Cortisol and Its Effects on Your Sleep

Cortisol is more than a stress hormone—it also plays a major role in regulating sleep and other important physiological functions.

March 24, 2020 By Michael Breus, PhD

It's a hot topic in sleep research: the relationship between cortisol and the quality and patterns of sleep. I've been talking about cortisol for a while, but I've never devoted a stand-alone article to this important topic. It's time to correct that. Today, I'll talk about the role that cortisol plays in the sleep-wake cycle, how disruptions to healthy cortisol levels interfere with sleep and contribute to sleep disorders—and how poor sleep, in turn, negatively affects cortisol. I'll also discuss ways to encourage healthy cortisol levels, for the benefit of your sleep and broader health.

What does cortisol do?

Cortisol is a stimulating, alerting hormone. It's the body's primary stress hormone—that's the role that gets cortisol most of its attention. Urged on by a complex network that incorporates elements of the central nervous system and the adrenal system, cortisol drives the body's fight-or-flight response, in the presence of a threat or stressor. But cortisol does more than spur fight-or-flight. This hormone has a number of other functions, including:

- Regulating blood pressure
- Balancing blood sugar
- Influencing inflammation
- Regulating energy levels
- Contributing to cardiac system function
- Helping to control the sleep-wake cycle

Cortisol gets a pretty bad rap these days—and there's no question that chronically elevated cortisol contributes to sleep disruptions and other health problems (more on those in a moment). But it's important to be clear: cortisol is an essential component of human physiology. The challenge for many of us is to keep cortisol levels from veering too high. (As you'll see, sleep can help with that).

When cortisol is elevated too frequently and over long periods of time, it can cause a number of

health problems. They include:

- Chronic illnesses, including high blood pressure, diabetes, and heart disease
- Weight gain (both by stimulating appetite and by encouraging the body to store fat more aggressively)
- Fatigue
- "Foggy brain", and difficulty with memory and focus
- Compromises to the immune system, increased inflammation and greater vulnerability to illness, disease, and other effects of aging
- Problems with digestion
- Mood disorders, including depression and anxiety
- Sleep problems

Cortisol doesn't operate in isolation. It's part of a complex system known as the HPA axis (that's short for hypothalamic-pituitary-adrenal axis, which combines parts of the central nervous and endocrine systems. Cortisol is produced in the adrenal glands, and the hypothalamus and pituitary gland, located in the brain, monitor cortisol levels and send messages to the adrenal system to adjust its production, depending on the body's needs and circumstances. It's the complex, dynamic communication of the HPA axis that produces cortisol and helps to regulate body functions ranging from sleep-wake cycles to stress and mood to digestion and immune function.

Cortisol is a major—but not the only—hormone that functions within this system, with direct effects on sleep. The sleep-facilitating hormone melatonin is another. Together, melatonin and cortisol work within the HPA axis to regulate sleep and wakefulness.

When it comes under prolonged or chronic stress, this network can become constantly activated, the hypothalamus and pituitary gland constantly signaling the adrenal system to produce more cortisol. It is cortisol's role as part of this axis that's attracted a lot of attention from sleep scientists in recent years. That's because chronic stress is such a widespread problem with such deep effects on sleep. It's also because cortisol and the HPA axis it operates within interact with sleep in several different and important ways.

What to remember: Cortisol is more than a stress hormone—it also plays a major role in regulating sleep and other important physiological functions, all from within a network known as the HPA axis.

The cortisol rhythm and sleep

Like nearly all hormones in the human body, cortisol has a daily, 24-hour rhythm. For most bio types, cortisol levels are at their highest in the morning, usually around 9 a.m. Cortisol begins to rise gradually in the second half of a night's sleep. The hormone begins a more rapid rise around the time you're waking up before peaking at about 9. From that point on, cortisol makes a gradual decline throughout the day, reaching its lowest levels around midnight. The activity of the HPA axis, which produces cortisol, reduces to its lowest levels in the evenings, right around your bedtime. In this way, cortisol plays a critical role in sleep-wake cycles: stimulating wakefulness in the morning, continuing to support alertness throughout the day while gradually dropping to allow the body's own internal sleep drive and other hormones—including adenosine and melatonin—to rise, and help bring about sleep.

This evening-low, morning-high daily cortisol rhythm is true for most chronotypes: Lions, Bears and Wolves. In Dolphins, however, the cortisol rhythm is inverted. Dolphins have cortisol on the rise at night and reaching its lowest levels in the morning. This inverted cortisol rhythm contributes to the difficulty falling asleep, restless and light sleep, groggy mornings and daytime fatigue that is so common among Dolphin chronotypes.

Don't know your chronotype yet? Take my quiz at www.chronoquiz.com. To learn more about how your chronotype affects your health, your relationships, and about the very best times for you to do just about everything in your daily life, check out my book, The Power of When.

That's cortisol and its rhythm in balance, or homeostasis. Too often, the cortisol rhythm is thrown out of sync, leading to problems with sleep and health. Cortisol levels can be too low, but much more often, it's elevated cortisol that's the problem.

Chronic stress is a major contributor to elevated cortisol, an excessively active HPA axis, and an ongoing state of arousal that's exhausting, anxiety-producing and sleep-depriving. As I've said, elevated cortisol also contributes to a compromised immune system, chronic inflammation, weight gain, and, eventually, to chronic disease.

