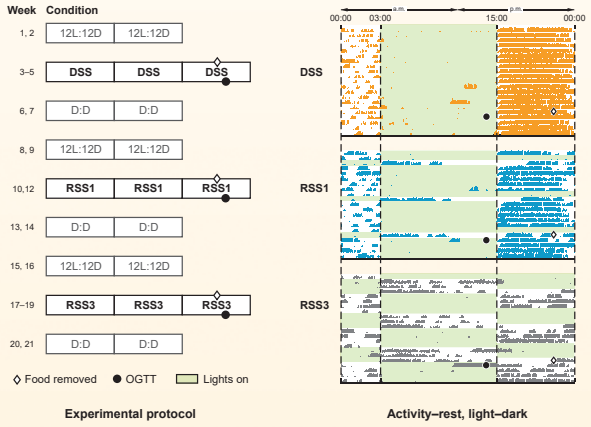
Mouse Glucose Tolerance and Light on Shift Work Schedules

Previous laboratory studies have shown that circadian disruption is associated with decreased glucose tolerance in animals and humans. The LRC measured glucose tolerance in mice exposed to mouse-specific light–dark stimulus patterns simulating those that humans would experience while working dayshift and rotating night shift schedules over three consecutive weeks. The study explored the relationship between rotating shifts, circadian disruption (phasor magnitude), and glucose tolerance (using oral glucose tolerance test [OGTT] measurements).

Methods

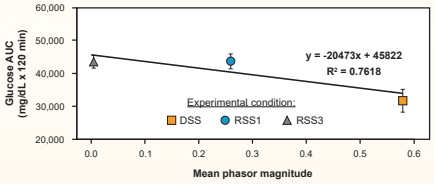
Twenty-four C57BL/6 male mice experienced three experimental lighting conditions developed and installed by the LRC: (1) simulated dayshift (DSS), (2) simulated rotating shift work including one night per week (RSS1), and (3) simulated rotating shift work including three nights per week (RSS3). Twelve of the mice received OGTT at the same time and light phase during the third week of each experimental session. The other 12 mice were not tested for glucose tolerance, but were provided access to running wheels for phasor analysis of their light–dark exposure and activity–rest patterns.



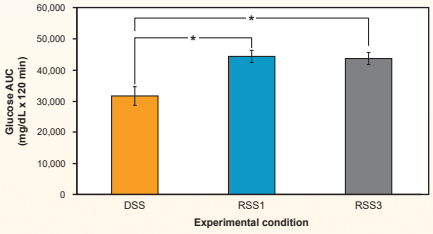
Experimental protocol for light–dark stimulus and oral glucose tolerance test (OGTT) measurements (left) and activity–rest and light–dark stimulus patterns recorded for the wheel-running animals (right).

Results

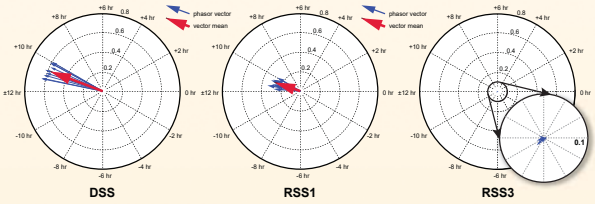
- Glucose levels reduced more quickly for the DSS condition, in contrast to the RSS1 and RSS3 conditions.
- Glucose area-under-the-curve (AUC) measured for the DSS condition was also significantly less than that for the RSS1 and RSS3 conditions.
- Circadian disruption for mice in the DSS condition, measured via phasor magnitudes, was significantly less than that for the RSS1 and RSS3 conditions.
- There was a significant relationship between AUC and phasor magnitudes; the greater the phasor magnitude (more entrained), the lower the AUC.



Mean phasor magnitudes and glucose AUC suggest that glucose AUC is reduced as phasor magnitude increases.



Mean glucose AUC, suggesting a significant decrease in glucose tolerance for the RSS1 and RSS3 conditions.



Phasor magnitudes calculated from animals experiencing the DDS condition were significantly greater than those calculated from the RSS1 and RSS3 conditions, suggesting greater circadian entrainment.

Publication

Figueiro MG, Radetsky L, Plitnick B, Rea MS. Glucose tolerance in mice exposed to light–dark stimulus patterns mirroring dayshift and rotating shift schedules. *Scientific Reports*. 2017;7:40661.

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Practical Applications

This research shows that even one night of shift work disrupts circadian rhythms and decreases glucose tolerance in mice, possibly representing a bridge toward understanding the health implications of circadian disruption in humans.

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