

# WHAT EFFECTS DOES SLEEP DEPRIVATION HAVE ON MEMORY IN STUDENTS?



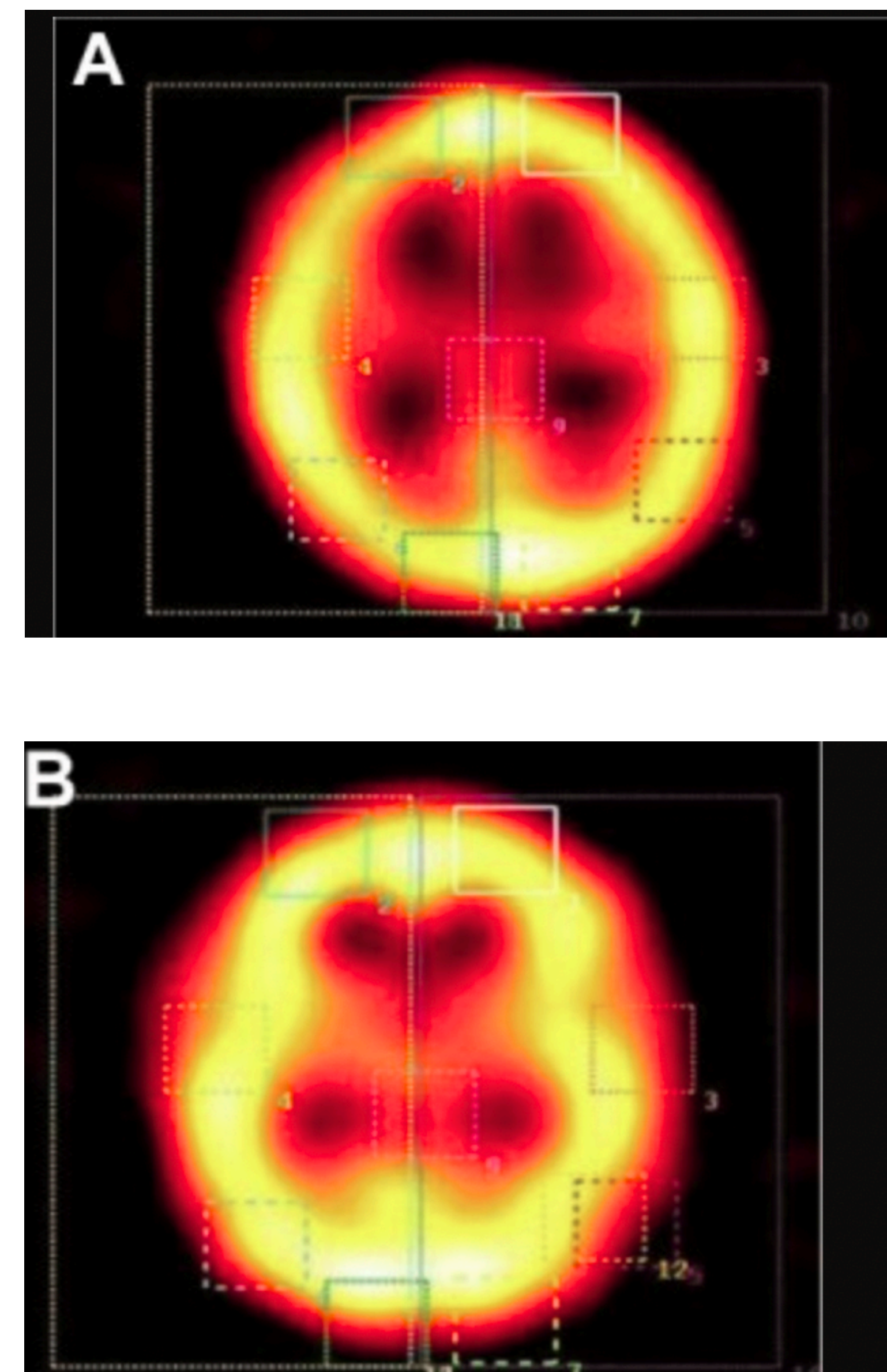
## INTRODUCTION

Recently, pressure has been mounting on students to meet tight deadlines with busy schedules both inside and outside of school, while fulfilling academic expectations by maintaining good grades. This pressure not only manifests in unhealthy stress levels from a young age, but most importantly, sleep deprivation in growing bodies (Zhou et al. 2022). Even though the aftermath of sleep deprivation may present immediate symptoms of exhaustion, what effects could it have beneath the surface? We are now exploring the relationship between sleep and memory to analyze our question in depth: does sleep deprivation impair memory and cognitive function in students, and to what degree?

## METHODOLOGY

Data was extracted from a psycho-neuroradiological study by Tantawy et al. in 2013. The study involved 40 male students aged 16 to 19, who were then divided into four groups: normal sleep, total sleep deprivation, early night sleep deprivation (no sleep from 11 PM-3 AM), and late night sleep deprivation (no sleep from 3 AM-7 AM). Each group was then tasked to complete a word pair association, where they learned and recalled words (Tantawy et al. 2013).

The numerical data from this study were graphed to compare how each sleep condition affected memory performance. In Figure 1, we graphed the mean of correctly recalled word pairs in each group to visualize the relationship between sleep and a word pair recall test that assessed memory. Figure 2 was produced based on the scores each group achieved in two separate testing sessions. Utilizing the scores of each group, a clustered column chart was constructed to analyze the performance for both recall attempts.



**Figure 3:** Comparison between baseline (A) and post-retrieval (B) activation of the brain region in a subject after total sleep deprivation.

