

The Effects of UVC Light as a Form of Sterilization in Multiple Settings

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Abstract

The application of Ultraviolet-C (UVC) light in multiple public settings were analyzed through thorough research and various discussions with professionals in each of the respective fields. The public settings we analyzed were as follows: hospitals, schools, hubs of travel, places of entertainment, and in the food industry.

Background

UV radiation comes in three forms: UVA, UVB, and UVC. Of the three, UVC light is the best for sanitation since it does help prevent skin damage. It is also known as the most germicidal, meaning the energy from the light can target the DNA of microorganisms and this causes the cells to die or unable to replicate itself. Furthermore, UVC radiation is already being used as disinfectants and is known to kill bacteria, viruses, and pathogens.

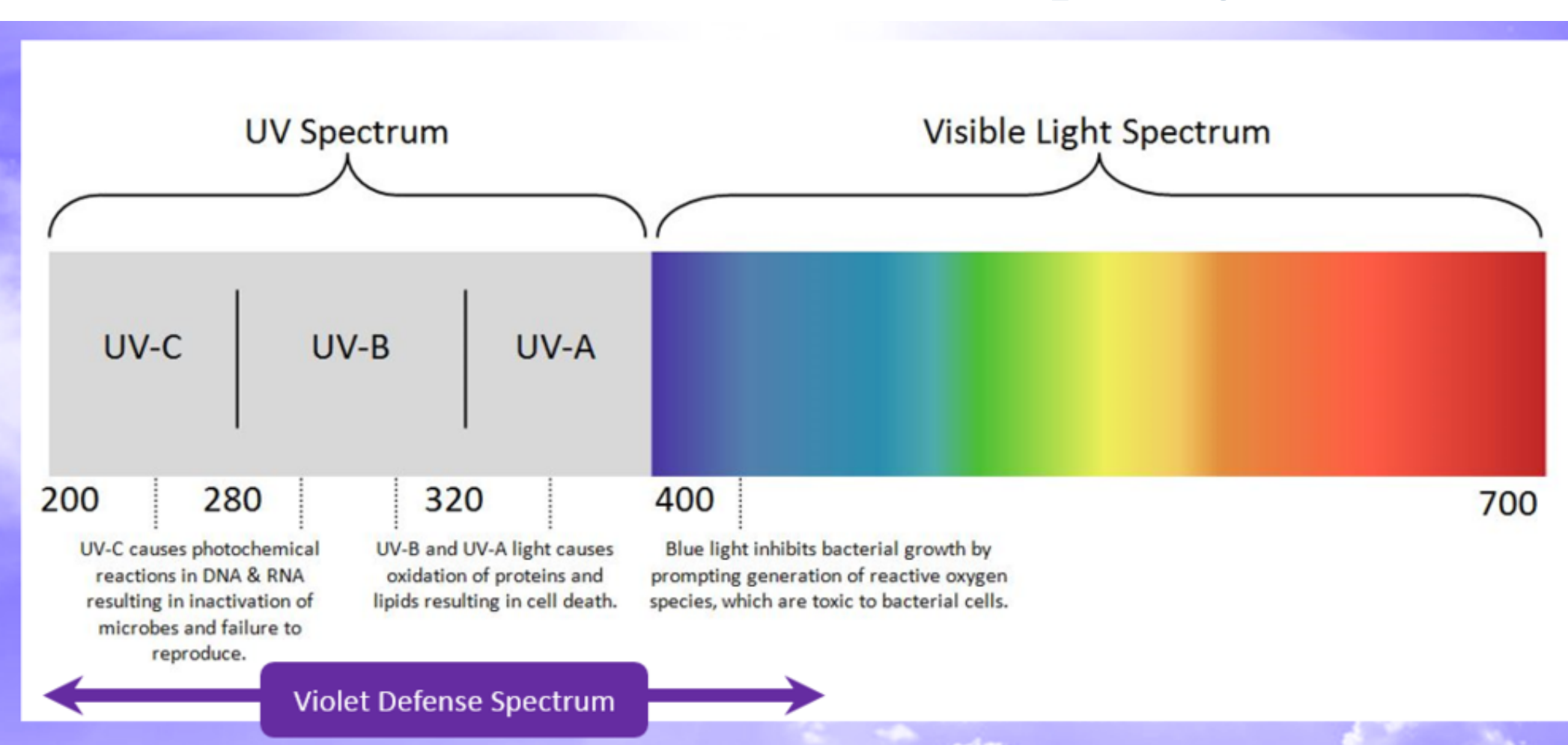


Figure 1: The UV light spectrum showing the UV spectrum alongside the visible light spectrum, displaying the color spectrum. LB 2020-C and. UV-C light - Air Purifiers Air Cleaners Ionizers – Clean Air Optima - Air purifiers, air purification, air cleaner, home air purifiers, air cleaners, air filters. [accessed 2020 Dec 9]. <https://www.cleanairoptima.com/info/UV-C-light/>.

