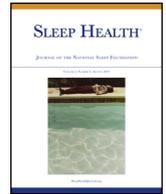




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Follow-up to Hartmann & Prichard: Should universities invest in promoting healthy sleep? A question of academic and economic significance

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ABSTRACT

Objective: We use regression results from Hartmann & Prichard (2018) in conjunction with other publicly available data to estimate the economic benefits from early identification and treatment of sleep problems on raising the likelihood of students' college graduation and future earnings.

Results: The benefits of improved graduation rates and future earnings exceed the cost of being screened, educated, and treated for sleep problems.

Conclusions: Based on the demand for information about healthy sleep by students and the established link between sleep problems and academic success, universities should consider instituting sleep health programs to identify and support students with sleep disturbances early in their academic careers.

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Introduction

Hartmann & Prichard (2018),¹ the first study to use a multi-institution, national survey to assess the impact of disturbed sleep on undergraduate academic performance, establishes that sleep disturbances are associated with a lower cumulative GPA and increased rates of course withdrawals and incompletes. This relationship holds even after controlling for physical and mental health diagnoses, alcohol and other drug use, work hours, and other demographic variables. Specifically, each additional day per week that a student experienced sleep problems raised the probability of dropping a course by 10 percentage points and lowered the cumulative GPA by 0.02. In this follow-up article, we consider what our estimates would imply for policy considerations about the return on investment in promoting healthy sleep in college students. We quantify a lower bound estimate of how improved sleep raises lifetime earnings and compare this against the expected costs associated with improved sleep.

Academic success in college is clearly associated with greater future economic stability, but remains elusive for many of students. United States Census data shows that approximately 60% of adults over 25 have attended at least some college after high school. However, 34% of students who initially enrolled in college in the fall of 2011 have not completed their degree, nor were they enrolled in courses 6 years later.² These students are then saddled with debt without the benefits of a degree. Higher educational attainment is consistently associated with higher median earnings.^{3,4} For example, in 2015 the median earnings of young adults (ages 25–34 who worked full time, year round) with a bachelor's degree (\$50,000) were 64 percent higher than their high school educated peers (\$30,500).⁵ Performance in the classroom is also a factor in acceptance into graduate and internships programs, thereby influencing a student's future career opportunities and advancement. Higher GPAs are associated with higher post-baccalaureate annual earnings, even after controlling for standardized test scores, major, and other academic and demographic characteristics.^{6–8} Therefore, addressing modifiable risk factors that impede academic performance early in an undergraduate student's career has important lifelong implications for future earnings.

Results from our 2018 study demonstrate that poor sleep as a predictor for academic performance is on par with or exceeds other

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predictive health factors for which universities routinely provide services (e.g., drug and alcohol education, stress management). Yet few universities invest wellness resources in promoting healthy sleep, despite the significant impact of sleep on academic success. Publicly released data from the Spring 2017 American College Health Association's National College Health Assessment (ACHA-NCHA) II survey revealed that 66% of students surveyed actually *want* to learn more about sleep from their universities, yet only a quarter report hearing anything about sleep from their schools.¹ Similarly, sleep is one of the most requested health topics NCAA varsity athletes identify as wanting the athletic staff to address.⁹ Shepardson and Funderburk (2014) found that when a university implemented a universal screening program in which all students visiting a university health clinic were screened for sleep disturbance problems, one third of the students expressed dissatisfaction with their sleep.¹⁰

However, even when students do approach college health professionals with sleep concerns, rarely are these concerns prioritized as a focus of treatment. The 2017 Center for Collegiate Mental Health annual report revealed that fewer than 3% of clinicians treating students who indicated sleep concerns on intake elected to prioritize sleep as a primary concern.¹¹ Given the important role of sleep in learning and health, sleep education programs for both students and college health professionals represent an underutilized opportunity for universities to further support student academic success and maximize retention rates.

