



# The Effect of Sleep on Cognition in Aging Adults

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## Introduction

- Executive functioning (EF) and episodic memory (EM) are measures of cognitive function that are used to learn, work, and manage daily life. These measures change based on both age and sleep quality.<sup>1-4, 7-10</sup>
- Sleep quality has been linked to negative cognitive effects in middle-aged and older adults,<sup>2,4,5,7</sup> including decreased synaptic plasticity<sup>2</sup> and white matter.<sup>5,7</sup>
- There is relatively little evidence that sleep has a significant impact on cognition in younger adults.<sup>1, 6-8</sup>
- Both sleep and age are associated with cognitive function, however their potential interactive effects on cognition are not understood.<sup>1-5,7,12</sup>

### Hypotheses

- We predict that worse sleep quality and older age will negatively impact memory and executive functioning.
- We also predict that the effect of sleep quality on cognition may depend on age, such that poor sleep quality will only negatively impact cognition for older adults.

## Methods

### Sample

- All variables and data were collected using the Midlife in the United States (MIDUS), a longitudinal study of U.S. middle-aged and older adults. This study utilized data from MIDUS Wave 2 Biomarker Project 4 (2006-2009), with N=1,255.

### Measures

- **Covariates** included self-reported sex, household income, number of chronic conditions, and education.
  - Sex: 1=male 2=female
  - Number of chronic conditions: re-coded from 0-30 to 0-8+ to adjust skewness from outliers
  - Household income from wages: numeric scale 0-200,000
  - Highest level of education: 0 (no school/some grade school) to 12 (Ph.D., JD, other professional degree)
- **Sleep quality** was measured subjectively, participants ranked their sleep on a scale of 0-3, with 3 being the worst.
- **Age** was collected over the phone during initial interviews with participants, ranging from 35-84 years old at MIDUS 2.
- **Executive Functioning (EF)** was the Z-score of the the Brief Test of Adult Cognition by Telephone (BTACT), including the Backward Digit Span, Category Verbal Frequency, Stop and Go Task, immediate and delayed Word List Recall.
- **Episodic Memory (EM)** was the Z-score of the Brief Test of Adult Cognition by Telephone (BTACT), including the Backward Digit Span, Category Verbal Frequency, Stop and Go Task, immediate and delayed Word List Recall.

### Analyses

- Sex, number of chronic conditions, education, and income were included as covariates.
- We used a hierarchical linear regression with an interaction term to determine relationship between age and cognition while controlling for covariates.

## Results

### Demographic Characteristics

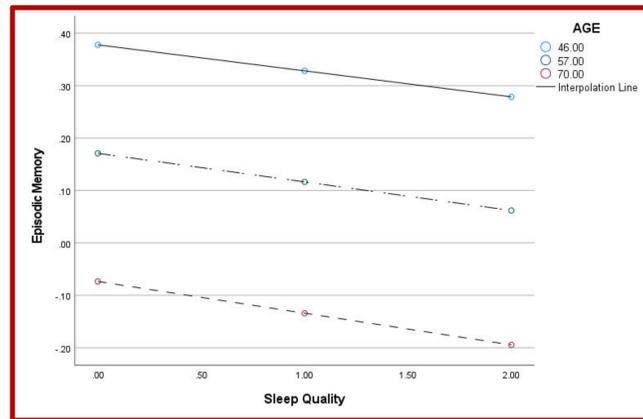
- Sex: 48.3% female 51.7% male
- Number of chronic conditions:  $M=3.14$ ,  $SD=2.041$
- Income from wages:  $M=53,458.19$ ,  $SD=53,629.285$
- Highest level of education:  $M=7.03$  (3 or more years of college, no degree yet),  $SD=2.537$
- Age:  $M=50.49$ ,  $SD=24.039$
- Sleep Quality:  $M=1.01$ (fairly good),  $SD=.704$

### Direct Effects

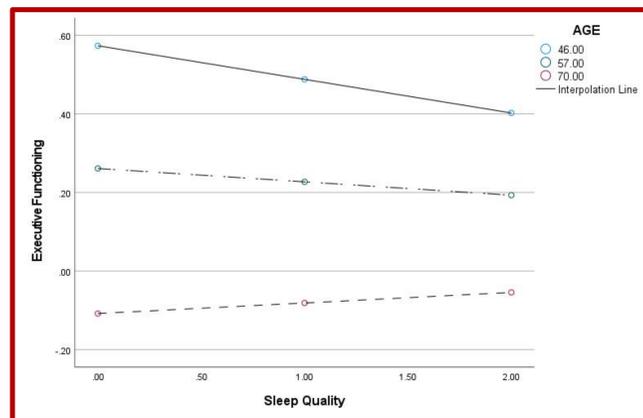
- Age was negatively associated with EF ( $B=-.309$ ,  $p<0.001$ ) and EM ( $B=-.251$ ,  $p<0.001$ ) after controlling for income, sex, education, and number of chronic conditions.
- Sleep was not directly associated with EF ( $B=.035$ ,  $p=.318$ ) or EM ( $B=.016$ ,  $p=.649$ ) after controlling for covariates.

### Moderation Effects

- Figures 1 and 2 demonstrate that the age-sleep interaction was not associated with EF ( $B=.033$ ,  $p=.299$ ) or EM after controlling for covariates ( $B=.005$ ,  $p=.865$ ).
- Figure 2 reveals that when age was categorized into younger, middle-aged, and older there was a statistical trend for sleep quality to have a greater impact on EF for younger adults, but not older adults.



**Figure 1**  
Episodic Memory vs. Sleep Quality based on Age Groups



**Figure 2**  
Executive Functioning vs. Sleep Quality based on Age Groups

## Conclusions

- As expected, older age was significantly associated with poorer performance on measures of EF and EM; however, contrary to our predictions, sleep was not associated with either cognitive domain.
- Further, we found no interaction between age and sleep on either cognitive domain, although there was a trend for poorer sleep quality to have a more significant impact on EF in younger individuals in the sample.
- These findings were surprising given that previous studies have found that both subjective and objective measures of sleep quality and duration are negatively associated with cognition in middle-aged and older adults, but not on the cognition of young adults.<sup>1,2,4,5,6-8</sup>
- One possible reason for our discrepant findings is the inclusion of multiple important covariates. This study accounted for sex, chronic conditions, education, and income. Thus, relatively small effects of sleep on EF and EM may be better accounted for by these factors.
- As evidenced by our findings, older adults had overall worse EF and EM performance. It is possible that, given the higher performance of younger adults, variation and negative effects of sleep are more easily detected.

### Limitations and Future Directions

- Sleep quality was assessed using self-report. Future studies should determine if objective measures of sleep are consistent with these subjective measures.
- Participants were relatively healthy, which may have prevented detection of a true effect. A sample with diverse cognitive baselines should be studied to determine if there is a true effect of sleep quality on cognition can be found.
- Further studies should explore the relationship between sleep quality, and EF of participants 18-35 years to determine if the relationship becomes significant.

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