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Association Between Nonmedical Use of Prescription Drugs and Sleep Quality in a Large College Student Sample

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Abstract

Objective/Background—Poor sleep and nonmedical use (NMU) of prescription drugs (NMUPD) are both common among college students. Since lack of sleep adversely influences academic performance, this study examined the association between NMUPD and subjective sleep quality among college students.

Participants—Students who completed the American College Health Association–National College Health Assessment data (Fall 2010, Spring 2011; $N = 135,874$).

Methods—Associations were examined between NMUPD in four classes over the past 12 months (antidepressant, painkillers, sedatives, and stimulants), and five aspects of sleep quality (Enough Sleep, Early Awakening, Daytime Sleepiness, Difficulty Falling Asleep, and Problem With Daytime Sleepiness) in the past seven days.

Results—Any NMUPD (at least one class), NMU of stimulants specifically, and NMU of painkillers specifically were associated with getting fewer days of Enough Sleep (OR: 0.86, 0.93, and 0.84 respectively), more days of Early Awakening (OR: 1.28, 1.10, and 1.28 respectively), Daytime Sleepiness (OR: 1.23, 1.13, and 1.16 respectively), and Difficulty Falling Asleep (OR: 1.32, 1.10, and 1.27 respectively; $p < .0001$, each). NMU of sedatives was significantly associated with having Problem With Daytime Sleepiness (OR: 1.10), more days of Early Awakening (OR: 1.12), and Difficulty Falling Asleep (OR: 1.17; $p < .0001$).

Conclusions—NMUPD is associated with poor sleep among college students. Therefore, behavioral medicine screening and treatment of this vulnerable population should consider sleep health, NMUPD, and the potential that these problems may be comorbid.

Poor sleep is highly prevalent (over 60%) among college students (Lund, Reider, Whiting, & Prichard, 2010; Tsai & Li, 2004) with females reporting poorer sleep quality than males. In

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addition to struggling with daily functions, poor sleep in college students increases their risk for lower grade point averages, compromised learning, impaired mood, and motor vehicle accidents (Hershner & Chervin, 2014; Lund et al., 2010). Poor sleep, defined as short sleep duration with poor sleep quality (Robotham, Chakkalackal, & Cyhlarova, 2011), is associated with a host of negative behavioral and health outcomes such as poor mental health, heart disease, substance use, violent behavior, and overweight-obesity status (Benca, 2012; Fredriksen, Rhodes, Reddy, & Way, 2004; Healthy People, 2015; McKnight-Eily et al., 2011; Ram, Seirawan, Kumar, & Clark, 2010; Wells & Vaughn, 2012). An estimated one in three U.S. adults have poor sleep, with fewer than 7 hours of sleep per night (Centers for Diseases Control and Prevention [CDC], 2015; National Institutes of Health [NIH], 2013).

Prescription medications designed to treat pain, anxiety, sleep disorders, and other medical problems have proliferated in the United States. However, their increased availability has also led to increased nonmedical use (NMU). Nonmedical use of prescription drugs (NMUPD) refers to the use of medication for reasons, or in ways, or in amounts, not intended by a doctor; taken without a prescription; or taken by someone other than the person for whom they are prescribed (National Institute on Drug Abuse [NIDA], 2015; Substance Abuse and Mental Health Services Administration [SAMHSA], 2015). Family, friends, and peers are the most common sources for obtaining prescription drugs intended for nonmedical use by college students (McCabe & Boyd, 2005; McCabe, Teter, & Boyd, 2006). However, the increased medical use of prescription stimulants in the treatment of ADHD (attention deficit hyperactivity disorder; McCabe, West, Teter, & Boyd, 2014) has also made prescription stimulants more accessible in the college environment (Babcock & Byrne, 2000; McCabe & Boyd, 2005).

There were 15 million individuals, aged 12 years or older, who engaged in NMUPD in 2015, and NMUPD is more common than use of any other drug, with the exception of marijuana (Hughes et al., 2016; SAMHSA, 2015). Lifetime prevalence of NMUPD is 20% among college students for at least one prescription medication class (i.e., sedatives, opioids, or stimulants; McCabe et al., 2014). In addition, college students also have the highest NMU of opioid painkillers (McCabe & Teter, 2007). NMU of antidepressants is unexplored in many large-scale epidemiological surveys. However, 8% of Americans 12 years or older used antidepressants between 2005 and 2008 for reasons other than depression (Pratt, Brody, & Gu, 2011). Such usage increased from 2.4% to 10.8% between 2007 and 2010 among adults (National Center for Health Statistics [NCHS], 2014).

