Light Pollution and Melatonin Suppression: Implications for Pediatrics

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Evolution has dictated biological rhythmicity and physiology influenced by the light/dark cycle.

The key elements of the circadian system.
The pineal gland is the source of the circadian blood melatonin rhythm.

The pineal gland is roughly the size of the tip of your little finger.
Essentially every function in the body exhibits a 24 hour rhythm.

The quantity of melatonin produced is proportional to the duration of darkness.

1879, a critical year for circadian rhythms.
The eyes are required for light inhibition of melatonin production and for adjusting circadian rhythms.

Light at night suppresses melatonin levels proportional to the brightness.

Classic photoreceptors (rods and cones) are not involved in regulation of circadian rhythms.
Light regulation of circadian rhythms involves a unique set of ganglion cells and melanopsin.

Blue-green wavelengths (peaking at 480 nanometers) is most inhibitory to the biological clock and melatonin levels.

Light regulation of the biological clock and pineal melatonin production.
Epidemiological studies have reported an increased cancer incidence in night shift workers.
62% of world population and 99% of US and European populations are exposed nightly to sky brightness greater than baseline levels.

The World Health Organization has classified light at night as Group 2A carcinogen due to (a) melatonin suppression (b) chronodisruption (c) or both.
Increasing nighttime light intensity accelerates the growth of rat hepatoma and human MCF-7 xenografts.

Blood levels of melatonin of premenopausal women at day and night and the effects of this blood perfused through rat hepatoma or human breast cancers.

Simulated jet lag also eliminates the circadian melatonin rhythm.
Multiple mechanisms of cancer inhibition by melatonin

- Anti-angiogenesis
- Inhibition of cellular proliferation
- Apoptosis induction
- Antioxidative actions and free radical scavenging actions
- Dedifferentiation of cancer cells
- Actions via nuclear binding sites
- Inhibition of growth factor uptake

- Increased quinone reductase activity
- Immunomodulation
- Endocrine modulation
- Interference with ERs
- Aromatase inhibition
- Telomerase inhibition

Melatonin

The wrong message!

Think beyond cancer
Melatonin use in childhood sleep disorders

- ADHD and melatonin – 19 references
- ASD and melatonin – 35 publications
- Neurodevelopmental disorders and melatonin – 8 publications

Melatonin is the most widely recommended treatment for childhood sleep disorders in the United Kingdom

Potoki, L., Reiter, R.J., Lupski, J.R.

Circadian rhythm abnormalities in Smith-Magenis syndrome.


These individuals have an inverted melatonin rhythm

Melatonin: Current research

- Melatonin-antioxidant 1,321 ref
- Melatonin-diabetes 133 ref
- Melatonin-obesity 93 ref
- Melatonin-metab syndrome 7 ref
Oxygen and nitrogen-based reactants and their removal by melatonin

Diabetes, hyperglycemia and melatonin

Safety of Melatonin

- No LD$_{50}$ has been determined
- Despite its use for three decades, no toxicity has been reported
- When tested in pregnant animals at exceptionally high doses (>200 mg/kg) no fetal or maternal toxicity
Light as a “drug”

1. It synchronizes circadian and circannual rhythms
2. It inhibits melatonin synthesis and changes the phasing of circadian rhythms

As a result of these effects it influences metabolism

Melatonin is a readily available and is absorbed when administered via any route