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# Light Pollution and Cancer incidence: Can we live without light?

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## Abstract

Light energy is the most essential part of life. The relationship of this planet with the prime source of light, the sun, is made in such a way that most of the inmates will get light from the sun only 12h., which is healthy too. On the polar region where people get either too much or very little depending on the season; such conditions are not healthy. Our body rhythms are aligning with the time of sun shine; pineal gland converts serotonin into melatonin, the hormone which regulates whole endocrine system, only in dark and therefore we need darkness also. Thomas Elva Edison, who made our nights bright, forced some of us to work during nights and created health hazards for them. This paradoxical situation is discussed in this review. By advocating our Blind Menopausal Women model, in which by survey we conclude that where they may live on this planet and whatever their food habits are, the incidence of breast cancer is very low among them. And among sighted women those who work in night shifts and those who live near polar region they have higher incidence of breast cancer compare to those who live near equatorial zone. Thus, it is concluded that longer exposer to the natural or artificial light increases the chances of breast cancer. Therefore, keeping balance between light and dark is essential for good health.

**Key Words:** Cervical pregnancy; fertility; uterine artery embolization

## Introduction

Light regulates our biological clock and diseases borne due to disturbances or deregulation of biological clock are increasing in recent times. Ninety eight percent Sunlight enters the human body through eyes and the other 2% by way of skin. Every 2 hours approximately 99% of the body's new blood volume is exposed to light as it circulates through the blood vessels on the back of the eye, continually altering blood chemistry [1]. The sunlight stimulates immune system which in turn offers resistance to diseases which in turn regulated by hours we remain under conditions [2]. A new study has found that chronic disruption of one of the most basic circadian (daily) rhythms resulted in increased incidence of hormone dependent cancers in humans [3]. The alternation of the day and night circadian cycle is due to earth's movements around the Sun and we cannot regulate it, so ideally according to Nature's rule we should remain 12h in sun light and 12h in dark. Our modern ways of living don't quite match up with our natural clocks and hence we have so much of sickness today. In fact, by disturbing clock rhythms we are creating chaos and confusion in the body [4]. Human beings need Sunlight but not man-made light at least during night since pineal gland converts serotonin into melatonin in dark only [5].

## Factors influencing the rhythms:

The notes in the rhythm of reproduction are affected by environmental factors such as light, temperature, altitude, radiation, etc. [6] and the physiological factors such as aging [7], diseases [8] and heredity [9]. These factors control the production of key hormones in the endocrine glands. The sex steroid hormones which are produced by endocrine glands act in harmony to regulate the rhythm of reproduction. The notes in the reproductive rhythm are the glands - pineal, hypothalamus, pituitary and testis or ovary - which produce various hormones that interact in a specific and sequential manner to regulate this vital body function [10]. For example, the production of melatonin (Dark reaction) in pineal gland is controlled by light [10], which in turn

controls sex cycle in females and males.

Artificial light is light created by humans. There are many examples of man-made light such as candles, matchsticks and flashlights in addition to electricity by Thomas Elva Edison. Man-made light needs to be generated with energy. Also, man-made light is helpful in addition to many others specially life saver in health industry.

Blue light, in particular, has been shown to reduce levels of melatonin in humans. New energy-efficient and cost-efficient light sources such as LED [11] will only aggravate light. However even carefully used light-emitting diodes (LED) light fundamentally alters natural conditions light pollution has a wide range of negative effects on human health such as disrupting our circadian rhythms, messing with our melatonin levels, and generally contributing to sleeping disorders. Blue light is found in cell phones and other computer devices, as well as in LEDs, the kinds of bulbs that have become popular at home and in industrial and city lighting due to their low cost and energy efficiency [11].

## LEDs Effect:

Light-emitting diodes (LEDs), used in computers, tablets, smartphones and TVs, have experienced a revolution in the last couple decades. It is important to bear in mind that although the light they emit might seem white, their peak emission is in the blue light range [12]. Wavelengths between 300 and 400 nm can pass through the cornea and be absorbed by the pupil or the iris. As a consequence, within the visible light spectrum, high energy blue light with a wavelength between 415 nm and 455 nm is greatly related to eye diseases, including age-related macular degeneration, cataract and dry eye, among others. Moreover, this type of light can stimulate the brain, enhancing adrenocortical hormone production and inhibiting melatonin secretion, leading to a disruption of hormonal balance and directly affecting sleep patterns and quality [13].

