

## 3. Melatonin suppressors

The involvement of melatonin in so many bodily processes, means that any disruption in its function is of critical importance. Erren & Reiter ([2008](#)) have proposed that “*the final common cause of many cases of cancer may be what has been termed chronodisruption (CD), relevant disturbance of the temporal organization or order of physiology, endocrinology, metabolism and behaviour, with melatonin as a key time messenger and keeper being a marker of CD.*”

### Alcohol

Alcohol consumption was found to reduce urinary levels of melatonin in women, with 4 or more drinks reducing the levels by 17% (Stevens [2000](#)). This may result in an increase in circulating oestrogen, which could affect breast cancer risk.

### Diet

High-fat diets significantly decrease nocturnal pineal melatonin synthesis (Cano [2009](#)).

## Electromagnetic fields (EMFs)

### Powerfrequency radiation

Electronic equipment repairers, exposed to ELF-EMF had low levels of serum melatonin. They are at risk of oxidative stress and sleep insufficiency. El-Helaly & Abu-Hashem ([2010](#)) recommend antioxidant supplementation, such as melatonin, should be taken to ameliorate these effects.

Studies in human populations, though not in wild kestrels (Dell'Omo [2009](#)) have shown that magnetic fields, such as those from powerlines and other powerfrequency EMFs, are capable of disrupting the night-time production of the important hormone melatonin in the pineal gland, especially polarised fields, in combination with the earth's geomagnetic field disturbances ([Burch 1999, 2000](#)), and in exposed workers (Burch [1998, 1999](#)).

Corona ions emitted by powerlines produce highly variable disturbances in the atmospheric electric field down wind. It is hypothesised ([Henshaw 2008](#)) that these random disturbances can result in the disruption of nocturnal melatonin synthesis and related circadian rhythms leading to an increased risk of a number of adverse effects.

Dr Yves Primault, Honorary Professor at the University of Milan suggested that exposure to magnetic field levels of more than 0.1 microtesla can stop overnight production of melatonin. The batteries from a mobile phone will exceed this level at the user's head. Girgert ([2010](#)) found that EMFs significantly disrupted the antioestrogenic effect of melatonin in breast cancer cells.

### Radiofrequency radiation

A study by the Citizens Initiative Kempten West (in Germany) found that a mobile phone transmitter affected levels of melatonin and serotonin. 'Before' and 'after' blood samples were

taken from residents near a newly installed mobile phone mast. The participants had removed other RF sources such as DECT phones and wLANs from their homes. Measured microwave fields showed a several fold increase in RF exposure after the mast was activated. 84% of participants reacted with a massive decrease in serotonin level. Nearby residents nearly all experienced increases in depressive mood disturbances, lethargy and listlessness, appetite disturbances, inner agitation and reduced quality of life. There was also a fairly steep nightly melatonin decrease for 56% of the group. More than half the group reported sleep disturbances. Some genetic variations (on SLC6A4 and BDNF genes) make people more likely to suffer from depression as a result of environmental stressors, yet other changes in the same gene appear to be protective. Many complained of waking between 2 and 4 a.m. and had difficulty getting back to sleep again. Sleep disturbance is increasingly being seen as a cancer promoting risk factor. They also found a displacement in time of melatonin excretion, when getting up rather than earlier in the morning. This results in feeling very tired on getting up, and consequent tiredness, irritability, loss of concentration during the day.

Clark (2007) found that postmenopausal women may be a sensitive subgroup of the population, whose melatonin excretion increases when they live near radio & TV transmitters.

A study by Burch (2002) concluded that the prolonged use of mobile phones may lead to reduced melatonin production, and elevated magnetic field exposure could make it worse. Wood (2006) found that melatonin onset time was delayed by mobile phone handset emission exposure.

### **Light at Night (LAN)**

Until recent times, humans in temperate climates were exposed to up to 18 hours of darkness in the winter. In the modern world, artificial lighting reduces this to typically eight hours or less per day all year round. Even low light levels inhibit melatonin production to some extent, but over-illumination can create significant reduction in melatonin production.

Circadian rhythms are endogenous and will continue indefinitely in the absence of light signals. Light just serves to synchronise them to the true day/night cycle. Their function is to enable the body to anticipate its needs throughout the day night cycle. It's not just sleep that is affected; almost all of our metabolism is regulated in this way so that it makes the best use of limited resources. If the amplitude of these rhythms were to be reduced (e.g. by electromagnetic radiation) it would not perform any of these functions at maximum efficiency. One of the casualties would be the production of melatonin (which would be reduced - Reiter 2007, Korkmaz 2009), and we would also become tired more easily during the day and our immune systems would be less efficient at night. Reiter says that a potential negative consequence of chronodisruption and nocturnal melatonin inhibition is cancer initiation and growth. The frequency of breast, prostate, endometrial and colorectal cancers has increased in individuals whose circadian rhythms have been disrupted. In addition to cancer, there may be other diseases that result from the chronic suppression of melatonin by light at night.

There have been suggestions that light in the evening and at night time, at the red end of the spectrum, is less likely to disrupt melatonin production during the following hours of sleep. Stevens (1992, 1993a, 1993b, 1996, 2006, Schernhammer 2004, 2005 Srinivasan 2008) also suggest that light (especially blue light Figueiro 2009) at night reduces melatonin production. However, short-wavelength 'blue' light in the *morning* helps entrain the circadian system, and the removal can delay dim light melatonin onset in adolescents (Rea & Figueiro 2010). this finding is relevant to lighting practice in schools.

A Russian article (Panchenko [2008](#)) found that constant lighting increased tumour growth, whereas light deprivation slowed down growth. Hanifin ([2006](#)) found that bright red light also suppresses melatonin, so care has to be taken with the intensity of any light chosen.

Long-term, night shiftwork has been identified as a potential carcinogenic risk factor, possibly because increased light at night exposure during shiftwork reduces melatonin production. Grundy ([2009](#)) found that 2 nights of rotating shift work may not change the timing of melatonin production.

Kloog ([2011](#)) found a positive association between bedroom light intensity and breast cancer risk.

Wideman & Murphy ([2009](#)) found that rats exposed to light all the time had decreased melatonin levels and changed metabolism, circadian rhythms and behaviour, compared with rats on 12 hr light/ 12 hr dark and those exposed to dark conditions all the time.

Hill ([2011](#)) reported that studies in both rats and humans indicated that LAN induced circadian disruption of the nocturnal melatonin signal activates human breast cancer growth, metabolism, and signalling, providing the strongest mechanistic support for epidemiological studies demonstrating the elevated breast cancer risk in night shift workers and other individuals increasingly exposed to LAN. Kloog ([2008](#)) had found a strong positive association between LAN intensity and breast cancer, but not lung cancer.

It was felt that increased light exposure of different types (e.g. fluorescent) may be responsible (Blask [2005](#)), at least in part, for the incidence of breast cancer, especially as blind women have a lower incidence. Pukkala ([2006](#)) also found that breast cancer risk in females decreased according to the amount of visual impairment. There was a similar but less consistent trend for prostate cancer in males.

Investigations by Brainard ([2001](#)) suggested that a single retinaldehyde based photopigment may be primarily responsible for melatonin suppression.

## Fracture risk

Experimental evidence suggests that light at night (including nightshift work) acts through endocrine disruption likely mediated by melatonin. Osteoporotic fractures are highly sensitive to sex steroids. Feskanich ([2009](#)) found that 20+ years of nightshift work was associated with a significantly increased risk of wrist and hip fractures. The risk was strongest for women with a lower body mass index and those who had never used hormone replacement therapy.