

Investigation of the Effects of Light Pollution on Life Health

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ABSTRACT

In this study, the definition, sources, components, and effects of light pollution were examined. Photographs in which the pollution caused by the light is visually evident were added to the study. In order to examine the effects of light pollution on the health of living things, studies in the literature have been meticulously scanned. It is believed that bringing together various research in this study will contribute to the world of science and will pave the way for new research by scientists. The study reveals whether there is a link between light pollution in human health and cancer types, obesity, birth health, sleep disorders, and difficulty concentrating. A separate title has been created for the effects of light pollution on animal health. In the study, research on animal species such as moths, birds, Caretta Caretta, grass mice, chicks, and ant species were included. In addition, some studies on the general effects of light pollution on all animal species are presented.

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1. Introduction

While people could easily see the objects around them thanks to the sun, they wanted to live at night with the help of a different light source. As a result, they created artificial light sources with developing technologies and inventions. These artificial light sources have also had a very important place in human life.

Most modern people live under domes of light brought together by over-illuminated roads and refracted rays from factories. In public spaces, lighting levels are also thought to be effective in deterring crime, although there is no clear evidence [1–3]. The comfort area that light and lighting bring to society has also led to an increase in the level of light day

by day. As a result, the emergence of the term light pollution has become inevitable. The term light pollution was first used in the 19th century [4]. After the use of the term, scientists tried to determine the current situation with various studies.

2. Light Pollution

Light pollution is defined as an ineffective and disturbing lighting problem where the light produced for a specific purpose fall outside the desired places [5].

The main causes of light pollution can be listed under 4 main headings:

- Choosing luminaires and lamps that are not suitable for lighting and lighting principles,

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- Incorrect installation in such a way that it overflows beyond the targeted lighting area.
- Misdirection of light
- Use of more than necessary light [6].

Figure 1 shows an example of misdirected lighting pollution from Italy.



Figure 1 Via Guiseppe Mengoni, Milan (Italy). Photograph Courtesy of Valentino Zangara [7]

As can be easily seen in Figure 1, light pollution has occurred due to the false reflection of the light placed to illuminate the building, hitting non-purpose areas instead of the building surface. Such misapplications seen in this example are frequently seen in many countries and cities of the world. Figure 2 shows strikingly the light pollution that can be seen by astronauts even from space.



Figure 2 Night lights of the Levant, Astronaut photo ISS053-E-50422 taken on 9/28/2017, 00:10:11 GMT.

Figure 2 shows the Nile Delta at the bottom of the image. The image center covers Israel, the West Bank, Jordan, and Lebanon. Many illuminated towns and cities in Turkey can

be seen in space photographs. The very bright night sky also prevents astronomical studies from being carried out. In studies for the perception and observation of the universe, very few celestial bodies can be observed at night due to the bright lights emanating from the cities [8]. The dimming practices applied during World War II contributed greatly to Walter Baade's success in researching the stars in the Andromeda Galaxy. It is stated that Baade also discovered that the Universe is expanding in the 1920s, but the observatory was closed in 1985 due to the increasing light in the following years. Because, at that time, the increasing lights of the city of Los Angeles were illuminating the sky 6 times more [9].

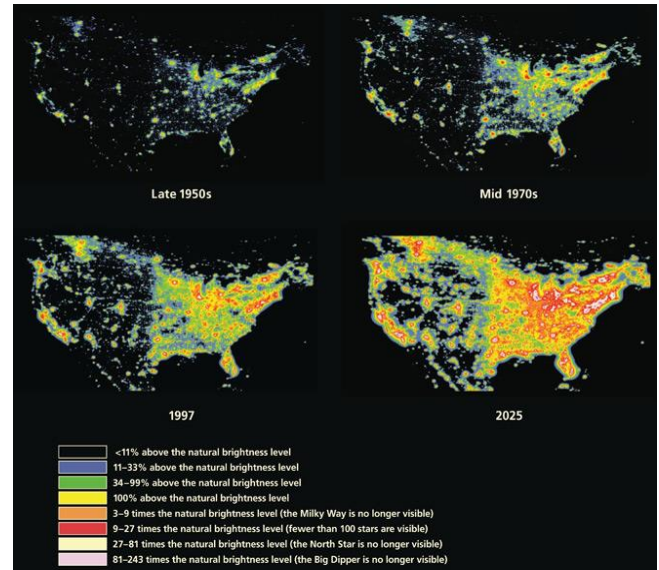


Figure 3 Variation of the amount of light over the years [10]

Figure 3 shows how much the amount of light seen from space is increasing with each passing year and its estimated amount in 2025 for North America. As can be seen, there has been a significant increase. According to the projection, until 2025, there will be almost no dark areas on the continent at night.