Multiple studies indicate that approximately 60% of undergraduate students meet the criteria for poor sleep quality using the Pittsburgh Sleep Quality Index.^{12,13} Broadly speaking, students' sleep problems can be grouped into three major treatment categories: 1) disturbances stemming from physiological sleep disorders, which would require medical treatment (e.g., sleep apnea, narcolepsy, restless legs); 2) those associated with mental health disorders including insomnia, depression, and anxiety, which would be improved with psychological counseling and/or psychopharmacological treatment; and 3) disturbances associated with problematic behaviors including poor sleep hygiene and behaviorally-induced insufficient sleep, which could be addressed through targeted education.¹⁴ A campus-wide sleep screening and education program could offer students education to improve sleep, help identify students who are most at risk for physiological, psychological, and behavioral disturbances to their sleep, and then direct those students to the appropriate resources for follow-up education, diagnosis and treatment.^{15,16}

Randomized controlled trials on the effectiveness of sleep education programs to improve sleep behavior and quality in the college population have yielded moderate to mixed results.¹⁷ In a recent systematic review of sleep health promotion programs on college campuses, Ingargiola & Knowlden found that eight of nine sleep health and intervention programs produced significant improvements in sleep outcomes, including self-reported sleep quality.¹⁸ Another systematic review of 27 studies involving interventions in sleep hygiene, cognitive behavioral therapy (CBT), relaxation and mindfulness, including 15 randomized control trials, found that programs that encouraged the use of sleep tracking were associated with increased total sleep time, and programs that incorporated CBT were the most effective at reducing insomnia symptoms.¹⁹

Based on the demand for information about healthy sleep by students, and the established link between sleep problems and academic success (as reviewed in^{1,19}), universities should consider instituting a universal sleep screening program to identify and support students with sleep disturbances early in their academic careers. Here, we use our previous study's regression results in conjunction with other publicly available data to estimate the economic benefits from early identification and treatment of sleep problems on raising the likelihood of college graduation and, consequently, students' future earnings. We compare these benefits against the

cost of being screened, educated, and treated for sleep problems. For each step of the estimation process, we choose the most conservative approach. We provide a summary of the analysis in the body of the paper and a more detailed explanation of the assumptions underlying the estimates in the [Appendix A](#). Because we make conservative assumptions in our calculations, our conclusions likely underestimate the net positive impact of sleep intervention.

Economic estimations

Estimating how sleep treatment raises graduation rates

Universities can offer a universal sleep screening program to help identify and support students with sleep problems, which should in turn reduce the reported number of weekly sleep disturbances. The literature has shown that improved sleep is associated with a lower likelihood of dropping a course and this in turn would raise the likelihood of graduating. More specifically, we estimate that on average, each *additional* day per week a first-year student experiences sleep problems raises the predictive probability he or she drops a course by 14.16 percentage points, holding other variables constant.¹ We also know that earning a single withdrawal by a first-year, full-time college student lowers the likelihood of graduating within 6 years, the standard benchmark for graduation rates at higher education institutions, by 14 percentage points, holding other variables constant.¹⁹ Taken together, a reduction of 1 day per week in which a first-year student experiences sleep problems raises graduation rates by two percentage points.

In order to estimate how sleep treatment raises graduation rates, we must also quantify how much sleep intervention programs improve the quality of students' sleep. According to the 2009 ACHA-NCHA II data, students who receive treatment for a diagnosed sleep disorder report 1/4 of a night fewer self-reported sleep disturbances in a given week than those who were diagnosed, but untreated. Using this conservative estimate of treatment impact, we calculate that the treatment in turn will reduce the probability of a first year student dropping a course by 3.55 percentage points and thereby raise the probability of graduating within six years of entering college by 0.5 percentage point.

Estimating Sleep Disturbances' Impact on Higher Net Income Earnings

Given that higher educational attainment is consistently associated with higher median earnings, institutional sleep education programs may not only raise graduation rates, but also lifetime net earnings (earnings minus expenses associated with higher educational attainment). Using earnings data from the U.S. Census Bureau's 2015 Current Population Survey (CPS)²¹ in conjunction with other data, we determine that the benefit in higher net earnings from a bachelor's degree versus a high school degree is \$622,000. If treatment for sleep problems raises the probability of graduating from college by 0.5%, then the higher net earnings generated from treating sleep problems is approximately \$3110 (0.5% * \$622,000). Implementing a universal sleep screening program instituted by a university is expected to identify treatable sleep problems in approximately 60% of students.^{12,13} Based on the ACHA-NCHA II survey data, we also know that 70% of college students who are diagnosed with a sleep disorder actually seek treatment. This implies that implementing a universal sleep screening program will yield about \$1110 in expected economic returns per student (\$3110 * 60% * 70%).

