



The relationship between nightshifts, light and cancer

Man is a diurnal animal: active in the daytime and asleep at night. Man started to live and work indoors for most of the daytime only a few hundred years ago, at the start of the industrial revolution and especially after the introduction of electric light. Before that time, man worked the land or hunted in the woods during the daytime. Man has changed from a hunter-gatherer into modern man who spends most of his life indoors in offices, factories and houses.

By Marijke Gordijn, PhD and Toine Schoutens, RN

Modern man's anatomy and physiology is virtually identical to that of medieval man or people in Roman or Greek antiquity or even earlier. Hence man is best suited to working during the daytime and sleeping at night. Night work only became structural after the introduction of the conveyor belt allowed 24-hour production 7 days a week.

Nowadays, approximately 16% of the population works nightshifts regularly. This is in line with percentages in neighbouring countries. Working during the night causes problems such as sleep deprivation (sleep debt), poor sleep quality and reduced alertness during work. Nightshift workers are more irritable and are more likely to have gastrointestinal problems. These problems resemble those caused by jetlag, which is also a disruption of the sleep/wake cycle. Working nightshifts for a long time affects man's overall functioning and health. There is a much higher incidence of obesity among nightshift workers, for instance. Moreover, nightshift workers smoke more, run a bigger risk of developing cardiovascular problems and have a shorter life expectancy.

Light

Light has a big effect on our bio-rhythm and on how we feel. Our brain contains a biological clock that regulates all kinds of processes in the body, causing them to vary in 24-hour periods. Examples are the sleep/wake cycle, body temperature, heart rate and the production of various hormones such as melatonin and cortisol. The body clock may run out of sync. Light that reaches the eye keeps the clock in sync. Without light-darkness stimulation, the body clock will start to follow a free cycle of 23.5 to 24.5

hours and get further out of sync with our 24-hour society every day. Light also has a direct effect on our mood, performance and alertness. In half-light humans are sleepier than when they are in a brightly lit room. People who work nightshifts regularly are often less alert, less able to concentrate and in a lower mood. They also tend to be more tired. This is because their biological clock prescribes sleep and because the light intensity is often too low.

The biological clock stimulates the production of melatonin at night. This hormone is often referred to as hormone of the night. It signals when it is time to go to sleep. Melatonin is also a powerful antioxidant that regenerates many of the body's processes. As melatonin is able to react with free radicals, it is able to render these radicals harmless. Light inhibits the production of melatonin. Some scientists now claim that light disrupts the antioxidating effect of melatonin, causing it to be a factor in the development of breast cancer.

Breast cancer

Breast cancer or mamma carcinoma is a type of cancer that causes uncontrolled growth of the mammary gland. It is the most common type of cancer in women: approx. 22% of all cancer in women is breast cancer. Approximately one million women worldwide are diagnosed with it every year. In the Netherlands one out of nine women get this type of cancer. Known risk factors for breast cancer are:

- Breast cancer among first-degree relatives
- A mutation in the BRCA1 or BRCA2 gen
- Earlier occurrence of benign or malignant breast tumours
- No pregnancies
- Giving birth to first child after age 35
- Going into menopause after age 55
- Using an oestrogen substitute after menopause
- Being on the pill
- Becoming obese after menopause
- Daily alcohol consumption over a longer period
- No breastfeeding
- Too little exercise
- Women who worked nightshifts for over 20 years (data from Netherlands Centre of Occupational Diseases, 2009)[1]



The Netherlands Health Council already detected a link between prolonged night work and breast cancer in 2006, but established that there was too little evidence to conclude that night work increased the risk of breast cancer. In response to questions in Dutch parliament, it was therefore decided not to take any measures. Since that time the Health Council follows scientific research very closely.

Current status

The report by IARC (International Agency for Research on Cancer) from 2007 shows the current research status and bases its conclusions on animal studies and prolonged research among nurses and flight attendants. Their conclusion: "Shiftwork that involves circadian disruption is probably carcinogenic to humans." Animal studies also show that disruption of the 24-hour bio-rhythm is probably carcinogenic.