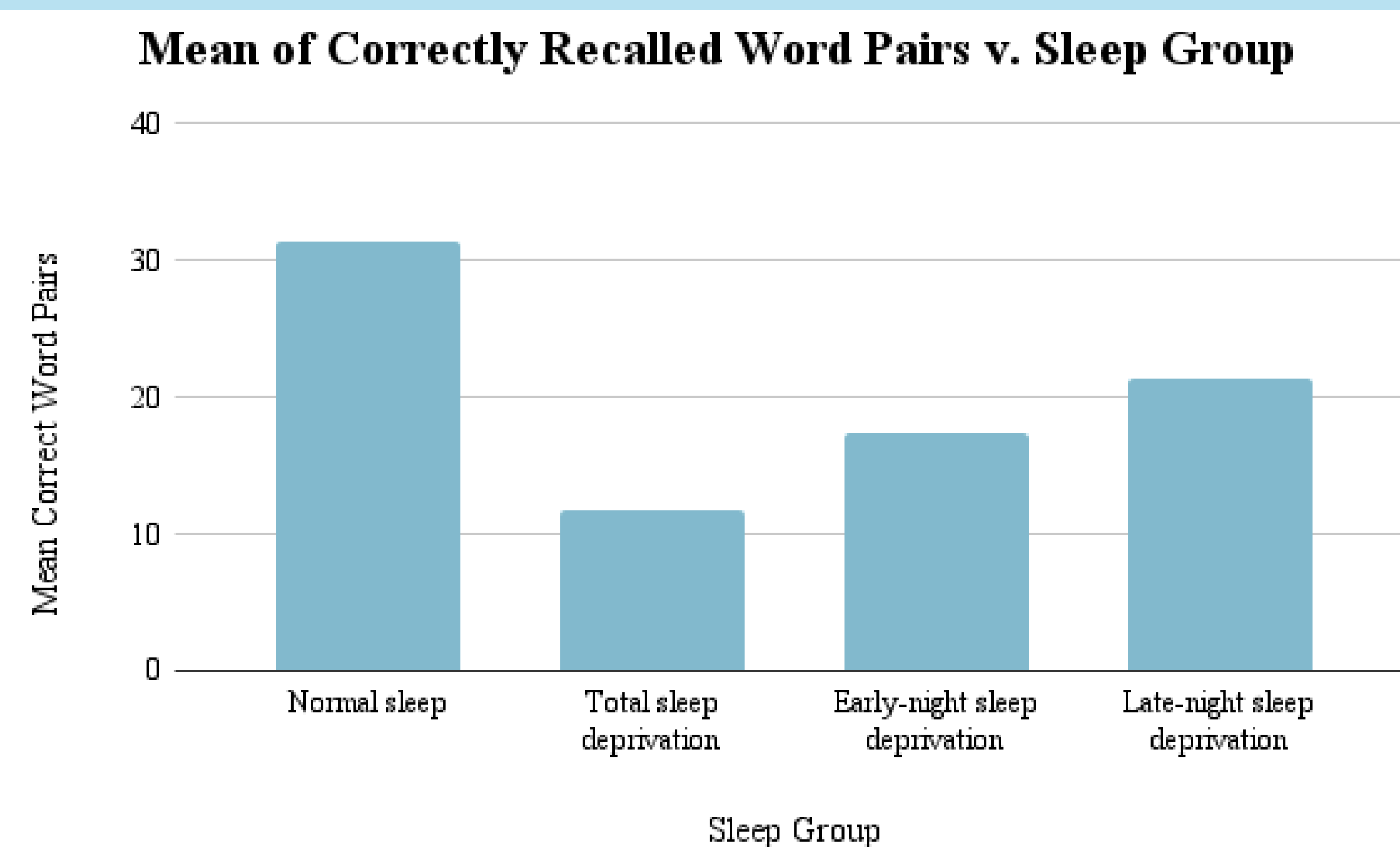
## ANALYSIS

Most results align with our hypothesis, with students who slept normally significantly outperforming sleep-deprived students in memory tests. Based on Figure 1, the normal sleep group averaged the highest score of 31.35, with all types of sleep deprivation following behind, the lowest being the total group averaging a score of 11.8. Figure 2 partially supports the same trend; while normal sleep has the highest combined score from both tests, the scores on recall test 2 for the total and late-night groups both come close to normal sleep. Surprisingly, the late-night group scored 35 on recall test 2, equivalent to normal sleep's score, with the total group following behind at 34. This could be a contradiction to this study's original hypothesis, aligning with multiple previous studies concluding that less sleep had little to no effect on declarative memory consolidation (Gais et al. 2006). However, this could also be an indicator of outside factors, such as a learning curve that appeared on the second test (Tantawy et al. 2013).