## Light and Cancer:

The first preliminary evidence linking light to cancer in people emerged from the register-based studies. In 1980, the first clear evidence was published in Science that ocular exposure to bright white light during the night could suppress melatonin production in young adults [14]. Later Hahn 1991 computed the incidence of this malignancy in blind and sighted women and discussed the connection between light and melatonin. As early as 1990, scientists reasoned that anybody whose eye cannot detect light should be resistant to oestrogen generated tumours. This angle of discussion paved way for the epidemiologist to reason that people whose eyes cannot detect light should be resistant to tumour growth. Subsequently, cancer register based studies also supported melatonin hypothesis in Sweden and Finland respectively [15,16]. The later study gave a clue that 50% decreased risk of the disease and an inverse association between BC incidence and degree of visual impairment. Similarly, Kliukiene found only 5 subjects suffering from BC among 15,412 visually impaired subjects in blind registry in Norway [17]. Pukkala et al. added to the suggestive epidemiological evidence for the 40% decreased risk of hormone related cancers in people with visual impairment in Finland [18].

People all over the world are living under the nighttime glow of artificial light, and it is causing big problems for humans, wildlife, and the environment. Most environmental pollution on the Earth comes from humans and their inventions for example, the electric light bulb, thought to be one of the greatest human inventions of all time Electric light can be a beautiful thing, guiding us home when the sun goes down, keeping us safe and making our homes cozy and bright. Nevertheless, artificial light can wreak havoc on natural body rhythms in both humans and animals. Nocturnal light interrupts sleep and confuses the circadian rhythm—the internal, twenty-four-hour clock that guides day and night activities and affects physiological processes in nearly all living organisms.

There is a moderate overall weight of evidence that ill-timed exposure to light (light-at- night indirectly measured by night shift work), possibly through melatonin suppression and circadian disruption, may increase the risk of breast cancer. There is furthermore moderate overall weight of evidence that exposure to light-at-night, possibly through circadian disruption, is associated with sleep disorders, gastrointestinal and cardiovascular disorders, and with affective disorders. The overall evidence for other diseases is weak due to the lack of epidemiological studies.

Recent studies also show a connection between reduced melatonin levels and cancer. In fact, new scientific discoveries about the health effects of artificial light are well established by epidemiological surveys, namely:

## The human population who lives near polar region:

In polar region however, the strength of the Zeitgeber is greatly reduced due to continuous day or continuous night. In such abnormal condition's melatonin level will be maintained in the blood at a low level for most part of the 24hours day in people unable to put the cancer susceptible cells to sleep [19, 20]. Light, whether from the Sun or electric luminaries, is the most potent environmental exposure having an impact on either resetting the circadian system or disrupting endogenous circadian rhythm.

Latitude plays a major role on the photoperiod of a place. From the literature survey we found a several-fold difference in the BC incidence between countries closer to the poles than to the equator (Table 1).

| SNO | Name of the Country | | | |
|---|---|---|---|---|
| | Towards poles | Incidence rate / 10,0000 women | Towards Equator | Incidence rate / 10,0000 women |
| 1 | Alaska | 125 | Magnolia | 7 |
| 2 | Belgium | 109.2 | Bhutan | 7 |
| 3 | Denmark | 101.1 | E Asia | 18 |
| 4 | France | 99.7 | S C Asia | 18 |
| 5 | Netherlands | 98.5 | Indonesia | 18.6 |

**Table 1:** A comparison of incidence of BC in the populations living in countries closer to poles and equatorial regions respectively.

Table showing the high incidence of BC in the countries closer to poles compared to equatorial region with disturbed circadian rhythm due to a long exposure of Natural and /or artificial light (adopted from Ref 19).

## Night-shift workers:

Several studies over the last decade have suggested that the modern practice of keeping our bodies exposed to artificial light at night (LAN), increases cancer risk, especially for cancers such as breast and prostate cancers[21- 26] that require hormones to grow. Women who work night shifts have shown higher rates of breast cancer,

1. Whereas blind women, who are not likely to be exposed to or perceive LAN, have shown decreased risks.
2. In 2007, the International Agency for Cancer Research declared shift work a probable human carcinogen.
3. Now a large study of 164 countries adds another piece of evidence, implicating overall light pollution.

