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Daytime Impairment due to College Student Technology use during Sleep: a First Step toward Exploring Similarities to Obstructive Sleep Apnea

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Abstract

Similar to Obstructive Sleep Apnea (OSA), technology use after sleep onset causes fragmented sleep, as well as daytime impairment to functioning. Young adults are at increased risk for sleep disruption due to technological interruptions during sleep. The purpose of this study was to explore sleep disruption caused by technology use after sleep onset, using three quantitative measures that are regularly used to assess sleep disruption in OSA. Our aim was to determine the most robust measure of daytime impairment among college-aged technology users. In a sample of 60 college students, findings revealed that students who attended to technology after sleep onset reported increased sleep disruption and daytime impairment as compared to non-technology users. Technology use after sleep onset also predicted general ratings of fatigue upon waking and increased scores on Epworth Sleepiness Scale (ESS), but not on the Pittsburgh Sleep Quality Index. General ratings of fatigue and the ESS may be the most valid measures of functional impairment in college students.

Keywords: Sleep; Technology; Cellular phone; Obstructive sleep apnea; College; Daytime impairment

Introduction

Technology use is an omnipresent distraction in the lives of college students. Answering cellular phones and texts during the night can have profound effects on sleep, resulting in fragmented sleep and more distal negative outcomes such as decreased grade point average (GPA), alertness, problems concentrating, depression, anxiety [1,2]. Researchers have reported that between 25-47% of college students experience disruptions in sleep due to cellular phones. This may be due to phone use before, during, and/or after sleep onset [2,3].

Obstructive sleep apnea (OSA) is also a condition where fragmented sleep causes an array of negative short and long-term outcomes, including daytime impairment, hypertension, diabetes, heart attack, and stroke [4]. Clinically, OSA is becoming more prevalent in younger populations and is commonly under-diagnosed in college-aged students. In a sample of over 1,845 college students, over 500 students were at risk for at least one sleep disorder, with OSA being commonly reported. Those who reported having one or more sleep disorders had a significantly lower GPA than those with no sleep disorders [5]. Moreover, common measures of OSA assess daytime impairment. Specific measures, however, of daytime impairment due to OSA do not exist for college populations; thus, we assume that the current measures have face validity and measure indicators of daytime impairment consistent with a college lifestyle. Additionally, others have suggested that three questions assessing symptoms of fatigue, tiredness, and lack of energy may be the most reliable markers of daytime impairment in young adults [6]. Excessive drowsiness, tension, and nervousness have also been reported as the most frequent complaints of sleep deprivation in college students [7].

The current pilot study has two primary aims. First, we will examine if students who use technology use after sleep onset experience more daytime impairment than students who do not use technology. Second, we will compare the use of three different measures commonly used to assess OSA and sleep problems in young adult populations, with the aim of determining the most robust measure of daytime impairment due to technology use. The following aims and hypotheses will guide this pilot study:

1) Exploratory Aim 1: To explore differences in daytime impairment between students who use technology after sleep onset and students who do not use technology.

2) Technology use after the onset of sleep will significantly predict rates of daytime impairment among college students as measured by the a) *Epworth Sleepiness Scale*, b) general markers of feeling *fatigued* upon waking, and the c) *Pittsburgh Sleep Quality Index.*

3) It is predicted that in college students, measures of feeling rested will be a more robust predictor of impairment due to technology than traditional OSA measure (i.e., *Epworth Sleepiness Scale*).

Method

Participants for this study were junior and senior college students recruited from the principal investigator's Family and Community Health courses. Students received extra credit for their participation in research. Those who chose not to participate were given the option of a secondary extra credit assignment. All research methodology used in this study was approved by and complied with the Institutional Review Board at the University of Rhode Island.

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Participants

The sample comprises 44 females (73%) and 16 males (27%) (Table 1). The mean age of participants was 23.63 (SD=7.99), with a range of 19-61. In general the sample was comprised of traditional college aged students with a mean of 23.63 (SD=7.99). The most common age group was 21, which comprised 42.9% of the sample. The majority of the sample identified their race/ethnicity as White (75%), followed by Black/African American (13.3%), 6.7% Hispanic/Latino, 3.3% Multiracial, and 1.7% Other. Sixty percent of students were of senior standing, 38.3% Junior, and 1.7% sophomore.