The most commonly reported reasons for NMUPD among college students are to “stay awake to study” or to “increase concentration” (Clegg-Kraynok, McBean, & Montgomery-Downs, 2011; McCabe & Teter, 2007). However, the association between NMUPD and sleep quality among college students has not been generally explored, with the exception of stimulant use. Clegg-Kraynok (2010) found that college students not only have poorer sleep quality and shorter sleep duration than adolescents but also are more likely to use psychostimulants nonmedically (defined as stimulants used for the treatment of ADHD) to compensate for shortened sleep; students with lifetime NMU of psychostimulants report poorer sleep quality and more sleep disturbance than nonusers (Clegg-Kraynok et al., 2011).

However, the association between sedative, painkiller, and antidepressant use and sleep quality has not been explored among college students, and only sparsely in the general population. Sedatives are often referred to as sleep aids (Chong, Fryar, & Gu, 2013). Chong et al. (2013) reported that U.S. adults who obtain either fewer than 5 hr or more than 9 hours of sleep, use sleep aids in higher proportions (6.0% and 5.3% respectively). Use of sleep aids is also high among adults who report sleep-related disorders and trouble sleeping (Chong et al., 2013).

Painkillers can significantly disrupt sleep architecture in healthy adults (Dimsdale, Norman, DeJardin, & Wallace, 2007). Dimsdale et al. (2007) found both sustained-release morphine sulfate and methadone use significantly reduced deep sleep and increased stage N2, resulting in overall sleep quality disturbance. Studies of adolescents' use of pain relievers showed they have more trouble sleeping (in the past six months) than nonusers (McCabe, West, & Boyd, 2013). Poor sleep quality was also reported by 80.6% of prescription opioid users compared to healthy controls (Hartwell, Pfeifer, McCauley, Moran-Santa, & Back, 2014). The prescription opioid-dependent group also had shorter sleep duration, longer sleep latency, and more awakening times.

Antidepressants, on the other hand, change and improve sleep architecture, specifically by decreasing the amount of REM sleep and increasing its onset latency in both healthy individuals and depressed patients (Lam, 2005; Wilson & Argyropoulos, 2005). These effects vary by drugs, with some short-term sleep disturbance early in treatment (e.g., clomipramine and the selective serotonin receptor inhibitors [SSRIs]), while others are sleep-promoting (e.g., amitriptyline and the newer serotonin 5-HT2-receptor antagonists; Wilson & Argyropoulos, 2005). However, some antidepressant drugs may cause insomnia and daytime sleepiness (Lam, 2005; Mayers & Baldwin, 2005). In general, sleep improved with effective antidepressant treatment within 3–4 weeks (Wilson & Argyropoulos, 2005).

The current literature on NMUPD and sleep quality among both college students and in the general population is limited because (a) many large-scale epidemiological surveys of prescription drug use have not included NMU of antidepressants, and (b) they have not explored important demographic and behavioral covariates, including sleep disorders and other gateway drugs (NMU of stimulants, in particular, is associated with increased use of other drugs including alcohol, cocaine, cigarettes, and marijuana; Hershner & Chervin, 2014; McCabe & Teter, 2007).

Therefore, our study purpose was to use a large, national college student sample to examine the associations between four classes of NMUPD (antidepressant, painkillers, stimulants, and sedatives) in the past 12 months and five aspects of sleep quality (Enough Sleep, Early Awakening, Daytime Sleepiness, Difficulty Falling Asleep, and Problem associated with Daytime Sleepiness) in the past seven days. Specifically, we sought to take into consideration known limitations, and to include important demographic and behavioral covariates that have not been controlled in previous studies. In line with the extant literature, we expected NMUPD to be significantly associated with sleep quality as reflected by five aspects of sleep behavior. However, given the relatively exploratory nature of the study, no

other specific hypotheses were developed. We examined potential associations that may exist with any NMUPD, as well as within each drug class individually.

