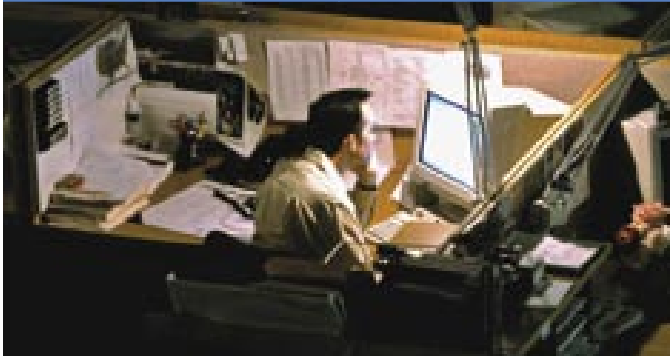


the CANCER- LIGHT connection

Reading yourself to sleep. Late-night TV. Answering e-mail into the wee hours. Startling new research has linked habits like these to cancer. Here's how to protect yourself

BY CATHERINE GUTHRIE

From 1992 to 1999, Eva Schernhammer, MD, worked rotating night shifts in a cancer ward in Vienna, Austria. Her shifts included 10 all-nighters a month in addition to her regular hours; she labored under banks of flickering fluorescent lights through the darkest hours. "I didn't think much of it," she says, "until two of my colleagues developed cancer. These were healthy women in their 30s. They really had no risk factors, no family history." She couldn't help wondering: Could working late nights be linked to cancer?



Three years later, Schernhammer landed at Harvard Medical School in the Channing Laboratory—the perfect place to find an answer to that question. The lab is home to the Nurses' Health Study, one of the largest data banks of women's health information ever amassed. She tapped into medical, work, and lifestyle records gleaned from 78,562 nurses. The end result, published in 2001, was startling: Nurses who'd worked 30 or more years on night shifts had a 36% higher rate of breast cancer, compared with those who'd worked exclusively days. Three years after her initial study made headlines, she followed up by methodically reviewing 13 new trials on night-shift workers and cancer risk. These findings, published last September, were even more jaw-dropping than her original work: On average, her peers had uncovered a 48% rise in breast cancer among women on the night shift.

Schernhammer had discovered something other researchers had

suspected for some time: Exposure to light at night appears to raise the risk of several types of cancer. And evidence suggests that night-shift work isn't the only risk. Watching TV, sitting in front of the computer, or even reading under a lamp into the wee hours may be enough to throw a wrench into the body's cancer-fighting machinery. Simply put, light at night snuffs out one of the body's most powerful anticancer crusaders, a hormone called melatonin. Because it's only active at night, melatonin has been dubbed "the hormone of darkness." It's the perfect name for a biological superhero. But if melatonin is the body's superhero, then light is its nemesis, and research suggests it's gaining the upper hand.



Breast cancer rates are highest in industrialized nations: Could our 24-7 lifestyles be one of the factors putting us at risk?

SKYLINE: DAVID TROOD/GETTY IMAGES; NURSE: ENIGMA/ALAMY; BASEBALL FIELD: ROY COOMES/MASTERFILE

OPENING SPREAD (LEFT TO RIGHT, TOP TO BOTTOM): ANDY COX/GETTY IMAGES; JASON HETHERINGTON/GETTY IMAGES; BILL VARIE/CORBIS; RICK GAYLE/CORBIS; LWA-DANN TARDIF/CORBIS

a case of bad timing

"Humans evolved on a planet without electric light over thousands and thousands of generations," says George Brainard, PhD, a professor of neurology at Thomas Jefferson University who has spent 20 years studying how light affects human biology. "The body is designed to be awake and alert during

light, either from the sun or a bulb, hit the photoreceptors in the back of the eye, signals are sent to the SCN. The SCN resets itself daily by tracking the strength of the signals. Weaker ones at night, when it's dark, trigger the release of melatonin from the pea-size dollop of brain tissue called the pineal gland. Acting as the body's sandman, mela-

SCHERNHAMMER'S RESULTS WERE STARTLING: NURSES WHO HAD WORKED THE NIGHT SHIFT HAD A 36% HIGHER RATE OF BREAST CANCER

daytime hours and to sleep at night. Now we have a 24-7 society that isn't in harmony with our biological design."

That design is the circadian system—internal rhythms that repeat roughly every 24 hours. The sleep/wake cycle is the rhythm we're most familiar with, but the body is constantly adjusting its internal machinery—the ebb and flow of hormones, the rise and fall of body temperature, and other subtle rhythms—to mesh with the 24-hour solar day. Monitoring and directing this dance is the brain's master clock, the suprachiasmatic nucleus (SCN).

