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Artificial light at night stimulates breast cancer growth in laboratory mice

Results from a new study in laboratory mice show that nighttime exposure to artificial light stimulated the growth of human breast tumors by suppressing the levels of a key hormone called melatonin. The study also showed that extended periods of nighttime darkness greatly slowed the growth of these tumors.

The study results might explain why female night shift workers have a higher rate of breast cancer. It also offers a promising new explanation for the epidemic rise in breast cancer incidence in industrialized countries like the United States.

The National Cancer Institute and the National Institute of Environmental Health Sciences, agencies of the federal National Institutes of Health, provided funding to researchers at the Bassett Research Institute of the Mary Imogene Bassett Hospital in Cooperstown, New York and The Thomas Jefferson University in Philadelphia, Pa. The results are published in the December 1, 2005 issue of the scientific journal Cancer Research.

"This is the first experimental evidence that artificial light plays an integral role in the growth of human breast cancer," said NIEHS Director David A. Schwartz, M.D. "This finding will enable scientists to develop new strategies for evaluating the effects of light and other environmental factors on cancer growth."

"The risk of developing breast cancer is about five times higher in industrialized nations than it is in underdeveloped countries," said Les Reinlib, Ph.D., a program administrator with the NIEHS' grants division. "These results suggest that the increasing nighttime use of electric lighting, both at home and in the workplace, may be a significant factor."

Previous research showed that artificial light suppresses the brain's production of melatonin, a hormone that helps to regulate a person's sleeping and waking cycles. The

new study shows that melatonin also plays a key role in the development of cancerous tumors.

"We know that many tumors are largely dependent on a nutrient called linoleic acid, an essential fatty acid, in order to grow," said David Blask, M.D., Ph.D., a neuroendocrinologist with the Bassett Research Institute and lead author on the study. "Melatonin interferes with the tumor's ability to use linoleic acid as a growth signal, which causes tumor metabolism and growth activity to shut down."

To test this hypothesis, the researchers injected human breast cancer cells into laboratory mice. Once these cells developed into cancerous tumors, the tumors were implanted into female rats where they could continue to grow and develop.

The researchers then took blood samples from 12 healthy, premenopausal volunteers. The samples were collected under three different conditions ‧during the daytime, during the nighttime following 2 hours of complete darkness, and during the nighttime following 90 minutes of exposure to bright fluorescent light. These blood samples were then pumped directly through the developing tumors.

"The melatonin-rich blood collected from subjects while in total darkness severely slowed the growth of the tumors. "These results are due to a direct effect of the melatonin on the cancer cells," said Blask. "The melatonin is clearly suppressing tumor development and growth."

In contrast, tests with the melatonin-depleted blood from light-exposed subjects stimulated tumor growth. "We observed rapid growth comparable to that seen with administration of daytime blood samples, when tumor activity is particularly high," Blask said.

According to the researchers, melatonin exerts a strong influence on the body's circadian rhythm, an internal biological clock that regulates sleep-wake cycle, body temperature, endocrine functions, and a number of disease processes including heart attack, stroke and asthma. "Evidence is emerging that disruption of one's circadian clock is associated with cancer in humans, and that interference with internal timekeeping can tip the balance in favor of tumor development," said Blask.

"The effects we are seeing are of greatest concern to people who routinely stay in a lighted environment during times when they would prefer to be sleeping," said Mark

Rollag, Ph.D., a visiting research scientist at the University of Virginia and one of the study co-authors. "This is because melatonin concentrations are not elevated during a person's normal waking hours."

"If the link between light exposure and cancer risk can be confirmed, it could have an immediate impact on the production and use of artificial lighting in this country," said Blask. "This might include lighting with a wavelength and intensity that does not disrupt melatonin levels and internal timekeeping."

"Day workers who spend their time indoors would benefit from lighting that better mimics sunlight," added Blask. "Companies that employ shift workers could introduce lighting that allows the workers to see without disrupting their circadian and melatonin rhythms."

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