Materials and methods

This study utilized data from the fall 2010 and spring 2011 National American College Health Association–National College Health Assessment (ACHA-NCHA). We were granted access to these data through a formal request to the American College Health Association. There were 42 and 129 institutions that participated in fall 2010 (n = 30,263) and spring 2011 (n = 116,254) NCHA, respectively. However, we selected only those schools (39 and 129 during fall 2010 and spring 2011, respectively) that surveyed all available students or used a random sampling technique (N = 135,874; ACHA, 2011). The ACHA-NCHA uses mixed-method data collection (paper and web) and reports three response rates: paper survey, web survey, and the mean response proportion. The response rates for fall 2010 were 81% (paper), 21% (Web), and the mean response proportion was 28.5%; response rates for the spring 2011 were 78% (paper), 19% (Web), and the mean response proportion was 30.9%. Both paper and Web response rates, individually or combined, mirror other national surveys in higher education (Sax, Gilmartin, & Bryant, 2003). Missing values (missing at random), n = 2,663 and 16,321 individuals, were excluded from descriptive analysis and from inferential analysis, respectively. All statistical models were fitted based on the available data and these gave us unbiased estimates provided that the probability of missing data depends only on the covariates in the model. We checked this assumption by looking at the predictors of missingness. For example, if there is no association between the missing indicator and any observed variable, then the missing data mechanism is missing completely at random (MCAR).

Instrumentation

Nonmedical use of prescription drugs—The independent variables included four classes of nonmedical prescription drugs: antidepressants, painkillers, sedatives, and stimulants. The four questions used to assess NMUPD were: “Within the last 12 months, have you taken any of the following prescription drugs that were not prescribed to you: (1) Antidepressants (e.g., Celexa, Lexapro, Prozac, Wellbutrin, Zoloft); (2) Pain killers (e.g., OxyContin, Vicodin, Codeine); (3) Sedatives (e.g., Xanax, Valium); (4) Stimulants (e.g., Ritalin, Adderall)?” Response options for each question were (1) yes or (2) no.

Sleep quality—The dependent variables measured aspects of sleep quality. Specifically, we assessed sleep quality in the past seven days, as reflected by participants’ experiences with Enough Sleep, Early Awakening, Daytime Sleepiness (frequency), Difficulty Falling Asleep, and Problem with Daytime Sleepiness (magnitude). Two aspects of Daytime Sleepiness have been assessed: the frequency of feeling sleepy during the day, and the magnitude of feeling sleepy (problem associated with sleepiness during the day). The following questions were the only questions available in the ACHA-NCHA data that matched the study aim: (a) Enough Sleep = “On how many of the past 7 days did you get enough sleep so that you felt rested when you woke up in the morning?”; (b) Early Awakening = “In the past 7 days, how often have you awakened too early in the morning and

couldn't get back to sleep?"; (c) Daytime Sleepiness = "In the past 7 days, how often have you felt tired, dragged out, or sleepy during the day?"; (d) Difficulty Falling Asleep = "In the past 7 days, how often have you had an extremely hard time falling asleep?"; (e) Problem with Daytime Sleepiness = "In the past 7 days, how much of a problem have you had with sleepiness during your daytime activities?" Response options for the first four questions ranged from zero to seven days; response options for question five were: 1 = no problem at all, 2 = a little problem, 3 = more than a little problem, 4 = a big problem, and 5 = a very big problem.

For descriptive analyses, we grouped each sleep quality measure into three groups based on the literature (Becker, Adams, Orr, & Quilter, 2008): *Enough Sleep* (6–7 days = optimal, 2–5 days = middle, and 0–1 = poor). *Early Awakening, Daytime Sleepiness*, and *Difficulty Falling Asleep* were coded as: (6–7 days = poor, 2–5 days = middle, and 0–1 = optimal). Finally, *Problem With Daytime Sleepiness* was coded as: optimal = having no problem with sleepiness, poor = combining having a little, more than a little, a big, and a very big problem with sleepiness during the daytime activities.

Covariates—Study covariates (Table 1) included gender, race, age, body mass index (BMI) (obtained from the reported height and weight), other substance use (i.e., cigarette, alcohol, and marijuana use in the past 30 days), diagnosed medical disorders (depression, insomnia, ADHD, sleep-related disorder), and overall perceived stress (participants were asked to rate their overall level of stress they have experienced in the past 12 months, on a 5-point Likert scale ranges from no stress to tremendous stress). These covariates were included because of known associations with sleep quality, NMUPD, and to control for any interrelated effects between the proposed covariates, NMUPD, and poor sleep (Hershner & Chervin, 2014; McCabe & Teter, 2007; Tsai & Li, 2004).