Poor sleep itself also can increase cortisol production and dysfunction of activity along the HPA axis. Research shows that cortisol can be elevated by:

- Poor quality sleep
- Lack of sufficient sleep
- Inconsistent sleep schedules (including rotating schedules adhered to by shift workers)

Research shows a complex two-way street between the HPA axis (which produces cortisol and regulates its levels) and sleep. Poor, insufficient, irregular sleep increases the activity of that system, leading to more stress, greater arousal, and over time to the health complications I've mentioned above. And a more active HPA axis can interfere with the ability to maintain consistent sleep routines and to get enough sound, high-quality sleep. It can be a vicious cycle.

What to remember: Cortisol production follows a daily, 24-hour bio rhythm, lowest overnight and highest first thing in the morning. When that rhythm gets disrupted, sleep does too.

Cortisol and sleep disorders

One big question is this: does too-high cortisol cause sleep disorders such as insomnia and sleep apnea, or is high cortisol a result of those sleep disorders? The answer is complex, and one that scientists are still reaching for; we don't yet fully understand the directionality of the relationship between sleep disorders, cortisol, and the HPA axis. The short answer is, it's likely some of both. That's the two-way relationship in action.

Research shows that heightened HPA-axis activity is linked to more restless, fragmented sleep, less slow wave sleep, and lower overall sleep amounts. This strongly suggests a role for cortisol as a sleep disruptor. Research including this 2014 study, show that sleep deprivation is linked to higher cortisol levels and to a more extreme cortisol response in the presence of stress—that's the HPA axis going into action urging the body into a state of fight-or-flight. This strongly suggests a role for sleep problems as aggravators of cortisol. And other research shows links between compromised sleep quality and heightened HPA axis activity.

What about specific sleep disorders, such as insomnia? High cortisol levels frequently appear with insomnia. But it's not clear whether elevated cortisol is a cause or consequence of insomnia. And it's entirely possible that depending on an individual's circumstances, cortisol could be both a cause and a consequence.

Obstructive sleep apnea is another sleep disorder with links to cortisol. Elevated cortisol levels are often present in people with sleep apnea, but it's not clear that cortisol contributes directly to sleep apnea. Research does indicate that elevated cortisol, and heightened activity of the HPA axis, can result from the sleep loss, arousal, and compromised breathing that characterizes sleep apnea. There's also evidence that high cortisol and over-active HPA-axis activity may contribute to the metabolic complications that accompany sleep apnea, including diabetes. It's still unclear if it's the sleep deprivation from the undiagnosed apnea, that's raising your cortisol levels or it's the apnea itself.

High cortisol is associated with obesity, as well as depression, anxiety and other stress-related mood disorders. These are conditions that are often contribute to and occur alongside insomnia and sleep apnea. They're also conditions that are strongly associated with poor sleep even in the absence of clinically formal sleep disorders.

We've got more work to do to better understand the mechanisms by which cortisol affects sleep. It is already clear, however, that disordered sleep and out-of-balance cortisol frequently go hand-in-hand. Tending to sleep problems is one important way to help bring cortisol levels back into line while improving your nightly rest and lowering your risk for illness, both physical and psychological.

What to remember: High cortisol may be a consequence of common sleep disorders, including

insomnia and sleep apnea. It also may be a contributor to sleep disorders. And it's a contributor to other health problems (weight gain, stress) that undermine healthy sleep.

How to improve cortisol level, naturally

Keeping cortisol levels in check—and HPA axis activity from ramping up too high—can contribute to healthier sleep. Of course, sleeping better—making enough time for nightly sleep, adhering to a consistent sleep routine, practicing other fundamentals of sleep hygiene—is one way to lower cortisol. Here are others:

Practice regular, light-to-moderate exercise

Research shows light to moderate exercise doesn't create a short-term spike in cortisol like intense exercise can—and it also can reduce cortisol levels overall. Yoga and tai chi, two fantastic and gentle mind-body exercises for sleep, have been shown in scientific studies to lower cortisol.

Manage stress with mindfulness and breath

Deep breathing exercises can reduce cortisol, studies show. Developing mindful awareness about our own stress and its triggers helps to relieve that stress, and reduce cortisol. Research shows that mindfulness-based stress reduction lowers cortisol in the body. Changing patterns of negative thinking can also reduce cortisol. Negative, angry, self-critical thoughts can lead to cortisol spikes—but studies show when we address these thinking patterns, and employ positive thinking in their place, cortisol levels go down. A positive outlook is also linked to better sleep, as I've talked about before. And mindfulness is a powerful contributor to healthy sleep, as you've heard me talk about frequently.

Consider supplements

Several supplements that may help sleep also may help lower cortisol. Elevated cortisol is associated with deficiencies in omega-3 fatty acids, and research suggests omega-3 fatty acids may improve cortisol levels. L-theanine and magnesium, two natural supplements that have demonstrated benefits for sleep, may also help to keep HPA-axis functioning at healthful levels, and thereby keep cortisol levels in check.

Don't stress about cortisol. Take steps to manage it. Sleep is both a tool and a beneficiary of attention to keeping stress in check, and cortisol levels healthy.

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