NIH Public Access
Author Manuscript
Behav Sleep Med. Author manuscript; available in PMC 2014 March 19.

Published in final edited form as:
Behav Sleep Med. 2013 ; 11(3): 159–172. doi:10.1080/15402002.2011.602776.

The Role of Sleep in Predicting College Academic Performance: Is It A Unique Predictor?

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Abstract

Few studies have looked at the predictability of academic performance (i.e., cumulative grade point average [GPA]) using sleep when common nonsleep predictors of academic performance are included. The present project studied psychological, demographic, educational, and sleep risk factors of decreased academic performance in college undergraduates. Subjects (N = 867) completed a questionnaire packet and sleep diary. It was hypothesized that low total sleep time (TST), increased sleep onset latency (SOL), later bedtimes, later wake times, and TST inconsistency would predict decreased academic performance. The most significant predictors of academic performance were high school GPA, standardized test scores (i.e., SAT/ACT), TST, time awake before arising (TWAK), TST inconsistency, and the quadratic equations of perceived stress (PSS) and TST.

Keywords

Psychological; Demographic; Educational; Sleep; Academic; College; GPA

Academic performance in college is an important predictor of outcomes after college. For instance, cumulative grade point average (i.e., overall average of grades over a college career; GPA), predicts future financial success and affects psychosocial well-being (Erikson, 1963; Filer, 1981, 1983; Wise, 1975). Annual earnings for persons with degrees in business rise 8.9% for each one-point increase in grade point average (GPA; Jones & Jackson, 1990). Minimum GPA requirements often exist for internship and career positions (Baird, 1985), thus low achieving students are less likely to gain the degrees and relevant experience necessary to be eligible for high-earning jobs or graduate degree programs. Although these relationships may not be causal, they nevertheless suggest the need to identify factors that contribute to and predict undergraduate academic performance.

High school GPA and the American College Testing exam (ACT)/Scholastic Aptitude Test (SAT) scores are among the most significant predictors of college GPA, which is one reason colleges and universities often rely on them to predict college outcomes. Both the ACT and SAT are used as college admissions tests because they were created to predict the success a high school student would have at the college level. However, high school GPA and standardized tests (i.e, SAT/ACT scores) only account for approximately 25% of the variance in academic performance (Robbins, Lauver, Le, Davis, Langley, & Carlstrom, 2004). Studies have shown that gender and ethnicity are also robust predictors of academic

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performance (Betts & Morell, 1999; Peters, Joireman, & Ridgway, 2005). Socioeconomic status (SES) has a significant, but weaker association with GPA, which could be the result of restricted range (Robbins et al.; Sackett, Kuncel, Arneson, Cooper, & Waters, 2009).

Mental health problems have also been implicated as significant predictors of college outcomes, although findings have not always been consistent. It is intuitive to think that students suffering from mental health problems (e.g., anxiety disorders, substance use disorders, and depression) would have more difficulties in college. Anxiety disorders are associated with worse performance (Stringer, Crown, Lucas, & Supramanium, 1977; Woffe & Johnson, 1995), although anxiety per se may have an inverted U-shape relationship (i.e., Yerkes-Dodson Curve) with exam performance (Edwards & Trimble, 1992). Alcohol use disorders, drug use, and drug use disorders are also associated with decreased academic performance (Cox, Zhang, Johnson, & Bender, 2007; Dozier & Barnes, 1997; Kessler, Foster, Saunders, & Sang, 1995; Maney, 1990; Martins & Alexandre, 2009), although not all studies document this relationship (Paschall & Freisthler, 2003; Singleton, 2007). Similarly, students diagnosed with major depressive disorder have lower GPAs than those without (Hysengeasi, 2005), but the association between academic performance and depression using common depression scales is less clear (Svanum and Zody, 2001).

The relationship between sleep and GPA in college students has been understudied, especially considering the high prevalence of sleep problems in this age group (Gomes, Tavares, & Azevedo, 2002). For instance, college students report inconsistent sleep schedules, frequent difficulties falling and staying asleep (Forquer, Camden, Gabriau, & Johnson, 2008), lower total sleep times (TST) than the National Sleep Foundation recommends and lower ideal TST than they would choose for themselves (Taylor & Bramoweth, 2010). The effects of these sleep problems likely extend beyond the bedroom into daytime activities, including academic performance.

