

Post-Spring Break Sleep Variability Predicts Depression Among College Students

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Introduction

Sleep is a critical behavior predicting mental health and depressive symptomatology in young adults. Sleep duration and sleep chronotype have both been implicated as risk factors for depression, but the extant scientific literature relies on self-reported sleep measures, and there remains a debate on which sleep features are most predictive of depression.

Here, we examine whether actigraphy-measured sleep variables across the academic semester predict depressive symptomatology at the end of the semester among first and second year college students.

Methods

First and second year undergraduate students ($n=323$) from two separate cohorts in 2017 and 2018 at Carnegie Mellon University wore a Fitbit over the Spring academic semester (January - May) and completed a Center for Epidemiologic Studies Depression Scale (CES-D) survey to assess depressive symptomatology at the beginning and the end of the academic semester.

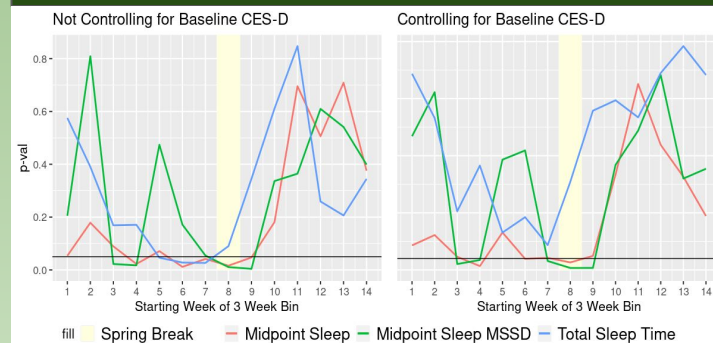
We broke up the semester into 3-week bins, and ran regression analyses for every bin with end of semester CES-D as our dependent variable. We first ran regressions with only a sleep feature of interest as our independent variable, and then ran regressions with both our sleep feature of interest and baseline CES-D as our independent variables. For each bin, we only included students who had at least 20% compliance (i.e. at least 5 days with a main sleep episode).

Our sleep features of interest were: midpoint sleep time, sleep variability as defined by the midpoint sleep time mean square successive difference (MSSD), and total sleep time.

To extract our sleep features from raw Fitbit data which labels each minute as sleep/awake, we first extracted sleep episodes. These were defined as any set of at least 20 consecutive sleep minutes with no greater than 5 consecutive awake minutes.

Once these episodes were extracted, we defined the main sleep episode of Day n as the longest sleep episode which started between noon of Day n and noon of Day $(n+1)$. This yields a bedtime and wake time for every night. Midpoint sleep is the midpoint of bedtime and wake time, midpoint sleep MSSD is average of the successive squared difference values of midpoint sleep, and total sleep time is the number of sleep/restless minutes between bedtime and wake time.

Results



*** Twelve significant associations at a $p=.05$ threshold were seen across the semester in our end of semester CES-D vs. sleep feature model**

*** Later chronotypes, increased sleep variability, and shorter total sleep times were associated with increased depression**

*** When additionally controlling for baseline CES-D, midpoint sleep MSSD remained significant for starting week 8 ($n=249$, $p<.01$) and week 9 ($n=248$, $p<.01$) where greater sleep window variability predicted increased depressive symptomatology**

*** When additionally controlling for baseline CES-D, midpoint sleep remained significant for starting week 8 ($n=249$, $p=.03$) where later chronotypes predicted increased depressive symptomatology**

Discussion

Greater sleep window variability, as measured by midpoint sleep MSSD, after Spring Break is a robust risk factor for increased end of semester depression.

Previous results have shown that irregular sleep is associated with poorer self-reported well-being in college students. This work extends these findings to measures of depressive symptomatology and identifies key periods of the academic semester where sleep variability is most predictive of end of semester outcomes.

We hypothesize that post-Spring Break is a relatively high stress period of the semester, and students who are most susceptible to academic stress present a phenotype of greater sleep variability.

This hypothesis is speculative, and more work needs to be done to determine its validity. Further investigation should be conducted to understand possible causal relationships between sleep variability and mental health.

Additionally, it is notable that total sleep time was not predictive of depression in these cohorts. Total sleep time is known to have a non-linear relationship with depression where short and long sleepers have increased depression risk. Future work to predict depressive symptomatology should examine features that distinguish short, standard, and long sleepers.

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