Changes in Circadian Timing Following Sleep Extension in Habitually Short Sleeping Adolescents

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Background

- Adolescents are at risk for insufficient sleep and circadian misalignment due to physiologically delayed circadian rhythms and slowed homeostatic sleep drive
- Existing studies report the feasibility of in-home sleep extension, but...

It is not clear whether sleep extension also shifts circadian rhythms

Aims and Hypothesis

Aim: To objectively measure circadian shifts following sleep extension in adolescents with typically insufficient sleep

Hypotheses
1. Dim light melatonin onset (DLMOn) will advance, while dim light melatonin offset (DLMOff) will remain consistent
2. Phase angle between DLMOn and bedtime will narrow following a one-week sleep extension manipulation

Methods

Participants
- N = 26
- Habitual short sleep duration (< 7 h per night on school nights)
- Average age of 16 ± 1.2 years, predominantly female (70%), and predominantly White non-Hispanic (67%)

Study Design
- Crossover design: participants were randomized to both one week of typical sleep and sleep extension in counterbalanced order
  - Typical Sleep week (TS): usual school sleep schedule
  - Sleep Extension week (SE): > 1 hour additional time in bed

Measurements
- Actigraphy-estimated sleep was assessed at home during both weeks
- Hourly in-the-laboratory evening and morning dim-light salivary melatonin samples were obtained following each condition
- DLMOn, DLMOff, and phase angles were calculated

Data Analysis
- Paired samples t-tests examined differences in variables between the SE and TS weeks.

Results

Figure 1: Actigraphy Assessed Sleep Variables During Typical Sleep and Sleep Extension

- There was no significant change in DLMOn or DLMOff following sleep extension (both p > 0.05) (see Figure 2)
- Phase angle between DLMOn and bedtime significantly narrowed during SE compared to TS by 1.14 h (p = 0.02)

Summary of Results

- Total sleep duration increased on average 1.52 h and bedtime advanced on average 1.20 h during SE compared to TS (both p < 0.001) (see Figure 1)
- There was no significant change in wake time during sleep extension compared to typical sleep (p= 0.06) (see Figure 1)
- There was no significant change in DLMOn or DLMOff following sleep extension (both p > 0.05) (see Figure 2)
- Phase angle between DLMOn and bedtime significantly narrowed during SE compared to TS by 1.14 h (p = 0.02)

Conclusions

- Sleep extension did not change melatonin onset or offset, but narrowed the DLMOn-bedtime phase relationship
- DLMOn-bedtime phase angles in the current sample are similar those reported in a sample of adolescents obtaining >7 h sleep per night (Crowley et al., 2014)
- Further research is needed to determine the potential benefits of this change for adolescents with habitually insufficient sleep

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