A recent study by Gaultney (2010) found that college students were at significant risk for having sleep disorders, most notably insomnia, and that those at risk for sleep disorders were performing more poorly in school. Previous studies have generally found that lower TST, later bedtimes, longer sleep onset latency, and later rise times, less frequent naps, and inconsistent sleep schedules are all associated with worse academic performance in college or medical students (Eliasson, Lettieri, & Eliasson, 2010; Jean-Louis et al., 1996; Johns, Dudley, & Masterton, 1976; Medeiros, Mendes, Lima, & Araujo, 2001; Smith, Reilly, & Midkiff, 1989; Trockel Barnes, & Egget, 2000).

The primary limitation of previous research was the use of single time-point retrospective estimates of sleep (e.g., Howell, Jahrig, & Powell, 2004; Thacher, 2008; Trockel et al., 2000). Retrospective estimates of sleep are often used in epidemiological studies because they are easy to administer, economical, and have little participant burden. However, retrospective questionnaires are limited in their usefulness because they tend to be biased and only give a partial sleep profile (Gau et al., 2007; Gray & Watson, 2002; Thacher, 2008). Since retrospective estimates open the possibility of exaggerating severity, it has been recommended that these types of estimates be supplemented with prospective assessments such as sleep diaries (Buysse, Ancoli-Israel, Edinger, Lichstein, & Morin, 2006; Thacher, 2008).

While previous studies show that many sleep variables share a relationship with academic performance, to date very few have examined all of the sleep variables simultaneously. Further, many studies failed to control for significant predictors of academic performance such as standardized test scores, high school GPA, and SES. This makes it difficult to interpret the true strength of the relationship between sleep variables and academic performance.

The objective of the present study was to perform the most comprehensive examination, thus far, of the relationship between sleep and college academic performance (cumulative GPA), concurrently with other traditional academic and psychological predictors, to begin formulating a theoretical explanation for GPA. It was hypothesized that even after all other significant variables where included in the regression model, sleep variables would continue to be significant predictors of academic performance in college students, but at a lower level that previously found in studies that did not control for other variables.

METHOD

Participants

Students (N = 1039) were recruited from undergraduate psychology classes at a large state university in Texas during the 2006 fall semester and the 2007 spring semester. Subjects received extra credit towards a psychology class in exchange for participation. Subjects registered for the study through the Department of Psychology's research participant pool. Participants signed consent forms prior to completing study materials and signed release of information forms to allow researchers to access their transcripts and standardized test scores from the registrar's office. Participants were first excluded from this study's analyses if they were not an undergraduate student or failed to provide information on academic rank (n = 75). We next excluded any remaining individuals who were over 26 years old (n = 46), because it was felt they were not representative of the traditional college student. Next, we excluded individuals who were missing cumulative college GPA data (n = 11) or who dropped out during the semester data was collected (n = 1). Finally, Native American (n = 5) and individuals who indicated "other" ethnicities (n = 34) were excluded from further analyses because cell sizes would be too small to allow for ethnicity to be investigated as a reliable predictor variable. Therefore, the final sample size was N = 867.

Of the remaining participants, 71% were females, which was representative of the undergraduate psychology classes sampled. The mean age of the sample was 19.8 years (SD = 1.9). Race/ethnicity was similar to that of the overall student population: 70% Caucasian, 13% African American, 11% Hispanic, and 6% Asian/Pacific-Islander. Freshmen accounted for 40% of the sample, 28% were sophomores, 19% were juniors, and 14% were seniors.

Procedure

Subjects were asked to download documents from online, then complete consent forms, a questionnaire packet, and a one-week sleep diary. Separate consent forms that allowed access to transcripts and standardized tests were forwarded to the Registrar's office; questionnaires and sleep diaries were returned to the Sleep and Health Research lab for data entry.

Materials

Academic performance—Academic performance was measured by cumulative college GPA, obtained from academic transcripts. Most transcripts included information on participants' high school and college GPA (semester and cumulative) as well as SAT/ACT scores. High school GPA was standardized to the 4.0 scale if originally in percentage form.

