# The Effect of Sleep Quality on aMCI Vulnerable Brain Regions in Cognitively Normal Elderly Individuals

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# Introduction

❖ Poor sleep quality = risk factor for the development of amnestic mild cognitive impairment (aMCI) and Alzheimer's Disease (AD)

❖ aMCI is accompanied by a characteristic pattern of bilateral brain atrophy involving the hippocampi, amygdala, posterior cingulate, and superior parietal cortex[1]

❖ Sleep quality-related atrophy has been shown to be cortically diffuse[2], but has never been evaluated in the context of aMCI, in cognitively normal subjects.

1.  Nickl-Jockschat T, et al.  Neuroanatomic changes and their association with cognitive decline in mild cognitive impairment: a meta-analysis. Brain Struct Funct. 2012;217(1):115–125.
2.  Lim AS, et al.  Regional neocortical gray matter structure and sleep fragmentation in older adults. Sleep.  2016;39(1):227–235.

# Methods

**74 Subjects (23 male, 51 female)**

- Cognitive Testing
- Geriatric Depression Scale (GDS) administered

**5 subjects excluded (GDS > 9)**

**69 Subjects (20 male, 49 female)**

- Pittsburgh Sleep Quality Index (PSQI) Administered

**31 Normal sleepers (PSQI<5)**

**38 Poor sleepers (PSQI≥5)**

**Structural MRI and Freesurfer brain parcellation used to measure aMCI-related regions**

## Objective:

to determine how sleep quality-impacts aMCI vulnerable regions in cognitively normal elderly individuals..

**Or**

**Are cognitively normal individuals effected by poor sleep quality ?**
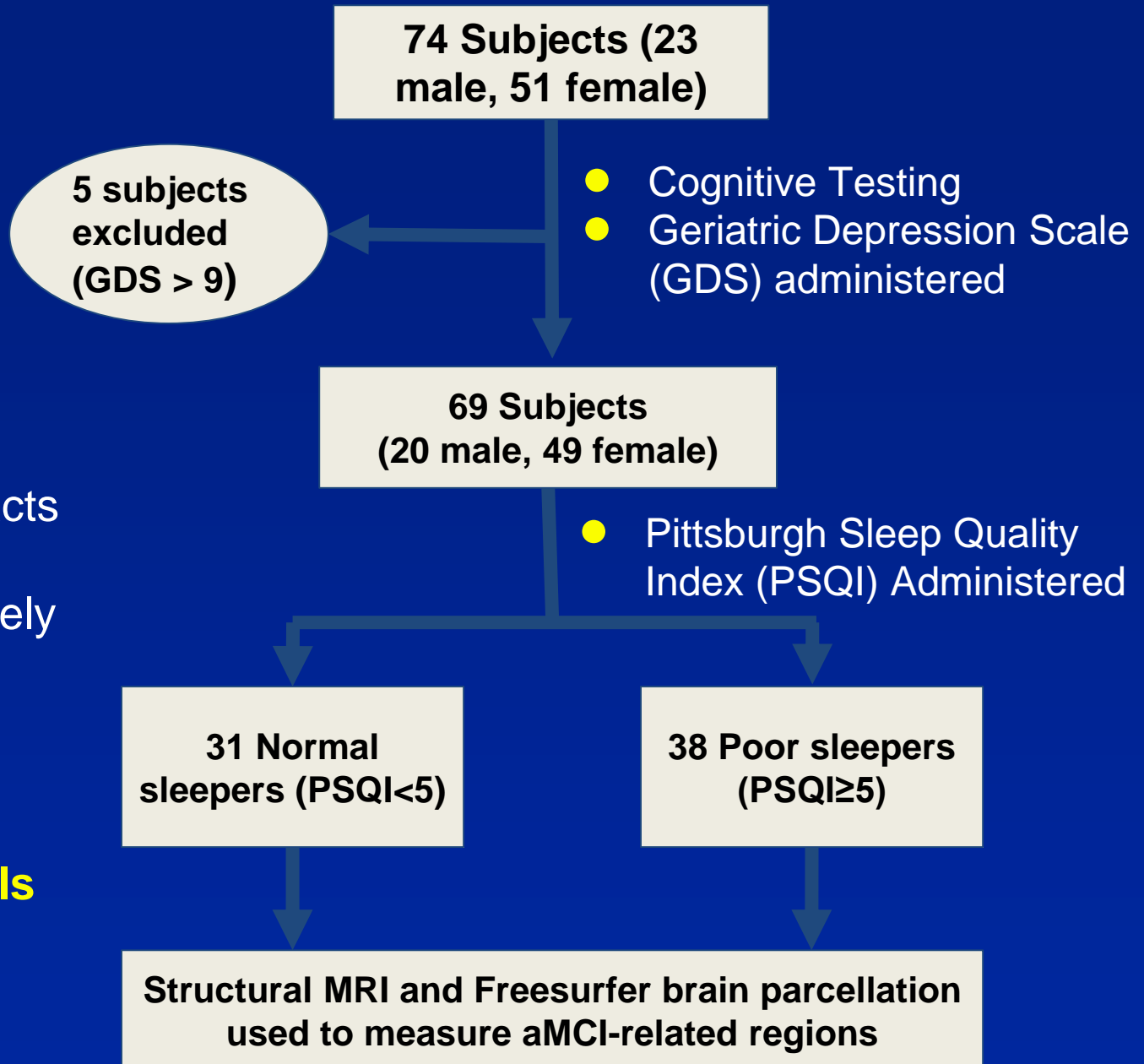
# The Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions. During the past month,