In his research, Shernhammer [2] shows that people with a higher melatonin secretion have a slightly lower risk of cancer. Animal studies have shown that a lower melatonin secretion contributes to faster growth of cancerous tissue. In international literature some researchers establish a causal link between nightly light exposure, melatonin suppression and the higher incidence of breast cancer among women working nightshifts over a longer period [3,4]. They refer to the fact that melatonin is a major antioxidant and that suppressing it with light disrupts its important protective function. The harmfulness of free radicals is caused by the fact that these molecules easily react with, for instance, DNA, which may disrupt normal cell division, leading to cancer, or may damage various proteins.

Clinical studies have never shown any positive effect of antioxidants. On the contrary, other researchers claim that high antioxidant levels may cause genetic defects in a stem cell culture, turning the culture cancerous. Whether this is relevant to the development of cancer in humans is not yet clear. In short, it is still unclear if melatonin offers protection against cancer and if suppression by light increases the risk of cancer.

People who work nightshifts have lower melatonin levels in their body. If this is a result of working at night is not clear, however. Perhaps women who have lower melatonin secretion by nature are better able to endure working nightshifts. These women would also have a higher risk of breast cancer if they did not work nightshifts. The Dutch trade union FNV, which was considering claims against employers who let women work nightshifts over a prolonged period, has meanwhile decided to drop these claims. It proved very hard to find enough evidence. Women had to prove that they had worked nightshifts for fifteen or twenty years, but were unable to provide work sheets or shift rosters from such a long time ago.

Lighting

Very little is known about the exposure to light during night work and there is no consensus about the potential harmfulness of this exposure. Research results contradict each other. This may be partly due to the fact that night workers perform many different tasks. There is a tendency to minimise the light intensity as much as possible, especially in situations where work permits low light levels, e.g. in control

rooms, in the restaurant and catering industry to create a pleasant atmosphere, at traffic control centres and in hospitals and other healthcare facilities. In factories and other large halls, the lighting levels are the same night and day, with the only difference being that there is no daylight at night.

In some workplaces experiments with dynamic lighting or artificial daylight are taking place, especially in environments where people have to perform critical tasks. The use of this type of lighting is increasing. More and more employers are also adopting shift schedules that keep people working nightshifts over a longer period followed by a longer period in which they do not work nightshifts. The offshore industry often uses these schedules; hence these schedules are often referred to as oil-rig shift schedules.

The claim that breast cancer in nightshift workers is caused by lighting cannot be substantiated in any way, especially because light levels differ considerably. However, prudence is called for. To reduce potential risks it is important to conduct more research into the use of special lighting, for instance lights with a lower light colour spectrum or a longer wavelength (red light) or into the use of different shift schedules, such as prolonged forward rotation or adapting the working hours to individual preferences. The difficulty is finding a proper balance between what is required to be productive and to work safely in the short term and what is required to improve health and wellbeing in the short and long term.

The working environment, the tasks to be performed during the night, including the potential risks involved, and the short-term and long-term pros and cons for employers and employees will play a role in the decisions on the best lighting during the night and the best shift schedule. Taking advantage of the individual preferences of people based on differences in their sleep/wake cycles may provide a solution. More research is urgently required to make night work safer, healthier and more productive.

This article was written by Toine Schoutens of Light and Health Research Foundation SOLG and DAVITA Nederland BV the Netherlands and Marijke Gordijn of Light and Health Research Foundation SOLG and Groningen University, the Netherlands

More info: www.solg.nl

References:

[1] T.M. Pal, Fact sheet Borstkanker en Nachtdienst: Een hulpmiddel voor de bedrijfsarts bij advisering en counseling NcvB 2009

[2] Schernhammer ES, F Berrino, V Krogh et al. Urinary 6-Sulfatoxymelatonin levels and risk of breast cancer in postmenopausal women. J Natl Cancer Inst 2008;100: 898-905

[3] Stevens, R.G., Light-at-night, circadian disruption and breast cancer: assessment of existing evidence. International Journal of Epidemiology 2009, Volume 38, Issue 4 Pp. 963-970

[4] Stevens, R.G., Blask, D.E., Brainard, G.C., Hansen, J. Lockley, S.W., Provencio, I., Rea, M.S, Reinlib, 2007, The Role of Environmental Lighting and Circadian Disruption in Cancer and Other Diseases, Environmental Health Perspectives, Vol. 115(9): 1357-1362.