In some cases high school GPA was either not standardized to a common scale (i.e., 4.0 or percentage; n = 116), or was not available because students transferred into the university and were not required to provide their high school GPA (n = 313). The amount of missing data was too great to be random, so this data was dummy coded (0 = high school GPA absent, 1 = high school GPA given) and used to run between groups analyses with college cumulative GPA as the dependent variable; no significant differences were found (p = .43).

SAT/ACT scores were standardized into Z-scores using normative data (i.e., SAT M = 1062.83, SD = 158.84; ACT M = 22.34, SD = 3.60), so scores could be compared between subjects when only one test was taken. In cases where both tests were taken, standardized scores were averaged.

Questionnaire packet—This questionnaire was created by the authors' research lab in order to collect data on demographics (i.e., gender, age, ethnicity, academic rank, and socioeconomic status [SES; based on reported parental income]), as well as other data of interest for other studies, for which no validated measures exist. Combined parental income was used to estimate students' socioeconomic standing.

Alcohol use disorders identification test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). The AUDIT is a screening instrument to identify alcohol use that has become injurious to health beyond alcoholism (i.e., illness, distress to drinker, family, or friends, trauma, hospitalization, prolonged disability, early death, ect). The AUDIT contains 10 multiple-choice and yes-no questions that use a 5-point Likert scale. Reliability was calculated on undergraduate students with a Cronbach's α of 0.80 (Saunders et al., 1993). In the present study, reliability was a Cronbach's α of 0.82. In clinical and non-clinical populations, the AUDIT was strongly correlated with other alcohol problem surveys such as the Michigan Alcohol Screening Test (r = 0.88; Bohn, Babor, & Kranzler, 1995).

Marijuana problem scale (MPS; Stephens, Wertz, & Roffman, 2000). The MPS is a 20-item self-report instrument that assesses negative social, occupational, physical, and personal consequences of excessive marijuana use. Participants specify the incidence and intensity of each item (0 = no problem; 1 = minor problem, 2 = serious problem) in the previous 90 days. The total number of problems (minor or serious) functioned as an index of the severity of marijuana related consequences. Reliability was calculated on a normative sample with a Cronbach's α of 0.85 (Stephens, Roffman, Fearer, Williams, Picciano, & Burke, 2004). In the present study, reliability was a Cronbach's α of 0.90.

Quick inventory of depressive symptomatology – self-report (QIDS; Rush, Trivedi, Ibrahim, Carmody, Arnow, Klein, et al., 2003). The QIDS is a 16-item self-report questionnaire that assesses nine symptom domains of depression: sleep disturbance, psychomotor disturbance, changes in weight, depressed mood, decreased interest, decreased energy, worthlessness and guilt, concentration and decision making, and suicidal ideation (Rush et al., 2003). Each item is rated 0 to 3 and the total score has a range of 0 – 27. Reliability was calculated with a Cronbach's α of 0.81 (Rush et al., 2003). In the present study, reliability was a Cronbach's α of 0.71. Using a cutoff score of 6, with higher scores indicating clinically significant depression, the QIDS has a sensitivity of 79% and a specificity of 81% (Rush et al., 2003). The QIDS is highly correlated with the Hamilton Rating Scale for Depression (Hamilton, 1960), r = .72, and the Inventory of Depressive Symptomatology (Rush, Gullion, Basco, Jarrett, & Trivedi, 1996), r = .82 (Rush et al., 2003).

Perceived stress scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). The PSS is a self-report questionnaire containing 14 items that is used for evaluating the stress domains of unpredictability, lack of control, stress overload, and stressful life circumstances. Respondents indicate the occurrence of feelings, thoughts, or circumstances expressed on a 5-point Likert scale (0 = never to 4 = very often). Items produce a compiled score with a range of 0–56; higher scores reveal greater perceived stress. Reliability was calculated on two undergraduate samples with a Cronbach's α of 0.84 and 0.85. Approximation of internal consistency for a clinical outpatient sample was 0.80 and 0.75 in a non-clinical population. In the present study, reliability was a Cronbach's α of 0.88. The PSS demonstrated convergent validity with the Maslach Burnout Inventory (r = 0.65).