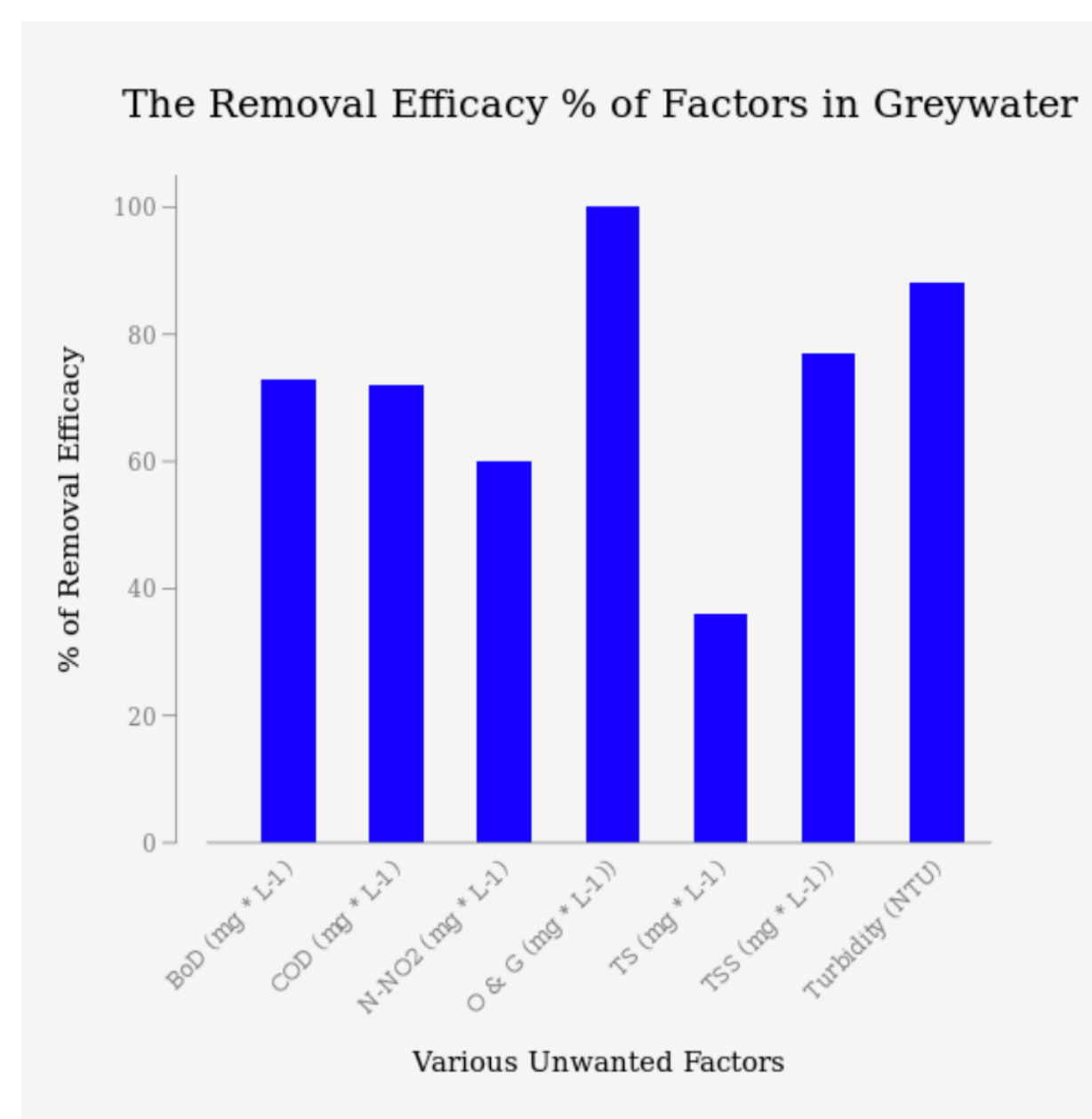


Figure 2: Adapted from Table 2, the removal efficiency of various unwanted factors within greywater in airport in mg/L⁻¹. Couto E de A do, Calijuri ML, Assemany PP, Santiago A da F, Lopes LS. 2015. Greywater treatment in airports using anaerobic filter followed by UV disinfection: an efficient and low-cost alternative. Journal of Cleaner Production. 106:372–379. doi:10.1016/j.jclepro.2014.07.065.

Hospitals

Hospitals across the globe each have their own standard operating procedures when it comes to sterilization of instruments and surfaces. Most involve the use of cleaning products such as bleach that kill 99% of bacteria. Although these are in place, patients still contact illnesses from each other or hospital visitors. In order to limit the spread of disease, the use of UVC light in hospitals should be used as an additional form of sterilization. This second defense system has been shown to significantly decrease bacterial loads and thus limit spread of disease between patients. In Figure 3 is a representation of how much bacteria was able to survive in comparison to exposure to UVC light. The larger quantity of the exposure, the less bacteria that was alive.