The SCN sits directly above the brain stem and houses nearly 20,000 nerve cells that receive and transmit information nonstop to various parts of the brain and body. The signal to which the SCN is most attuned—given its perch above a busy intersection of optic nerves—is light. When wavelengths of

tonin slows body functions and lowers blood pressure; consequently, core body temperature drops. Conversely, a strong light signal during the day reverses the process—cortisol and other hormones are released, raising blood pressure and core body temperature, as melatonin production declines.

the cancer connection

Cells throughout the body—even cancer cells—have melatonin receptors, and when melatonin makes its nightly rounds, cell division slows. Research by Steven Hill, PhD, a professor of structural and cellular biology at Tulane University, suggests that when this hormone latches on to a breast cancer cell, it counteracts estrogen's tendency to spur cell growth. In fact, melatonin has a calming effect on several reproductive hormones, male and female, which may explain why it seems to protect against sex hormone-driven cancers (ovarian,

endometrial, breast, and testicular).

However, there is one system in the body that resists melatonin's lulling effect: immunity. Studies have found that the hormone boosts the production of immune cells such as interleukin-2; they help recognize and attack the mutated cells that can lead to cancer. By slowing cancer growth *and* promoting immunity, melatonin seems designed to offer real protection.

One of the most compelling measures of light's power to affect cancer rates are studies of the only segment of the population unaffected by light: the blind. Their circadian rhythm ticks on undisturbed by the sun or indoor lamps, and it keeps steady time. Since 1991, four different studies have served up the same results: Blind women have a 50% reduced risk of breast cancer, compared with their sighted peers.

In an attempt to gauge melatonin's potency, David Blask, MD, PhD, a neuroendocrinologist at Bassett

group was exposed to bright light for 24 hours; the other was exposed to 12 hours of light followed by 12 hours of darkness. In the end, the tumors on rats that were bathed in continuous light grew up to seven times faster than tumors on the rats that spent their nights submerged in total darkness. Blask describes the exposure to bright light at night as comparable to shutting down melatonin production entirely. In people, he says, "melatonin directly inhibits cancer growth. Lose your melatonin signal at night, and you're losing an important layer of cancer protection."

Energized by these findings, Blask and Brainard teamed up to take the research one step further. In a just-completed study funded by the National Cancer Institute, they infused human breast cancer tumors with blood taken from healthy, premenopausal women at several times during the day, most notably the predawn hours, when

“LOSE MELATONIN, AND YOU'RE LOSING AN IMPORTANT LAYER OF CANCER PROTECTION. MELATONIN DIRECTLY INHIBITS CANCER GROWTH”

Research Institute in Cooperstown, NY, has been running studies on melatonin, cancer, and light's effect on both for 28 years. In 2001, he published results from research in which he grafted human breast cancer tumors onto rats, and then divided the animals into two groups. One

melatonin peaks, and again at night after the subjects had been exposed to bright fluorescent lights for 2 hours. As in the first study, light suppressed melatonin—and tumor growth accelerated. But when melatonin levels peaked at night, tumor growth slowed by 80%. “This is the first proof that light



LEFT TO RIGHT: ALLOVER PHOTOGRAPHY/LAMY; PHOTODISC/MEDIA BAKERY; WALTER HODGES/BRAND X/GETTY IMAGES

is indeed a risk factor for cancer and the first evidence of a biological link between circadian clock disruption and cancer,” says Blask. “Light at night could be a major driver of breast cancer.”

The studies are scary—and well-established. But not every cancer specialist draws the same conclusions. “There are a lot of hormones in the blood,” says breast oncologist Marisa Weiss, MD, who is president and founder of the Web-based nonprofit Breastcancer.org. “The dance and interplay of hormones has an effect on cancer, but it's impossible to gauge the influence of just one—especially in studies performed on animals and in petri dishes.” Schernhammer herself is cautious about the research. “I feel more confident saying that an associa-

tion exists between melatonin, light, and cancer—but not a direct cause and effect. I don't know what the causes are—maybe factors we haven't thought of yet.”

The first step in getting a firm

answer will be figuring out what kind of cancers may be affected by light. So far, researchers have looked mostly at breast cancer rates in studies of melatonin. But experts suspect that many types of cancer are sensitive to the hormone to some degree. In a 2003 review of women in the Nurses' Health Study, Schernhammer found a 35% increase in colon cancer rates among night-shift workers. “I think from the beginning, the focus has been on breast cancer,” says Schernhammer, “but by no means is breast cancer the only one affected by melatonin—other cancers, beyond those linked to male or female hormones, show likely links.”

Blask also suspects that melatonin's protection may extend to other forms of cancer. He has plans to study melatonin

6 ways to REDUCE YOUR RISK

Researchers are still deciphering how much light at night is too much. But keeping your circadian rhythm running smoothly jibes with healthy living.

embrace darkness Sleep in a completely dark room. Turn off all hall and night-lights. If the glow from street lamps or commercial signs invades your bedroom, consider investing in room-darkening shades or blinds.

shoot for nine A new study of 7,396 Finnish women found that those who slept an average of 9 or more hours a night were one-third as likely

to get breast cancer as those who slept 7 to 8 hours. "This is the first evidence of a relationship between sleep duration and breast cancer risk," says one of the study's authors, Richard Stevens, PhD, of the University of Connecticut, Farmington.

choose a dim bulb If you wake up in the middle of the night and can't sleep, don't turn on a bright light and read.