Measures

The Pittsburgh Sleep Quality Index (PSQI) was used to measure sleep disturbance among the participants [8]. It is composed of a 19-item self-report measure that assesses the quality of sleep as well as any issues with sleep during the past month. Questions 1-4 are open ended questions, whereas questions 5-19 are measured on a 4-point Likert scale. In healthy controls, this measure has good internal consistency (α=0.83). The internal consistency for this sample was α=0.72.

The *Epworth Sleepiness Scale* (ESS) was used to measure daytime impairment and daytime sleepiness among the sample of students [9]. It is composed of an 8-item self-report questionnaire measured on a 4-point Likert scale. In healthy controls, this measure has good internal consistency (α= .88) [10]. The internal consistency for this sample was .79.

A 7-day, self-report diary was used to collect data on college student sleep habits, technology use after the onset of sleep, and how fatigued they felt upon waking (fatigued, refreshed and moderately refreshed). Students were instructed to check their phone logs in the morning for accurate numbers on phone usage throughout the night. Technology use was examined using: 1) total minutes of technology use after the onset of sleep, and 2) total tally of technology use after the onset of sleep, which is a frequency count of the times one used technology of various sources (Text, Phone, Email, Facebook®, Twitter®).

Data analysis

Statistical analyses were conducted using SPSS 21.The preliminary analyses included tests for normality and multicollinearity. Descriptive statistics including means and standard deviations were conducted to examine the first exploratory hypothesis investigating differences between those who do and do not use technology after the onset of sleep. A series of hierarchical regressions were conducted to test our second hypothesis investigating the relation of technology use to daytime impairment (Hypotheses 2: a-c).

Results

Exploratory aim 1

Results from our exploratory aim revealed very few descriptive differences between those who do and those who do not use technology after the onset of sleep. Nighttime technology users comprised 55% of the total sample N=32 and non-technology users comprised 45% of the sample N=26. The nighttime technology users averaged 7.22 (SD .87) hours of sleep per night whereas the non-technology users averaged slightly more sleep with 7.16 (SD 1.16). The nighttime technology users woke up approximately 15.87 times per week due to technology (SD 38.23) for a weekly total of 68.75 (SD 111.03) minutes of technology use. The average score on the Epworth Sleepiness Scale for nighttime technology users was 7.84 (SD 3.35) and for non-technology users the average score was 7.11(SD 1.16). Overall, college students in both categories of technology use report feeling moderately fatigued on average. In particular, for the nighttime technology users the average score of the *fatigued* variable was 2.44 (SD .512) and for the non-technology users the average score was 2.80 (SD .686). Both categories classify as moderately fatigued. Finally, the average score on the Pittsburgh Sleep Quality Index for nighttime technology users was 7.94 (SD 4.23) and for non-technology users the average score was 7.22 (SD 4.88) indicating that both groups experience poor sleep quality (Table 1).

Hypothesis 2

A series of hierarchical regressions were conducted to investigate the relation of technology use to daytime impairment. The order of entry of the variables in the regression reflected their theoretical importance in predicting outcomes (i.e., *total minutes of technology use* was entered into the first block of the regression and *total tally of technology use* was entered into the second block of the regression).

Hypothesis 2a: Epworth Sleepiness Scale and Technology Use

As hypothesized, the first block of the regression was significant, with the *total minutes of technology use* significantly predicting 6.8% of the total variance on the *Epworth Sleepiness Scale*, F (1, 57) = 4.08, p<.05. Contrary to the hypothesis, the second block of the regression, *total tally of technology use,* was not a significant predictor.

Hypothesis 2b: General Rating of Fatigue and Technology Use

As hypothesized, the first block of the regression was significant, with the *total minutes of technology use* significantly predicting 10.6% of the total variance in the general rating of *fatigue*, F (1, 57) = 6.65, p<.01. Contrary to the hypothesis, the second block of the regression, *total tally of technology use,* was not a significant predictor.

Hypothesis 2c: Pittsburgh Sleep Quality Index and Technology Use

Contrary to hypothesis, *total minutes of technology use* and *total tally of technology use* did not significantly predict sleep disturbance as measured on the *Pittsburgh Sleep Quality Index* in either block of the hierarchical regression.

Discussion

The purpose of this study was to examine if students who use

Table 1: Differences between Technology and Non-Technology users across study variables.