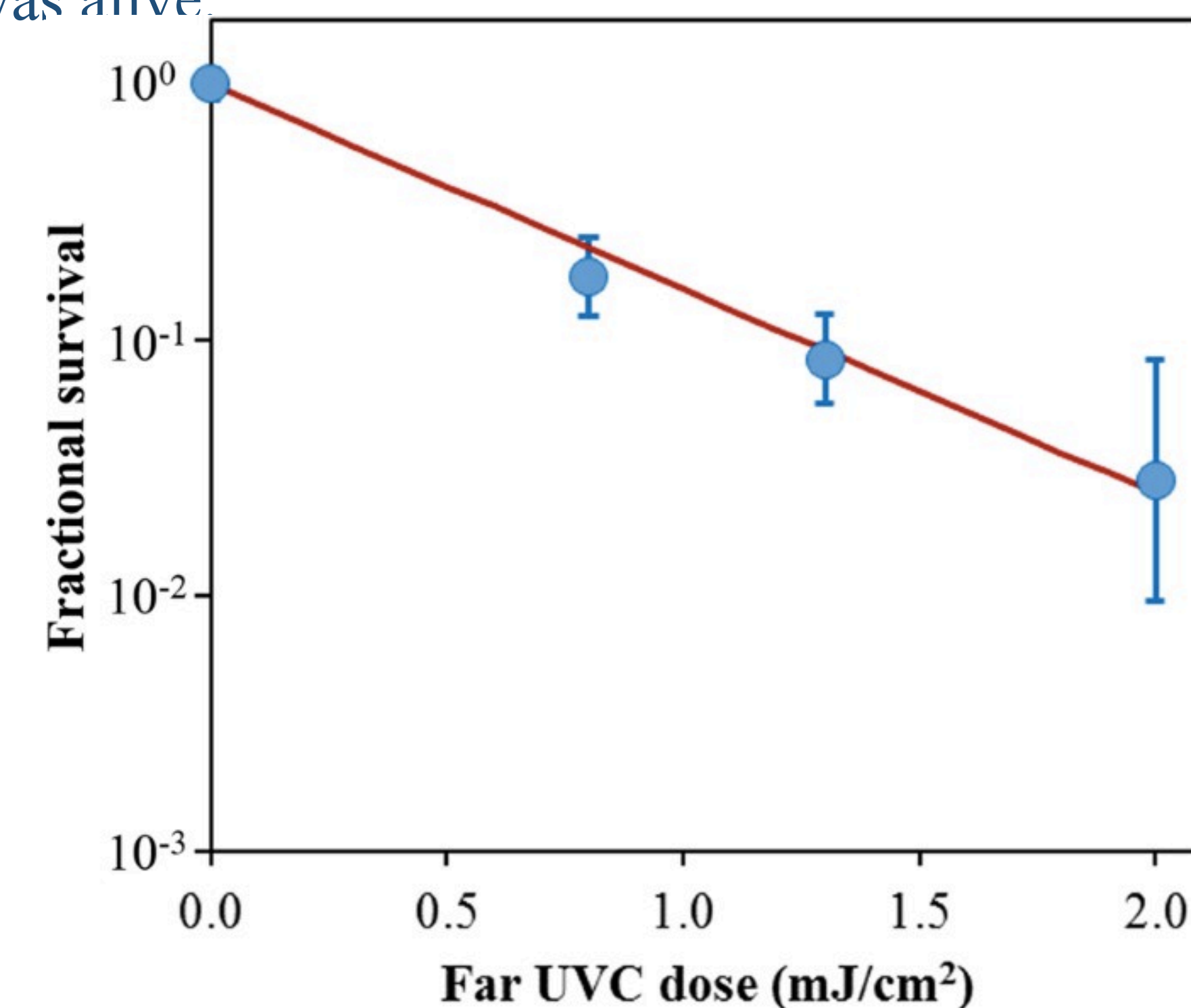


Figure 3: The fractional survival of bacteria based on the quantity of the UVC dosage. Welch D, Buonanno M, Grilj V, Shuryak I, Crickmore C, Bigelow AW, Randers-Pehrson G, Johnson GW, Brenner DJ. 2018. Far-UVC light: A new tool to control the spread of airborne-mediated microbial diseases. Scientific Reports. 8(1):2752. doi:10.1038/s41598-018-21058-w.

Travel

Though traveling has taken a halt in respect to the COVID-19 outbreak, many airports and hotels remain open. This calls for the implementation of safety measures. Specifically, the sterilization of trays, handrails, tables, and chairs using provided by a ray of UVC light. The use of UVC light can also be used in cleaning the used water that comes from bathrooms and showers within the airport. As seen in Figure 2 on the right, UVC disinfection was efficient in sanitizing the greywater into water that could be reused in that airport. Not only is this a cost-effective alternative, but it is also a more environmentally friendly solution to saving water. UVC light would be beneficial considering the millions of travelers that pass through the airports every day.

Schools

As a result of COVID-19, the shift to virtual learning has been an overwhelming transition for students and instructors. UVC light can contribute to a safe return to in-person instruction. Teachers can go through a short training session to be educated on the effectiveness of UVC light and slot it into their standard cleaning procedures to use in between classes. Along with classrooms, UVC light can be used in the cafeterias, libraries, lounges, and other common spaces around schools. Additionally, as seen in figure 4, UVC light can be placed near entrances for sanitization upon entering and exiting. Schools can also create programs that promote safety precautions involving UVC light for families to learn about.