Cost of sleep screening, treatment, and education programs

Now that we have calculated the benefits from instituting a sleep education program, we now need to compare them against the costs

Percentage of College Students	Treatment and Education Needed	Required Expenses	Expected Expenses Across College Students
40%	No treatment needed	\$0	\$0 *40%
5%	Require an overnight study to diagnose sleep disorders plus some form of treatment	\$1220 + \$2000	+ \$3220*5%
15%	In-person Counseling	Require bi-weekly counseling sessions including CBT (~\$770)	+ \$770*15%
40%	Online Sleep Education	Require sleep behavior modification offered by university health and counseling services (\$0)	+ \$0*40%
			= \$277

Fig. 1. Cost calculation

of obtaining these services. For simplicity, we start off by assuming that a sleep screening tool is similarly priced (\$975 per campus annually) to the program eCHECKUP TO GO, a substance abuse screening and education program used by over 600 campuses.²² Even if the university only has 500 students who participate in the online screening, the cost per student is quite low (\$2.00 in this case).

Expected costs for treatment for sleep disturbances will vary greatly depending on the severity of the sleep problem. Studies of college students' sleep suggest that approximately 40% of undergraduate students have adequate sleep quality,^{12,13} and thus will have no treatment costs. Another ~5% of undergraduates will likely have an undiagnosed physiological sleep disorder (e.g., sleep apnea, restless legs, narcolepsy, etc.).^{23,24} Those students will require a clinician consult and/or an overnight sleep study for diagnosis. A conservative estimate of the average out of pocket expenses for an overnight sleep study is \$1200.²⁵ This is an upper-bound cost estimate that is expected to fall over time as home sleep tests become more popular. Treatment for physiological sleep disorders would include costs associated with prescription medications, customized oral appliances, or continuous positive airway pressure (CPAP) devices. These students will likely not pay more than \$2000 for one of these treatment plans during their college years.

Research suggests that approximately 15% of students will have sleep disturbances associated with untreated psychological disorders including insomnia, depression and/or anxiety,^{11,14} and would benefit from personalized counseling including CBT.²⁶ These treatments are often covered by insurance and already provided at universities at little to no additional cost to students. However, universities may need to invest in additional professional development for their health staff members regarding best practices in behavioral sleep medicine. Even if we assume that universities passed on the expense of additional professional development and counseling hours to students, that cost is less than \$770 (see Appendix A). The remaining students (40%) are likely to experience sleep problems such as inadequate sleep hygiene, circadian rhythm disruption, behaviorally-induced

insufficient sleep, or pre-sleep cognitive arousal that are improved by education and behavioral modification.^{14,15,27} These students could benefit from a sleep education,^{15–18} which could be included in the cost of an online sleep screening and education program at no added cost.

Given these costs associated with the different categories of sleep disturbances, we can calculate the average treatment expense for an undergraduate student by weighing the possible expenses they will face (\$0 treatment expenses covered by an online sleep screening and education program, \$770 for additional out of pocket costs for counseling, and \$2000 for overnight sleep study and treatment) by the percentage of students who are estimated to pay those amounts. As a result, the expected out of pocket treatment cost for a given undergraduate student is estimated to be \$277. (See Appendix A for full calculations as shown in Fig. 1 and assumptions that underlie those calculations.) However, data from the NCHA on diagnosis versus diagnosis and treatment rates for sleep disorders suggest that of the 60% of students who are estimated to have a detectable sleep disturbance, only 70% will likely seek treatment. As a result, the expected out of pocket cost for treatment per student needs to be adjusted downwards to \$117 ($=\$277 * 60% * 70%$).

Given the above calculations, the total expected cost of *sleep screening, treatment, and education programs* per student is \$119.00 (\$117.00 + \$2.00). In comparison, promoting healthy sleep was estimated to yield about \$1110 in net present value of higher lifetime earnings per student. Thus, on the individual student level, the expected benefits of treating student sleep problems far exceeds the expected cost, even using the most conservative values for estimating costs.