According to a study conducted in 2001, 70% of Turkey's population lives a night without moonlight, under a sky brighter than the brightness of the first four moons, and at the same time, 25% of the population cannot see the Milky Way at night. As a result, astronomical observations are almost impossible in most cities [11]. In the United States, 66% of the population and 50% of the European population cannot see the Milky Way at night [12]. Scientists estimate that light pollution will spread rapidly in the near future, with a spreading rate of 2.2% per year [13]. Light pollution has not only hindered the development of astronomy, but its effects on healthy life have also been the subject of research. At the national level, it is also stated that people are willing to pay an average of more than \$16 per month to reduce light pollution in their hometowns [14].

2.1. Effects of light pollution on human health

Exposure to light pollution at night in humans has led to the suppression of melatonin and disruption of the human biological clock, called chronic deterioration [15]. It is

known that the highest melatonin secretion is secreted by the body between midnight and 4 am [16]. For this reason, melatonin production is inhibited in people who are exposed to light during these time zones of the day, and disruption of the circadian cycle may occur. Studies on the subject have investigated whether various diseases and physiological disorders are caused by light pollution. Light therapies' effects in treating seasonal affective disorders and other circadian disorders have also attracted attention [17, 18]. Light pollution has been reported to be associated with serious health problems such as fatigue [19], decreased work efficiency [20], diabetes [21], difficulty concentrating, irritability and chronic insomnia [22], and many different types of cancer [23]. Therefore, light pollution is actually a public issue [24, 25].

It has been researched for years that permanent damage occurs as a result of low secretion of the hormone melatonin in humans. Light pollution increases the risk of breast cancer in women and prostate cancer in men [26]. Studies on breast cancer confirm that high light pollution is a risk factor for breast cancer [27, 28]. In a study of elderly individuals, it was found that urinary melatonin levels of individuals exposed to LAN were not affected by measuring the intensity of night light (LAN) in their bedrooms, but high plasma triglycerides, low-density lipoprotein (LDL), and low-density lipoprotein were associated with LAN [29]. Obesity-related problems of children, one of the most important determinants of public health, increased by 7.8% in men aged 5-19 years and by 5.6% in women in 2016 all over the world [30]. A study of 47,990 Chinese children examined the relationship between outdoor lighting at night and the body mass index (BMI) Z-score. As a result of the examinations, it was determined that overweight/obesity and outdoor lighting were directly proportional [31]. Studies among adults have found a positive association between outdoor LAN levels and being obese, as in children [32, 33]. Striking research on pregnant women and premature birth rates again draws attention to light pollution. A study of 2,265 pregnant women diagnosed with sleep disorders found that pregnant women diagnosed with sleep disorders were twice as likely to give birth earlier than women without sleep disorders [34].

2.2. Effects of light pollution on animal health

It is expected that animals as well as humans will be affected by intense light levels. One of the most common problems is that animals that move with their abilities in the dark of night change direction with artificial lights. In 1917 the ornithologist Carlos Lastreto noticed that the night flights of migratory birds were altered by the light of a torch [35].

Light pollution causes baby sea turtles to become confused as they try to reach the sea. This reduces their chances of survival [36–38]. In a study in which wild city blackbirds (*Turdus merula*) were observed under different LAN intensities, it was determined that birds exposed to high levels of LAN searched for food longer in the evening than their species in darker areas. detected. It has also been observed that male Blackbirds are more sensitive to LAN than females [39]. In the study on the ocular growth and ocular rhythm of exposure to blue light in chicks, trials were conducted in the morning and evening hours, and according to the results obtained, it was explained that short lighting in the morning increased the ocular growth rate of the chicks,

but high brightness had no effect [40]. The harmful effects of blue light at night were demonstrated in an experiment on grass mice (*Arvicantha ansorgei*) [41].

3. Conclusion

As a result of the literature research, it has been determined that light pollution both affects the life of living things and prevents studies on the universe of living things. Studies in humans have found that melatonin causes changes in hormone levels, especially in adults. Considering that the hormone melatonin is an important part of human health, it has been determined that it invites many diseases due to its deficiency. It has been noticed that light pollution is one of the factors that cause people to suffer from important diseases such as sleep disorders, fatigue, breast cancer, prostate cancer and obesity. Studies have shown that exposure to intense light, especially at night, causes changes in migration routes, difficulties in finding food, and more importantly, the death of animals. Using the light used more carefully and thoughtfully to create a comfortable living space with developing technologies is important. Since the direction, intensity and amount of light are effective parameters for pollution, it should be evaluated from this perspective together with the precautions to be taken. In lighting projects, the direction and capacity of the apparatus should be evaluated according to the needs of the total area. All the articles examined in the literature have shown that it is essential to take various measures to reduce the harmful effects of light pollution on human health. Correct positioning of lighting equipment, adjusting light intensity and amount according to needs, increasing the use of sensor-LED light, and reducing the use of blue light will minimize both the efficient use of light and its negative effects on human and animal health. Thus, by using resources more economically, it will be beneficial to leave a more sustainable World to future generations.

Declaration of Conflict of Interest

Authors declare that they have no conflict of interest with any person, institution, or company.

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