

A Correlation Between Sleep Duration and Anxiety in a Group of High School Juniors

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Abstract

Mental health issues have been on the rise in recent years, especially in adolescents. Within the past 2 years specifically, mental health and sleep problems in adolescents have increased dramatically as a result of the COVID-19 pandemic and the isolation and extra stress it has caused (Sieberer, Kaman, Otto 2020). The Perfect Storm Model was developed in order to demonstrate how different factors, including psychosocial, bioregulatory, and school start times contribute to poor and ill-timed sleep for adolescents. This poor sleep exacerbates the already rising mental health problems. In this study, a group of 14 high school juniors was asked to complete the Consensus Sleep Diary every day for 2 weeks and to complete an anxiety questionnaire at the end of each week. Participants were asked to join a google classroom where the measurements were posted as google forms. A subset of questions from the anxiety questionnaire were selected for analysis, as done in *Using Item Response Theory to Enrich and Expand the PROMIS Pediatric Self Report Banks* (2014), and only the second week of the questionnaires was used because of temporality, reducing the sample size. Google sheets was used for statistical analysis to find R^2 , or the correlation of determination which was 0.168. This shows a small correlation and the data also suggests a positive association. These results could be attributable to a small sample size and limited adherence from participants.

Introduction

Mental health and sleep issues have been on the rise in recent years, especially in adolescents. In the last decade, youth suicide rates have been steadily increasing, and suicide has now become the second leading cause of death in ages 10-24 (Sullivan, Annet, Simon 2015). Within the past 2 years specifically, mental health and sleep problems in adolescents have increased dramatically as a result of the COVID-19 pandemic and the isolation and extra stress it has caused (Sieberer, Kaman, Otto 2020).

Review of Literature

Adolescent Sleep

The American Academy of Pediatrics recommends that adolescents, ages 13-17, get 8-10 hours of sleep every night, the optimum being approximately 9.25 hours (Dunster, Crowley, Carskadon, 2019). Yet, an astonishing 73% of adolescents do not meet this recommendation (Dunster, Crowley, Carskadon, 2019). Additionally, it was found that moderate sleep times, 11 pm - 8 am, resulted in the lowest anxiety scores (Schochat, Barker, Sharkey, 2017), which seems to conflict with most high school start times.

During adolescence, circadian rhythms, or the body's internal clock, shift later into the day, making adolescents more tired early in the morning and more awake later at night (Dunster, Crowley, Carskadon, 2019). Early school start times conflict with this shift in circadian rhythms during adolescence. This negatively affects academic performance and school attendance (Dunster, Crowley, Carskadon, 2019). On non-school days adolescents are not bound by school start times and can go to sleep and wake up at

times that coordinate with their circadian rhythms (Dunster, Crowley, Carskadon, 2019). It was also found that the highest standardized test scores were seen in 16-year-olds that reported about 7 hours of sleep each night (Fulgini, Bai, Krull, Gonzales, 2017). Thus, early school start times interfere with this circadian rhythm shift making adolescents not awake and alert when the school day begins, negatively affecting performance and attendance.

