Exposure to Bright Light and Darkness to Treat Physiologic Maladaptation to Night Work

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Approximately 7.5 million Americans work at night, either on permanent shifts or on schedules requiring a rotation of day, evening, and night work. These workers forgo nocturnal sleep and then attempt to sleep during daylight hours. Yet, as Benedict first noted at the turn of the century, a complete physiologic adaptation of endogenous circadian rhythms to such inversion of the daily routine does not occur— even after years of permanent nighttime work. A physiologic maladaptation to an inverted circadian rhythm results in diminished alertness and performance during nighttime work, with attendant increases in the number of fatigue-related accidents during night hours.

We hypothesized that bright light exposure in the morning and darkness during the night would improve nocturnal alertness and orient the circadian pacemaker to night-time hours.
EXPOSURE TO BRIGHT LIGHT AND DARKNESS TO TREAT PHYSIOLOGIC MALADAPTATION TO NIGHT WORK

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Abstract Working at night results in a misalignment between the sleep-wake cycle and the output of the hypothalamic pacemaker that regulates the circadian rhythms of certain physiologic and behavioral variables. We evaluated whether such physiologic maladaptation to nighttime work could be prevented effectively by a treatment regimen of exposure to bright light during the night and darkness during the day. We assessed the functioning of the circadian pacemaker in five control and five treatment studies in order to assess the extent of adaptation in eight normal young men to a week of night work.

In the control studies, on the sixth consecutive night of sedentary work in ordinary light (approximately 150 lux), the mean (=SEM) nadir of the endogenous temperature cycle continued to occur during the night (at 03:31 ±0:56 hours), indicating a lack of circadian adaptation to the nighttime work schedule. In contrast, the subjects in the treatment studies were exposed to bright light (12,000 lux) at night and to nearly complete darkness during the day, and the temperature nadir shifted after four days of treatment to a significantly later, midafternoon hour (14:53±0:32; P<0.0001), indicating a successful circadian adaptation to daytime sleep and nighttime work. There were concomitant shifts in the 24-hour patterns of plasma cortisol concentration, urinary excretion rate, subjective assessment of alertness, and cognitive performance in the treatment studies. These shifts resulted in a significant improvement in both alertness and cognitive performance in the treatment group during the night-shift hours.

We conclude that maladaptation of the human circadian system to night work, with its associated decline in alertness, performance, and quality of daytime sleep, can be treated effectively with scheduled exposure to bright light at night and darkness during the day. (N Engl J Med 1990; 322:1253-9.)