	Technology Users	Non-Technology Users
% Sample	55%	45%
Hours of sleep/night	7.16	7.22
# of times woken up/week by technology	15.87	--
Total # of minutes awake due to technology/week	68.75	--
Epworth Sleepiness Score	7.84 (3.35)	7.11 (1.16)
General Rating of Fatigue	2.44 (.51)	2.80 (.68)
Pittsburgh Sleep Quality Index	7.94 (4.23)	7.22 (4.88)

technology use after sleep onset experience more daytime impairment than students who do not use technology. Second, we compared the use of three different measures commonly used to assess OSA and sleep problems in young adult populations, with the aim of determining the most robust measure of daytime impairment due to technology use.

Researchers have assessed sleep quality in college students a number of ways, including using the *Pittsburgh Sleep Quality Index* to assess overall sleep quality and quantity and the *Epworth Sleepiness Scale* to assess functional daytime impairment. Others have proposed that a reliable measure of college student sleep is a general rating of fatigue upon waking [6]. After using these three assessment tools in a sample of college students, it was determined that the *total minutes of technology use* after sleep onset significantly predicted daytime impairment as measured by a) the *Epworth Sleepiness Scale* and b) the general rating of fatigue upon waking. The *Pittsburgh Sleep Quality Index* did not emerge as a significant outcome of technology use during sleep. Although the *Pittsburgh Sleep Quality Index* measure is a reliable and valid measure in multiple samples, it may not assess specific factors that disrupt sleep in college students as well as specific forms of daytime impairment such as fatigue when sitting in class for extended periods of time. Therefore, the PSQI may not have emerged as a significant outcome in this study. These findings suggest that a measure of general fatigue upon waking may be a reliable measure of disruption due to sleep problems in college students. Additionally, given that general fatigue has been found to be a reliable indicator for young adults with OSA, findings suggest the possibility of functional similarities in daytime impairment between OSA and technology use after sleep onset. To our knowledge, this is the first study to allude to conceptual comparisons between OSA and technology use. This topic, however, requires further investigation given that the current sample of students did not have OSA and OSA has a physiological etiology that extends beyond sleep disruption.

Exploratory Aim 1 examined mean differences of study variables in technology and non-technology users. Some interesting trends emerged. Specifically, although non-technology users reported getting more sleep, they felt less rested than technology users. On the other hand, students who used technology were found to experience more daytime impairment and sleep disturbance. This suggests that the role of technology on wellness may be counterintuitive to conventional assumptions. For instance, students who use technology throughout the night may find that they are less anxious about missing important conversations with their peers, thus enhancing their ability to enter into deeper and less interrupted sleep after technology use has ceased. Additionally, technology users may be so habituated to using their phones that their bodies compensate for the amount of sleep lost by increasing rapid eye movements (REM) sleep in the early mornings when there are fewer distractions. It is also plausible that students who reported not answering their phones after sleep onset are unconsciously attending to their phones and unknowingly experience brief disruptions in their sleep. Additionally, despite the fact that they do not report answering their phones, non-technology users may also be disrupted by phone notifications. Specific conclusions cannot be drawn since this study did not control for where their phones were physically located and whether the phone was on vibrate, silent, or sound. There is also research that suggests that individuals are rarely and/or never woken up by their mobile phones at night which would contradict the premise of this study [11].

Limitations and Future Directions

Although this study was exploratory in nature, there are multiple limitations that should be noted. First, the small sample size and limited sex distribution limits generalizability to larger populations. Second, the mean differences between technology users and non-technology users are small and should be interpreted as trends as best. Third, given that data were collected from the principal investigator's class, sampling bias may have occurred. Lastly, those with OSA may have sleep impairments all night long whereas sleep disruptions due to technology use likely decrease in the early morning, allowing them to get a restful sleep. Therefore, the nature of the daytime impairment may appear functionally different amongst the two groups.

This study was an exploratory, pilot study driven by conceptual ideas about the impact of technology on sleep disruption and daytime functioning. Larger samples should be used to determine if 1) daytime impairment is an accurate assessment of the effects of sleep disruption due to technology use, and 2) the trend of non-technology users sleeping more but feeling less rested is replicable. Researchers could also consider administering objective measures of sleepiness (e.g., Multiple Sleep Latency Tests) to examine the levels of sleepiness and fatigue resulting from technology use after sleep onset and then compare them to levels in college students diagnosed with OSA. Finally, future research should be conducted to explore the specific effects of nighttime awakenings due to technology use on individual health and wellness over time.

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