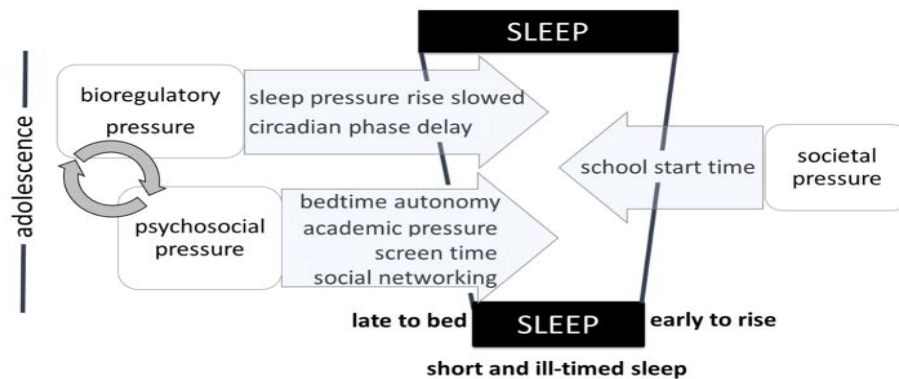
Sleep cycles naturally through the night between phases of NREM and REM. Each cycle lasts around 90 minutes. NREM sleep is divided into 4 stages, with 1 being the lightest and 4 being the deepest (Staner, 2003). Throughout the night, stages 3 and 4 of the NREM cycle shorten while REM cycles lengthen (Staner, 2003). Therefore, at the time when adolescents are waking up for school, they are more likely to be in this crucial REM stage. During REM sleep, emotional processing occurs and when it is disrupted, like by early school start times, there is increased emotional reactivity and irritability (Vandekerckhove, Wang, 2018).

Adolescence is a transitional and tumultuous time, impacting sleep. During these crucial years, there are increases in societal and academic pressure, bedtime autonomy, psychosocial changes, and increased use of social media (Dunster, Crowley, Carskadon, 2019). There are also bioregulatory pressures, like the shift in circadian rhythms (Crowley, Wolfson, Tarokh, 2018). This change in circadian rhythms, specifically has adolescents staying up later and needing to wake up later along with a change in the sleep/wake homeostatic process that controls sleep recovery and restoration (Crowley, Wolfson, Tarokh, 2018). During adolescence, sleep recovery does not accelerate but the sleep pressure system decelerates (Crowley, Wolfson, Tarokh, 2018). This means that

adolescents naturally can stay up longer and when they do sleep they still get all of the recovery sleep they need. However, sleep recovery and restoration are the sleep processes that make one feel refreshed (Crowley, Wolfson, Tarokh, 2018). These processes are important because they are vital in recovery, both physically and mentally.

When these factors are combined they result in poor ill-timed sleep and has been called the Perfect Storm Model, which can be seen in figure 1 (Crowley, Wolfson, Tarokh, 2018).

Figure 1:



Low sleep duration can cause increased depression, anxiety, suicidal thoughts, destructive behaviors, obesity, car crashes, sports injuries, and substance abuse (Dunster, Crowley, Carskadon 2019). This also creates issues in diagnosing mental health disorders because a lot of these symptoms mimic and exacerbate symptoms of many mental health disorders, leaving adolescents in a constant cycle of poor sleep and poor mental health (Dunster, Crowley, Carskadon 2019).

Anxiety is a normal part of life, but when anxiety begins to take over someone's life and negatively impacts daily functioning, it becomes a serious problem. Types of anxiety disorders include General Anxiety Disorder, Panic Disorder, Social Anxiety

Disorder, and many more (Smith, Legg, 2021). Some common symptoms of these disorders include racing thoughts, shortness of breath, rapid heartbeat, upset stomach, panic, sweating, muscle tension, confusion, poor memory and concentration, dissociation, and constant worry (Smith, Legg, 2021)

Sleep problems have been implicated in almost every mental health issue (Fuligni, Bai, Krull, Gonzales, 2017). Every adolescent needs a different amount of sleep for optimum daily mood functioning; however, sleep guidelines have been established mainly on opinion rather than real scientific facts (Fuligni, Bai, Krull, Gonzales, 2017). The daily average for optimum sleep is about 9 hours but adolescents with mental health issues require more sleep than their peers (Fuligni, Bai, Krull, Gonzales, 2017).

Furthermore, the COVID-19 pandemic has led to many problems for everyone, but the isolation and restrictions have especially affected adolescents (Sieberer, Kaman, Otto 2020). The pandemic has significantly impacted adolescents because social contact is crucial for development throughout adolescence (Sieberer, Kaman, Otto 2020). In a study with 1040 participants, including both parents (median age 43.9, 50% mothers) and children (median age 14.3, 51.1% girls), 65% of participants found school and learning more exhausting during the pandemic and 39% reported that their friendships deteriorated because of restrictions and limitations (Sieberer, Kaman, Otto, 2020). During this strenuous time, it is clear that mental health issues have increased dramatically for adolescents, specifically anxiety disorders and more specifically their symptoms (Sieberer, Kaman, Otto, 2020).