1. When have you usually gone to bed? _____

2. How long (in minutes) has it taken you to fall asleep each night? _____

3. When have you usually gotten up in the morning? _____

4. How many hours of actual sleep do you get at night? (This may be different than the number of hours you spend in bed) _____

| 5. During the past month, how often have you had trouble sleeping because you… | Not during the past month (0) | Less than once a week (1) | Once or twice a week (2) | Three or more times week (3) |
|---|---|---|---|---|
| a. Cannot get to sleep within 30 minutes | | | | |
| b. Wake up in the middle of the night or early morning | | | | |
| c. Have to get up to use the bathroom | | | | |
| d. Cannot breathe comfortably | | | | |
| e. Cough or snore loudly | | | | |
| f. Feel too cold | | | | |
| g. Feel too hot | | | | |
| h. Have bad dreams | | | | |
| i. Have pain | | | | |
| j. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s): | | | | |
| 6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep? | | | | |
| 7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity? | | | | |
| 8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done? | | | | |
| | Very good (0) | Fairly good (1) | Fairly bad (2) | Very bad (3) |
| 9. During the past month, how would you rate your sleep quality overall? | | | | |

# Results
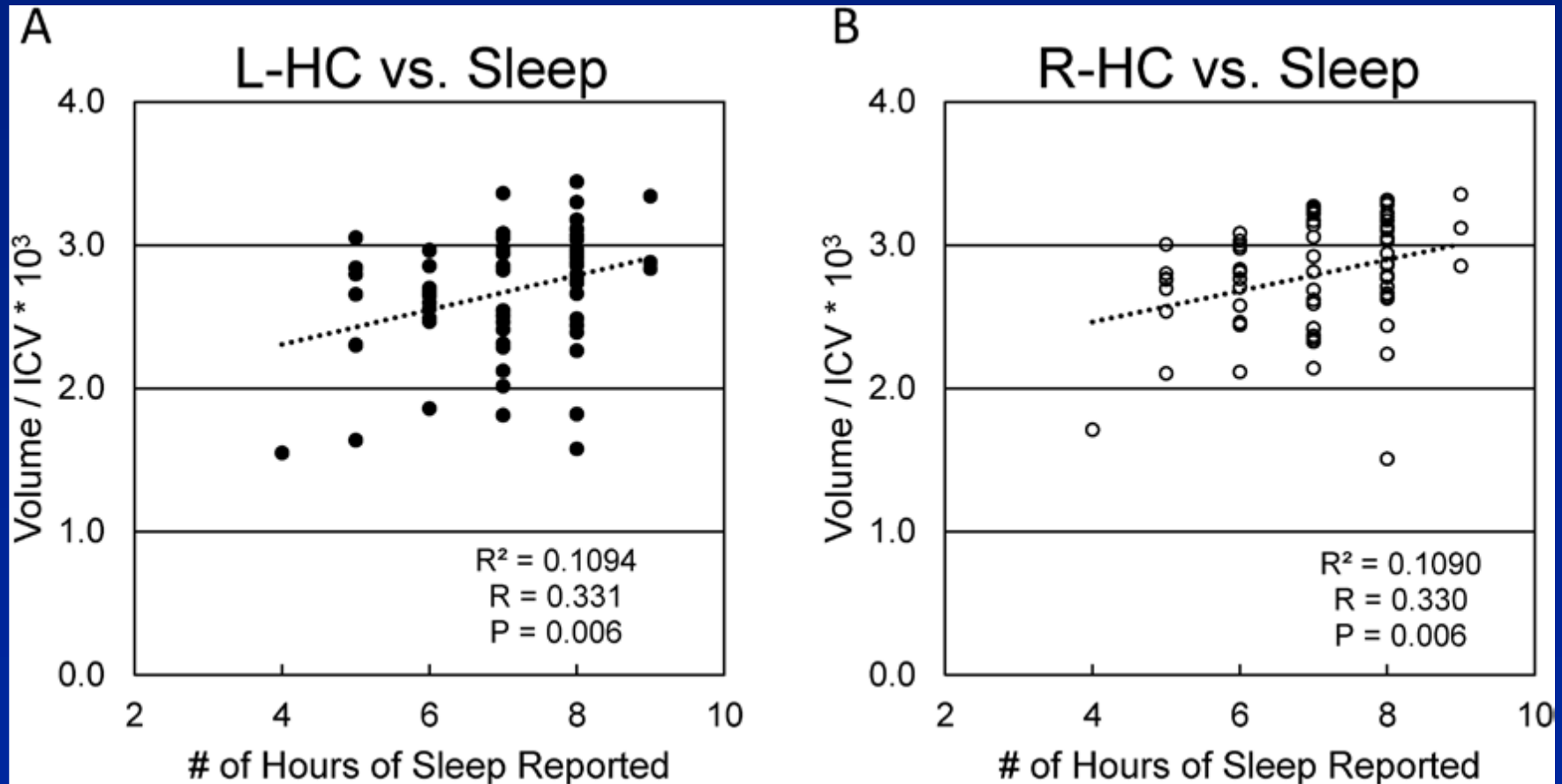## Cortical volume analysis
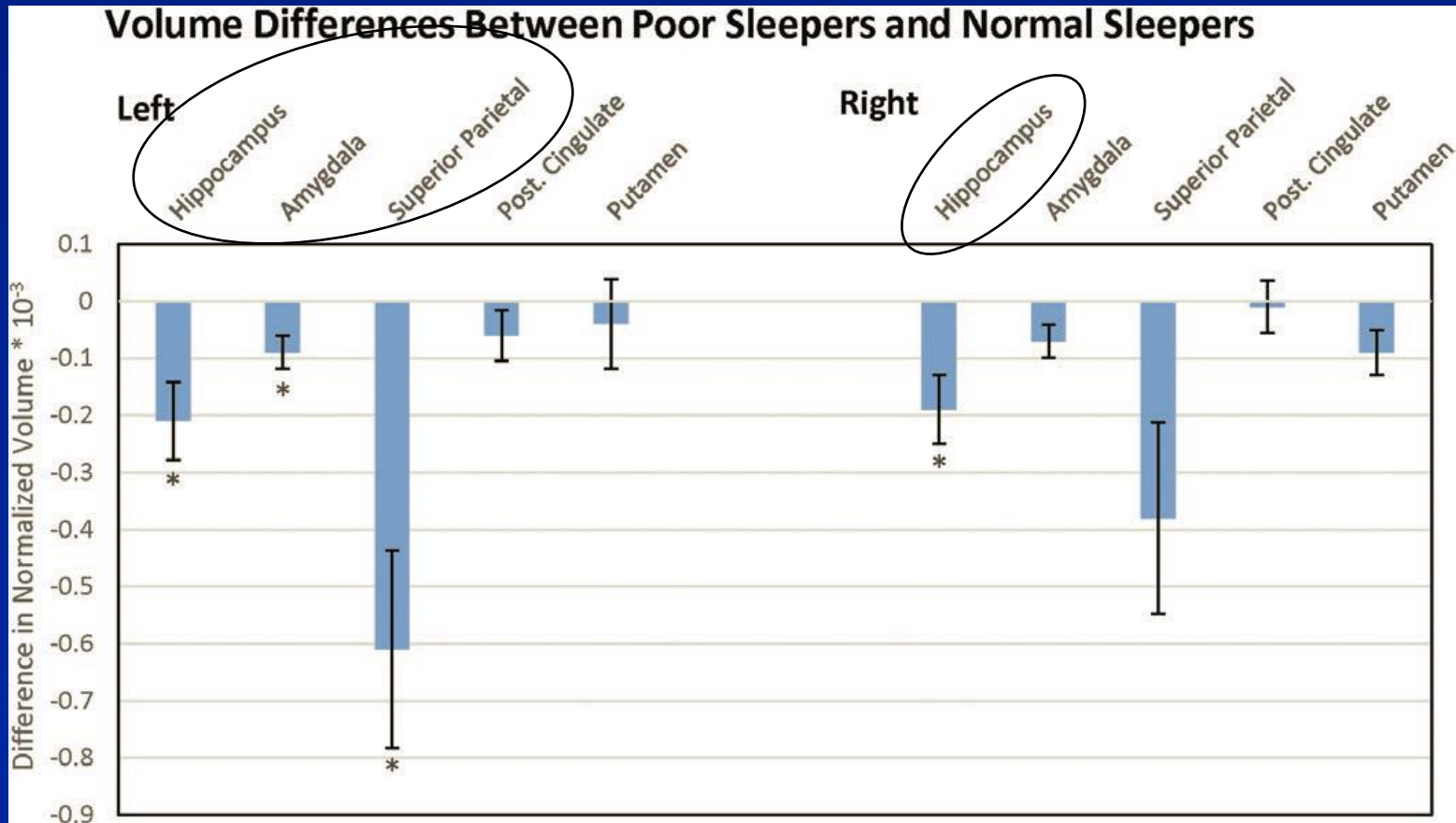
# Results
## Cortical thickness analysis
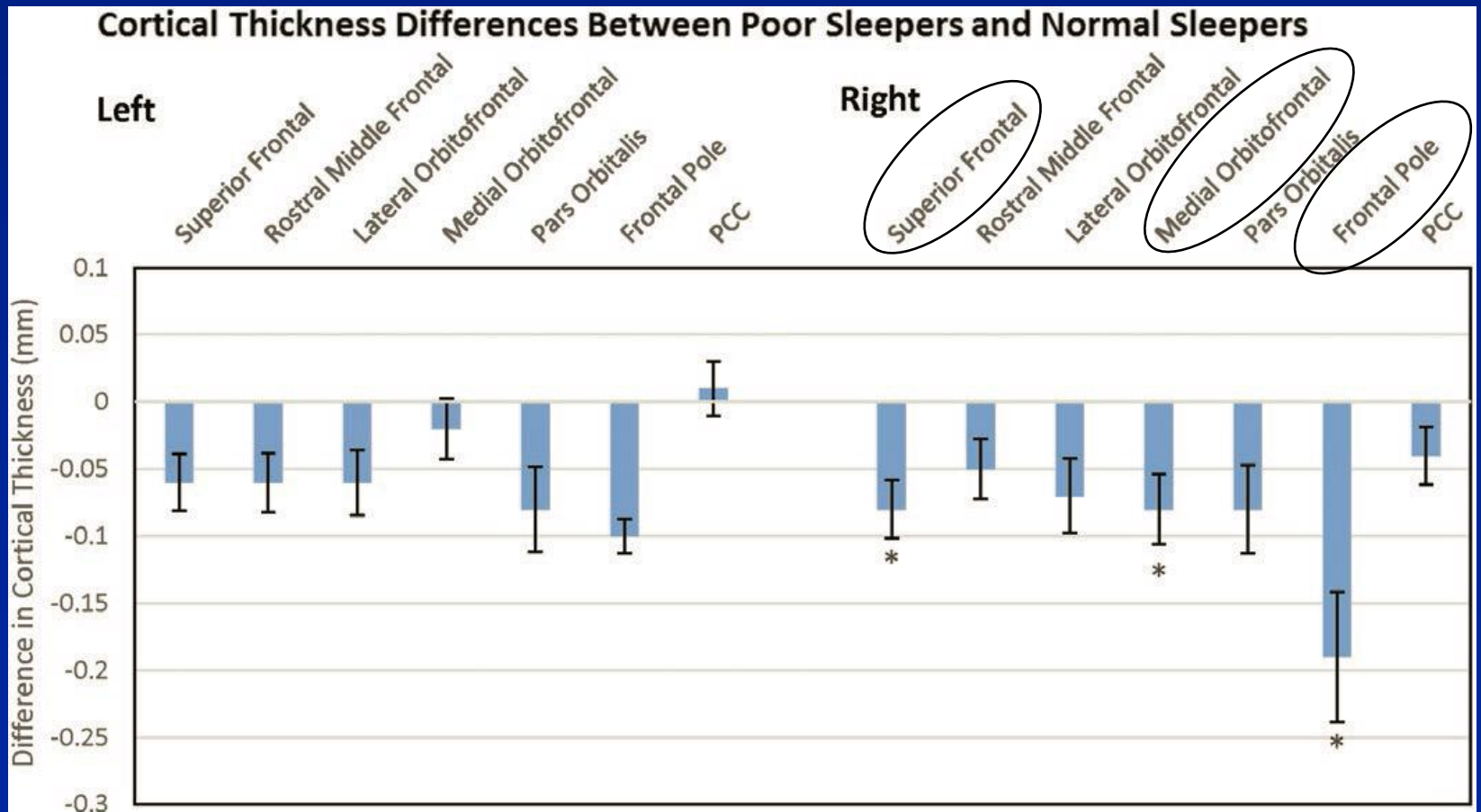
# Results
## Effect of sleep duration on hippocampal volume