Data analysis

Descriptive statistics were followed by inferential ordinal regression models to examine the associations between any NMUPD (antidepressants, painkillers, sedatives, and stimulants) in the past 12 months, and sleep quality in the past seven days (Enough Sleep, Early Awakening, Daytime Sleepiness, Difficulty Falling Asleep, and Problem With Daytime Sleepiness) as ordinal variables; while controlling for the study covariates using SAS 9.4. Three types of ordinal regression models were fit: one for males only, one for females only, and the third included both genders in order to identify gender effects. In addition, models were run with a composite NMUPD variable (use of at least one) and separate models with specific NMUPD variables (e.g., antidepressants, painkillers, etc.) and then examined effects specific to each class of NMUPD.

Results

Sample characteristics

Sample characteristics are displayed in Table 1. The majority of participants were female (65.3%), and White (68.1%). Around 66% had used alcohol in the past 30 days, roughly

15% reported smoking cigarettes during last 30 days, and around 15.4% using marijuana during the same period.

Sleep and NMUPD

Table 2 presents participants' experiences with the five different aspects of sleep quality in the past seven days; 22% of students reported not getting Enough Sleep (0–1 day/week); 24.3% reported having 2–5 days per week of Early Awakening and could not get back to sleep; 62.3% reported Daytime Sleepiness for 2–5 days per week; and 28.5% had Difficulty Falling Asleep during 2–5 days per week. In addition, approximately 90.0% reported having Problems With Daytime Sleepiness in the past seven days.

Chi-square analyses showed significant differences in the reported sleep quality aspects between females and males ($p < .0001$). For example, females (23.4%) reported significantly more frequently than males (19.4%) that they had 0–1 days of Enough Sleep; females also reported significantly more days of Daytime Sleepiness (18.0%) than males (12.8%) for 6–7 days/week. In addition, having 6–7 days of Early Awakening and 6–7 days of having Difficulty Falling Asleep were significantly higher among females (3.0% and 7.7%, respectively) than males (2.5% and 6.6%, respectively). Having Problem With Daytime Sleepiness was also significantly higher among females (91.7%) than males (86.5%). In addition, 14% of students in the total sample reported NMUPD, in at least one class, in the past 12 months (Table 2), while 7.5% reported use of painkillers, 7.4% use of stimulants, 4% use of sedatives, and 3% use of antidepressants.

Associations between NMUPD and sleep

Results of the ordinal regression analysis (odds ratio, 95% confidence interval [CI]) are in Table 3. Significant associations were found between NMUPD and sleep behaviors after adjusting for covariates. Students who reported NMUPD of at least one class of prescription drugs in the past 12 months reported significantly fewer days of getting Enough Sleep (OR = 0.86 [95% CI = 0.83–0.88]), more days of Early Awakening (1.28 [1.24–1.33]), Daytime Sleepiness (1.23 [1.19–1.26]), and more days of having Difficulty Falling Asleep (1.32 [1.28–1.37]).

In general, analyses did not differ when analyzing each drug class separately, even after controlling for covariates. For instance, students who reported NMU of painkillers reported significantly fewer days of getting Enough Sleep (0.84 [0.80–0.88]), significantly more days of Early Awakening (1.28 [1.22–1.34]), more days of Daytime Sleepiness (1.16 [1.11–1.22]), and having Difficulty Falling Asleep (1.27 [1.21–1.33]) ($p < .0001$).

This pattern was consistent for the NMU of stimulant use with the exception that results by gender suggest males were significantly more likely to report fewer days of getting Enough Sleep (0.88 [0.82–0.95]), and significantly more likely to report more days of Early Awakening (1.15 [1.06–1.25]) and Difficulty Falling Asleep (1.21 [1.12–1.30]), whereas the models for females for those same variables were not significant.

Finally, NMU of sedatives was significantly associated with Problem With Daytime Sleepiness (1.10 [1.03–1.17]), more days of Early Awakening (1.12 [1.05–1.19]), and having

Difficulty Falling Asleep (1.17 [1.09–1.24]). Results by gender suggest females had a significantly greater likelihood of reporting more days of Early Awakening and Difficulty Falling Asleep (1.14 [1.05–1.24], and 1.18 [1.09–1.27] respectively), whereas the models for males for those same variables were not significant.

Discussion

To our knowledge, this is the first study that has examined the association between NMUPD (antidepressants, painkillers, sedatives, and stimulants), and sleep quality using a large, national sample of college students. These results revealed that poor sleep is highly prevalent among college students across all five measured aspects of sleep quality. The majority of students (90%) reported Problems With Daytime Sleepiness, and about 62.3% reported Daytime Sleepiness for 2–5 days per week; this is consistent with prior research on poor-quality sleep (Tsai & Li, 2004; Lund et al., 2010). Female students reported poorer sleep quality, and that they felt more tired, dragged out, or sleepy during the day (Daytime Sleepiness) than did males, suggesting females have poorer sleep quality than males (Tsai & Li, 2004).