Purpose

The purpose of this study was to find a correlation between sleep duration and anxiety in high school juniors following the COVID-19 pandemic. It is hypothesized that low sleep duration will correlate with high anxiety in high school juniors.

Methods

Participants and Procedure

High school juniors were chosen for this experiment because they were the only group, all within the adolescent age range, that experienced normal high school before the pandemic. Students were excluded if they provided incomplete data precluding analysis, (e.g., missing anxiety measure). A final sample of ten junior high school students (age 16, 70% female) participated in the study.

Letters of consent were distributed to juniors through their US History Classes (appendix 1). Participants who turned in their letters of consent were assigned a number and asked to join a google classroom. Measures were put into separate google forms and to maintain anonymity, all participants were assigned a number to input instead of their names. The sleep diary was posted daily for two weeks and the anxiety questionnaire was posted at the end of each week.

Measure

For sleep duration, the Consensus Sleep Diary-M was used (Carney, Krystal, 2012). This is a 15-question, 2-week self-reported diary (appendix 2). Average sleep duration calculated across 14 days was used for analysis. The measure used to measure anxiety was the PROMIS Pediatric Item Bank v2.0 for Anxiety which is a 15 question self report of anxiety in the past 7 days (appendix 3). A subset of eight items were selected for analysis, consistent with literature commendations *Using Item Response*

Theory to Enrich and Expand the PROMIS Pediatric Self Report Banks. Only the second week of anxiety measures were used because of temporality therefore also reducing the sample size. T scores were used for analysis.

Data Analytic Strategy

Google sheets were used for statistical analysis. Descriptive analyses were computed to characterize sleep duration and anxiety symptoms in this sample. A bivariate correlation was calculated to assess the relationship between sleep duration and anxiety. R^2 , or the coefficient of determination which determines correlation, is presented as an effect size estimate.

Results

Results

Descriptive analyses revealed that participants slept an average of 7.25 hours on average. Further, participants reported an average anxiety score of 61.6. The coefficient of determination was found to be 0.168, indicating a small correlation. However, a linear trend fitted to the observed data (see Figure 2 below) suggests a positive association, consistent with previous research. The limited effect observed in this study may be sleep overall and anxiety. These results could be attributable to a small sample size and limited adherence from participants. These preliminary findings support replication of this study with a larger sample of high school juniors to further clarify this association and inform intervention.

