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# The Longitudinal Effects of Sleep Quality on Executive Function

Oscar Kronenberger, Cali Caughie, & Stuart Hall

## Introduction

- Executive functions are essential in daily life. Although it is normal for there to be some degree of decline in cognitive functions over our adult lifetimes, studies have shown that cognitive function can also be affected by lifestyle factors which can either delay or speed up cognitive decline (Fillit et al., 2002; Williams & Kemper, 2010).
- Poor sleep is one lifestyle factor that is known to be associated with a variety of negative cognitive and health outcomes. Despite a high prevalence of poor sleep quality today (Center for Disease Control and Prevention, 2018; Hinz et al., 2017), our understanding of how sleep quality affects cognition over time is limited.
- The current study thus sought to investigate the question: **what is the longitudinal relationship between sleep quality and executive function?**

## Participants and Methods

- Data from Waves 2 and 3 of the Midlife Development in the United States (MIDUS) research project, an ongoing longitudinal study on health and well-being in mid-life adults, was used.
- During Wave 2, 881 participants were administered the Pittsburgh Sleep Quality Index (PSQI) as a measure of global sleep quality and performed the Stop and Go Task (SGT), which measures executive function.
- Nine years later, during Wave 3, these 881 participants were again administered the SGT.
- Executive function decline was assessed as the change in task performance on SGT from Wave 2 to Wave 3.

**Table 1.** Participant Characteristics

Characteristics	Sample
Age: m (SD) range	64 (11) 42-94
Gender: n (%)	Female: 58 Male: 42
Ethnicity: n (%)	White: 96.3 Non-white: 3.7

## Results

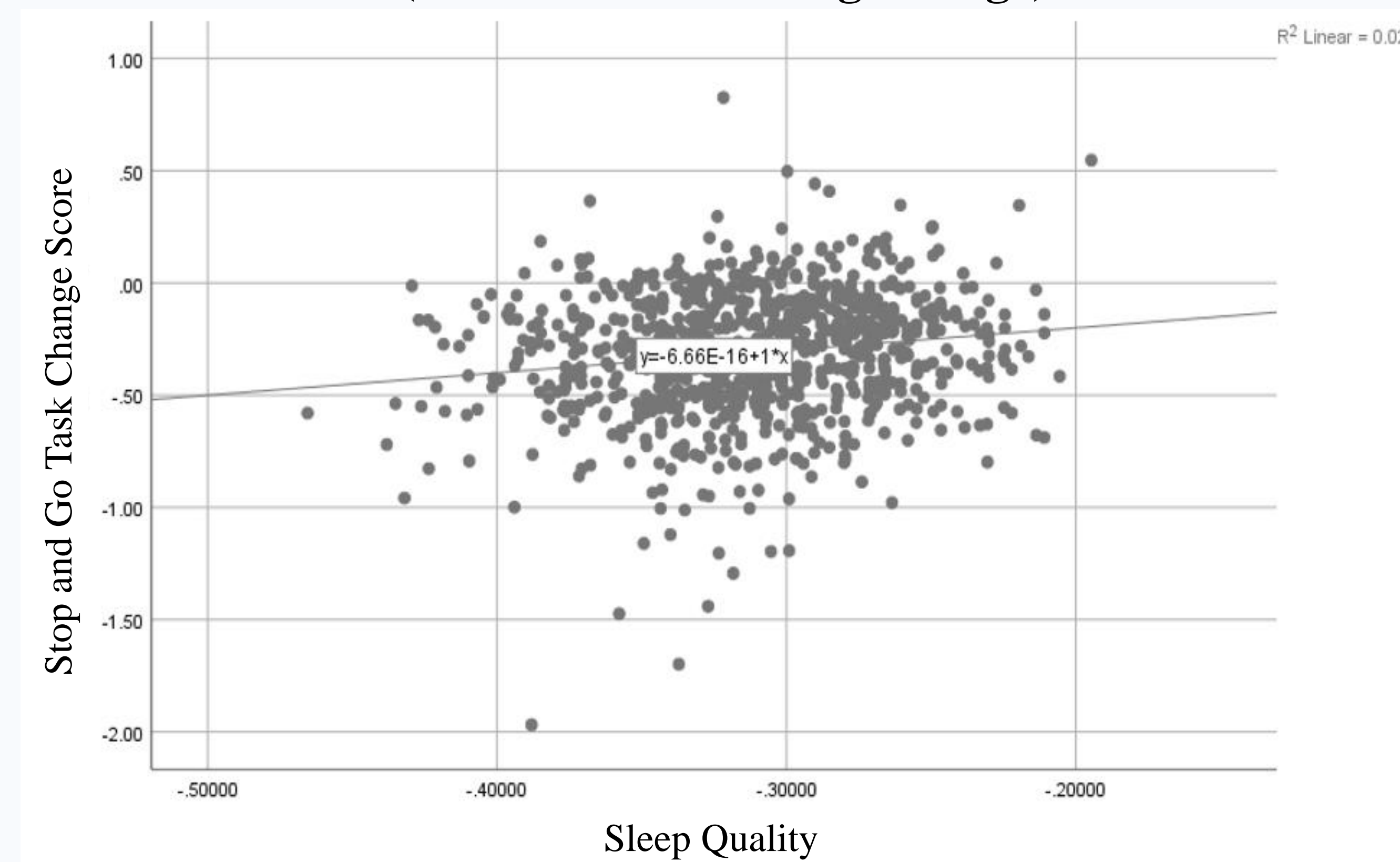
- A main effect of global sleep quality on decline in executive function, when controlling for age, was supported ( $F(2,878)=10.868, p<.001$ ).
- Specifically, **lower sleep quality was significantly predictive of longitudinal executive function decline.**