Sleep diary—Sleep diaries asked participants to give details about their sleep each night over the course of a week, including: sleep onset latency (SOL), number of awakenings (NWAK), wake after sleep onset (WASO), TST, naptime, time in bed, sleep efficiency (SE), bed time, wake time, and time awake prior to arising (TWAK). TWAK was developed in the researcher's lab to estimate the amount of time a person lies awake in bed before arising (i.e., getting out of bed).Previously, it has been shown to positively predict academic performance. Sleep diaries are the most commonly used method of prospective self-report measurement of sleep in the clinical realm, because they are inexpensive, efficient, prospective, and sensitive to change. Sleep diaries are more accurate than single-time point retrospective estimates of typical sleep (Coursey, Frankel, Gaarder, & Mott, 1980), and allow for a more detailed analysis of the relationship between sleep and other correlates (e.g., academic performance). There is also good agreement between sleep diaries and the "gold standard" objective measure of sleep, polysomnography (κ = 0.49 – 0.63; Gehrman, Edinger, Means, & Husain, 2003). In addition, we calculated the standard deviations for each of these variables over the course of each individuals seven day diary. This gave us a measure of variability or inconsistency individuals had in these variables over the course of a week.

Results

Correlates of GPA

Table 1 shows descriptive data of the academic, psychological, and sleep variables of interest. First, a series of analyses were performed to determine if GPA differed by demographic variables (i.e., ethnicity, gender, academic rank, and SES). As can be seen in Table 2, females had on average higher GPAs than males; Caucasian and Asian American students had higher GPAs than African American and Hispanic students; and freshmen had significantly lower GPAs than sophomores and seniors, with a trend for lower GPAs than juniors (p = .086). There were no significant differences between different SES groups on cumulative GPA (p = .155).

Next, bivariate correlations were run on continuous measures of demographics, psychological variables, sleep, and cumulative GPA. As can be seen in Table 3, age was not a significant predictor of cumulative GPA, but all of the academic and psychological variables were. Results indicated that as high school GPA and standardized tests scores increased so did cumulative GPA, whereas as depression, stress, alcohol use, and marijuana problems scores increased, cumulative GPA decreased. It is important to note that some of the significant correlations were very low due to high statistical power.

With respect to sleep variables, Table 3 shows that bedtime, wake time, SE, and Nap were all significantly correlated with cumulative GPA, as were variability (i.e., increased standard deviation) in bedtime and wake time, TST, SE, SOL, and NAP. Results indicated that later bed and wake times and increased nap taking were related to lower cumulative GPAs, as were greater variability in bedtimes, wake times, TST, SE, SOL, and NAP. Conversely, greater SE was significantly related to higher cumulative GPAs

Because previous findings have shown that stress actually has a curvilinear relationship to academic performance, where too little and too much stress were related to worse performance than intermediate levels, we next performed a polynomial analysis of PSS as a predictor of cumulative GPA. As can be seen in Figure 1, a significant quadratic relationship was found, R^2=.026, $F(2, 842) = 11.09$, $p < .001$, where students with low scores on the PSS (e.g., 0–5) had slightly worse cumulative GPAs than those in the intermediate range (e.g., 5–15), but as scores continued to increased (e.g., >15) cumulative GPA began to drop significantly.

Based on previous findings, it was surprising that a significant correlation was not found between TST and cumulative GPA. Given findings in other areas that show both long and short sleep duration are associated with impaired health status (e.g., Kripke, Garfinkel, Wingard, Klauber, Marler, 2002), similar to the relationship found for PSS, we next performed a polynomial analysis of TST as a predictor of cumulative GPA. As can be seen in Figure 2, a significant quadratic relationship was found, R^2=.02, $F(2, 864) = 8.89$, $p < .001$, where students with low and high TSTs had worse cumulative GPAs than those in the intermediate range.

Hierarchical Multiple Regression for Variables Predicting Cumulative GPA

As mentioned earlier, previous studies have found that traditional academic predictors (e.g., high school GPA, standardized test scores) only account for about 25% of the variance in academic performance in college. Studies looking at the impact of sleep on academic performance, however, have often failed to take these traditional predictors into account. To overcome this limitation, a hierarchical multiple regression was performed which included demographic, academic, psychological and sleep variables that were all significantly related to cumulative college GPA. Demographic, academic, and psychological variables were entered into the first block, sleep variables were entered into the second block, and computed quadratic variables for PSS and TST were entered into the final block. Table 4, shows the final regression model with all variables entered.