While 14% of students reported NMUPD in the past 12 months, this is less than a previous report of 20% lifetime use (McCabe et al., 2014). McCabe, Boyd, and Teter (2009) reported that 45% of college students had used painkillers, 46% had used sedatives, and 61% had used stimulants in their lifetime. Among adults, NMUPD has increased from 2.4% to 10.8% between 2007 and 2010 (NCHS, 2014). Nevertheless, the lower prevalence of NMUPD in this study is likely due to our assessment of NMUPD in the past 12 months as opposed to lifetime use. In addition, although the survey included the first part of the NMUPD definition (taken drugs that were not prescribed to them), the numbers here may have been much higher if the other ways of NMUPD (e.g., use of medication for reasons, or in ways, or in amounts, not intended by a doctor) were included in the questions.

Consistent with our expectations, findings confirm a significant association between NMUPD (during the past 12 months) and poor sleep quality, even after controlling for key covariates (Babcock & Byrne, 2000; Chong et al., 2013; Clegg-Kraynok, 2010, 2011; Dimsdale et al., 2007; Hartwell et al., 2014; Hershner & Chervin, 2014; McCabe et al., 2013). However, no significant association was found between antidepressant use and poor sleep, possibly due to the fact that most antidepressant drugs have few short-term effects on sleep and longer-term use eventually promotes sleep (Wilson & Argyropoulos, 2005). The most consistent short-term effect of antidepressants is on REM sleep (Lam, 2005; Wilson & Argyropoulos, 2005). However, some classes of antidepressants may cause insomnia, and daytime sleepiness in the early stage of treatment (Lam, 2005; Mayers & Baldwin, 2005). Therefore, additional research on the association between antidepressants and sleep should assess potential risks and benefits of NMU.

In our study, any NMUPD was significantly associated with reduced days of Enough Sleep; increased days of Early Awakening, Daytime Sleepiness, and having Difficulty Falling Asleep. Hence, our findings suggest a pattern of poor sleep quality among students who engage in NMU of any prescription drug class.

Similar to NMUPD overall, NMU of stimulants was significantly associated with reduced days of Enough Sleep; increased days of Early Awakening, Daytime Sleepiness, and having Difficulty Falling Asleep; which concurs with prior studies of poorer sleep quality, shorter sleep duration, and more sleep disturbances among users than nonusers (Clegg-Kraynok, 2010; 2011). Thus, our results support research demonstrating that stimulants increase sleep latency, decrease sleep duration, and lead to increased sleep disturbance (Babcock & Byrne, 2000; Hershner & Chervin, 2014). Since stimulants increase dopamine levels in the brain, the result may be a sense of euphoria, improved mental alertness, focus, and concentration, increased physical endurance, reduced appetite, extended wakefulness, increased energy levels, enhanced self-esteem, and elevated mood (Caplan, Epstein, Quinn, Stevens, & Stern, 2007; Khantzian, 1997; United States Drug Enforcement Administration [U.S. DEA], 2015). College students use stimulants to stay awake and study because stimulants delay sleep and increase alertness and wakefulness (Babcock & Byrne, 2000; Clegg-Kraynok, 2010; Clegg-Kraynok et al., 2011; Hershner & Cherwin, 2014). Thus, our findings extend knowledge on the impact of stimulants on sleep patterns and sleep quality among college students.

NMU of painkillers showed a similar pattern of associations with sleep quality and duration, as did stimulants and overall NMUPD. NMU of painkillers has been found to be associated with less sleep duration, longer sleep latency, increased trouble sleeping, and more awake time among adults (Hartwell et al., 2014; McCabe et al., 2013). Although opioids (e.g., hydrocodone, oxycodone, morphine, and codeine) are prescribed to relieve pain as they inhibit the transmission of pain signals (NIH, 2016b), misuse and abuse is common because they produce euphoria in addition to pain relief (NIH, 2016a; SAMHSA, 2016). Opioid painkillers also interrupt sleep by increasing wakefulness (which may lead to having difficulty falling asleep), increasing the number of shifts in sleep–waking states (increasing wake time), decreasing total sleep time (getting insufficient sleep), and affecting sleep stages (reducing deep sleep and increasing light sleep; Dimsdale et al., 2007; Hartwell et al., 2014).

