with sleep. The peanut-sized hypothalamus is the hub of sleep-promoting nerve cells that affect sleep and arousal. Within this organ is the suprachiasmatic nucleus (SCN), a cluster of thousands of cells sensitive to light. They control behavioral rhythm and are vital for the sleep/wake cycle. The SCN functions even in blind people, allowing them to sense light even when they can't see.

The cone-shaped pineal endocrine gland, located between the brain's two hemispheres, increases the production of the hormone melatonin from the SCN once we close our eyes. The pineal gland regulates the sleep-wake cycles and internal body clock, often called the circadian rhythm, which optimally should coincide with the external cycle of light and darkness.

The brain stem found at the base of the brain communicates with the hypothalamus, controlling transitions between waking and sleeping. The sleep-promoting cells in the hypothalamus combine with the brain stem to produce a brain chemical called gamma-aminobutyric acid (GABA), which tamps down the activity of arousal centers in both the hypothalamus and brain stem. This plays a

role in REM sleep—the fourth sleep stage— when dreams occur. The brain stem also sends signals to the body, instructing muscles to relax, preventing people from physically acting out their dreams.

The egg-shaped thalamus is located in the middle of the brain. It controls the sensory and motor signals from the body to the brain. It also relays information from the senses to the cerebral cortex, the brain's outer covering that interprets and processes information that is separated into long and short-term memories. In most sleep phases, the thalamus is quiet, becoming active only during the REM state when it transmits images, sounds, and other sensations to the cortex, forming the dreams we experience. During REM sleep, the almond-shaped amygdala also goes to work, processing emotions that often accompany the dreams.

The basal forebrain—near the front and bottom of the brain—is also involved in the sleep-wake cycle. It releases a chemical (a byproduct of cellular energy consumption) called adenosine, which is believed to promote sleep. Caffeine counteracts adenosine, delaying sleepiness, so caffeinated drinks are not recommended before bedtime.

The Stages of Sleep

Sleep occurs in five stages: wake, N1, N2, N3, and REM. Stages N1 to N3 are non-rapid eye movement (NREM) sleep, with each stage leading to progressively deeper sleep. Approximately 75 percent of sleep is spent in the NREM stages, with the majority spent in the N2 stage.

Typically, a person will go through all stages four to five times a night, each cycle taking roughly 90 to 110 minutes. The first REM sleep is usually short, becoming longer as the night continues.

Based on the frequency of waves during sleep, EEG recordings initially show alpha waves, which indicate wakefulness. Beta waves are seen when the person becomes drowsy. In the N1 sleep stage, we see the low-voltage theta waves—the lightest phase of sleep. In the more extended N2 sleep stage, the EEG registers sleep spindles—brief, powerful bursts of neuronal firing believed to be essential for memory consolidation.

The lowest-frequency delta waves are characteristic of N3—the deepest phase of non-REM sleep—during which the body repairs and regrows tissues, builds bone

and muscle, and strengthens the immune system. It is also the stage when parasomnias such as sleepwalking, night terrors, and bedwetting can occur.

REM comprises 25 percent of the cycle and is characterized by beta waves, which are similar to brain waves when a person is still awake but falling asleep. This stage is associated with dreaming and is not considered a restful state because the brain is highly active and uses more power. People often awaken spontaneously during an episode of REM sleep.

Dreams

In a 2021 article entitled "The Effects of Sleep Quality on Dream and Waking Emotions," authors Francesca Conte and her colleagues investigated dreams. They reached two basic conclusions: On one hand, "there is a significant overlap between sleep physiology and the brain networks and neurochemical processes involved in affective modulation." On the other hand, people who suffer from mood or affective psychiatric disorders are also likely to have sleep disorders.

Sleeping and dreaming are related to emotional regulation, especially in REM sleep, where most dreams occur. The study noted a "distinctive neurochemical balance occurring during REM sleep," which sets the stage for processing emotional information.

This finding has led sleep researchers to propose a link between brain networks involved in REM sleep and those involved in regulating emotion during the daytime. Researchers believe our dreams facilitate the "resolution of emotional conflicts, enhancing fear-extinction processes."

Another related theory—known as the "threat simulation theory" or the "social simulation theory"—proposes that we effectively rehearse or simulate threatening and difficult episodes in our dreams, which helps us cope with these situations when they arise in our waking lives. These researchers have determined that emotions we have while awake are closely associated with emotions we experience while we dream.