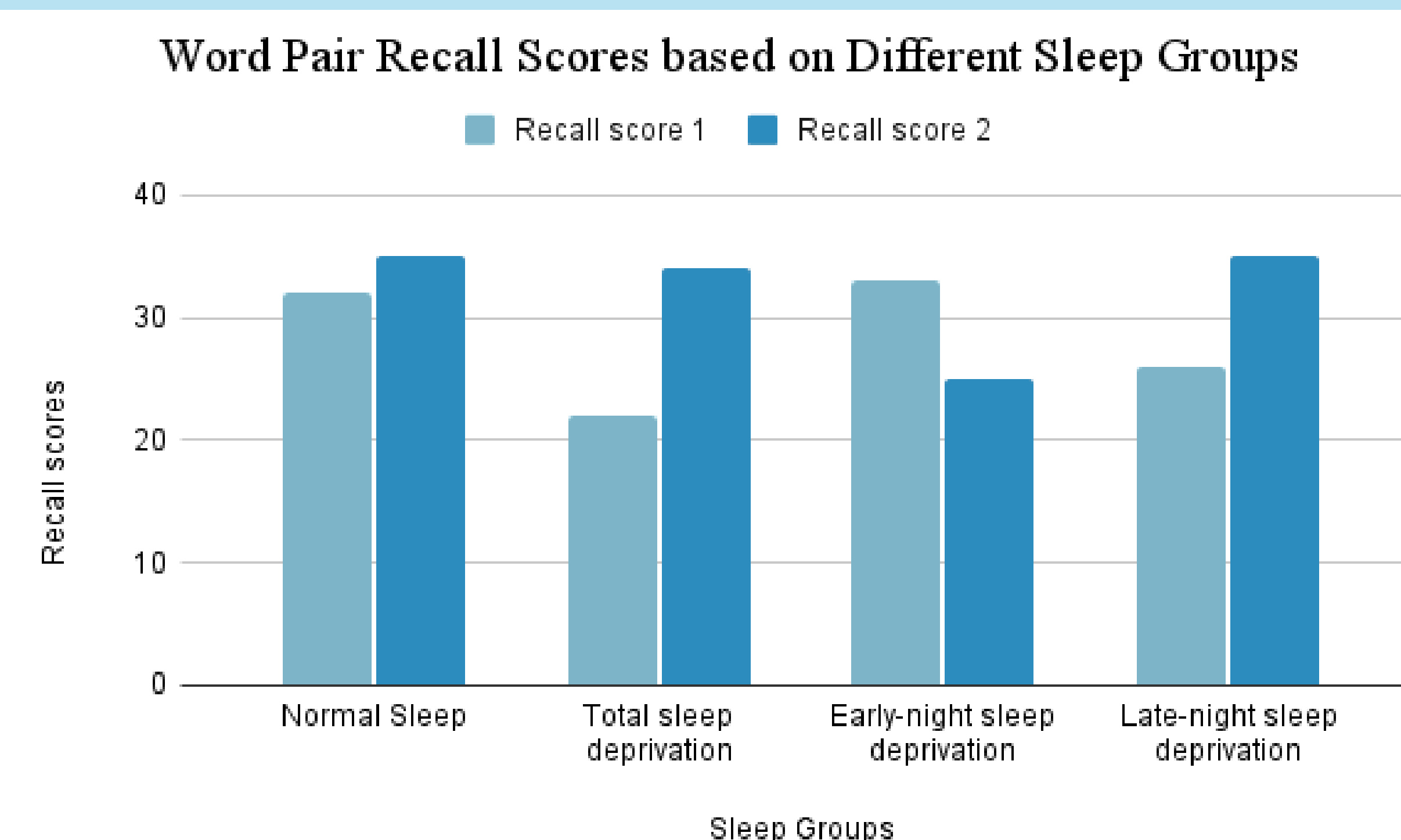
A SPECT imaging was also conducted before and after the recall test to examine how sleep deprivation affects the brain at the neural level. As shown in Figure 3, students who maintained normal sleep displayed higher levels of activity in the thalamus and also in some parts of the temporal lobes, which are known to support memory retrieval. Meanwhile, the neuroimaging for the students with sleep deprivation showed less engagement with regions responsible for memory performance (Tantawy et al. 2013).

While there are strong indicators that sleep deprivation can be detrimental to memory in this study, further research is needed to observe actual impacts on students' lives in the form of not only academics, but also in daily activities such as extracurriculars and driving.

## RESULTS



**Figure 1:** The average number of correctly recalled word pairs for each sleep group.



**Figure 2:** Word Pair Recall Scores from two testing sessions across four sleep groups.

## SOURCES

- Tantawy, Ahmed O, Hamdy N El Tallawy, Hussein RS Farghaly, Wafaa M Farghaly, and Amr S Hussein. 2013. "Impact of Nocturnal Sleep Deprivation on Declarative Memory Retrieval in Students at an Orphanage: A Psychoneuroradiological Study." *Neuropsychiatric Disease and Treatment* 9: 403-8. doi:10.2147/NDT.S38905.
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- Zhou J, Qu J, Ji S, Bu Y, Hu Y, Sun H, Xue M, Zhou T, Qu J, Liu Y. "Research trends in college students' sleep from 2012 to 2021: A bibliometric analysis." 2022. *Frontiers in Psychiatry* 13. doi: 10.3389/fpsy.2022.1005459.