**Table 2.** Regression Analysis of Sleep Quality on Executive Function Decline

Variable	Block 1 (b, SE, $\beta$ )	Block 2 (b, SE, $\beta$ )	R ( $\Delta R^2$ )
Age	0.003 (0.001) 0.115**	0.002 (0.001) 0.106**	0.013 (0.013**)
Sleep Quality		-0.018 (0.005) -0.125**	0.024 (0.011**)

$p<0.05^*$ ,  $p<0.01^{**}$

**Sleep Quality as a Predictor of Executive Function Decline (Block 2 - Accounting for Age)**



## References

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## Discussion

Over time, it is normal and expected that we experience cognitive changes. However, it is of great interest that we investigate which factors may be predictive of change of cognitive function. The current study provides evidence that sleep quality is longitudinally predictive of executive function decline. This finding is significant as it highlights a potential variable for intervention that could help us better preserve executive function over time.

These findings suggest a need for action given the high prevalence of sleep disorders documented by the CDC. Societal pressures and psychiatric complications make high quality sleep difficult to obtain for many individuals. Nonetheless, effective evidenced-based treatments are available. Both behavioral treatments such as Cognitive Behavioral Therapy (CBT), stimulus control therapy, relaxation therapy, and sleep compression therapy as well as a variety of pharmacological treatments have evidence supporting their efficacy for treating insomnia and other sleep disorders (Finucane, 2009).

A limitation of the current study is that only two collections of data were assessed. This limits the evidence for inferring causality and longer-term effects. In addition, the Stop and Go task was the only measure of executive function. The SGT is generally considered to specifically measure inhibition, one facet of executive function, so it remains to be seen if these results are generalizable to other measures of executive function.

Future studies should carry out longer-term longitudinal analysis with more data collection intervals and include other measures of executive function. Further, evidenced based interventions that seek to improve sleep quality should also measure change in executive function longitudinally in order to determine if they are effective at helping to preserve executive function.

## Conclusion

- Over a nine-year period, global sleep quality significantly predicted decline in executive function in middle aged adults.
- These findings provide insight into how a potentially modifiable lifestyle factor — sleep quality — may predict longitudinal cognitive decline.
- Evidenced based interventions that seek to improve sleep quality may help to preserve cognitive function as we age.