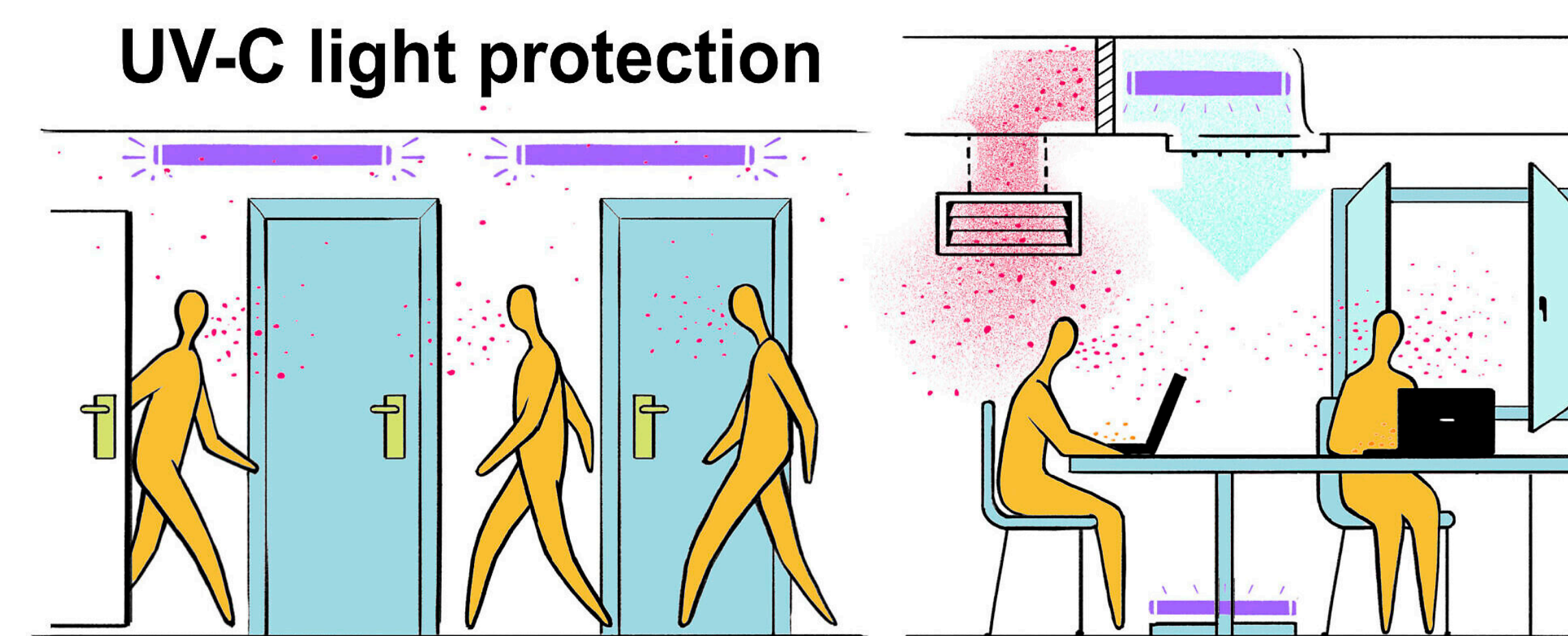


Figure 4: The implementation of UVC light fixtures in a public area, specifically classrooms. Researchers advocate for use of UV light in Covid-19 disinfection | Electro Optics. [accessed 2020 Dec 9]. <https://www.electrooptics.com/news/researchers-advocate-use-uv-light-covid-19-disinfection>.

Entertainment

As a result of the COVID-19 outbreak, it is vital that recreation and entertainment industries implement careful procedures and restrictions to ensure the safety of their employees and customers; specifically, utilizing regular UVC-light sanitation to quickly and thoroughly sterilize the business spaces and surfaces.

Food Industry

Food will always be an essential to the public, especially during the middle of a pandemic. People have turned to eat more fruits and vegetables that are nutrient rich rather than buying processed meats or handmade pastries. One way to ensure everyone's safety is to effectively sanitize public areas with UVC light. UVC light can be used to sanitize shopping carts, shields, and shelves at grocery markets and sanitize tables and chairs at restaurants.

Conclusion

In conclusion, UVC light can be utilized in a multitude of places. Due to the overpopulation of public areas, it is important to impose proper sanitization requirements. The implementation of UVC light is beneficial in killing harmful and unwanted bacteria, without causing any damage to the skin.