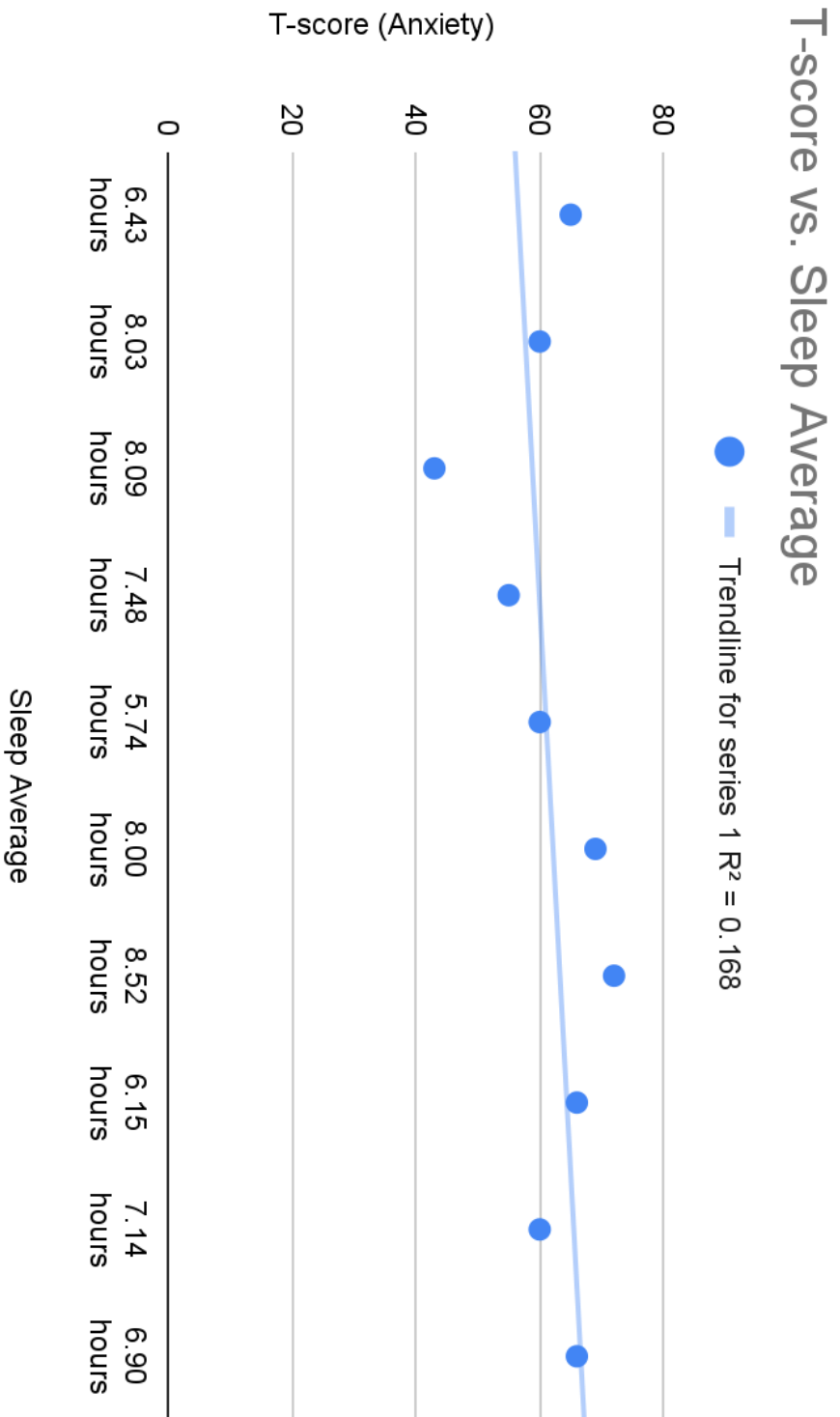


Figure 2:

Appendix 1

Dear Parent/Guardian,

My name is Emily Koenig and I am a junior at Columbia High School. I am a part of the Science Research program here at Columbia and am studying how sleep duration affects anxiety in high school juniors. The overall purpose of my project is to investigate if a correlation exists between lower sleep duration and higher anxiety scores in high school juniors.

Participants will be asked to fill out a sleep diary every morning through a google form for 2 weeks. You will also be asked to fill out a 15-question questionnaire at the end of each week the study. This will also be through a google form sent to maintain anonymity. If you agree to be involved in the study, please sign below and the researcher will give you the code to a google classroom where all materials will be located. Participation in this study is completely voluntary and the participant can stop at any time.

