Sleep in the NCANDA cohort

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NCANDA FUNDING: NIAAA • NIMH • NICHD • NIDA

Relevant Financial Disclosures: None
Sleep is critical in the teenage years!

Teen sleep problem ‘epidemic’ linked to bad grades

Sleepy Teens 4.5 Times Likely to Commit Crimes By Age 29: Study
February 23, 2017 10:50 AM

Chronic lack of sleep may make you less intelligent

DAILY BREEZE
EDUCATION

Does the school bell ring too early for sleepy students?
Why Consider Sleep?

1. Examine the developmental trajectory of functional sleep measures and how they are impacted by alcohol exposure.
2. Examine sleep behavior as a predictor of hazardous alcohol drinking in adolescents.

Sleep EEG & Sleep Behavior:
- Sensitive marker of brain function

Adolescent Development
Alcohol Use

Sleep Project:
SRI International
University of Pittsburgh
NCANDA sleep project: what we are learning

- Normal age-related differences in sleep architecture and EEG across adolescence (Baker et al., Sleep 2016)
- Links between sleep and brain structure (Goldstone et al., under review, 2017)
- Longitudinal changes in sleep architecture: impact of alcohol use
- Sleep behaviors as predictors of heavy alcohol use (Hasler et al., Alcohol Clin Exp Res., 2017)
Recording sleep with polysomnography

- Electroencephalograph
- Electromyograph
- Electro-oculograph
Non-rapid eye movement (NREM) sleep
REM sleep
Microstructure of sleep

- Sleep spindle
- K complex
Age-related differences in sleep architecture in adolescents

N3 (slow wave) sleep (% of total sleep time)

N2 sleep (% of total sleep time)

Wakefulness after sleep onset (min)

Awakening Index (No./h)

N = 141 adolescents

Baker et al., 2016
Age-related differences in sleep slow wave EEG activity in adolescents

Ln slow wave activity (µV²·Hz⁻¹) in NREM sleep at C3

Ln slow wave activity (µV²·Hz⁻¹) in NREM sleep at F3

Ln slow wave activity (µV²·Hz⁻¹) in NREM sleep at O1

Pubertal development scale

Baker et al., 2016
Cortical thickness and gray matter volume mediate the age-related difference in sleep slow wave activity.

Goldstone et al.
Experimentally evoking slow-wave K-complexes during sleep
Older adolescents have smaller amplitude of evoked slow-wave K-complexes than younger adolescents.

N550 amplitude at a frontal electrode site against age.
Transition to alcohol use: Impact on sleep architecture

<table>
<thead>
<tr>
<th>Follow-up drinking patterns (mean (SD))</th>
<th>No/low drinkers (n = 18)</th>
<th>Moderate/heavy drinkers (n = 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of drinking days in past year</td>
<td>&lt; 1</td>
<td>31 (48)</td>
</tr>
<tr>
<td>Average number of drinks per time</td>
<td>&lt; 1</td>
<td>4.4 (2.3)</td>
</tr>
<tr>
<td>Largest number of drinks at one time</td>
<td>&lt; 1</td>
<td>6.4 (2.8)</td>
</tr>
</tbody>
</table>
Sleep behavior and risk for drug and alcohol use

# NCANDA Sleep Behavior Metrics

**N = 729 adolescents (12 – 21.9 years)**

## Sleep Quality
- Pittsburgh Sleep Quality Index (Buysse et al., 1989)
  - During the past month, how would you rate your sleep quality overall? (Very good – Very bad)

## Daytime Sleepiness
- Cleveland Adolescent Sleepiness Questionnaire (Spilsbury et al., 2007)
  - In the morning when I am in school, I fall asleep (Never – Always)

## Chronotype
- Composite Scale of Morningness (Smith et al., 1989)
  - One hears about “morning” and “evening” types of people. Which ONE of these types do you consider yourself to be? (Extreme evening – Extreme morning)

## Sleep Behavior
- Bedtimes and Wakeup times
- Weekdays and weekends
NCANDA Baseline Sleep Data: Time in Bed

- **Time in Bed (hours)**
  - Age (years)
  - TIB_school
  - TIB_noschool
  - Poly. (TIB_school)

- **Recovery on non-school nights**
  - Time in bed on school nights (hours)
  - Non-school night recovery (hours)
Chronotype

![Graph showing the relationship between age (years) and morningness score. The x-axis represents age (years) ranging from 10 to 22, and the y-axis represents morningness score ranging from 0 to 20. The graph displays a scatter plot with a trend line indicating a slight decrease in morningness score with increasing age.](image)
Greater eveningness predicts Binge Alcohol Use

covariates: age, race, ethnicity, SES. Also, baseline substance use for 1-year F/U model

Hasler et al., 2017
Later bedtimes predicts Binge Alcohol Use

Hasler et al., 2017
Sleep and Past-Year Marijauna Use

![Sleep Quality and Circadian Preference Graphs](image)

Hasler et al., 2017
Summary

• There are dramatic age-related differences in sleep architecture and sleep behavior across adolescence, with some differences between boys and girls.

• Brain structural measures partially mediate the age-related difference in slow wave activity during sleep.

• Preliminary data suggests that transitioning to alcohol use impacts sleep architecture.

• Poorer sleep quality and later sleep timing (preferred and “actual”) show cross-sectional and longitudinal associations with risky substance use.

• Future longitudinal analyses will be aimed at further understanding the bidirectional relationship between sleep and alcohol use during this sensitive developmental period.
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