Researchers' findings suggest that even a single night of sleep deprivation is enough to increase reports of stress, anger, and anxiety, even in response to low-stress situations. This supports their theory that emphasizes the importance of sleep and dreaming to emotional regulation. "Habitual self-reported sleep quality has also been found to moderate the relationship between threat-related

amygdala reactivity, negative affect, and perceived stress," they write.

Sleep Disorders

Several disorders make it difficult for people to fall asleep or stay asleep for seven to eight hours: insomnia, obstructive sleep apnea, narcolepsy, restless legs syndrome, and circadian rhythm disorders. They all disrupt sleep and account for what is known as "sleep debt."

Insomnia is among the most common sleep disorders, occurring in one out of three adults worldwide. It can be a minor inconvenience or a significant problem, depending partly on the individual's sleep habits, which can change with age.

There are two basic types of insomnia—those related to *time* and those related to *cause*. In the former category, insomnia may be acute (short-term) or chronic (long-term). Insomnia disorder refers to the chronic kind.

Sleep experts also classify types of insomnia: primary, which refers to insomnia that occurs spontaneously, and secondary, which means it's a symptom of some other underlying condition or circumstance. Ten percent of people meet the criterion of insomnia disorder.

There are three additional classifications of insomnia—initial, middle, and late. The first involves sleep onset, meaning you have trouble falling asleep. The second, also known as "maintenance insomnia," occurs when you wake up in the middle of the night but then go back to sleep. This form is prevalent. The third, called "early waking insomnia," occurs when you wake up earlier than intended and can't fall back asleep. All these forms are time-related.

Individuals who have cause-related chronic insomnia are diagnosed based on various factors. The occurrences would have to take place at least three times a week; they would have to last at least three months, and extraneous causes like medications or mental or physical disorders would have to be excluded.

Chronic insomnia can disrupt how the body sends and processes information, which not only makes you more anxious and stressed but also makes it more difficult to concentrate or learn new information and skills. Coordination is adversely affected, too, putting an individual at a higher risk for accidents. If this condition persists over a long time, more harmful manifestations are possible, including hallucinations and mania in those with bipolar disorder.

Experts are still uncertain why insomnia, especially chronic insomnia, occurs. They consider a patient's family history, brain activity, and medical conditions such as acid reflux and Parkinson's disease, all of which may contribute to the condition. Mental health conditions and life changes—even positive ones like moving into a new home or a promotion—are also factors that can account for insomnia.

The Effects of Sleep Deprivation on the Body

Sleep deprivation makes you more irritable, and if it goes on long enough, it can also disrupt the proper function of the body and metabolism.

The Immune System

During sleep, the immune system produces protective, infection-fighting substances like antibodies and cytokines that help fight and prevent bacterial and viral illnesses. Some cytokines also promote sleep. Not getting sufficient sleep curbs the strengthening of the immune system and may also extend the time the body needs to recover from illness.

The Respiratory System

Among sleep disorders, obstructive sleep apnea (OSA) significantly affects the respiratory system and hurts sleep quality. Normally, air should flow smoothly from the mouth and nose into the lungs at all times, including during sleep. OSA is a breathing disorder that causes breathing to stop entirely for periods—known as apneic episodes—usually followed by periods of silence.

Snoring is associated with OSA, but it is not necessarily a sign of OSA, which is seen most typically in older males and many postmenopausal women. People afflicted with OSA are more vulnerable to respiratory infections like colds and flu. This can worsen existing respiratory diseases.

The Cardiovascular System

A meta-analysis by Qiao He and colleagues, published in the European Journal of Preventive Cardiology, concluded that "insomnia symptoms [consisting] of difficulty initiating sleep, difficulty maintaining sleep and non-restorative sleep were associated with an increased risk of future cardio-cerebral vascular events."

Because sleep affects processes that maintain the health of the heart and blood vessels—including those that affect blood sugar, blood pressure, and inflammation—sleep disruption may affect the body's ability to heal and repair

both organs. This can lead to cardiovascular disease, with an increased risk of heart attack and stroke.

The Endocrine System

The network of glands and organs that constitute the endocrine system releases hormones that regulate metabolism, energy level, reproduction, growth and development, and response to injury, stress, and mood. Thus, a typical night's sleep plays a vital role in the maintenance of this system. For instance, three hours of uninterrupted sleep is required for testosterone production. Any interruption of sleep, if it persists, could affect growth hormone production, which is especially important in children and adolescents since these hormones help build muscle mass and repair cells and tissues.

The Brain

Sleep deprivation may also harm the brain. Research published in October 2024 in Neurology showed that poor sleep quality in people's 40s can make their brains 1.6 to 2.6 years older in their 50s. The study examined nearly 600 participants asked about their sleep habits, including whether they had difficulty falling asleep, woke up multiple times a night, or woke up too early. MRI scans 10 years later revealed that those who reported poor sleep had brains that had aged prematurely compared to those who slept well.