Student Name: _____ School Email address: _____
Signature: _____ Date: _____

Parent/Guardian Signature: _____ Date: _____

Appendix 2

Consensus Sleep Diary-M (Please Complete Upon Awakening)

ID/NAME: _____

Sample								
Today's Date	4/5/11							
1. What time did you get into bed?	10:15 p.m.							
2. What time did you try to go to sleep?	11:30 p.m.							
3. How long did it take you to fall asleep?	55 min.							
4. How many times did you wake up, not counting your final awakening?	6 times							
5. In total, how long did these awakenings last?	2 hours 5 min.							
6a. What time was your final awakening?	6:35 a.m.							
6b. After your final awakening, how long did you spend in bed trying to sleep?	45 min.							
6c. Did you wake up earlier than you planned?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
6d. If yes, how much earlier?	1 hour							
7. What time did you get out of bed for the day?	7:20 a.m.							
8. In total, how long did you sleep?	4 hours 10 min.							
9. How would you rate the quality of your sleep?	<input type="checkbox"/> Very poor <input checked="" type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good	<input type="checkbox"/> Very poor <input type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good	<input type="checkbox"/> Very poor <input type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good	<input type="checkbox"/> Very poor <input type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good	<input type="checkbox"/> Very poor <input type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good	<input type="checkbox"/> Very poor <input type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good	<input type="checkbox"/> Very poor <input type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good	<input type="checkbox"/> Very poor <input type="checkbox"/> Poor <input type="checkbox"/> Fair <input type="checkbox"/> Good <input type="checkbox"/> Very good
10. How rested or refreshed did you feel when you woke-up for the day?	<input type="checkbox"/> Not at all rested <input checked="" type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested	<input type="checkbox"/> Not at all rested <input type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested	<input type="checkbox"/> Not at all rested <input type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested	<input type="checkbox"/> Not at all rested <input type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested	<input type="checkbox"/> Not at all rested <input type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested	<input type="checkbox"/> Not at all rested <input type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested	<input type="checkbox"/> Not at all rested <input type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested	<input type="checkbox"/> Not at all rested <input type="checkbox"/> Slightly rested <input type="checkbox"/> Somewhat rested <input type="checkbox"/> Well-rested <input type="checkbox"/> Very well-rested

Consensus Sleep Diary-M Continued

ID/NAME: _____

Sample								
Today's Date	4/5/11							
11a. How many times did you nap or doze?	2 times							
11b. In total, how long did you nap or doze?	1 hour 10 min.							
12a. How many drinks containing alcohol did you have?	3 drinks							
12b. What time was your last drink?	9:20 p.m.							
13a. How many caffeinated drinks (coffee, tea, soda, energy drinks) did you have?	2 drinks							
13b. What time was your last drink?	3:00 p.m.							
14. Did you take any over-the-counter or prescription medication(s) to help you sleep?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, list medication(s), dose, and time taken	Medication(s): Relaxo-Herb Dose: 50 mg Time(s) taken: 11 pm	Medication(s): Dose: Time(s) taken:	Medication(s): Dose: Time(s) taken:	Medication(s): Dose: Time(s) taken:	Medication(s): Dose: Time(s) taken:	Medication(s): Dose: Time(s) taken:	Medication(s): Dose: Time(s) taken:	Medication(s): Dose: Time(s) taken:
15. Comments (if applicable)	I have a cold							

Appendix 3

PROMIS Pediatric Item Bank v2.0 - Anxiety

Pediatric Anxiety

Please respond to each question or statement by marking one box per row.

In the past 7 days...

	Never 1	Almost Never 2	Sometimes 3	Often 4	Almost Always 5
1005 I felt too nervous to be with a group of kids my age.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2220c I felt like something awful might happen..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2202b I got scared really easy.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2272b I felt scared.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2011c I worried about what could happen to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2021c I was worried I might die.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2121c I woke up at night scared.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2150c I worried when I went to bed at night.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2020b I worried when I was away from home.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2020c I worried when I was at home.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2077c I was afraid of going to school.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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PROMIS Pediatric Item Bank v2.0 - Anxiety

Pediatric Anxiety

Please respond to each question or statement by marking one box per row.

In the past 7 days...

	Never 1	Almost Never 2	Sometimes 3	Often 4	Almost Always 5
2020c I felt worried.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2008 I worried that something might happen to my parents or guardians.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2011c I felt nervous.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2021c It was hard for me to relax.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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