Rhythms and Blues: Examining Potential Health Hazards of Blue Light-induced Circadian Disruption in Drosophila melanogaster

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Purpose: Disrupted circadian rhythms can have deleterious consequences for all organisms. The extent to which blue light from digital devices affects circadian biology and mental and physical health outcomes is unknown. This project studied the effects of varying blue light exposure on Drosophila melanogaster's: (1) lifespan (2) caffeine addiction (3) memory and (4) gut permeability. Procedure: Four experimental groups included: controls, flies with the Tim01 mutation, which eliminates circadian behavioral rhythms, flies exposed to 8 hours (BL8) and 12 hours (BL12) of blue (576 nm) light. Percentage of flies surviving over time, within each group, was calculated. Caffeine preference was evaluated using a constructed choice chamber with caffeine enriched and regular media. The aversive phototoxic suppression assay assessed learning/memory; flies learned to avoid light paired with an aversive stimulus. Intestinal barrier dysfunction was detected by the presence of non-absorbable blue food dye outside the digestive tract after feeding. Results: Control flies lived longer than the circadian mutants and flies exposed to blue light for 12 hours ($p<0.001$). Circadian mutants demonstrated significant impairment in memory and learning compared to the controls ($P=0.029$), as did the BL12($P=0.009$) and BL8($P=0.008$) groups. Caffeine preference was demonstrated by the circadian mutants (OR 10.52, $p<0.0001$) as well as the BL12(OR 6.07, $P<0.0007$) and BL8(OR 6.48, $P=0.0003$) groups. Circadian mutants and BL12 flies had impaired gut permeability compared to the controls. Conclusions: Prolonged blue light exposure, and associated circadian dysfunction, can adversely impact physical and mental health. The implications of a digital world require closer biologic scrutiny.

Awards Won:

Fourth Award of $500

American Psychological Association: Complimentary student affiliate memberships

American Psychological Association: Third Award of $500

Serving Society Through Science: Second Award of $500