

## ***Sleep and Circadian-Related Risk for Alcohol Use: Reward Function and Impulsivity as Putative Mechanisms.***

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**Introduction:** Sleep and circadian characteristics are linked to risk for alcohol use and problems, particularly in adolescents and young adults. However, the mechanisms by which sleep/circadian characteristics influence alcohol risk remain uncertain and are likely multifactorial. Growing evidence implicates reward function and impulsivity as processes that are modulated by sleep and circadian rhythms, and in turn, influence the development of alcohol use and related problems. Our ongoing research program is investigating sleep/circadian modulation of reward function and impulsivity in human adolescents and young adults, focusing particularly on a hypothetical pathway from circadian misalignment to alcohol use and problems.

**Methods:** Data comes from several recent studies of human adolescents and young adults, including both non-drinking and drinking samples, and utilizing observational and experimental designs (Hasler et al, 2019, 2021, 2022a, 2022b). Global self-report instruments and ecological momentary assessment (EMA) were used to collect sleep, alcohol use, and impulsivity data. Laboratory-based assessments included objective measurement of circadian phase via the dim light melatonin onset (DLMO) and fMRI assessments of reward function (Card Guessing Task) and response inhibition (Go/No-Go Task). Circadian alignment was operationalized via the interval between DLMO and the midpoint of sleep, with DLMO-midsleep intervals that are shorter than the median construed as increasing misalignment.

**Results:** In a sample of late adolescent drinkers, later circadian phase (DLMO) and weekday circadian misalignment (shorter DLMO-midsleep intervals) were associated with greater weekend alcohol use. In the same sample, weekday circadian misalignment was also associated with lower striatal activation during anticipation of monetary reward, which correlated in turn with more frequent binge episodes at baseline. In a sample of healthy adolescents who underwent an experimentally-imposed circadian misalignment protocol, the misalignment condition was associated with reduced striatal activation during monetary reward wins and reduced right frontal inferior gyrus activation during response inhibition. Finally, in a sample of young adult drinkers, later self-reported chronotype was associated with greater state-level impulsivity across multiple subdimensions, including but not limited to negative urgency.

**Discussion:** Across the studies, findings suggest that the later sleep/circadian timing, and the circadian misalignment often experienced by adolescents and young adults with later sleep/circadian timing, is associated with increased alcohol use, altered reward function, and impaired impulse control. Experimental designs are needed to confirm causality and further clarify directionality between sleep/circadian factors, reward function, impulsivity, and alcohol use.

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**References:** Hasler BP, et al. *Chronobiology International*. 2019;36(6):796-810.; Hasler BP et al. *Front Neurosci*. 2022;16:803349. Hasler BP, et al. *Psychol Med*. 2021:1-9; Hasler BP, et al. *Chronobiology International*. 2022:1-13.