

Honing in on device screens

by Maxine Lipner EyeWorld Senior Contributing Writer

New insight into how blue light may damage eyes

While it's well known that blue light can damage vision and lead to macular degeneration, until

recently scientists had little idea why. A study¹ published in *Scientific Reports* indicates what may happen to photoreceptor cells in the presence of blue light, according to **Ajith Karunaratne, PhD**, assistant professor, biochemistry department, University of Toledo, Ohio.

Initially, investigators in Dr. Karunaratne's lab were focused on engineering photoreceptors and inserting them in cancer and other types of cells, he explained, adding that one of the things that they needed to do was introduce a molecule known as retinal into cells. Although those cells had nothing to do with vision, "we found that when we exposed these cells to blue light they die," Dr. Karunaratne said. "So then we introduced retinal without having any photoreceptors in these cells and exposed the cells to blue light." Once again, the cells died. However, when exposed to other colors of light, this did not occur. "Also, when we exposed cells to just blue light without retinal, nothing happened," Dr. Karunaratne said.

Investigators started examining how this process might work in a similar situation in the eye. "We can reflect or completely eliminate UV light entering the eye, but the human eye is transparent to blue light, so blue light gets in," he said, adding that this gets focused on the retina. Meanwhile, the retinal, which is a vitamin derivative, is continuously produced by the eye.

Reactive oxygen concerns

"We started investigating and found that the retinal absorbs blue light," Dr. Karunaratne said. "Then, this molecule goes to a high-energy state and the high-energy state can deliver that high energy into oxygen." The eye itself is well oxygenated, and the transfer of the energy makes the oxygen toxic and becomes what is known as a reactive oxygen species, Dr. Karunaratne said. Hydrogen peroxide is one of the reactive oxygen species, and when you place a drop on the skin, you can see bubbles as it reacts.

As part of their work, investigators found that when they exposed cultured cells to blue light the retinal molecule ended up attacking important biomolecules needed for cell survival, likely by generating reactive oxygen species. "If you expose them to retinal and blue light long enough, cells die," Dr. Karunaratne said.

Investigators also discovered that alpha tocopherol, a molecule derived from vitamin E, can prevent this cell death. "We found that alpha tocopherol can quench and neutralize these toxic reactions and

prevent the damage to cells," Dr. Karunaratne said.

While it is unknown whether blue light from devices such as smartphones and computers is intense enough to induce this type of toxic reaction in the eye, some scientific literature suggests that blue light induces vision damage. "We wonder if the previously reported blue light-induced vision damage is from the same set of reactions that we observed," Dr. Karunaratne wondered. "We don't know yet and we are looking into that."

Role for vitamin E

In addition, they are also investigating the potential role of vitamin E. "We think this specific molecule from vitamin E is a natural antioxidant and alpha tocopherol is, too," Dr. Karunaratne said. "We think this is going into the same location in the cell where retinal accumulates, so this can directly take up those reactive species and neutralize them."

Practically speaking, while Dr. Karunaratne understands concerns that the public has about blue light emanating from current technology, he stressed that it remains unknown what effect these truly have. Although retinal is known to be in the eye, it is unknown how much free retinal is available to induce this toxic reaction. "I think the human body is very resilient; we have natural antioxidant machinery," Dr. Karunaratne said. However, in cases where people have problems with the retinal clearance mechanism, they may be more vulnerable to damage by blue light.

"In general, I'm not too worried that the light from mobile devices can induce substantial vision damage," he said. "I use my mobile phone and computer every day and I'm not wearing any glasses at this point because I want to see what the upcoming experiments tell us." **EW**

Reference

1. Ratnayake K, et al. Blue light excited retinal intercepts cellular signaling. *Sci Rep.* 2018;8:10207.

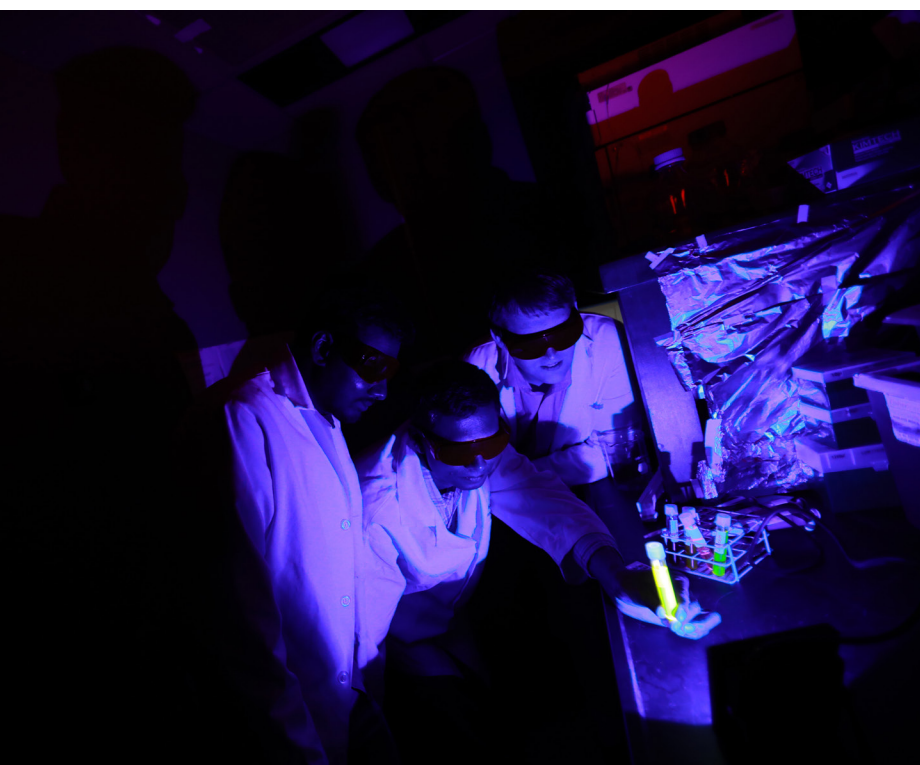
Editors' note: Dr. Karunaratne has no financial interests related to his comments.

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Graduate students working in Dr. Karunaratne's lab



Kasun Ratnayake (left), Dr. Karunaratne (middle), and Dr. John Payton (right) work on a blue light exposure experiment.

Source (all): Ajith Karunaratne, PhD