The interrelated effects between chronic pain and severity, painkillers, and poor sleep quality in adults and among prescription opioid dependents are supported by previous studies (Dimsdale et al., 2007; Hartwell et al., 2014). Both pain severity and opioid use disrupt sleep (Hartwell et al., 2014); however, opioid use disturbs sleep even in pain-free individuals (Dimsdale et al., 2007). Although our cross-sectional research design precludes temporal conclusions regarding the role of opioid use in sleep disruption, our analyses did control for sleep-related disorders. Findings highlight the importance of including painkiller use and pain assessments when assessing sleep quality among college students.

NMU of sedatives was significantly associated with Problem With Daytime Sleepiness, more days of Early Awakening, and having Difficulty Falling Asleep. Although our study controlled for depression, a large body of literature suggests that individuals who engage in NMU of sedatives also suffer from depression (Brunette, Noordsy, Xie, & Drake, 2003; Conway, Compton, Stinson, & Grant, 2006). Sedatives decrease central nervous system activity (College of Psychiatry of Ireland, 2012) to produce a drowsy or calming effect. However, risk of addiction is high, especially when used with opioids and stimulants (SAMHSA, 2009) to complement the psychoactive (euphoric) effects (Hernandez & Nelson, 2010).

Sedatives cause a relaxing effect that is helpful for people with anxiety or sleep problems, but also cause sleepiness (NIDA, 2016). Therefore, dependence on, and tolerance for, NMU of sedatives for euphoric effects can lead to adverse health outcomes, including sleep disturbance (Chong et al., 2013). Interestingly, sedatives are often refereed to and used as sleep aids, and the rate of their use is high among those who suffer from short (< 5 hr) and long (> 9 hr) sleep (Chong et al., 2013). This may be done to compensate for short sleep; conversely, long sleep is nonoptimal and may result from high sedative use. Regardless, although the current study cannot be used to deduce causation, the association between NMU of sedatives and sleep supports the potential for drug use linking to poor sleep quality.

Finally, we found suggestive evidence for gender differences in NMUPD and sleep that will require explicit testing in the future. Associations were generally stronger among males for NMU of stimulants and among females for NMU of sedatives. These variations may be explained by the following. Although the rates of stimulant and sedative use among males (8.3% and 4.4% respectively) was higher than females (6.9% and 3.9% respectively), the physiological characteristics of females (Alexander, LaRosa, Bader, Garfield, & Alexander, 2010) may play an important role in explaining theses variations. For example, because evidence that drug metabolism and efficacy differ among males and females, resulting in higher rates of adverse drug reactions for females (Franconi, Brunelleschi, Steardo, & Cuomo, 2007), the pharmacological effects of stimulants in females may hinder the impact they may have on sleep. In addition, females had poorer sleep quality, as shown in our results and previous studies (Tsai & Li, 2004), and suffer from having more days of Early Awakened and Difficulty Falling Asleep than males, which has been exacerbated by sedative use.

Limitations

Results should be interpreted in the context of several study limitations. These data were cross-sectional and self-reported, and thus vulnerable to potential recall bias and socially desirability for subjective measures. The analyses were limited to questions available from this national survey, specifically the participants' sleep in the past seven days. Assessing sleep over just one week may not reflect typical sleep behavior. In addition, we were also limited to the questions available and timescale of the NMUPD items, which query use over 12 months. The ACHA-NCHA did not include additional potential confounding variables such as caffeine use, which may also influence sleep patterns and behaviors (Hershner & Chervin, 2014). Finally, since colleges self-select to participate in the ACHA survey, results cannot necessarily be considered generalizable to the larger U.S. college population.

Conclusions

Despite these limitations, our study demonstrates that poor sleep was common in this sample of college students and that these results show significantly increased odds for poor sleep with NMUPD. Our study extends the current literature by revealing associations between NMUPD and sleep in terms of several specific aspects of poor sleep quality, but also among several classes of prescription drugs based on gender. We submit that assessment of both sleep quality and NMUPD behavior among college students should consider their potential

synergistic risk factors in screening, treatment initiatives, and research, toward better understanding and improving college students' sleep health, productivity, wellness, quality of life, and academic achievement.

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Table 1

Overall and by gender sample characteristics.

