Out Like a Light? The Effects on Sleep of Being a Nocturnal Mouse in a Diurnal Lab

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Introduction: Sleep disruption in humans, caused by shift work, can be detrimental to physical and behavioral health. Laboratory mice are nocturnal animals living in the diurnal world of investigators and husbandry staff. However, it is unknown if mouse sleep is disrupted by normal human schedules or if this affects their welfare. We hypothesized that the timing of human disruptions would alter mouse sleep patterning. We predicted that mice disturbed during their normal rest period (light period) would either sleep less overall or spend more time sleeping during their typical active period (dark period).

Methods: We utilized a non-invasive sleep apparatus that uses a piezoelectric mat underneath each cage to detect mouse movement, which requires solitary housing. It analyzes these movements to discern a waking mouse from a sleeping mouse with 90% accuracy. Forty eight mice were used in a factorial design to test 2 main treatments: disruption treatment (disturbed with routine husbandry at either 10:00 or 22:00) and nesting material treatment (3, 6, 9, or 12 g). We tested both sexes of 3 types of mice (CD-1, C57BL/6, and BALB/c). Nesting material amounts correlate with nest quality, therefore we wanted to determine if there were any potential ameliorating effects of a quality refuge on sleep disruption. All mice were exposed to each sleep treatment for one week; the first treatment they experienced was balanced across groups to account for order effects. Sleep in the home cage was continuously recorded over the 2 weeks. Data were analyzed as a GLM.

Results: C57BL/6 mice, regardless of sex or disruption timing, slept less overall compared to other mice($P<0.001$), and their overall sleep percentage did not change between treatments. CD-1 and BALB/c male mice slept more during the day than females when they were disturbed at 10:00 ($P<0.001$). Two hour interval percentage of time sleep analysis over 24 hours showed multiple significant differences between types of mice throughout the day, particularly immediately after lights on ($P=0.004$) and immediately prior to and after either disturbance time ($P<0.001$). Nesting material was only found to increase sleep bout length in CD-1 mice with 12g of nesting material compared to those with 3g ($P=0.02$). These results suggest that disturbance timing does effect sleep, but varies between mouse type and sex, and our brief welfare checks may have been too predictable and inconsequential to induce true sleep disruption.

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