Blue Light in Association with Health and Diseases

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Abstract:
There is a sea change in human physiology due to light pollution which in turn caused by artificial light. Light pollution is less familiar cause of cancer, however it is widely spread. It’s a well-known fact that light regulates our biological rhythms. Because of exposed to high energy light (blue band) the property of bio photons changes and inhibit cell to cell communication. It looks like the amount and timing of high energy emission exposure to body makes all the difference in production /degradation and/or development/damage of cancer cell.

Key words: cancer; light spectrum; bio photon; light pollution; photo repair system

Introduction:
A variety of drugs can occasionally cause paradoxical reactions resulting in the induction or aggravation of the conditions they are being used to treat. They include drugs for anesthesia, analgesia, allergy, cardiac arrhythmias, arthritis, cancer, anticoagulation, epilepsy, diarrhea, hypertension, infection, bronchospasm, nasal congestion, Parkinson's disease, and sedation. Epidemiological evidence indicates several factors likely to have a major effect on reducing rates of cancer: reduction of smoking, increased consumption of fruits and vegetables, and control of infection [1]. Other factors are avoidance of intense sun exposure, increases in physical activity, and reduction of alcohol consumption and possibly red meat. Similarly, calcium is causative and protective element for cataract [2]. There are many paradoxical other substances for humans, such as, salt, sugar, alcohol, etc. which are needed to sustain life but on increasing uptake they become threat to life.

Understanding Blue Light:
Sir C V Raman showed for the first time that white light (sun light) is made up of red, orange, yellow, green, blue, indigo and violet light [3]. Each of these components has a different energy and wavelength. Rays on the red end have longer wavelengths and less energy. On the other end, blue rays have shorter wavelengths and more energy. (Fig.1).

![Diagram of the light spectrum]

Fig. 1. Part of the visible light spectrum, blue light is the high energy spectrum just beyond the UV light. Over exposure to the blue light may lead to harmful effects.
Part of the visible light spectrum, blue light is with high-energy wave length normally transmitted through the eye to the retina. Since it is a visible light, our eyes are designed to receive and trigger visual process and sight.

The largest source of blue light is sunlight, however, in addition there are many other man made sources for blue light, e.g. Fluorescent light, CFL (compact fluorescent light) bulbs, LED light, flat screen LED televisions, computer monitors, smart phones, and tablet screens. From screens, blue light exposure is small compared to the amount of exposure from the sun. Nevertheless, due to close proximity of the screens in addition to the length of time spent looking at them; we are more prone to effects of screen exposure. According to recent reports children’s eyes absorb more blue light than adults from digital device screens [4, 5].

This light may affect vision and could premature aging of the eyes. Early research shows that too much exposure to blue light could lead to decrease contrast leading to digital eyestrain. Fatigue, dry eyes, bad lighting, and the posture in front of computer can cause eyestrain resulting in sore or irritated eyes and difficulty focusing. Studies suggest that retinal cells are damaged due to continued exposure to blue light over the time, causing vision problems such as macular degeneration. However an intraocular lens (IOL) naturally protects the eye from almost all ultraviolet light and some blue light.

The body has a lot of protective measures against lights that are too bright or too hot: blinking, pain, natural aversion from bright lights and pupil constriction, but damage can still occur as a result of overexposure. The oxidant compounds from chemical reactions due to visible light and UV, attack cells which are destroyed by antioxidants, pigments and other chemicals in the skin and the eye to slow down the damage and the amounts of products formed will be harmless. However the high doses of these toxic reactive chemicals will cause diseases.

Both UV and the blue components of light from natural and artificial light source can also disrupt the human body clock and the hormonal system leading to health problems [6].

Some studies suggest a link between exposures to light at night, such as working the night shift, to diabetes, heart disease, sleep disturbances, gastrointestinal, mood and cardiovascular disorders and obesity. Too much exposure to blue light late at night (through smart phones, tablets, and computers) can disturb the wake and sleep cycle, leading to problems sleeping and daytime tiredness.

**Relations between blue light and cancer:**

Exposure to light at night while awake, such as in shift work, may be associated with an increased risk of hormonal dependent cancer due disruption of the natural circadian rhythm. WHO's International Agency for Research on Cancer (IARC) has classified night shift work as probably carcinogenic to humans, since old candescent light has been replaced with Fluorescent light, CFL (compact fluorescent light) bulbs, LED light, at homes and street lights. Exposure to artificial bright light during the night time suppresses melatonin secretion, increases sleep onset latency (SOL) and increases alertness. Circadian misalignment caused by chronic ALAN (Artificial light at night) exposure may have negative effects on the psychological, cardiovascular and/or metabolic functions [7].

By exploiting the optical properties of materials, i.e. the interaction of light with materials, Albert Einstein postulated that these liberated electrons were ionized by the absorption of a quantum of light with an energy = hf. The intensity of the radiation field is then just proportional to the number of light quanta in it. These quanta were later dubbed photons. In other words when light strikes on certain substances, the substances gave out electrons and blue light does the maximum [8].