Another study conducted in 2023 with a smaller sampling reached similar conclusions. "Age-related changes in several sleep characteristics indicate that reduced sleep quality is a frequent characteristic of aging," the researchers wrote in the Journal of Neuroscience. Poor quality sleep has been associated with an increased risk of dementia, inflammation, and a weakened immune system.

The Digestive System

Sleep affects the levels of two hormones—leptin and ghrelin—which control feelings of fullness and hunger. Therefore, overeating before bed or snacking in the middle of the night can disrupt these hormones, raising the level of ghrelin, an appetite stimulant usually lowered during sleep.

Sleep deprivation also causes your body to release less insulin after you eat, interfering with its ability to reduce your glucose level and tolerance, a condition known as insulin resistance. This can lead to conditions like obesity and diseases like diabetes.

Obesity and Diabetes

Laboratory and epidemiological studies suggest that sleep loss may play a role in the increased prevalence of diabetes and obesity. Current data suggest the relationship between sleep deprivation and weight gain and diabetes risk may involve at least three pathways: 1) alterations in glucose metabolism, 2) upregulation of appetite, and 3) decreased energy expenditure. (Upregulation is defined as the process by which a cell increases its response to an external signal or a substance).

In the last few decades, more than 30 percent of adult men and women between 30 and 64 have reported sleeping less than six hours per night. This decrease in reported sleep occurred over the same period during which there was a significant increase in diabetes and mortality.

Furthermore, laboratory studies conducted by Kristen Knutson and her colleagues, documented in the Journal of Clinical Sleep Medicine, show an adverse impact of sleep loss on glucose regulation. This raises the possibility of an association between short sleep duration and the severity of existing diabetic conditions.

Two hormones—insulin and glucagon—work together to strike a balance and play a vital role in regulating a person's blood sugar levels. Glucagon triggers the liver to convert glycogen into glucose. Insulin enables blood glucose to enter cells, which are used to produce energy. This balance, called homeostasis, is necessary for health; when blood sugar is too high, the pancreas will secrete more insulin. Consistently high blood sugar levels can damage cells. When the balance is thrown off—which could be caused by diminished sleep—diabetes and other adverse conditions can result.

Causes of Sleep Deprivation

So why are people losing sleep? It's mainly stress. The American Psychological Association found that "the relationship between sleep and stress goes both ways—those who sleep less are more stressed, and those who are more stressed sleep less." In a 2024 Gallup poll, 63 percent of people who said they weren't getting enough sleep reported being often stressed, compared to 31 percent who said they were getting enough sleep.

Over the past 30 years, more Americans have become stressed, except for a sharp

decrease in 2003. The Gallup poll showed that nearly half of all Americans—49 percent—reported frequently experiencing stress, up 16 points over the past two decades; these were the highest figures in Gallup's trend to date. Younger women were likelier to say they were stressed—29 points more likely than women 50 and older.

Stress is by no means the only cause of sleep deprivation. Not getting enough sleep is relatively common. Experts estimate between 50 million and 70 million adults in the U.S. meet the medical criteria for sleep deprivation at any point in time.

A variety of causes apart from stress may be to blame. Shift work may require employees to sleep during the day when sleep quality is worse than at night. The use or abuse of alcohol or caffeine consumption late in the day may be a factor. Sleeping in a new or unfamiliar place, such as a hotel, can negatively impact sleep. Also, medications such as corticosteroids and stimulants can create fitful sleep.

Medical conditions may also be responsible, such as sleep apnea; concussions and traumatic brain injuries; short-term illnesses like the common cold and flu; degenerative neurological disorders such as Alzheimer's disease or Parkinson's disease; and Parasomnias (disruptive sleep disorders) like night terrors, sleep paralysis, and sleepwalking.

Sleep Labs

Sleep labs or sleep centers are located in several metropolitan areas throughout the U.S. They are set up to diagnose and treat people with severe sleep disorders such as obstructive apnea and chronic insomnia. Sleep studies, known as polysomnography, may require patients to stay overnight.

The rooms where the studies are conducted are designed to resemble hotel rooms and are dark and quiet. The sleeping area has a low-light video camera that lets technicians see what's happening when the lights are out. They communicate with the patient through an audio system and can enter the room to remove wires if they need to use the bathroom.