Just 10 minutes of light is enough to suppress melatonin in some people. Instead, lie in bed to see if you can drift back to sleep. If you must get up, keep the lights dim.

see red If you get up in the middle of the night to go to the bathroom, resist the urge to flip on the fluorescent vanity light, says Stevens. Instead, keep a red lightbulb in one fixture. Blue wavelengths cast by fluorescent and halogen lights are the worst offenders. Red wavelengths, on the



other hand, are the most innocuous.

get some sun... The circadian system needs bright light to reset itself. Ten to 15 minutes of morning sunlight will send a strong timekeeping signal to the brain's clock, leaving it less likely to be confused by weaker signals from night-lights, says Mariana Figueiro,

PhD, a researcher at the Lighting Research Center in Troy, NY. If it's dark when you leave for work or dusk when you get home, a brisk lunchtime walk will help.

and more sun as you age

In older adults, the brain's master clock, the suprachiasmatic nucleus (SCN), shrinks and slows down, which makes the receptors less alert to light signals. "Due to eye changes, a 60-year-old gets one-third the amount of light that a 20-year-old gets," says Figueiro. If you can't be outdoors as much as you'd like, throw open the blinds and position a chair near a window to maximize rays.

What about supplements?

Melatonin pills are readily available, but experts don't recommend taking them. "It's a very powerful hormone," says Blask. "We just don't know if it's safe to take." However, research on cancer patients suggests that melatonin can boost survival and quality of life for people with tough-to-treat cancers like lung cancer and melanoma. And taken alongside chemotherapy, it seems to improve appetite and ease other side effects. But check with your doctor before adding melatonin to your regimen. —CG

suppression in prostate cancer cells, based on earlier test-tube studies that hint at a connection.

which lights are worst?

Back in 1980, scientists at the National Institute of Mental Health discovered that 2 hours of bright light at night could knock down melatonin to daytime levels, a finding that led them to test bright light as a treatment for the winter-related depression known as seasonal affective disorder. (They had no idea there might be cancer ramifications.) The light they used was intense and continuous, which left Brainard

wondering what ordinary household lighting's effects on melatonin might be. He and his colleagues spent 5 years conducting more than 600 experiments on light and the hormone.

Ultimately, they discovered that short light wavelengths, such as those at the blue end of the spectrum (found in fluorescent and halogen lights), suppressed melatonin the most. On the flip side, long wavelengths, such as those put out by a red lightbulb, stifled melatonin the least. "In a healthy person, you can measurably curb melatonin with as little as 1.3 lux of blue light," says Brainard. (One lux is the illumination cast by a wax

candle.) A 40-watt bulb—what you'd find in a typical reading lamp—is about 50 lux. A moderately lit bedroom measures around 100. Brainard is still working out what happens to melatonin in the face of that kind of exposure, but other research is beginning to suggest answers.

Back in 2001, researchers at the Fred Hutchinson Cancer Research Center in Seattle queried 1,600 women about their sleeping habits over the past 10 years and how brightly lit their bedrooms were. The women who tended to stay up late 2 to 3 nights a week on average had a 70% increase in risk of breast cancer. (Those with bright bedrooms had a

barely perceptible increase.)

In one of Schernhammer's most recent studies, she analyzed morning urine samples taken from women in the Nurses' Health Study to gauge their nighttime production of melatonin. Women who had the lowest levels also had a 70% higher risk of breast cancer than women with the most melatonin. What surprised her was that the high-risk group wasn't made up solely of night-shift workers: Women who had worked only days were in the group, as well. "Who knows what these women were doing at night?" she says. But if

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Light and Cancer

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they were up late for some reason, she speculates, their light exposure may have been enough to chase away melatonin.

Blask's goal is to further study household lighting's impact. He has found that breast cancer cells divide faster when light cuts melatonin levels by as little as 15%. His next step is to find out the light intensity and length of exposure needed to trigger cancer cell activity in women's breasts. Until more is known, one of the best things people can do is protect themselves from unnecessary exposure to light at night, he says.

That advice seems perfectly reasonable to epidemiologist Heather Spencer Feigelson, PhD, a spokesperson for the American Cancer Society. She's intrigued by the biological mechanism Blask, Brainard, and others have uncovered. "Based on the research, limiting light exposure at night could match the protection from breast cancer that regular physical activity provides," she says. "And there's certainly no downside to sleeping in a dark room, aside from bruised shins, maybe." (For advice on keeping your circadian rhythm on track, see "6 Ways to Reduce Your Risk," p. 144.)

Based on Schernhammer's work, the group at highest risk are people working rotating night shifts under bright lights. She believes the irregularity of the schedule prevents the body from adjusting and adapting; that, in turn,

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keeps circadian rhythms off track and melatonin production down. Regular night-shift work doesn't seem as risky as, say, three all-nighters a month, she says.

Should TV and computer screens prove to be culprits in cancer, that may solve, at least in part, the maddening riddle of breast cancer. Last year, 211,000 women were diagnosed with

breast cancer and another 40,000 died, yet doctors still have few clues as to what drives the disease. "Even if lighting is at the root of only 10% of breast cancer cases," says Brainard, "what we learn may help thousands and thousands of women."

Catherine Guthrie writes about women's health from her home in Indiana.

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