Age & Sex Differences in Cognitive, Motor, & Sleep Indices: Initial Findings of the National Consortium on Alcohol & NeuroDevelopment in Adolescence

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Age & Sex Differences in Cognitive, Motor, & Sleep Indices: Initial Findings of the National Consortium on Alcohol & NeuroDevelopment in Adolescence

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Disclosures
Financial and Academic Interests

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Editor-in-Chief

Salary and research support

NIH National Institute on Alcohol Abuse and Alcoholism
Monitoring brain development of 831 adolescents over a 5 year period and recruited from 5 U.S. sites to
- determine the effects of early, heavy alcohol use on brain structure and function
- identify factors that predict Alcohol Use Disorder

Kilian M. Pohl
NCANDA – Data Flow

Sites

Demographics
Clinical Scores
Traditional NP Tests
Computerized Tests (Web CNP)

MR DICOM

Neuro-Informatics Platform

Process Case, QA
Statistical Group Analysis

Fusing data across time, sites, and modalities

Kilian M. Pohl
NCANDA – Data Flow

Sites

Demographics
Clinical Scores
Traditional NP Tests
Computerized Tests (Web CNP)

Neuro-Informatics Platform

REDCap
XNAT

Process Case
Statistical Group Analysis
Report

Provide comprehensive report of measurements to scientists

Kilian M. Pohl
Neuropsychology Testing Procedures

- Combination of traditional pencil & paper tests and computerized tests (UPenn Computerized NP Battery-WebCNP)

- Examiners at each site were initially trained and continue to undergo annual calibration with two team leaders
  - Devin Prouty, Ph.D. from SRI and Lindsay Squeglia, Ph.D. now at MUSC oversee test administration, data scoring, data entry, and data uploading to Redcap
  - Kevin Cummins, M.A. at UCSD installs programs and upgrades on all test computers at each site
  - Weiwei Chu, M.A. at SRI curates all Redcap data by conducting range and ID checking, identifying misclassified data, and finding missing data. She reports errors to sites for correction.
# Group Characteristics

**age = 12-21 years**

## No/Low Drinker

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<th>Male</th>
<th>Female</th>
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Creation of Neuropsychological Test Composite Scores

• **Data reduction**
  - Computerized tests yield **accuracy** and **speed** measures
  - Create composite scores reflecting 8 target functional domains

• **Test composite construction → 3-step process**
  - Standardize each measure on scores achieved by all no/low drinking male and female adolescents and express them as a Z-score, with a mean = 0 ± SD
  - Transform all scores (including reaction time) so that higher score reflect better performance
  - Calculate the mean Z-score of all measures that comprised a composite
Speed Composites

General Ability

Abstraction

Attention

Emotion

Episodic Memory

Working Memory

Motor Speed
Alcohol and Drug Use Criteria
No/low vs. Exceeds

Exceeds Criteria Group (N=139)

Max Drinks on One Day by Age and Sex

Age: 12-21 12-13 14-19 20-21
Drinks: ≤3 ≤3 ≤4 ≤5
Balance Accuracy

Delayed Discounting $1000 Condition

Accuracy: No/Low > Exceeds Drinkers

Adjusted Z-score

Age (years)

In k

short delay for $

long delay for $

Age (years)
Speed Composites: No/Low > Exceeds Drinkers

**Total Speed**

**General Ability**

**Attention**

**Emotion**

**Episodic Memory**

**Motor**

**Accuracy - Speed**
Neuropsychological Test Summary

• **No/low drinking group**
  – Age differences were greater in Accuracy composite scores (General Ability, Abstraction, Attention, Emotion, and Balance) than Speed scores.
  – Delay Discounting performance in younger boys and girls was consistent with poor impulse control