Before the patient goes to bed, technicians use a mild adhesive to apply sensors to the scalp, temples, chest, and legs. A small clip is placed on the finger or ear to monitor blood oxygen levels. As the patient sleeps, technicians monitor several

signals: brain waves, eye movements, heart rate, breathing pattern, blood oxygen levels, body position, chest, abdominal and limb movement, and snoring and other noises.

Technicians may also use a positive airway pressure (PAP) machine for those with apnea. This device consists of a tight-sealing nosepiece or face mask through which a stream of air is delivered to help the patient breathe while sleeping. Although patients may not sleep as well under constant monitoring, the test results are usually unaffected. Getting a full night's sleep while being tested isn't necessary.

Who's Getting Enough Sleep and Who Isn't

According to Sleep Savvy Magazine, in 2023, the Dutch, Danes, and Swedes slept the best, with 77.05 percent, 76.17 percent, and 75.18 percent, respectively, sleeping between seven and nine hours per night. The worst sleepers were residents of Qatar (42.64 percent), Iran (43.42 percent), and South Korea (45.45 percent).

Australia, Egypt, and New Zealand had the highest number of extended sleepers (those who slept for ten hours or more). Meanwhile, 70.14 percent of Americans were estimated to sleep between seven and nine hours per night.

Despite their proven capacity to sleep longer, the Swedes led the world in online searches (86,014) for sleep aids, including products like white noise machines and supplements like melatonin. Americans came in second, with 49,486 searches for sleep aids. According to the Centers for Disease Control and Prevention (CDC), one in three adults in the U.S. experiences sleep deprivation, which may account for the increasing number of searches.

In 2013, Gallup found that 56 percent of Americans got the sleep they needed in terms of quality and quantity, and 43 percent did not. Eleven years later, the poll's results were almost the opposite, with 57 percent saying they were sleep deprived and 42 percent saying they were happy with the sleep they got. The share of those who got five hours or less rose to 20 percent, a dramatic rise compared to previous generations. In 1942, for example, only 3 percent reported getting five hours or less of sleep. According to the National Institutes of Health (NIH), an estimated 50 million to 70 million Americans have chronic or ongoing sleep disorders.

Although the decline in America's sleep in 2024 is across the board, adults 65 and older are more likely than those who are younger to get the sleep they need. Young adults aged 18 to 29 reported getting the least amount of sleep.

A Contrarian Survey?

Despite research showing that a good night's sleep is becoming increasingly rare among Americans, a survey by the American Time Use Survey (ATUS), conducted by the Bureau of Labor Statistics and the Census Bureau, showed that Americans slept about 10 minutes more daily compared to previous years. A careful look at the data shows the reason for contradictory results. The data came from a sample of people asked to report what they did all day. However, the sample was taken after the COVID-19 pandemic had shifted work habits for many but not all Americans.

Those who were able to work from home did indeed get a little more sleep, but people who had difficult jobs that required them to work away from home still suffered from sleep deprivation. In fact, in the last 30 years, the portion of the population getting less than five hours of sleep has increased to 20 percent. Furthermore, men are getting more sleep while women are still amassing sleep debt.

Sleep Deprivation and Women

Younger women are especially susceptible to sleep deprivation. A 2024 Gallup report found that 27 percent of younger women, compared to 46 percent of younger men, reported getting enough sleep. Furthermore, according to a 2024 report in Science Direct, "females are more affected by extended wakefulness and circadian misalignment than males are."

This led the researchers to propose that the "long-term effects such as sleep and metabolic disorders are likely to be more prevalent in females than in males." They admitted, though, that much about the sex-related differences in "key aspects of sleep-wake and circadian regulation" were still unknown.

"When you look in particular at adult women under the age of 50, that's the group where we're seeing the steepest movement in terms of their rate of sleeping less or feeling less satisfied with their sleep and also their rate of stress," reports Gallup senior researcher Sarah Fioroni.

She adds that sleep is undervalued even though it is considered one of the three

pillars of health, along with diet and exercise. Fioroni argues that current policies are not conducive to women getting enough sleep and that paid family leave and flexible work hours might help women sleep more restfully.

Why sleep quantity and quality differ significantly between the sexes isn't well understood, particularly since women are often underrepresented in sleep and circadian rhythm research. Sleep researchers are exploring three areas: 1) how sex differences systematically influence sleep-wake and circadian regulation in humans; 2) how sex differences in sleep and circadian factors modulate metabolic control; and 3) how these differences may affect the development of precision medicine.

Women are approximately twice as likely to develop anxiety disorders, which are associated with lower sleep quality. They also report more incidences of sleep disturbances, including insomnia, frequent awakenings, non-restorative sleep, and unpleasant dreams or nightmares, especially during the premenstrual week and the first days of menstruation.