As can be seen in Table 4, when all of the variables previously shown to be related to cumulative GPA were entered into the model simultaneously, the only variables that remained significant predictors of cumulative GPA were high school GPA, Standardized Test Scores, gender, academic rank, TWAK, TST, TST inconsistency, and the quadratic equation of TST. This final model was a significant predictor of cumulative GPA, $R^2 = .344$, $F(2, 405) = 8.49$, $p < .001$, and explained 31.5% of the variance. There was a significant F change for each block (all *p*s < .05), where the traditional academic predictor variables predicted 21.5% of the variance, the demographic variables explained an additional 3.9% of the variance, the psychological variables explained an additional 1.9% of the variance, the addition of sleep variables explained an additional 5.3% of the variance, and finally the quadratic PSS and TST variables explained an additional 1.4%. Interestingly, the strongest single predictor of cumulative GPA was TST ($\beta = 1.566$) followed by the TST quadratic function ($\beta = -.870$).

Due to the large amount of missing high school GPA data, multiple imputation was performed to impute high school GPA to see if the relationships above continued to be significant when all subjects were entered into the analysis. As can be seen in Table 4, all of the aforementioned predictors remained significant in this analysis except TST. In addition, ethnicity, PSS, AUDIT, and the quadratic equation for PSS were added to the list of significant predictors.

Discussion

These data add to the literature investigating predictors of college student academic performance. The hypothesis was confirmed that even after all other significant variables where included in the regression model, sleep variables continued to be significant predictors of academic performance in college students, but at a lower level than previously found in studies that did not control for other variables. These results appear to be a conservative and accurate estimate of academic, psychological, and sleep predictors of college academic performance.

Consistent with previous research, gender and ethnicity were both significantly correlated to academic performance (Betts & Morell, 1999; Peters et al., 2005). Specifically female students, Caucasian and Asian American students had higher GPAs. Previous research studied the relationship between ethnicity, gender, and academic performance within the context of personal background (e.g., Betts & Morell, 1999). Without accounting for all other variables that predict GPA, it is reasonable to imagine that homoscedasticity among similar variables could have inflated gender and ethnicity's effect.

SES was not significantly predictive of GPA, which is in line with current studies (Robbins et al., 2004; Sackett et al., 2009) that challenge previous results showing a strong predictive relationship existing between SES and academic performance. Recently, the relationship between SES and academic performance has been weaker perhaps due to improved academic programs or advances in statistical analyses. There may also have been a restriction of range of SES within college samples.

Since this study looked at the factors associated with academic performance holistically, the relationship between psychological factors and academic performance was also evaluated. Perceived stress, as measured by the PSS, was significantly predictive of academic performance, but in a curvilinear manner, similar to results in anxiety literature (Edwards & Trimble, 2002; Stringer et al., 1977; Woffe & Johnson, 1995). Increased and unmanaged stress and less than mild to moderate amounts of stress may lead to decreased functioning in many areas of life, including academics.

Previous results have been unable to consistently show a relationship exists between depression and academic performance (Hysenbegasi, 2005; Svanum & Zody, 2001). The current study found the QIDS was negatively correlated to academic performance. However, once all variables were included in the same model, the QIDS was not a significant predictor of academic performance, which is line with previous research of self-reports of depression (Svanum and Zody, 2001).

A similar pattern of results was seen for the AUDIT, MPS, and PSS, although the AUDIT and PSS did regain significance with multiple imputation. The initial results were in accordance with the literature in both adolescent and college populations (Cox et al., 2007; Dozier & Barnes, 1997; Kessler et al., 1995; Maney, 1990; Martins & Alexandre, 2009, Singleton & Wolfson, 2009). However, the loss of significance after including all possible predictors reduces confidence in the previous findings where other predictors were not always accounted for. However, the loss of results for the AUDIT and PSS may have simply been a factor of reduced power because missing high school GPA data resulted in pairwise exclusion in the overall model. Thus, when this missing high school GPA data was imputed using a multiple imputation technique, the relationship became significant again.

