Previous Sleep and Light at Night Affect Biomarkers

Circadian rhythms repeat approximately every 24 hours and are synchronized to the solar day by light/dark patterns. Examples of circadian rhythms include:

- **Melatonin**, a hormone synthesized by the pineal gland at night and under the condition of darkness;
- **Cortisol**, a hormone synthesized by the adrenal gland, peaks 30-60 minutes after awakening in the morning; and
- **Alpha amylase**, an enzyme used as a marker for the sympathetic system, roughly mirrors cortisol production, peaking in the early afternoon.

LRC researchers investigated the impact of sleep and light exposure on these biomarkers over a period of 27 hours.

**Methods**

Ten subjects, ages 18 to 46, participated in the three-session, within-subjects study and were: restricted from sleep; allowed to sleep for 3 hours (01:00-03:45); and allowed to sleep for 7 hours (01:00-07:45). The 27-hour experiment included seven sample times which were instituted to obtain baseline biomarker measurements (open arrows) and another seven sample times which followed one-hour exposures to 470-nm light emitting diodes (LEDs) that delivered 40 μW/cm² (40 lx) at the subject’s cornea (filled arrows). Subjects started each session at 07:00 and ended at 10:00 the following day. Saliva samples were collected for biomarker assays just prior to and at the end of the one-hour light exposures.

**Results**

- All three biomarkers follow a circadian pattern
- Sleep and light interact to affect alpha amylase and cortisol response but not melatonin; only light affects nocturnal melatonin suppression
- Magnitudes of alpha amylase and cortisol responses are dependent upon the duration of sleep and the time of waking
  - The longer the sleep duration and the later the time of waking, the greater the response
- Directions of response to waking are opposite for alpha amylase and cortisol
  - Waking increases cortisol and decreases alpha amylase

**Sponsor**

Office of Naval Research (ONR) Young Investigator Program

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