# Results
## Additional observations

- Increased incidence of nocturnal awakenings are correlated with bilateral decreases in <u>hippocampal volume</u>

- increased daytime sleepiness is correlated with atrophy of the <u>left lateral orbitofrontal cortex</u>

- Sleep latency, difficulties in breathing during sleep, and snoring did not correlate significantly with any of the ROIs analyzed.

(i.e., when we snore we still sleep, but we may negatively effect the sleep quality of a nearby sleeper)

# Limitations

✓ Measures of sleep quality are subjective

✓ Subjects were not assessed for a diagnosis of insomnia and/or sleep apnea

# Potential mechanism

Shorter sleep duration has been previously tied to higher cortical amyloid burden. Thus, sleep has been proposed as a mechanism for β amyloid clearance

The observed relationship between sleep duration and brain volumes supports a role for sleep in modulating aMCI susceptible brain regions.

# Why removal of toxins from the brain is faster in Supine?



Mean and SD of Main Hemodynamic and Hydrodynamic Parameters Measured in Supine and Upright Postures*

|  | Supine (Mean ± SD) | Upright (Mean ± SD) |
|---|---|---|
| tCBF (mL/minute) | 825 ± 166 | 724 ± 127 |
| Venous flow in IJVs (mL/minute) | 614 ± 143 | 304 ± 261 |
| Venous pulsatility index | 0.61 ± 0.15 | 0.35 ± 0.10 |
| Osc. CSF volume (mL) | 0.55 ± 0.12 | 0.23 ± 0.11 |
| Max. ICVC (mL) | 0.48 ± 0.15 | 0.89 ± 0.44 |
| Intracranial compliance index | 7.3 ± 2.6 | 20.2 ± 10.7 |
| MR-ICP (mmHg) (skull base) | 10.6 ± 3.6 | 4.5 ± 1.82 |
| MR-ICP (mmHg) (ventricles level) |  | - 3.2 +/- 1.9 |

*All differences are statically significant with a *P* value of 0.002 or smaller.

Higher CSF stroke volume better mixing of toxins in the CSF