Sleep Deprivation and Teens

A study by the National Sleep Foundation found that teens weren't sleeping well—a staggering 87 percent weren't getting the recommended eight to 10 hours of sleep per night. Sleep deprivation was associated with difficulty in concentration, poor grades, drowsiness while driving, anxiety, depression, suicidal ideation, and suicide attempts.

And it's only getting worse. "I think high school is the real danger spot in terms of sleep deprivation," said William Dement, founder of the Stanford Sleep Disorders Clinic, the first of its kind in the world. He claims that lack of sleep can impact kids' physical and emotional health and performance in school, sports, and driving. The problem becomes more pronounced when teens start high school and have to get up earlier for class even though they're going to bed later, a universal issue in this age group.

High school hours are out of sync with their students' biological clocks. "When teens wake up earlier, it cuts off their dreams," says pediatric sleep specialist Rafael Pelayo with the Stanford Sleep Disorders Clinic. Their circadian rhythm shifts to a later time, making it more difficult to fall asleep before 11 p.m., which would be necessary for a sufficient night's sleep.

Then there's the habit—some call it an addiction—of checking their smartphones. Some 92 percent of U.S. teens have smartphones, and 24 percent report being online "constantly," according to a 2023 report by the Pew Research Center. Some 72 percent of teens bring cell phones and other electronic devices into their bedrooms.

This issue has received much-renewed attention thanks to a 2024 book titled *The Anxious Generation* by social psychologist Jonathan Haidt. He argues that smartphones have led to a "great rewiring of childhood," which in turn has led to an "epidemic of mental illness." Haidt calls these phones "experience blockers," adding that "once you give the phone to a child, it's going to take up every moment that is not nailed down to something else." Another name for these phones could be "sleep blockers." He advocates banning phones in high school and prioritizing real-world play and independence.

Sleep Deprivation and Workers

According to a 2022 Gallup report, 11 million of the 155 million full- and part-time U.S. employees reported getting less than adequate sleep over the previous month. This was followed by 33 million respondents who reported only fair sleep. Gallup also concluded that absenteeism due to poor sleep results in an estimated $44.6 billion in lost productivity each year.

A sense of well-being is linked to sleep and is essential for optimal job performance. Research has shown poor sleep impairs a worker's ability to focus, learn efficiently, and consolidate memory. Depression and anxiety may be triggered or exacerbated by poor sleep and can adversely affect job performance, on top of the effects of just being tired.

Lack of adequate sleep is also related to turnover. The Gallup survey suggests that workers who don't sleep well are more likely to report having changed jobs in the previous 12 months, either voluntarily or involuntarily. This tendency to change jobs could become a vicious cycle, as workers who change jobs frequently may experience poorer sleep than they did previously.

Businesses should emphasize the importance of sleep, exercise, healthy eating, and stress management to their employees. Gallup adds that "by treating sleep as a major mechanism for improving employee well-being, employers can simultaneously improve the lives of their workers along with business outcomes

that are critical to their success."

The Business of Sleep

Sleep deprivation has driven desperate people to try new solutions that might give them a good night's sleep. Revenue in the sleep aids market in the U.S. is estimated to be $3.89 billion in 2024. With an annual growth rate of 2.48 percent, "sleep economy" revenues should reach $4.29 billion by 2028. The global market for sleep aids (beds, mattresses, and tech devices) is $432 billion annually.

According to the Sleep Foundation, a company that compiles news about sleeping trends, the sleep apnea devices market alone is estimated to be worth $13.5 billion in 2024, and it's expected to keep growing.

New tech products drive tremendous growth in the sleep market. Venture capital funding for sleep tech nearly doubled between 2017 and 2021.

A 2023 American Academy of Sleep Medicine survey shows that one-third of Americans have tried a sleep tracker. These devices, which people use to optimize their sleep, typically cost between $200 and $300 and monitor physical signs during sleep, such as heart rate and body movement.

Most of these devices are promoted for tracking sleep duration, sleep phases (deep or close to waking), sleep quality (by detecting interrupted sleep and letting the user know if they are tossing, turning, or waking at night), and environmental factors such as light and room temperature. Users can also track lifestyle factors affecting their sleep, like how much caffeine they consumed that day.

There are two main classifications of sleep trackers—wearable and nonwearable. A nonwearable product called Dodow, which claims to have over one million users, is a small wireless device that can be turned on with a button. It projects a soft light that stops the user's mind from racing and guides their breath back to a relaxed state.