Now let us explore why universities should consider investing in promoting healthy sleep on their campus. The additional university expenses required by a sleep screening, treatment, and education program are only the cost of screening (\$2 per person) and the personal counseling (\$770 per person for approximately 15% of the student body). Given that the reduction in sleep disturbances raises

academic success¹ through raising GPAs and lowering the likelihood of dropping courses, funding this sleep program would support the university's educational mission. However, in funding decisions, universities often also factor in the ability to pass onto students additional expenses in the form of a surcharge or tuition increase. Students could be willing to pay a surcharge for the added university expenses, given the improved academic success and the positive long-term added net value of a sleep program. Furthermore, improved sleep could speed up the time to graduation, thereby potentially lowering student debt with students dropping fewer courses. If adding a surcharge for the additional services is not an option, the university can bundle the price of the sleep program into the tuition. Universities routinely discount their posted tuition rates. The average discount in the United States is 50%.²⁸ This suggests the typical university will have to absorb 50% of the program's expenses (~\$60 per student in this case). Despite the higher expenses, universities may still earn higher net revenue if instituting a sleep program generates greater demand for their educational services in the competitive higher education market.

Discussion

Sleep education is one of the most requested and least provided health topics for college students in the United States. In Hartmann & Prichard (2018),¹ we demonstrated a significant negative relationship between poor sleep and both GPA and course completion. In fact, the strength of the association between poor sleep and academic success is on par with or exceeds that of other health factors for which universities routinely provide services. Given the salary advantage of completing college, the negative relationship between poor sleep and academic success also has pronounced implications for students' future earnings.

Low-cost sleep education programs have been shown to be effective at reducing sleep disturbances in adolescents and young adults.^{15–19} Our estimations demonstrate that the economic benefits of identifying and addressing sleep problems far outweigh the costs on an individual, per student level. Offering a university-provided sleep health and education program would likely confer economic benefits to the institution as well through increased retention and graduation rates, which account for 22.5% and 7.5%, respectively, of the *US News & World Report* college rankings.²⁹ Additionally, universities could implement systemic changes in policies (e.g., earlier assignment deadline times for online coursework), programming (creating sleep hygiene workshops), and facilities (e.g. residence hall lighting; library and exercise facility schedules) in ways that promote healthier sleep from an environmental perspective.³⁰

Importantly, the economic outcomes we estimate here are based solely on how poor sleep predicts academic performance. Beyond its pronounced relevance to course completion and GPA, poor sleep is also physically and mentally costly to students. Inadequate and nonrestorative sleep increases accident frequency, drug use, health care utilization, and depression and anxiety symptoms.^{31,32} Therefore, our results likely underestimate the true economic benefits of sleep treatment because they do not take into account the ballooning benefits of improved sleep, (e.g., decreased illness, health care utilization, and motor vehicle accidents).³³ As such, addressing sleep problems early in a student's college career would likely lead to improved wellness across a number of clinically relevant measures.

Identification and treatment of sleep disorders are becoming increasingly common in the corporate world,³⁴ as economists and health care analysts better understand the true cost of untreated sleep disturbance. For example, using data from the American Time Use Survey, Gibson and Shrader showed that a permanent one-hour increase in weekly average sleep increased average wage by 5% in the long run.³⁵ At the national level, the overall cost of sleep

disorders (e.g., direct health costs, work related injuries associated with excessive sleepiness, sleep-related motor vehicle accidents, productivity losses) was found to represent 0.8% of Australian gross domestic product.³⁶ As institutions of higher learning navigate the tuition-driven climate of students with record levels of sleep disturbance and mental health challenges,³⁷ sleep screening and education programs provide universities a low-cost, easy to implement approach to increasing academic performance and retention.

Disclosure statement

Financial Disclosures: None.

Non-financial Disclosure: J.R. Prichard is a co-developer of the College Sleep Questionnaire,TM which is currently in beta-testing.

Appendix A

In this appendix, we provide a more detailed explanation of the assumptions that underlie our estimates of the economic benefits and costs of promoting healthy sleep for each section of the paper.

A.1. Estimating How Sleep Treatment Raises Graduation Rates

Here, we calculate how reducing sleep problems raises graduation rates. We already know the link between sleep treatment and dropping a course¹ and the link between dropping a course in the first year and graduating in six years¹⁹ from the extant literature. Now, we need to know how sleep treatment affects quality of sleep. Using the 2009 ACHA-NCHA II survey data, we observe that students who were both diagnosed and treated for diagnosed sleep disorders (70% of those diagnosed) had fewer days of self-reported poor sleep in a given week by 1/4 of a night on average than those who were diagnosed, but untreated (30% of those diagnosed). This reduction in number of reported nights of poor sleep is equivalent to 10% of the mean sleep disturbances reported by college students. This figure likely underestimates the impact of treatment of sleep disorders on improved sleep because there was no accounting for best practices in behavioral sleep medicine, or in improvements in diagnosis and treatment of physiological sleep disorders since 2009. As a result, we are underestimating the benefits of promoting healthy sleep on graduation rates.