Finally, the primary aim of this research study was to further examine the relationship between sleep and academic performance. It was found that later bedtime and wake times, increased TWAK (trend) and increased nap time were all related to lower cumulative GPA, as were increased inconsistency in bedtime and wake time, TST, SE, SOL, and nap time. Increased SE was related to higher academic performance. All of these results were in agreement with previous research (Eliasson et al., 2010; Gomes, Tavares, & Azevedo, 2002; Jean-Louis et al., 1996; Johns et al., 1976; Medeiros et al., 2001; Peters et al., 2005; Smith et al., 1989; Trockel et al., 2000). Although low TST has been consistently shown to be correlated with lower academic performance (Gomes et al., 2002; Jean-Louis et al., 1996; Medeiros et al., 2001; Trockel et al., 2000), this effect was not found in the present study when examined singly, but a significant quadratic relationship was shown, meaning that low and high TST were related to lower academic performance. When all significant variables were included in the overall regression model, only TWAK, TST, and TST inconsistency, and the quadratic equation for TST remained significant sleep predictors. When multiple imputation was used, the TST variable lost significance.

A possible behavioral theory tying all the sleep variables of the final model together (i.e., TWAK, TST inconsistency, and TST quadratic equation) is centered on conscientiousness. The Conscientiousness/Disinhibition personality scale of the NEO Personality Inventory-Revised is related to both sleep schedule and academic performance, and is the only personality trait related to sleep schedule. Specifically, individuals that score high for this personality trait have more consistent sleep schedules and earlier bedtime/wake times than individuals scoring low (Gray & Watson, 2002). Similarly, eveningness, keeping a later sleep and wake schedule, is significantly related to low self-control (Digdon & Howell, 2008). Therefore, it is suggested that students with low conscientiousness are more evening oriented, have greater TST, TST inconsistency, and TWAK because they do not use time wisely and perhaps procrastinate on schoolwork and projects. This in turn leads to later bedtimes, longer TST, and later wake time. If more time is needed than sleep will allow, lesser TST would be taken or all-nighters could even be implemented, which has been shown to predict decreased academic performance, even if only used once in an academic career (Thacher, 2008). Other research has suggested the same idea, but in reverse where students on an earlier schedule appear to be more achievement-goal oriented and disciplined (Gray & Watson). College students have a great amount of flexibility in their sleep schedule when compared to high school or working adults, so it stands to reason that students that are unable to properly manage the new increased amount of time at their disposal will not do as well in school or sleep as well.

Some limitations of this research are important to note. All data, except high school GPA data, standardized test scores, and academic performance, were self-report and therefore only as accurate and reliable as the subjects in the sample. Participants were asked to complete sleep diaries upon awakening in order to increase the accuracy of the previous nights' sleep, and this is still better than single time-point retrospective estimates. A great deal of the sample was missing high school GPA, so multiple imputation was used in the final hierarchical regression, with few changes in results.

Despite these limitations, the findings of this study are of importance to university administrators, healthcare workers, and students themselves. What is most telling from these results are that in the overall model without imputation, sleep variables are the only significant modifiable risk factors for decreased academic performance. With imputation, stress and alcohol use measures also became significant, but most of the sleep variables remained significant. These results suggest that one way to improve academic performance in college students may be to provide a multimodal treatment approach addressing sleep as well as alcohol use and stress. These domains have some overlap, so the interventions for stress management would likely improve sleep and alcohol use. However, the results presented here argue for additional attention to the sleep and alcohol use domains, which colleges and universities' health centers could easily translate into real world application. It would be advantageous for schools to add guidelines for new students to be educated on the effects of sleep, alcohol, and stress on academic performance. In addition, students on academic probation could be screened for sleep patterns, alcohol use, and stress problems as part of the "additional counseling" required to increase academic performance to a satisfactory level and prevent drop-out.