Most organic compounds do not absorb visible light, and thus appear as being colorless or white. Blue light is of concern because it has more energy per photon of light than other colours in the visible spectrum, i.e. green or red light. Blue light, at high enough doses, is therefore more likely to cause damage when absorbed by various cells in our body. During 1970 Popp and his group [9] examined two almost identical molecules: benzo[a]pyrene, a polycyclic hydrocarbon known to be one of the most lethal carcinogens to humans, and its twin with slight alteration in its molecular structure benzo[e] pyrene. He had illuminated both molecules with ultraviolet (UV) light in an attempt to find exactly what made these two almost identical molecules so different. To his surprise he found that benzo[a]pyrene (the cancer producing molecule) absorbed the UV light, and then re-emitted it at a completely different frequency -- it was a light "scrambler". On the other hand benzo[e] pyrene (harmless to humans), allowed the UV light to pass through it unaltered. Popp tried the same experiment with 37 different chemicals, some cancer-causing, some not. The results made him to predict which substances could cause cancer. Xeroderma pigmentosum patients with eventually die of skin cancer because their photo repair system can't repair solar damage. Photo repair works most efficiently at 380 nm -- the same frequency that the cancer-causing compounds react to and scramble.

**Photons regulate living cells**

Photons switch on the body's processes at different frequencies, they perform different functions. It was found that molecules in the cells responded to certain frequencies, and that a range of vibrations from the photons caused a variety of frequencies in other molecules of the body. Living processes depend on selective interactions between particular molecules, and that is true for basic metabolism to the subtle nuances of emotion. It's like trying to find a friend in a very big very crowded ballroom in the dark. Molecules in a cell are suspended in water and through bumping into one another by chance -- random collisions -- those molecules with complementary shapes lock onto each other so the appropriate biochemical reactions can take place.

This lock and key mechanism is responsible for酶 recognize respective substrate, antigen antibodies reaction, proteins can 'lock' with different partner proteins, or latch onto specific nucleic acids to control gene expression, or assemble into ribosomes for translating proteins, or other multi-molecular complexes that modify the genetic messages in various ways. The ‘biophoton emission', provided an ideal communication system for the transfer of

Information too many cells across the organism. When ethidium bromide is applied to samples of DNA, it insinuates itself in between the base pairs of the double helix, causing DNA to unwind. It was found that the greater the concentration of ethidium and the stronger the intensity of light more the DNA unravelled. It was also found that DNA could send out a wide range of frequencies, some of which seemed to be linked to certain functions. If DNA stored this light, it would naturally emit more light on being unzipped. Exactly the way it happens in the epigenetic process [9, 10].

There is evidence pointing to an association between exposure to artificial light at night, disruption of the circadian rhythm, due to which more chances for developing hormone dependent cancers. In our earlier epidemiological study we sought to determine whether night exposure to light in cities can affect the development of hormone dependent cancers. We surveyed 2060 menopausal blind women (risk age for breast cancer (BC) and compared with sighted women in the same geographical and social status and found visually impaired subjects are resistant to the disease because of their inability to allow light through eyes. Our blind menopausal women model provides strong evidence for light as a major contributory factor for the increased incidence of the disease worldwide. We have also reviewed possible light regulating mechanism. Three
Blue light is needed for good health:
It boosts alertness, helps memory and cognitive function and elevates mood. It regulates circadian rhythm – the body's natural wake and sleep cycle. Exposure to blue light during daytime hours helps maintain a healthy circadian rhythm. Not enough exposure to sunlight in children could affect the growth and development of the eyes and vision. Early studies show a deficiency in blue light exposure could contribute to the recent increase in myopia/nearsightedness [23].

Blue light therapy
Blue light therapy is a painless, non-invasive procedure to treat different conditions in an outpatient environment with limited long-term side effects, and only a few mild, immediate side effects. When photosynthesizing drugs are added, photodynamic therapy can be an effective alternative therapy for cancer that’s found beneath the skin. Blue light therapy is most frequently used to treat sun damage and premalignant or malignant skin cancer growths. This therapy was successfully used to prevent skin cancer and remove both precancerous skin lesions and cancerous skin lesions that haven't spread to other areas of the body (or metastasized). Blue light therapy is an FDA approved in-office treatment for Actinic Keratoses (precancerous lesions). During the treatment, a topical photosensitizing drug is applied on the skin. This medication is absorbed preferentially by the precancerous skin cells within one to three hours. The medication is then activated by blue light which is illuminated for about 17 minutes. Once the medication is activated, it destroys the precancerous lesions [24]. Patients can leave immediately after the treatment is over. Following the treatment, limiting the amount of light that affects your skin, avoiding outdoors exposure and keep the area clean with soap and water are recommended.

References:
7. Effects of Artificial Light - European Commission.ee.europe.eu › scientific_committees › opinions_layman Exposure to light at night while awake, such as in shift work may be associated with an increased risk of breast cancer and also cause sleep, gastrointestinal, mood and cardiovascular disorders. However, these effects are due disruption of the natural circadian rhythm, regardless of the type of illumination.


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