

Circadian Disruption: Comparing Humans to Mice



Mice were housed in individual cages with a running wheel. Green LED fixtures provided the lighting for this experiment.

Light-dark (LD) patterns incident on the retina synchronize circadian rhythms to local time on Earth. Disruption of the 24-hour LD cycle has been implicated as an endocrine disruptor and linked to increased morbidity and mortality in animal studies. In order to bridge ecological measurements of circadian disruption in humans to disruption in nocturnal animals used in medical research, researchers at the LRC developed:

- Spectral and absolute sensitivity functions for the circadian systems of humans and of mice
- A circadian light dosimeter, the Daysimeter, and used it in a variety of populations to measure circadian light exposures in actual living environments
- A measure of circadian disruption using phasor analysis

Here we compare previously reported measurements of circadian disruption in day-shift and rotating-shift nurses with new mouse data where the light-dark patterns simulated those measured during the shift work.

Sponsors

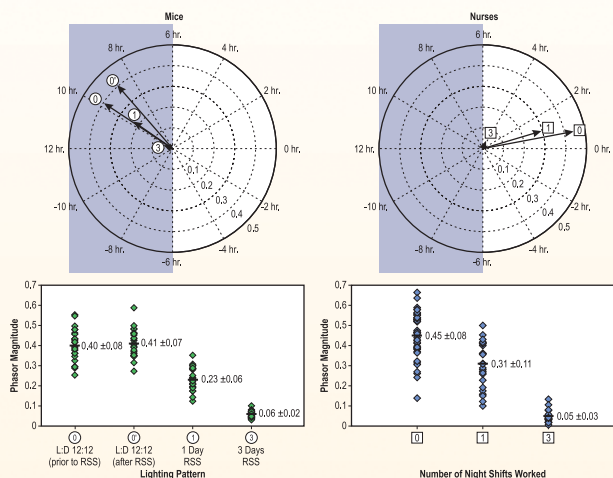
Office of Naval Research

DMX lighting control system donated by Philips Color Kinetics



Methods

Twenty-four male C57BL/6 mice were housed in individual cages with running wheels located in a dedicated light-tight facility in the RPI BioResearch Core. Special lighting had to be created for the mouse cages such that the spectrum and amount of light was tuned to the spectral and absolute sensitivities of the mouse circadian system. The daily LD exposure patterns presented to the mice were scaled to those previously measured for day-shift and rotating-shift nurses working one and three consecutive shifts.



Circadian disruption for mice and for human nurses exposed to different light-dark patterns associated with shift work. **Top Left:** Phasor averages for mice data for different LD patterns; the first (0) and the second (0') 12:12 LD pattern and the 1-Day (1) and the 3-Day (3) rotating shift schedule (RSS) patterns. **Bottom Left:** Individual mouse phasor magnitudes for the different LD patterns. Phasor magnitudes become statistically shorter with increasing number of days of RSS. **Top Right:** Phasor averages for day-shift (0) and rotating-shift nurses who worked one (1) and who worked three (3) consecutive nightshifts during a week. **Bottom Right:** Individual nurse phasor magnitudes for three different number of nights worked. As with the mouse data, phasor magnitudes for the nurses become statistically shorter ($p < 0.05$) as the number of nights worked during the week increased.

Results

As the number of rotating-shift patterns increased phasor magnitude decreased. Phasor analysis may be a useful method for quantitatively bridging ecological measurements of human LD exposures with controlled parametric studies of those LD patterns as they may affect health outcomes in a mouse model.