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Future studies investigating correlates of academic performance would benefit from measuring weekday and weekend sleep variables rather than a combined measure of weeklong sleep behaviors. Studying class times is another avenue of research that can help the field better understand how scheduling and daytime rhythms affect academic performance. The inclusion of objective measures (e.g., actigraphy) in future research will help improve the accuracy of measuring sleep behaviors and longitudinal analyses are necessary to build a more causal model for the relationships between sleep and academic performance. Finally, additional research is needed to determine successful methods to help students change sleep patterns once areas of corrections have been identified.

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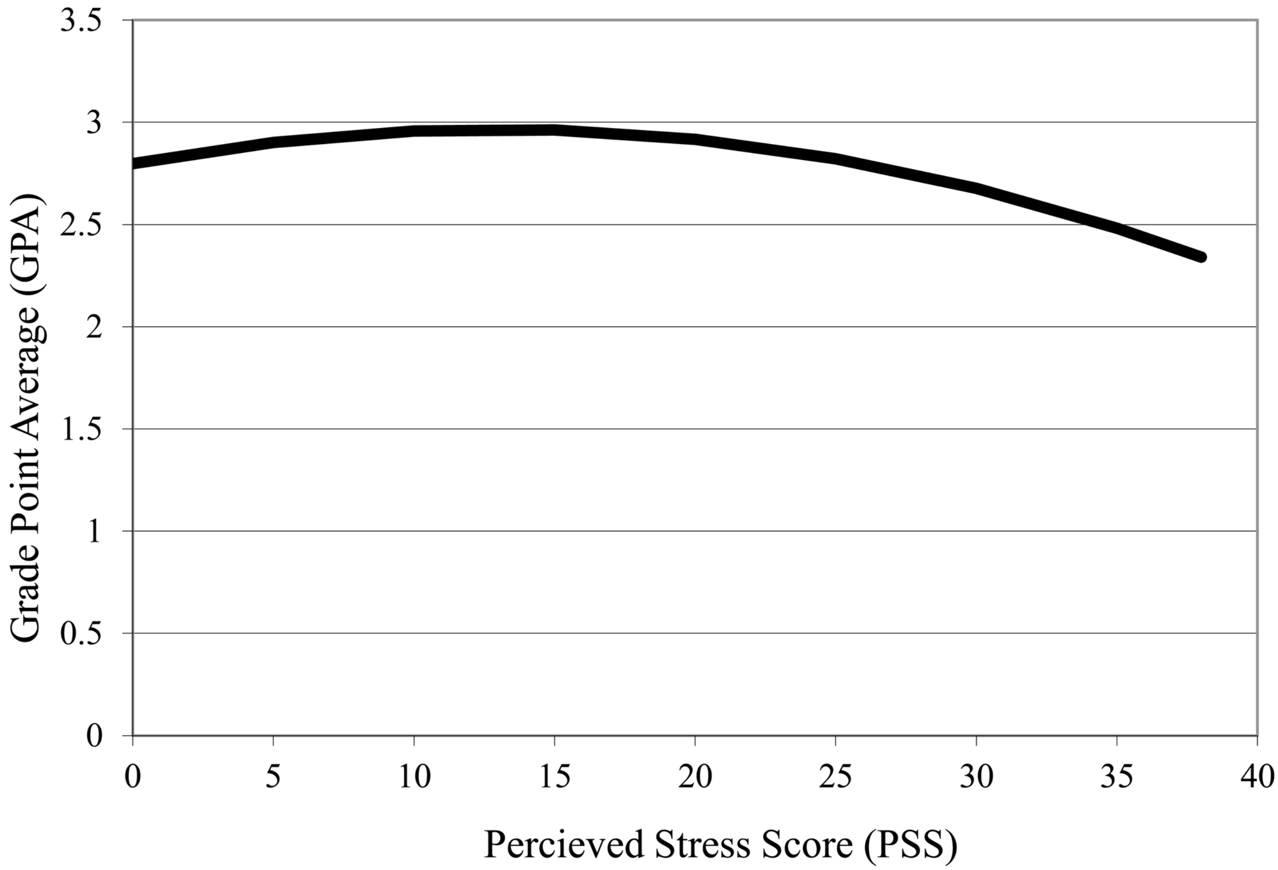

Figure 1.
Quadratic relationship between Perceived Stress Scale (PSS) score and cumulative GPA.

