

The Effects of Stress and Shorter Sleep Duration on Concentrations of Proinflammatory Neuroinflammatory Molecules IL-6 and CRP in Circulation

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Abstract

The influence of sleep on the immune and nervous system is very complex, where different forms of stress can elicit stress-induced sleep disturbances. With continued disturbance of sleep architecture, this also disrupts overall sleep continuity. Obstruction of sleep continuity can consequently induce increases in the release of proinflammatory cytokines and thus impact the immune system's baseline neuroinflammatory response.

The Pearson correlation coefficient in SPSS Pearson Correlation table stands for the strength of the correlation between two variables. We generated the bivariate correlation model between overall stress level and sleep hours, and between sleep hours and inflammation level. Linear regression models and strength of correlation analysis revealed that correlation between stress and sleep from our participant data was not significant. In the context of IL-6 and CRP, neither inflammatory molecule was found to significantly correlate with shorter durations of sleep from participants in our collected sample. However, drawbacks from this study include a small, and not representative sample, and only measuring two specific cytokines, as there may be others also involved in sleep and inflammation. Overall, our study displays that future research is necessary and that a larger sample size would be necessary to have definitive support or lack of support for our hypothesis.

Introduction

The National Institute of Health suggests that adults should be receiving at least 7 to 8 hours of sleep a day to be well rested and perform at their best (*NIH Offers New Comprehensive Guide to Healthy Sleep*, 2015). Sleep plays a vital role in both physical and mental functioning. Stress can induce sleep deprivation due to the body being in a heightened state of alertness and thus unable to fall asleep (Morates, 2019). The stress response can both trigger cytokine release and be triggered by cytokine release. Stress hormones also activate anti-inflammatory cytokine production (Elenkov & Chrousos, 2002). The activity of the HPA axis is critical in this inhibition of IL-6 (Koelsch et al., 2016). Therefore, stress can mediate both pro- and anti-inflammatory responses in the CNS.

Hypothesis

Students who report higher levels of stress in the questionnaires and report shorter sleep duration experience increased baseline inflammatory marker amounts of cytokine IL-6 and C-reactive protein in circulation

Methods

Blood Collection

- A finger prick was performed and blood drops were placed on a specimen collection card.
- A Tasso blood collection device attached to the upper arm.

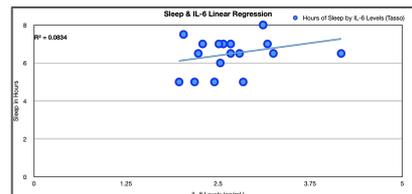
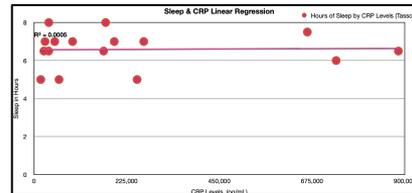
Immunoassay The ELLA platform was used to conduct an enzyme-linked immunoassay (ELISA) to quantify the concentrations of CRP and IL-6 in each blood sample obtained.

Questionnaires

- The Perceived Stress Scale (PSS)
- The Perceived Stress Questionnaire (PSQ)

Statistical Analysis Pearson Correlation in SPSS to analyze the two groups of correlation between three variables. Excel was used to generate linear regression models for our scatter plots; we generated fitted regression lines and arrive at R^2 values for each figure.

Results



Discussion

- Linear Regression Results:**
 - Sleep & CRP: $R^2 = .0005$
 - Sleep & IL-6: $R^2 = .0834$
- Neither proinflammatory molecule strongly, or even moderately correlated with low or high amounts of sleep. We expected to see a negative correlation, or in other words, the less sleep a participant reports, the higher the levels of proinflammatory molecules we expect to see from their blood samples. Instead, no correlation was found between either proinflammatory molecule and the variable of sleep.
- Pearson Correlation Results**
- The degree of correlation are expressed as the Pearson correlation coefficient (r) and the 2-tailed significant value (p -value). The correlation coefficient between sleep hours and stress level is 0.199 with the p -value as 0.444, much greater than 0.05. The correlation coefficient between two variables is -0.211 , and the p -value is 0.400.
- Findings suggest that there is no correlation between sleep hours and neuroinflammation, and no correlation between sleep and stress.
 - Based on our findings there is no correlation between stress and neuroinflammation
- Major limitations of the study design include small sample size, and lack of variability in the sample. There was also no control in the study.
- CRP and IL-6 were the only pro-inflammatory markers that we tested, although there are others that may have been significant that we missed out.

Conclusions and Future Directions

- Using an improved study design will allow for further research to be conducted to assess if there are significant main effects of each independent variable on the pro-inflammatory cytokine activity.
- Next experiments should use a larger sample size selected randomly from a population and analyze other pro-inflammatory cytokine levels, such as TNF- α and IL-10.

References & Full Article



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