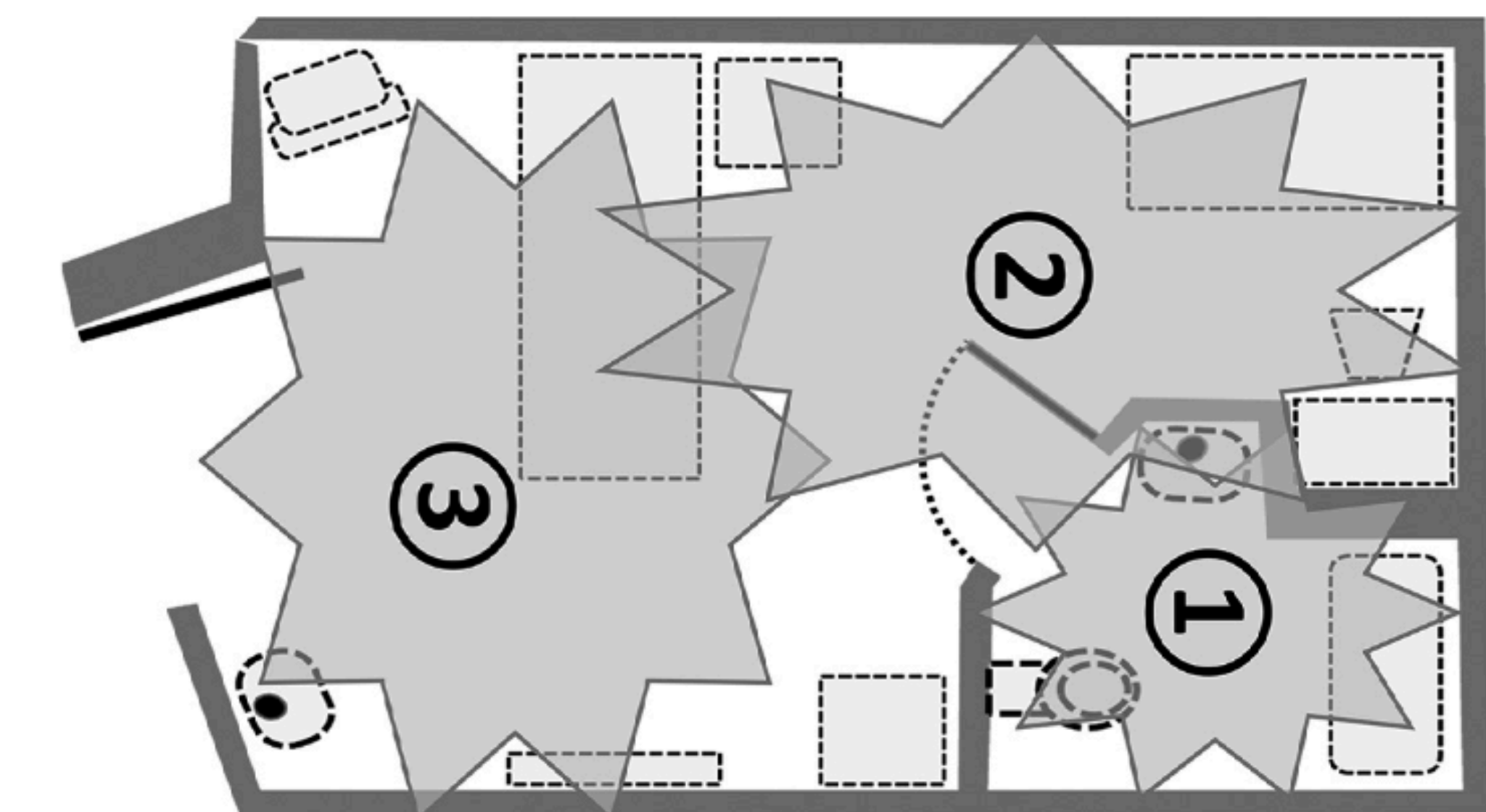


Figure 5: The best position to place the UVC light so that it will effectively sanitize the room. Schaffzin JK, Wilhite AW, Li Z, Finney D, Ankrum AL, Moore R. 2020. Maximizing efficiency in a high occupancy setting to utilize ultraviolet disinfection for isolation rooms. American Journal of Infection Control. 48(8):903–909. doi:10.1016/j.ajic.2020.05.004.

