The Association Between Unstable Non-Rapid Eye Movement Sleep Duration and Cognitive Impairment Using Wearable Sleep Device

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Introduction

Background

- Unstable non-rapid eye movement sleep ($NREM_{US}$) is "ineffective sleep" that may not accomplish restorative functions of healthy sleep
  - Characterized by cyclic alternating pattern (CAP), unstable respiration, cyclic variation in heart rate, non-dipping blood pressure, and low relative delta power[1]

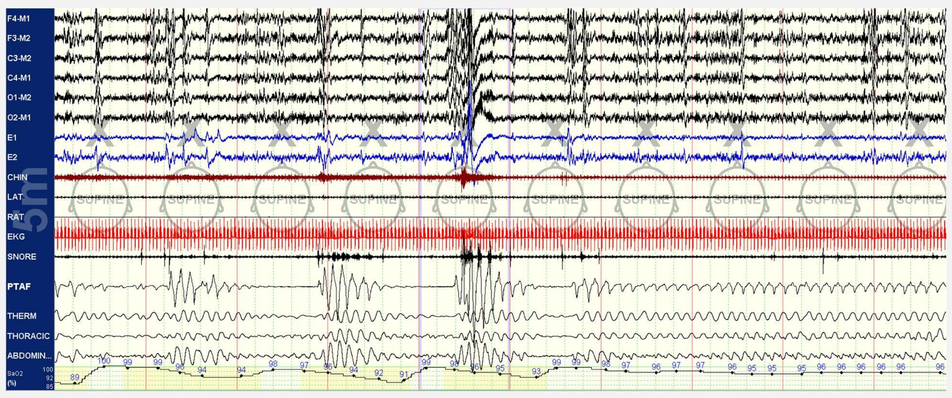

Figure 1. EEG showing $NREM_{US}$ then switching to stable NREM sleep[1]

- Irregularity in characteristics of NREM sleep involved in memory consolidation and learning (slow wave theta and sigma activity, sleep spindles) may be early biomarkers for cognitive decline in older adults[2]

Goal

- Examine the association between unstable NREM sleep and cognitive impairment, using a wearable sleep device as a potential method for early detection

Hypothesis

- Increased $NREM_{US}$ duration may be associated with cognitive impairment as the body does not spend as much time in effective, restorative sleep

Methods

<u>Participants</u>: n=112 (6 cognitively impaired)

- Recruited from the Boston University Alzheimer's Disease Research Center (BU ADRC) Clinical Core

<u>Analyses</u>: Multivariable Logistic Regression

- Adjusted for sex and age
- Analysis done with data from first night only

<u>Predictor variable</u>: $NREM_{US}$ duration

- Participants wore the SleepImage ring measuring heart rate and oxygen

Figure 2. SleepImage Ring[3]

<u>Outcome variable:</u> Cognitive Impairment

- Clinical measures of cognitive ability determined by consensus review with neuropsychologists and neurologists

Results

- **No association found between $NREM_{US}$ duration and cognitive impairment** (OR = 1, 95% CI [1, 1], p = 0.2973)

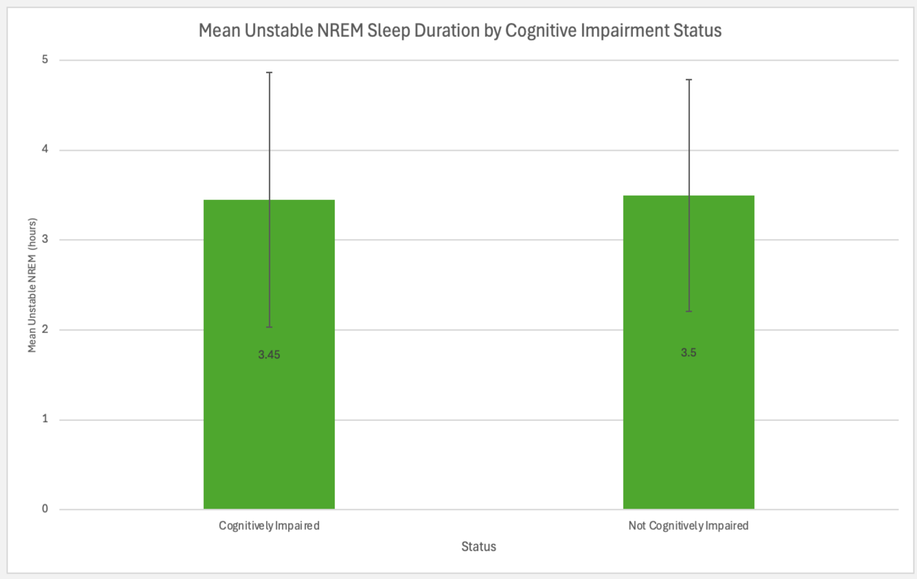

Figure 3. The figure shows that the mean unstable NREM sleep are very similar between cognitively and non-cognitively impaired participants.

Demographics Table

Variable	Not Cognitively Impaired N = 106	Cognitively Impaired N = 6	All N = 112
Age, m (sd)	72.77 (9.21)	65.33 (9.61)	72.38 (9.34)
Sex, N (%)			
Male	47 (44.34)	1 (16.67)	48 (42.86)
Female	59 (55.66)	5 (83.33)	64 (57.14)
Education in years, m (sd)	17.10 (2.08)	16.33 (1.51)	17.063 (2.06)
Unstable NREM sleep duration in hours, m (sd)	3.45 (1.42)	3.50 (1.30)	3.45 (1.41)
Sleep duration in hours, m (sd)	7.13 (2.20)	7.64 (0.95)	7.15 (2.15)

Conclusion

Discussion

- **No statistically significant association** between $NREM_{US}$ duration and cognitive impairment (OR = 1, 95% CI [1, 1], p = 0.2973)

Limitations

- Limited sample and case size
- Cross-sectional study, long term sleep patterns not accounted for
- Data prone to human error with elderly participants potentially wearing sleep device incorrectly, especially within cognitively impaired population

Future Directions

- Collect and examine longitudinal data with a larger group of participants using the SleepImage ring
- Continue exploring specific characteristics of $NREM_{US}$ and NREM sleep and their association with cognitive impairment

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References