Title. The acute effects of sleep restriction therapy for insomnia on circadian timing: a within-subjects evaluation of phase angle

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Objectives/Introduction: Sleep restriction therapy (SRT) has been shown to improve insomnia symptoms by restricting sleep opportunity. Curtailment of time in bed affects the duration and consolidation of sleep, but also its timing. While recent work suggests that the relationship between circadian and behavioural timing for sleep may be abnormal in insomnia, no study has investigated if SRT modifies this relationship. Here, we examined change in phase angle after 2 weeks of SRT.

Methods: Participants followed standard SRT guidelines for 2 weeks. Phase angle was derived from the difference between the decimal clock time of dim light melatonin onset (DLMO) and average attempted sleep time of the previous 7 days at baseline and post-treatment. Secondary outcomes included sleep continuity, insomnia severity and repeated measures of vigilance that were assessed in the laboratory at the same day as DLMO at baseline and post-treatment.

Results: Eighteen participants meeting insomnia criteria (mean age = 37.06+8.99) were included in the analysis. In line with previous research, results showed improvements in subjective and objective sleep continuity variables (*ps* < 0.001) and reductions in insomnia severity ($p < 0.001$) following 2-weeks of SRT. The primary outcome, phase angle, was determined in 15 participants and revealed an increase of 34.8 (+62.16) minutes from baseline to post-treatment (2.27+0.94 hr vs 2.85+1.25 hr; $p = 0.048$). While attempted sleep was 46.8 (+40.2) minutes later (23:05 vs 23:52; $p < 0.001$), DLMO stayed relatively stable (20:49 vs 21:01; $p = 0.543$). Consequently, the time span between melatonin rise and attempted sleep was increased from baseline to post-treatment. Repeated measures of reaction times, attentional lapses and subjective sleepiness indicated significant deteriorations after 2 weeks of SRT (*p*s ≤ 0.042).

Conclusions: For the first time, this study has illustrated that SRT increases phase angle in its acute phase by delaying the timing for sleep attempt when DLMO stayed relatively stable. Future studies are needed to experimentally test if an increase in phase angle is linked to therapeutic benefits for insomnia.

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