Effects of Classroom Lighting on Sleep, Health, and Academic Performance

Recently our school switched to LED lighting for energy efficiency and cost benefits. We, along with many of our peers, started to experience headaches, visual fatigue, and found it more difficult to focus in class. Several teachers stressed the importance of protecting ourselves from harmful artificial light exposure. One teacher even gave yellow tinted glasses to a student to see if there was a difference in the student's visual symptoms. A few students were inspired to bring in their own blue light blocking glasses and wear them while in school. In researching this topic further we learned of health consequences from the different types of light exposure and the effects of blue light on sleep, and that blue light, which constantly surrounds us, can be harmful. These school lighting changes motivated us to ask the following question: “What is the effect of classroom lighting on sleep, health, and academic performance?” We also wanted to make people aware of the hazards from the increasing amount of blue light exposure from artificial light. Our main focus was how lighting can affect students. We also researched the increasing number of diseases associated with light exposure and how they are predicted to grow in prevalence over the generations.

Humans are particularly impacted by blue light, which includes the wavelengths of light between 380 – 500 nm. Different wavelengths of blue light affect humans differently. For example, the very short wavelengths can cause us to strain our eyes when trying to focus on something in this lighting and can cause of loss of concentration and headaches. “How does this relate to sleep?” one might ask.

Melatonin is a hormone in our body that regulates sleep. Melatonin is released according to our circadian cycle, which is similar to a biological clock. The production of melatonin is controlled by one’s exposure to certain wavelengths of blue light through ipRGCs (Intrinsically

Photosensitive Retinal Ganglion Cells). These cells use melanopsin, a light sensitive protein, to detect light and relay the information to the pineal body in the brain, which regulates the human circadian cycle.(Hanifan, 2007) This cycle was once necessary to our survival so that we could hunt and find food. However, artificial light has disrupted our sleeping pattern, since we are being exposed to more artificial light for longer periods of time, particularly at night. While some blue light is needed to establish our circadian cycle, too much blue light from artificial light sources can disrupt the cycle. Blue light exposure during the morning can help develop alertness and establish the circadian rhythm, but one should avoid blue light during the evening when melatonin is supposed to be released.(Melton, 2014)

There is clear evidence to how increased light exposure has affected the population through the many diseases associated with artificial light exposure, including macular degeneration. Artificial light exposure can also cause sleep disruption and take a toll on our performance. A study was conducted on 240 eighth grade students of Smith Middle School on the effect of circadian system disturbance from lighting and its relation to students' academic performance. This particular school building was designed to make use of natural lighting and therefore had minimal use of artificial light. One group of students wore orange tinted glasses to filter out the blue light, while the other group of students were not given the protective glasses. Each student wore a device called a Daysimeter, a device that measures the specific amount of light exposure. The Daysimeter was worn by each participant for a total of seven days. They wore the device constantly (even placing the device at their bedside while they slept). The device could differentiate photopic light, usually read in the front part of the eye in natural lighting, from blue light, which is read toward the back of the eye. The device was used to measure light exposure in students wearing protective glasses, as well as those who were not. Participants were

also placed in rooms with different lighting, according to the wavelength. The secretion of melatonin was tracked carefully by samples of the students' saliva. Several additional tests and self reports of sleepiness were also conducted on each participant. Students wearing the orange tinted glasses received significantly less blue light exposure. They were asked to keep sleep logs, and the students who wore protective glasses had a lower difference in sleep duration from school days and weekends. The students who wore the orange tinted glasses also had faster reaction times on the performance tests given the following morning.(Figueiro, 2001) As a consequence of our research on blue light, we have made alterations in our own lives such as purchasing protective glasses, switching to fluorescent light bulbs, and limiting our computer screen time. We've also taken other precautionary methods, such as wearing sunglasses when outdoors (which will block out blue light from the eyes), and not using electronics before sleeping, as electronic use at night can significantly disrupt sleep (Chang et al, 2015). To share this information with others we have created our own website, http://lightawareness.weebly.com/, so that more people will become aware of the dangers of blue light. It includes most of the information we researched and links to many other organizations involved in blue light awareness. Future steps would be to expand on our research, such as a longitudinal study on the exposure to artificial light over the course of a lifetime, and research why there is such a small population of ipRGCs compared to other retinal ganglion cells. We are interested in making more videos on these topics so that they would be more understandable for the common viewer. We would also like to learn to improve the operation of the website we created. We will continue to improve our own campaign, and share this vital information to those we meet.

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