

The Power of Sleep

PAMELA WEINTRAUB · MARCH 2013

New science shows that sleep is essential to our mental and physical health — and most of us aren't getting enough.

Jason Karp is a successful hedge-fund manager and restaurateur with a close-knit family and a deep respect for work-life balance. Today, his world is cruising along quite nicely. More than a decade ago, though, he was in near-constant overdrive — and dangerously close to crashing. Karp graduated at the top of his class at Wharton business school. He was the youngest person to make partner in his elite financial firm. He had a great deal of ambition and a nearly unquenchable thirst for knowledge.

After teaching himself to speed-read, he spent long evenings consuming history, philosophy, literature and science. In an effort to absorb even more, Karp trained himself to forgo sleep. He cut back from his usual seven nightly hours to just two or three. Sometimes he wouldn't go to bed at all, staying up to read or work instead.

“It was like something out of *Icarus*, where someone thinks he has a gift and takes it too far,” the 36-year-old recalls.

Karp was especially fascinated with the subject of neuroscience. And ironically, the more he stayed up late learning about the inner workings of his brain, the more he noticed that his sensory perception was beginning to erode.

“Within three months I was seeing double,” Karp says.

Eventually, Karp was diagnosed with keratoconus, a progressive degeneration of the cornea that can necessitate a corneal transplant. At the time, it never occurred to Karp or his doctor that his vision problems could be traced to his lack of sleep.

With his vision deteriorating, Karp began reading even more furiously, staying up longer and focusing on health-related literature. Soon his prostate region pulsed with pain and a urologist suspected testicular

cancer. His hair fell out in clumps, his skin broke out in a rash and his cortisol levels were so high that at one point a doctor told him he doubted Karp would live to see his 40th birthday.

“I fell into a deep depression,” Karp recalls. “I lived in terror because I thought I was dying.”

Finally, Karp came across an obscure bit of research that drew a link between the skin disorder eczema and the keratoconus that was threatening his vision. The article prompted Karp to remember that his rash appeared after he’d stayed awake for 48 hours straight: “I naively thought if I could make the rash go away, I could make the keratoconus go away, and I wondered if I could do it through sleep and better diet.” It took months for Karp to retrain himself to sleep, but once he did, the rash disappeared. Then his vision returned — even though an ophthalmologist had told him it probably never would. His prostate pain subsided. Six months after returning his sleep pattern to normal, every single malady, disorder and disease had disappeared. “I cured myself through sleep and better diet,” Karp says.

Sleep, new research reveals, is a master regulator of health. A sleep deficit or disruption can create wide-ranging havoc, compromising our immune system, causing inflammation, and damaging our genes. Losing just an hour of sleep a night increases risk of cancer, heart attack, stroke and type 2 diabetes.

Lack of sleep can also lead to memory loss, negatively affect people’s reflexes and decision-making skills, cause hearing loss and psychiatric disease, and impede sexual function.

And it’s not just people who suffer from sleep disorders like insomnia and sleep apnea who have to worry, says James Maas, PhD, a recently retired Cornell scientist and one of the world’s foremost sleep researchers. He says at least seven out of 10 Americans aren’t getting enough sleep and they’re at risk for serious health problems, as well. “People devalue sleep and are completely unaware of what happens to them when they have a deficit,” Maas says. “As a society we are so habituated to low levels of sleep that most of us don’t know what it feels like to be fully alert and awake.”

We treat sleep like a “tradable commodity,” adds University of Chicago sleep researcher David Gozal, MD, sacrificing it for work, entertainment or some other lifestyle choice. In large part, he believes, we do this because it can take months or even years for a disease caused by sleep deficit to fully emerge.

In the meantime, everything from our health to our relationships to our sense of wonder gets diminished. “Sleep is the food of the brain,” says Gozal. And a great many of us aren’t just hungry for sleep, he notes. “We are starving.”

INFLAMMATION NATION

The damage caused by sleep deficit first dawned on Gozal, a pediatrician, about 20 years ago, while treating children with sleep apnea, in which breathing is rendered irregular (through physical obstruction or damage in the brain) and sleep is interrupted. After they had surgery to correct the problem, many children appeared transformed. Those labeled mentally challenged became stellar students, and friendships and personalities improved dramatically.

Over the years, researchers traced apnea to cognitive and psychiatric impairments, high cholesterol and atherosclerosis, high blood pressure, obesity, and type 2 diabetes, to name a few.

Eventually, Gozal realized the apnea findings were applicable to adults who were burning the candle at both ends, whether they had apnea or not. He and his colleagues traced perturbations in sleep to a surge of pro-inflammatory molecules — from dangerous cytokines to C-reactive protein — that did massive damage throughout the body. For example, in adipose tissue (body fat), these pro-inflammatory molecules set the stage for obesity and type 2 diabetes; in the cardiovascular system, heart disease; in the brain, neuronal loss.