Another non-wearable device, Homni, resembles a bedside lamp equipped with integrated sensors, light, and a Bluetooth speaker connected to an app that "analyzes your sleep environment, tracks sleep quality and cycles, and makes your morning wakeup routine more pleasurable."

The wearable Muse S Headband "tracks brain activity, heart rate, breathing, and movement while [an individual] fall[s] asleep and throughout the night." However,

these products come with a caveat: The data they collect can't be used to diagnose sleep disorders, and the FDA doesn't approve them.

Mattress sales have also enjoyed a boom, doubling between 2015 and 2020. Smart mattresses and beds are costly; they retail for between $2,000 and $5,000. These products are called "smart" because they allow the user to control firmness levels and temperature at the push of a button. They're also supposed to provide insights into one's sleep health over time.

One example is the Sleep Number 360 p6 Smart Bed, which offers "built-in, adjustable air chambers for customizable comfort, along with biometric sensors, so the bed can automatically adapt to movement to keep you at your preferred firmness all night long." The bed also comes with an app that allows users to track their sleep and measure how long it takes to fall asleep.

The Satva Solaire Adjustable Firmness Mattress features 50 different firmness levels. It offers users memory foam and latex to "experience the familiar comfort and support you'd expect from a more traditional mattress."

The Eight Sleep Pod 4 Ultra smart mattress allows users to adjust the temperature on each side of the bed to suit their comfort.

There are many other novel sleep products, including eye masks made of high-end materials like mulberry silk. Other masks are weighted with glass beads or have pockets for storing sleep stones. Weighted blankets containing ball bearings, plastic pellets, and other objects that make them five to 30 pounds heavier than standard blankets have grown in popularity because they make users feel more comfortable and secure. Furthermore, specially designed pillows are available to those who want to customize their product's shape retention, moldability, and temperature control.

There is also a flourishing market for podcasts that promise to lull users to sleep. The Women's Meditation Network has produced 20 podcasts for this purpose, which consist of "a soothing series of episodes" intended to "calm the stresses typical of many women."

Katie Krimitsos, the founder of the network, is responsible for the podcast "Sleep Meditation for Women," which has drawn about one million monthly listeners. "Our interpretation of how fast life should be and what we should 'accomplish' or

have or do has exponentially increased," Krimitsos says, explaining why her podcasts for women have become so popular.

Those who want to try a beverage that might help them fall asleep can make themselves a Sleepy Girl Mocktail. This drink consists of tart cherry juice and magnesium powder topped with ice and sparkling water or soda. The cherry juice contains small amounts of melatonin—which may improve sleep quality and insomnia—and tryptophan, which increases sleep time and efficiency in insomnia patients.

The fitness center Equinox is getting into the sleep business, offering clients who can afford its elite concierge services a "sleep coach." Its website says, "[I]n each session, [a client] and [their] coach will evaluate sleep habits, find opportunities, implement better behaviors, and track your progress towards your goals."

Sleep Medications

Americans are taking fewer prescription and nonprescription medications to help them sleep. A 2022 study published in the Journal of Clinical Sleep Medicine documented a 31 percent decline in the use of common sleep medications between 2013 and 2018. The trend is likely due to a growing awareness of these medications' potential side effects and dangers. The 86 percent decrease among Americans over 80 is particularly noteworthy.

A 2020 survey from the National Center for Health Statistics presented a snapshot of those Americans who regularly took sleep medication:

– 8.4 percent of adults took sleep medication every day or most days throughout the previous month.

– 6.6 percent of men compared with 10.2 percent of women took sleep medication.

– Men in lower and middle-income groups were more likely to use sleep medication than men with the highest family incomes.

Furthermore, a 2023 study by Leng and her colleagues found that sleep medication varied by race for both men and women:

– White people were more likely than Black people to take sleep medication, with 7.71 percent of White respondents taking them frequently, compared to 2.66

percent of Black respondents. Black people were half as likely to take prescription hypnotics.

There are three types of sleep medications—nonprescription (over the counter), supplements (which can be sold without FDA approval), and prescription.

Nonprescription Medications
According to the American Academy of Sleep Medicine, antihistamines are the most common ingredient in over-the-counter sleep aids.

These medications tend to fall into two main types—diphenhydramine (Benadryl) and doxylamine succinate (Sleep Eze, Sominex, Nytol, Tylenol PM, Kirkland Sleep Aid, and Unisom SleepGels). Both types of antihistamines help allergy sufferers with difficulty sleeping. Diphenhydramine is the milder of the two and is less likely to cause grogginess, equivalent to a hangover the next day. It may, however, cause daytime drowsiness, constipation, and dry mouth. Still, tolerance builds up quickly, and the medication loses effectiveness after a few nights.