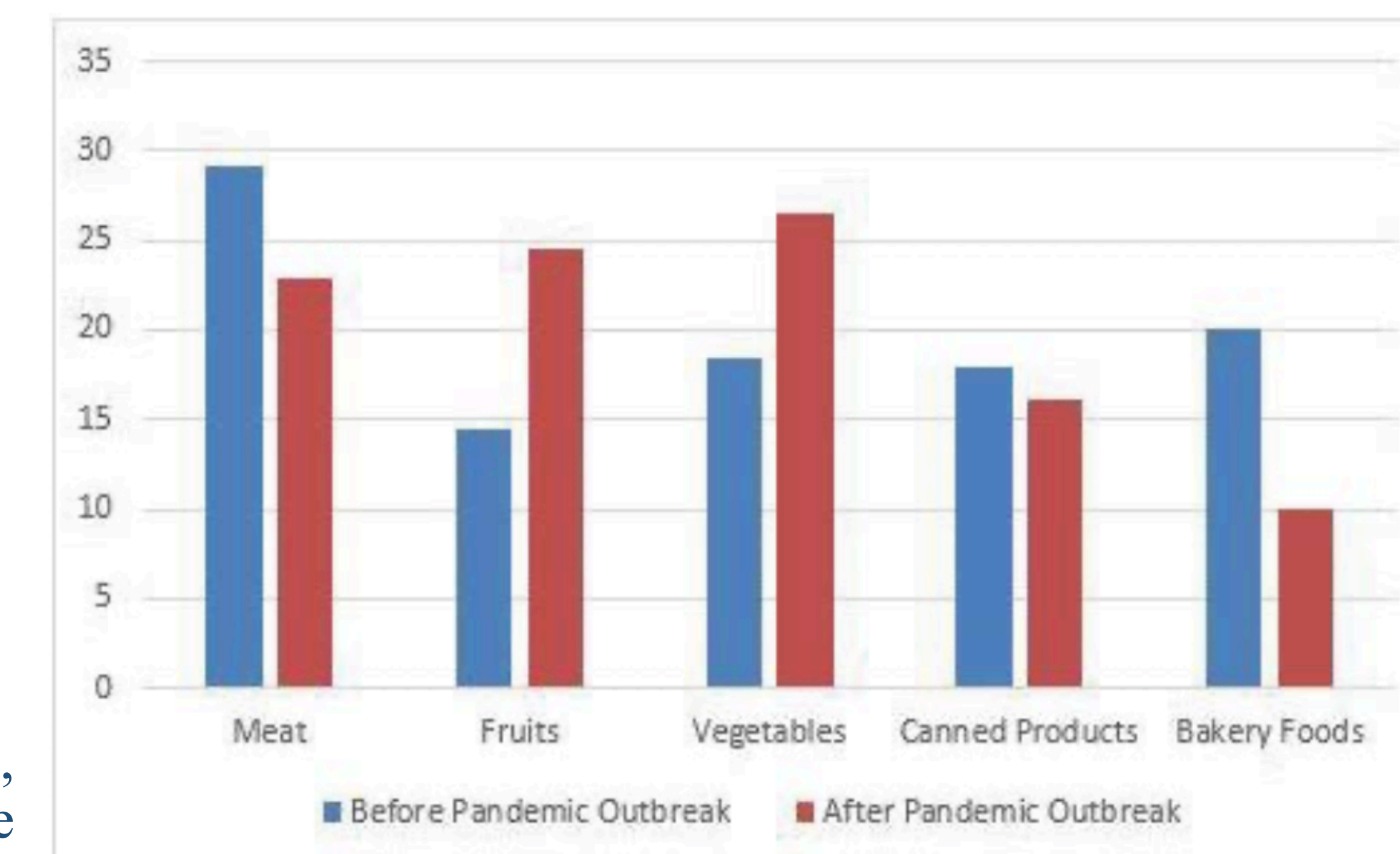


Figure 6: The change in people's choice in food consumption before COVID-19 (blue) and after the pandemic outbreak (red). Celik B, Dane S. The effects of COVID-19 Pandemic Outbreak on Food Consumption Preferences and Their Causes. Journal of Research in Medical and Dental Science. 2020;8(3):5.