A.2. Estimating Sleep Disturbances' Impact on Higher Net Income Earnings

Higher educational attainment is consistently associated with higher median earnings. Thus, if sleep education programs raise graduation rates, it also will raise lifetime net earnings (earnings minus expenses associated with higher educational attainment). In order to calculate this, we must determine how much a college degree raises one's lifetime net earnings. We obtain earnings data from the U.S. Census Bureau's 2015 Current Population Survey (CPS).²⁰ In our calculations of present value of lifetime earnings, we assume a 3% discount rate for future earnings and a 7% return to a year of schooling based on a review of the causal relationship between education and earnings.³⁸ Given this, we determine that the marginal present discounted value of earnings from graduating from college verses graduating from high school equals \$710,000 (in 2014 dollars).

However, in comparing the benefits from graduating versus not graduating, we must take into account that a student could have earned a salary and would not have had to pay for tuition if they were not attending a university. According to the CPS, 18–21 year olds who graduated from high school but did not attend college earned approximately \$7000 more per year than their peers of the same age who were attending college.²⁰ In addition, on average students at four-year institutions paid approximately \$15,000 (in

2014 dollars) for tuition and required fees per year.³⁹ This implies that the full cost of attending college for 4 years is approximately \$88,000. As a result, the net benefit in higher earnings from graduating from college is \$622,000 and not \$710,000.

A.3. Cost of Sleep Screening, Treatment, and Education Programs

Here, we calculate the costs associated with sleep diagnosis and treatment as well as psychological counseling services so we can compare them against the benefits generated. The cost figures reported in the body of the paper are higher than what most undergraduate students typically will pay. For example, the \$1200 out of pocket expenses for an overnight sleep study is from a survey of truck drivers, some of whom did not have health insurance. Typically, most students will not have to pay the full cost. Eighty-four percent of people between the ages of 18 and 25 are covered by health insurance.²⁰ If one assumes a 20% co-pay, students with insurance will only pay approximately \$240 for this test or even zero if covered by insurance. We also acknowledge that the sleep study expenses will fall over time with increased use of at-home sleep tests. For example, the cost of diagnosing sleep apnea at home is between \$150 and \$500 and is covered by most insurance companies.⁴⁰ Thus, you could view the \$1200 as a worst case scenario of what a student will have to pay.

We also use a conservative estimate for expenses for sleep treatment plans for students with physiological sleep disorders. For example, those who pursue CPAP treatment will likely need a CPAP machine with a humidifier (\$512), CPAP mask (\$119), and other miscellaneous supplies (\$1000).⁴¹ Alternatively, the treatment plan may require a sleep apnea dental appliance. The average cost for this appliance is between \$1800 and \$2000, which includes the actual mouthpiece, dentist visits, adjustments, follow-ups and adjustments.⁴² University students will like only have to pay a fraction of these expenses either because of insurance coverage and/or because technological advancements lower prices of items over time.

For students with sleep disturbances associated with psychological disorders, insurance often covers counseling services, and many universities are able to provide those services to students at no added cost. However, in calculating the expected costs to students, we use a more stringent assumption and assume students must pay for these services. If the student must visit a counselor off campus or the university charges for these services, these students may anticipate paying total of ~\$770 for counseling services every other week for the entire academic year. For simplicity, we assume that a student meets with a counselor every other week for the entire academic year (i.e., 15 meetings.) If the 2017 median pay (in 2014 dollars) for Ph.D. Clinical, Counseling, and School Psychologists is \$35.76 per hour⁴³ and wages and salaries only account for 69.7% of employee compensation,⁴⁴ the student will be charged \$770 for counseling services. There is a growing industry of online sleep education and CBT for insomnia tools that provide effective behavioral sleep modification at low cost, so our estimations for psychological treatment are likely an upper bound, the highest you would expect students on average will have to pay.

Given that we are using inflated expenses to calculate the cost of promoting healthy sleep, our conclusions are more powerful than they seem. The true net benefits from these programs are then actually higher than what we calculate. We are actually making it more difficult for ourselves to prove that the benefits exceed the costs for implementing these programs.

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