Doxylamine is one of the most sedating over-the-counter antihistamines, and it leaves the system slower than diphenhydramine. In general, it is also more expensive than diphenhydramine. In the absence of allergies, these drugs are not recommended for sleep.

Another product—Aleve PM—combines the antihistamine diphenhydramine and naproxen (a non-steroidal anti-inflammatory drug or NSAID) to treat sleeping problems caused by minor aches and pains.

Doctors advise patients to take these medications only on a short-term basis because extended use can exacerbate insomnia. These medications are also not recommended for patients with certain types of glaucoma, peptic ulcers, urinary retention, women who are pregnant or breastfeeding, or seniors at risk for dementia.

Supplements
Many people prefer supplements because they are naturally—as opposed to chemically—derived. However, the hormones, amino acids, herbs, and plants available in stores haven’t been well studied, so their effectiveness as sleep medication is uncertain.

People often take melatonin for sleep because it is a hormone that helps control an individual's natural sleep-wake cycle and may reduce the time it takes to fall asleep. Travelers frequently use it to mitigate the effects of jet lag. Valerian root, a plant extract, has been shown to have some therapeutic effects. Some people take it to help them fall asleep and experience better-quality sleep.

A meta-study found that melatonin was "remarkably effective in preventing or reducing jet lag," especially for travelers crossing five time zones (although it can be beneficial for those traveling shorter distances), in an easterly direction who have had jet lag in the past. If taken early in the day, however, it can cause sleepiness and difficulty in adjusting to the local time zone. Researchers maintain that melatonin still needs further study and routine pharmaceutical quality control.

Ginkgo biloba is a natural herb that may aid sleep and relaxation, but the evidence is limited.

Glycine is an amino acid that may help people sleep more quickly and improve sleep quality.

Magnesium is an essential ion in the human body and is used to help relax and enhance sleep quality.

L-theanine is another amino acid that may improve sleep quality.

Lavender is an herb that can induce a calming and sedentary effect to improve sleep. It has been studied for its therapeutic use in treating parasitic infections, burns, insect bites, and spasms. Growing evidence suggests that lavender oil may effectively treat several neurological disorders.

Cannabidiol, or CBD, is a chemical derived from the cannabis plant that may cause drowsiness and have a calming effect in large doses. In a 2019 studypublished in the Permanente Journal, researchers found that people who took CBD oil felt less anxious and slept better within a month.

Prescription Drugs

There are several types of prescription drugs used as sleep aids, including benzodiazepines, which belong to a class of medications called hypnotics. Examples include alprazolam (Xanax), clonazepam (Klonopin), diazepam (Diastat,

Valium), estazolam (Prosom), lorazepam (Ativan), temazepam (Restoril), and triazolam (Halcion).

These drugs may be used to treat parasomnias—disruptive sleep-related disorders that can include abnormal movements, talking while sleeping, nightmare disorder, sleep terrors, sleepwalking, sleep-related eating disorders, and sleep paralysis. Occasionally, they are also used to treat bruxism (teeth grinding) and short-term insomnia. These sleeping pills may be helpful to those who want an insomnia medication that stays in the system longer, but they have some severe downsides because they can cause addiction and dependence.

Non-benzodiazepine hypnotics, such as eszopiclone (Lunesta), zaleplon(Sonata), zolpidem (Ambien, Edluar, Intermezzo), and Zolpimist—a sedative administered as a nasal spray—are used to treat short-term insomnia. Ramelteon (Rozerem), a melatonin receptor stimulator, also treats insomnia.

Anti-Parkinsonian drugs (dopamine agonists) such as gabapentin enacarbil (Horizant), pramipexole (Mirapex), ropinirole (Requip), and rotigotine (Neupro) may be used to treat restless legs syndrome and periodic limb movement disorder (also called nocturnal myoclonus syndrome).

Anticonvulsants, such as carbamazepine (Carbatrol, Epitol, Tegretol), gabapentin (Neurontin), gabapentin enacarbil (Horizant), pregabalin (Lyrica), and valproate (Depakene, Depakote, Depakon) may be used to treat nocturnal eating syndrome, restless legs syndrome, periodic limb movement disorder, and insomnia related to bipolar disorder.

Antinarcoleptics, such as methylphenidate (Ritalin) and modafinil (Provigil), can improve daytime wakefulness in shift workers or people with narcolepsyor apnea. Pitolisant (Wakix) and sodium oxybate (Xyrem, Xywav) are drugs that can control excessive daytime sleepiness and loss of muscle control in people with narcolepsy.