Fortunately, it’s often possible to reverse the damage caused by sleep loss. A 2007 study published in the journal *Circulation*, for instance, followed 26 children with apnea who had the inflammatory precursors of cardiovascular disease. By curing the apnea, Gozal reversed the damage

in all except six of the children, and that's because those six had a genetic predisposition to the disease.

This led to a seminal finding: The pro-inflammatory state caused by sleeplessness makes those who are already at genetic risk for certain maladies far more vulnerable to triggering them into an active disease state.

Gozal explains, for example: "If you are born with a familial predisposition to Alzheimer's at age 70, a sleep disturbance could bring it on at an earlier age, say 55."

FROM SLEEPLESS TO MINDLESS

Some of the most groundbreaking sleep studies have involved fruit flies, because they have very similar sleep-wake cycles to humans. In recent years, researchers have used them to show how fundamental sleep is for proper brain function. It turns out that sleep affects our long-term memories, emotional stability, cognitive skills and ability to learn. Neuroscientist and psychiatrist Giulio Tononi, MD, PhD, at the University of Wisconsin–Madison, first hypothesized in 2003 that sleep had a modulating effect on synapses — the regions connecting neurons in the brain.

If sleep was capable of affecting our synapses, then it followed that sleep could also control a great many fundamental functions of the brain.

Sleep researcher Paul Shaw, PhD, a neurobiologist at Washington University in St. Louis, and his team created a fruit-fly boot camp to test the hypothesis. First thing in the morning, after the flies woke up, the scientists counted their synapses and set about training them in various tasks. In one case, for instance, male flies were taught to distinguish between real females and other males disguised with female pheromones.

During the training sessions, fruit flies mastered the tasks, and afterward, scientists found that the number of their synapses increased. But there was a cost: The brain had literally become saturated with an overload of

synapses, preventing the flies from learning other things, and far more energy was required to get through the day.

The trained flies needed more sleep than a control group of untrained flies. When his flies fell asleep, Shaw found, the “entire milieu of the brain changed. The connections between all the synapses got weaker, and the weakest ones went away.”

That might sound like a bad thing, but it’s not. Instead of causing all stored information to disappear, the sleep process just wiped out the least important impressions, in essence, the noise; only the essential synapses remained. As a result, long-term memories were formed, and the brain was free enough to learn again.

Conversely, when the researchers trained flies but then prevented them from sleeping until the next day, they forgot everything they had learned. “If you don’t sleep after learning, the memory is erased,” Shaw emphasizes, “but if you sleep after learning, the memory is saved.” (For more on how downtime can help us become more effective thinkers and achieve mental clarity, see “Take a Break.”)

THE WEIGHT OF THE MATTER

Researchers have found that your risk of weight gain can be influenced almost as much by your sleep as by your eating habits. Eve Van Cauter, PhD, at the University of Chicago, first hypothesized this was because the sleepless were overeating during those long stretches of night. To test the hypothesis, she recruited a group of young men to spend four nights in her lab.

For two nights the men were allowed to sleep only four hours, and for two nights their rest period was 10 hours. Importantly, two hormones that regulate appetite changed radically when the subjects slept less: Leptin, which signals the brain to feel full and stop eating, decreased by 18 percent, and ghrelin, the hunger hormone, increased by 28 percent. For the first time, Van Cauter was able to establish that sleep deficits are capable of triggering a damaging hormone cascade. These hormonal changes, Van Cauter observed, suggest that if the subjects had unlimited

access to food — which they did not — they would have eaten more and gained weight. (For more on how sleep influences weight management, visit ELmag.com/sleepitoff.)

Since her work was published in 2004, countless studies have provided support. At Columbia University, researchers reported that those who regularly slept just four hours were 73 percent more likely to become obese than those sleeping between seven and nine hours. (Even people sleeping a more respectable six hours were 23 percent more likely to become obese.)

Researchers from Uppsala University in Sweden used MRIs to show that sleep loss triggered the area of the brain associated with hunger and the desire to eat. And Van Cauter ultimately concluded that sleep restriction disrupts the daily drop-off of the damaging stress hormone, cortisol, which should be at its lowest levels right before bedtime and which is implicated in weight gain.

SLUMBER FOR SUCCESS

Sleep scientist James B. Maas, PhD, has already shown the real-world power of these findings by training pro athletes looking for an edge. For example, after working with Maas to improve her sleep habits, U.S. figure skater Sarah Hughes reported improved performance, contributing to an Olympic gold medal.