Characteristic	Male *n* = 46,062 (34.7%)	Female *n* = 86,593 (65.3%)	Overall *N* = 13,3211 (100%) Frequency missing = 2,663
Demographics			
N = 135,874; Age mean (*SD*) = 22(*6*)			
Race or ethnicity *F* (%)			
White	31,037 (68.1)	58,566 (68.1)	89,603 (68.1)
Black	2,125 (4.7)	5,045 (5.9)	7,170 (5.5)
Hispanic or Latino	3,208 (7.0)	6,324 (7.4)	9,532 (7.2)
Asian or Pacific Islander	5,794 (12.7)	9,374 (10.9)	15,168 (11.5)
American Indian, Alaskan Native, or Native Hawaiian	727 (1.6)	1,361 (1.6)	2,088 (1.6)
Biracial or Multiracial	1,370 (3.0)	3,285 (3.8)	4,655 (3.6)
Other	1,337 (2.9)	2,001 (2.3)	3,338 (2.5)
BMI Mean (*SD*)	24.8 (*4.8*)	23.9 (*5.2*)	24.2 (*5.1*)
Substance use (past 30 days) *F* (%)			
Cigarette smoking	8,543 (18.7)	11,344 (13.2)	19,887 (15.0)
Alcohol use	29,542 (64.7)	55,353 (64.5)	84,895 (65.6)
Marijuana use	8,599 (18.8)	11,698 (13.6)	20,297 (15.4)
Diagnosed medical disorders in the past 12 months and the perceived overall stress level *F* (%)			
Attention deficit hyperactivity disorder (ADHD)	2,258 (5.0)	3,579 (4.2)	5,837 (4.4)
Insomnia	1,358 (3.0)	3,511 (4.1)	4,869 (3.7)
Sleep-related disorders	921 (2.0)	1,709 (2.0)	2,630 (2.0)
Depression	6,014 (13.7)	1,7115 (20.3)	2,3129 (18.0)
Stress	44,162 (96.6)	85,487 (99.2)	129,649 (98.3)

Table 2

Overall and by gender distribution of sample sleep behaviors (Dependent variables) and nonmedical use of prescription drugs (NMUPD; independent variables).

Variable	Male *n* = 46,062 (34.7%)	Female *n* = 86,593 (65.3%)	Overall *N* = 133,211 (100%)
Sleep variables (*in the past 7 days),* number of days (%)			
Enough Sleep			
0–1 Day "*Poor*"	8,865 (19.4)	20,280 (23.4)	29,145 (22.1)
2–5 Days "*Middle*"	30,633 (67.0)	57,254 (66.1)	87,887 (66.6)
6–7 Days "*Optimal*"	6,239 (13.6)	8,626 (10.0)	14,865 (11.3)
Early Awakening			
0–1 Day "*Optimal*"	34,842 (76.3)	61,197 (71.1)	96,039 (72.9)
2–5 Days "*Middle*"	9,698 (21.2)	22,304 (25.9)	32,002 (24.3)
6–7 Days "*Poor*"	1,113 (2.5)	2,523 (3.0)	3,636 (2.8)
Daytime Sleepiness			
0–1 Day "*Optimal*"	12,398 (27.1)	15,926 (18.5)	28,324 (21.5)
2–5 Days "*Middle*"	27,496 (60.1)	5,4691 (63.5)	82,187 (62.3)
6–7 Days "*Poor*"	5,834 (12.8)	15,527 (18.0)	21,361 (16.2)
Difficulty Falling Asleep			
0–1 Day "*Optimal*"	30,547 (66.8)	53,981 (62.7)	84,528 (64.1)
2–5 Days "*Middle*"	12,140 (26.6)	25,447 (29.6)	37,587 (28.5)
6–7 Days "*Poor*"	3,021 (6.6)	6,697 (7.7)	9,718 (7.4)
Problem With Daytime Sleepiness			
No Problem "*Optimal*"	6,198 (13.5)	7,168 (8.3)	13,366 (10.1)
Little to Very big problem "*Poor*"	39,573 (86.5)	78,990 (91.7)	118,563 (89.9)
Prescription drugs *(past 12 months)*			
Antidepressant use	1,264 (2.8)	2,742 (3.2)	4,006 (3.0)
Painkiller use	3,915 (8.6)	5,911 (6.9)	9,826 (7.5)
Sedative use	3,781 (4.4)	5,881 (3.9)	9,661 (7.4)
Stimulant use	1,998 (8.3)	3,340 (6.9)	5,338 (4.1)
Any NMUPD	6,786 (15.0)	11,651 (13.6)	18,437 (14.1)

Table 3

Overall and by gender Ordinal Regression Analysis (OR; 95% CI) for the nonmedical use of prescription drugs (NMUPD) as variables predicting sleep behaviors among college students (N = 135,874; adjusting for covariates[Δ]).