Antidepressants or antianxiety medications may be used to aid sleep because drowsiness is one of their main side effects. These include medications such as mirtazepine (Remeron), quetiapine (Seroquel), and trazodone (Desyrel).

Orexin receptor antagonists are involved in regulating the sleep-wake cycle. This type of drug reduces the action of orexin in the brain, which is active during the day. These include daridorexant (Quviviq), lemborexant (Dayvigo), and suvorexant

(Belsomra).

Doxepin (Silenor) is approved for use in people with trouble sleeping. Silenor may help with sleep maintenance by blocking histamine receptors.

Physicians caution patients against developing a physical dependence on any of these drugs or using them with opioids, which depress breathing and increase the risk of overdose. Patients should also avoid alcohol, only take sleep medication at bedtime, be alert to side effects, and quit any medications slowly and carefully. A medical evaluation is essential before taking any prescription drug, and patients are also advised to take these medications only as directed by a physician.

Getting a Good Night's Sleep
When searching online for "restful sleep," one would find many sites offering advice to insomniacs. The Mayo Clinic promotes "Six Steps to Better Sleep." Harvard Health offers "Eight Secrets to a Good Night's Sleep." Healthline suggests "Top 15 Proven Tips to Sleep Better at Night." The Sleep Foundation provides "20 Tips for How to Sleep Better." All these sites—and many others—share common tips.

Sticking to a sleep schedule is advised, though the recommended amount of sleep changes with age. For example, an infant might need up to 17 hours of sleep, a teen would need eight to 10 hours, an adult would need seven hours, and older adults would require seven to eight hours.

Consistency is important. We should consider turning the process of going to bed into a ritual. For instance, a calming bath before bedtime may improve sleep quality and efficiency (getting to sleep quickly). One should go to bed and get up at the same time every day—even on weekends. If you're still tossing and turning after 20 minutes, it might help to leave your bed and bedroom and read a book or listen to soothing music until you become drowsy and ready for sleep.

Heavy meals within a couple of hours before bedtime should be avoided. Health.com recommends a healthy small snack like an apple if you are hungry before bedtime. Caffeine and alcohol should also be avoided two or three hours before bedtime. A high-carb meal eaten four hours before bed helps people fall asleep faster. A low-carb diet also improves sleep, indicating that carbs aren't always necessary to induce sleep, especially if you're used to a low-carb diet.

Some sleep experts warn against drinking any liquids two hours before bedtime. Nocturia is the medical term for excessive urination during the night, which can keep one from getting a good night's sleep.

The bedroom should be cool, dark, and quiet. Studies have shown that increasing temperatures can disturb sleep. A temperature of 70 degrees Fahrenheit (20 degrees Celsius) is considered optimal, but this may vary depending on individual preferences.

Smartphones, laptops, and televisions that emit blue light should be avoided before bedtime. Optimally, electronic devices should be banned from the bedroom altogether. Individuals shouldn't eat in bed or turn it into an office by using the bed to make calls, text, or work on their laptops.

Long daytime naps may interfere with sleep at night. A nap lasting no more than an hour is recommended. However, there are exceptions; some people who nap regularly and frequently don't have any difficulty falling or staying asleep at night.

Exercise and exposure to the outdoors may also positively influence sleep. But exercise shortly before bedtime may do the opposite. A morning workout or a brisk walk is recommended.

Exposure to sunshine and bright lights (especially in winter) can be helpful if you have insomnia. Some studies have shown that exposure to bright lights reduced the time it took to fall asleep by up to 86 percent. Furthermore, meditation and stress management can be helpful to those who have trouble falling asleep due to anxiety.

If one has trouble falling asleep over a prolonged period, a constant urge to move their leg, or a burning pain in their stomach, chest, or throat—symptoms of apnea, restless legs syndrome, and gastroesophageal reflux disease, respectively—they should consult their healthcare provider.

By Leslie Alan Horvitz

Author Bio: Leslie Alan Horvitz is an author and journalist specializing in science. His nonfiction books include *Eureka: Scientific Breakthroughs That Changed the World*, *Understanding Depression* with Dr. Raymond DePaulo of Johns Hopkins

University, and *The Essential Book of Weather Lore*. His articles have been published by Travel and Leisure, Scholastic, Washington Times, and Insight on the News, among others. He has served on the board of Art Omi, is a member of PEN America, and contributes to the Observatory. Horvitz is based in New York City. He is a contributor to the Observatory. You can find him online at lesliehorvitz.com.

Source: Independent Media Institute

Credit Line: This article was produced by Earth | Food | Life, a project of the Independent Media Institute.