Schernhammer et al. [25] confirmed that Women, who reported more than 20 years of rotating night shift work, experienced an elevated relative risk of breast cancer compared with women who did not report any rotating night shift work. Shift work that requires the use of artificial light (in the evening, night, or early morning) leads to suppression of pineal secretion of melatonin, low serum melatonin concentrations have been reported in women with estrogenic-receptor-positive breast cancer. Impaired pineal secretion of melatonin is also associated with 5-lipoxygenase activity in B-lymphocytes, and increased ovarian estrogenic and pituitary gonadotropin production, which are associated with increased breast cancer risk. Susceptibility of night shift workers, (for example in hospitals, graveyards and airports) to develop breast cancer has been addressed by many epidemiological studies. This observation has further strengthened by our recent evidence that blind subjects are showing less prevalence of breast cancer. Some researchers speculated that the effect may be due to the changes in levels of melatonin.

Harvard epidemiologist Eva Schernhammer [25] agrees that the positive result from this study adds more evidence to the idea that LAN exposure contributes to breast cancer risk. But as an ecological study,5 even if the result had been negative, it would not be strong enough to rule out evidence from prior case–control studies, she says.

**The blind menopausal population in the region where practically13/11h dark (WINTER) And 11/13h (SUMMER)sunshine periods, depending on summer/winter season:**

## Blind Women:

In the survey, out of 2060 (collected during 2006 - 2013) menopausal blind women, we found only twelve subjects were suffering with breast cancer. This study [3-8] gave a clue for the low prevalence of BC in blind menopausal women BC compared to sighted women in India [9] where stable circadian rhythm is maintained. Our study is the first of its kind considering the influence of parameters such as total blindness / partial blindness /development of blindness before menarche /after menarche /development of blindness before premenopause/after menopause, on the prevalence of breast cancer in blind women. Though earlier studies in Finland and Sweden [27,28] also reported low prevalence of BC in totally blind women compared to sighted women, the comparison between the incidences of BC between above mentioned parameters were wanting. Hahn indicated that, overall, women with bilateral blindness had almost half the risk of developing breast cancer compared to sighted women from a US case control study [29]. Our study showed thrice the elevated risk of developing BC, where age at onset of blindness has a profound role to play in the progression of BC. Coleman and Reiter suggested that a hypothesis could be tested that long-term blindness protects against breast cancer from long-standing register-based studies of adequate quality 29]. In this study we observed postmenopausal stage of a woman has more risk of developing BC than pre-menopausal stage. Flynn-Evans et al. observed blind women with no perception of light (NPL) have a lower prevalence of breast cancer compared to blind women with light perception (LP). But they observed little difference in these associations when restricting to postmenopausal women, non-shift workers or when excluding women diagnosed with breast cancer within 2 or 4 years of onset of blindness [30 31].

## In Praise of Light:

Light is the essence of life since it provides energy for existence of life. Light is the crucial source for food chain; without light the food chain cannot be completed. Plants, main sustainers of life, are crucial in this conversion process and need light for photosynthesis that enables them to make their own food and food for others. Without the Sun's heat and light, the Earth would be a lifeless ball of ice-coated rock. The Sun warms our seas, stirs our atmosphere, generates our weather patterns, and gives energy to the growing green plants that provide the food and oxygen for life on Earth [32-37].

Adult human being, it is unlikely would die directly without light exclusively from prolonged darkness the person would become ill and die from a range of chronic diseases caused by lack of sunshine, such as diabetes, high blood pressure, and tuberculosis, therefore, all humans need sunlight to survive.

## Bring Back the Dark Sky:

Embrace the dark for better health [38] but we need full day light for healthy life. The darkness actually helps the circadian clock function more naturally Being exposed to artificial light at night breaks the circadian clock, while being in the darkness resets it. A better circadian clock means a better sleep, which contributes to better overall health. Artificial lighting disrupts the rhythm of the clock. Artificial light at night can lead to health problems such as insomnia and depression. Here are ways to reduce light pollution and reduce circadian disruption resulting from LAN exposure [39,40]

⟫ Install room-darkening shades in bedrooms Do not use bright light use only dim light so one can extend the dark period at night to 9 or 10 hours in the bedrooms.

⟫ Avoid even brief light exposures. Turn off the lights, television, and computer in the bedroom when sleeping. Avoid watching television or working on the computer right before sleep.

⟫. Do not put on the usual bathroom lights, use only dim red nightlight if get up in the night, Red light suppresses melatonin production less than other wavelengths.

⟫ Do not take melatonin tablets for sleep. The spike in circulating melatonin may actually worsen, not alleviate, circadian rhythm is disrupted.

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