	Sleep Variables				
NMUPD Variables Yes vs. No	**Enough Sleep (OR^)**	**Problem with Daytime Sleepiness (OR^^)**	**Early Awakening (OR^^^)**	**Daytime Sleepiness (OR^^^)**	**Difficulty Falling Asleep (OR^^^)**
Antidepressants (CI)					
Overall	0.98 (0.92–1.05)	0.99 (0.93–1.07)	1.02 (0.95–1.09)	1.07 (0.99–1.14)	1.04 (0.97–1.11)
Male	0.96 (0.85–1.08)	1.04 (0.92–1.18)	1.07 (0.95–1.22)	1.01 (0.89–1.13)	1.01 (0.89–1.14)
Female	0.99 (0.92–1.08)	0.97 (0.89–1.05)	0.99 (0.91–1.07)	1.08 (0.99–1.17)	1.05 (0.97–1.14)
Painkillers					
Overall	0.84*** (0.80–0.88)	0.98 (0.93–1.02)	1.28*** (1.22–1.34)	1.16*** (1.11–1.22)	1.27*** (1.21–1.33)
Male	0.87** (0.80–0.93)	0.98 (0.91–1.06)	1.34*** (1.24–1.45)	1.16*** (1.08–1.25)	1.33*** (1.23–1.43)
Female	0.83*** (0.78–0.87)	0.98 (0.92–1.04)	1.24*** (1.17–1.31)	1.17*** (1.11–1.24)	1.23*** (1.16–1.30)
Sedatives					
Overall	1.07 (1.01–1.14)	1.10* (1.03–1.17)	1.12** (1.05–1.19)	0.98 (0.92–1.04)	1.17*** (1.09–1.24)
Male	1.08 (0.97–1.19)	1.09 (0.98–1.22)	1.07 (0.96–1.19)	0.96 (0.86–1.06)	1.13 (1.02–1.26)
Female	1.07 (0.99–1.16)	1.09 (1.00–1.18)	1.14* (1.05–1.24)	0.99 (0.92–1.07)	1.18*** (1.09–1.27)
Stimulants					
Overall	0.93* (0.89–0.97)	0.97 (0.93–1.02)	1.10*** (1.05–1.16)	1.13*** (1.08–1.18)	1.10*** (1.05–1.15)
Male	0.88** (0.82–0.95)	0.93 (0.86–1.01)	1.15** (1.06–1.25)	1.20*** (1.11–1.29)	1.21*** (1.12–1.30)
Female	0.96 (0.91–1.01)	0.99 (0.94–1.06)	1.07 (1.01–1.14)	1.09** (1.04–1.16)	1.04 (0.99–1.11)
Use at least one					
Overall	0.86*** (0.83–0.88)	0.98 (0.95–1.02)	1.28*** (1.24–1.33)	1.23*** (1.19–1.26)	1.32*** (1.28–1.37)
Male	0.84*** (0.80–0.89)	0.97(0.92–1.03)	1.33*** (1.26–1.41)	1.22*** (1.16–1.29)	1.44*** (1.36–1.52)
Female	0.87*** (0.83–0.90)	0.99 (0.95–1.03)	1.26*** (1.21–1.31)	1.23*** (1.18–1.28)	1.26*** (1.22–1.31)

Note. OR interpretation:

^ Less days of having Enough Sleep "Poor" < **1** > More days of having Enough Sleep "Optimal."

^^ No problem with Daytime Sleepiness "Optimal" < **1** Little to a very big problem with Daytime Sleepiness > "Poor."

^^^ Less days of Early Awakening, Daytime Sleepiness, and Difficulty Falling Asleep “Optimal” **< 1 >** more days of Early Awakening, Daytime Sleepiness, and Difficulty Falling Asleep “Poor.”

* $p < .01$;

** $p < .001$;

*** $p < .0001$

Δ Controlling for race; gender; age; BMI; cigarette, alcohol and marijuana use; being diagnosed for ADHD (attention deficit hyperactivity disorder), insomnia, sleep disorders, and depression; and the overall stress level. When we modeled one of the NMUPD variables as a predictor, we controlled for the other NMUPD.