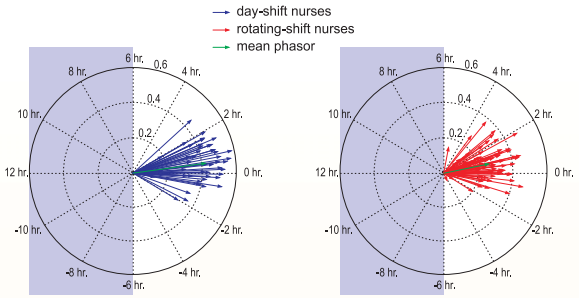
New Insight on Ways Circadian Disruption Affects Human Health

Studies indicate rotating-shift working women have a greater probability of contracting breast cancer than day-shift women possibly due to exposure to light at night and/or circadian disruption. Circadian disruption occurs when the light-dark pattern is uncoordinated or out of phase with the activity-rest pattern. However, ecological studies to measure human light exposure are virtually nonexistent, making it difficult to determine if, in fact, light-induced circadian disruption directly affects human health.

LRC researchers developed a framework that would permit ecological studies of circadian disruption, perhaps leading to new insights into breast cancer, obesity, sleep disorders, and other health problems.

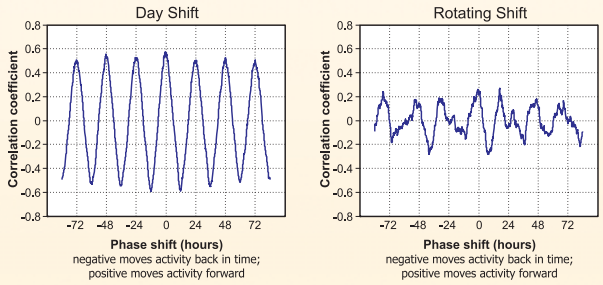


Phasors for day-shift and rotating-shift nurses. Phasors represent the magnitude of entrainment and phase relationship between the activity-rest data and the light-dark data.

Experiment

The Daysimeter™—a small, head-mounted device designed to measure an individual's daily rest and activity patterns, as well as exposure to circadian light—was worn for seven days by both day-shift and rotating-shift nurses. Simultaneously, LRC researchers studied the effect of irregular light exposure on the circadian system of 40 rats, in order to determine if the relationship between circadian disruption and health outcomes could be uncovered using rodent models.

Twenty rats were exposed to a consistently repeating pattern of 12 hours of light followed by 12 hours of dark, to mimic the light exposure experienced by day-shift workers. The remaining rodents were exposed to irregular 12-hour patterns of light and darkness.



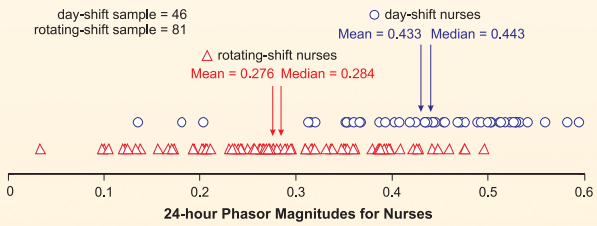
Circular cross-correlations of activity and light exposures in day-shift nurses (left) and rotating-shift nurses (right).

Results

A quantitative measure of circadian disruption (phasors) was developed based on the circular cross-correlations of activity and light exposure data from both the nurses and the rats.

The circadian disruption levels for day-shift and rotating-shift nurses were remarkably different from each other, but remarkably similar to the levels for the two parallel groups of nocturnal rodents, suggesting that, with the new quantification method, health-related problems associated with circadian disruption in humans can be parametrically studied using animal models.

This allows for new, meaningful studies examining light as a stimulus for circadian entrainment or disruption, as well as a more relevant translation of circadian disruption studies employing animal models for human disease.



Distribution of phasor magnitudes for day-shift and rotating-shift nurses.

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