• **Exceeded-threshold group**
  – After accounting for age, sex, and other demographic factors, the exceeded-threshold group performed significantly below the no/low-drinking group:
    • Balance and response time (General Ability, Attention, Episodic Memory, Emotion, and Motor)
    – Speed-accuracy trade-off → Faster speed at the expense of accuracy
    – Delay Discounting performance was consistent with poor impulse control in exceed group regardless of age
    – Even where statistically significant, identified differences were modest.
Neuropsychological Test Summary

- Whether the performance differences between no/low-drinking adolescents and those who exceeded drinking thresholds are attributable to drinking or to other modulating factors requires the ongoing, longitudinal study of this NCANDA cohort.
Disclosures
Financial and Academic Interests

Fiona C. Baker, Ph.D.
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and
Brain Function Research Group, University of the Witwatersrand, South Africa

Salary and research support: NIAAA, NHLBI
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.
Consequences of poor sleep in adolescents

- Adolescents with sleep problems report more mood disturbances, inattention and memory problems, conduct disorders, and increased drug and alcohol use.
- Poor sleep quality and chronic insomnia predict alcohol use in adolescents.
- Shorter sleep duration predict alcohol-related problems.
- A tendency towards eveningness is associated with greater alcohol and other substance use.
- A larger weekday–weekend sleep difference is linked to increased risk-taking behaviors, substance use, and depressed mood.

NCANDA Sleep Behavior Metrics

**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

**Graph 1:**
- **X-axis:** Age (years)
- **Y-axis:** Time in bed (hours)
- Data points represent the time in bed for school nights (TIB_school) and non-school nights (TIB_noschool). A polynomial trend line (Poly. (TIB_school)) is also plotted.

**Graph 2:**
- **X-axis:** Time in bed on school nights (hours)
- **Y-axis:** Non-school night recovery (hours)
- Data points show the non-school night recovery, with a linear trend line indicating a decrease in recovery as time in bed increases.
Daytime Sleepiness

University of Pittsburgh and SRI International samples (Complete questionnaire)
Chronotype

Morningness Eveningness: Girls

Morningness Eveningness: Boys

R² = 0.0037

R² = 0.0522
Sleep Quality

- Very good: 58.4%
- Fairly good: 31.1%
- Fairly bad: 9.2%
- Very bad: 1.3%

University of Pittsburgh and SRI International samples (Complete questionnaire)
NCANADA Baseline Sleep EEG

Age-related differences in slow wave sleep (N3) and frontal EEG delta power
No/low Drinking vs Exceeded Threshold: Bedtime

Bedtime (24-hour)

Weekday

Weekend

No/low drinking
Exceeds threshold
No/low Drinking vs Exceeded Threshold: Wake-up time

- **Weekday**
  - No/low drinking: 07:00
  - Exceeds threshold: 09:00

- **Weekend**
  - No/low drinking: 08:00
  - Exceeds threshold: 10:00

*Note: The difference in wake-up times between No/low drinking and Exceeds threshold is statistically significant on the weekend.*
No/low Drinking vs Exceeded Threshold: Chronotype

Morningness score

- No/low drinking
- Exceeds threshold
Summary of baseline sleep behavior

• Cross-sectional results confirm findings of others showing that older adolescents have shorter time in bed and later bedtimes.

• Older adolescents are more likely to be evening-types, particularly evident in boys.

• Adolescents show high weekday-weekend variability in time in bed.
• Adolescents who exceed drinking thresholds have later bedtimes on both weekdays and weekends, and later wake-up times on weekdays than others.

• Adolescents who exceed drinking thresholds tend to have greater eveningness tendency and a poorer sleep quality.
With a longitudinal design, NCANDA will be able to evaluate the impact of sleep behavior on subsequent alcohol use in adolescents and how the transition to alcohol use impacts sleep behavior.

NCANDA will also longitudinally explore associations between neuropsychological performance, sleep behavior, and alcohol use in maturing adolescents.
Composites with Greatest PDS Sex Effects

Pubertal Development Scale (PDS)

Total Accuracy

General Ability Accuracy

Abstraction Accuracy