Among Maas's other recent clients are the high school educators at Deerfield Academy in Deerfield, Mass., who were concerned by research showing that adolescents functioned poorly very early in the day. Under Maas's guidance, Deerfield changed its starting time to allow students an extra hour of sleep, and the school's average grades rose to a record winter-term high. Teachers reported students showed increased alertness, and visits to the health center were down 20 percent in a year when other schools reported substantial increases in flu and colds.

This raises a question that sleep scientists like Maas hear all the time: How much sleep does the average person need to function optimally, or even competently? Can some people really get by on, say, four hours of

sleep a night (as Bill Clinton famously claimed was the case for him), or will chronic sleep deprivation ultimately catch up with everyone? It depends, says Maas. While most people do well with seven and a half to eight hours, there are individuals who need less — or substantially more. “Some people find they need 10 hours,” says Maas, “and they can no more change that than they can change a size-9 shoe to a size 6. Women, especially, often need more sleep because of fluctuations in hormones, including testosterone, cortisol and melatonin during menstruation and pregnancy, and at the start of menopause. It’s ultimately in the genes.”

To figure out how much sleep you need, Maas suggests finding out what time you need to bed down to wake up in the morning without any grogginess or even an alarm. Each week go to bed 15 minutes earlier, he says, until you find how many hours you really need. He also advises getting most of your rest in a single stretch, and not in chunks.

Fragmented nights compromise energy and cognition and lead to daytime exhaustion, he says. So consider sleeping alone if your partner’s snoring, wakefulness or restless legs disturb you. If you do lose time on any given night, says Maas, make up for it as soon as possible. Catch up by going to bed earlier, not sleeping in later. And make up the sleep over a number of successive days, not all at once. (For more tips on how to reclaim your sleep rhythms, visit ELmag.com/getyourgrooveback.)

There are those rare few who truly don’t need much sleep, Maas says, but they usually come from families with a particular genetic trait. For most of us, though, the belief that we don’t need much sleep is delusional. As Maas points out, “Clinton now says he made his worst decisions on those sleepless nights.”

WHILE YOU'RE NOT SLEEPING

Anyone who’s ever pulled an all-nighter to meet a deadline or study for a test knows the day-after results aren’t pretty: The body feels sluggish, the mind fogged or frenetic. Recent research shows that a chronic lack of sleep is far more damaging than previously assumed by many experts.

Sleep deficits as small as an hour a night can increase the risk of a wide range of conditions. Why? Because when we don't get enough sleep, our immune systems go into overdrive, which causes systemic inflammation and turns on dangerous genetic switches.

Everyone's immune system is unique, so how sleep deprivation affects you might be different from how it affects another person. Here are just some of the ways chronic skimping on sleep can affect your health:

- Neuropsychiatric disorders, impaired alertness and cognition, and headaches
- Vision problems, including blurred vision, floppy eyelid syndrome, glaucoma, even temporary blindness
- High blood pressure
- Increased levels of cortisol, a hormone associated with stress
- Cancer
- Difficulty with sexual functioning
- Increased food cravings and hunger
- Insulin resistance, type 2 diabetes
- Hearing loss
- Muscle weakness and decreased athletic performance
- Heart disease
- Skin problems and rashes, including eczema
- Hair loss
- Disrupted metabolism, weight gain and obesity

THE SLEEP DEPRIVATION TEST

The following test is a rendition of The Maas Robbins Alertness Questionnaire, developed by sleep expert James B. Maas, PhD, a pioneer of sleep research and a recently retired professor at Cornell University.

Please indicate true or false for the following statements:

- 1 I often need an alarm clock in order to wake up at the appropriate time.
- 2 It's often a struggle for me to get out of bed in the morning.
- 3 Weekday mornings I often hit the snooze bar several times.
- 4 I often feel tired and stressed out during the week.

- 5 I often feel moody and irritable, and little things upset me.
- 6 I often have trouble concentrating and remembering.
- 7 I often feel slow with critical thinking, problem solving and being creative.
- 8 I need caffeine to get going in the morning or make it through the afternoon.
- 9 I often wake up craving junk food, sugars and carbohydrates.
- 10 I often fall asleep watching TV.
- 11 I often fall asleep in boring meetings or lectures or in warm rooms.
- 12 I often fall asleep after heavy meals or after a low dose of alcohol.
- 13 I often fall asleep while relaxing after dinner.
- 14 I often fall asleep within five minutes of getting into bed.
- 15 I often feel drowsy while driving.
- 16 I often sleep extra hours on the weekends.
- 17 I often need a nap to get through the day.
- 18 I have dark circles around my eyes.
- 19 I fall asleep easily when watching a movie.
- 20 I rely on energy drinks or over-the-counter medications to keep me awake.

If you answered “True” to four or more of these statements, consider yourself seriously sleep-deprived.

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