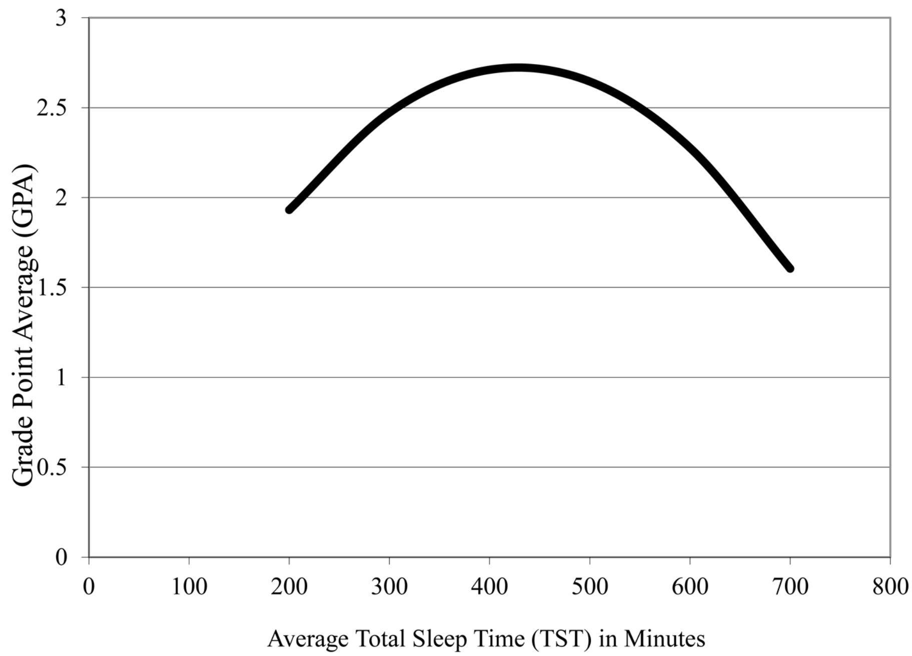

Figure 2.
Quadratic relationship between Total Sleep Time (TST) score and cumulative GPA.

Table 1

Means and Standard Deviations of Sleep Variables (N = 867).

Variable	n	M (SD)
Academic		
High school GPA	490	3.49 (.29)
College cumulative GPA	867	2.87 (.72)
Psychological		
QIDS	858	6.53 (3.89)
PSS	845	18.13 (7.24)
AUDIT	848	4.32 (4.69)
MPS	852	.99 (2.85)
Sleep	867	
Bedtime	867	12:56 am (1hr 9min)
Wake Time	867	8:52 am (1hr 15min)
TST (min)	867	446.96 (64.00)
SOL (min)	867	21.66 (21.27)
WASO (min)	867	6.61 (9.88)
TWAK (min)	867	15.49 (12.77)
SE (%)	867	90.82 (6.08)
NAP (min)	864	26.00 (28.34)

Note. QIDS = Quick Inventory of Depressive Symptomatology; PSS = Perceived Stress Scale; AUDIT = Alcohol Use Disorders Identification Test; MPS = Marijuana Problem Scale; TST = total sleep time; SOL = sleep onset latency; WASO = wake time after sleep onset; TWAK = time awake after arising; SE = sleep efficiency; NAP = naptime.

Table 2

Cumulative GPA Means for Gender, Ethnicity, and Academic Rank

Variable	M	SD	F	p	η^2
Gender (n=833)			11.59	.001	.014
Female	2.92	.73			
Male	2.72	.68			
Ethnicity (n = 867)			7.85	<.001	.027
African Americans	2.65[b]	.69			
Asian/Pacific Islander	3.02[a]	.72			
Caucasians	2.92[a]	.70			
Hispanic	2.68[b]	.80			
Academic Rank (n = 867)			4.78	.003	.016
Freshman	2.76[a]	.81			
Sophomore	2.94[b]	.67			
Junior	2.92	.68			
Senior	2.98[b]	.53			

Note. Means with differing letters are significantly different at the $p < .05$ based on Tukey's HSD post hoc paired comparisons.

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Table 3

Correlations of Between Cumulative GPA and Demographic, Academic, Psychological and Sleep Variables

Variable	n	r	p
Demographic			
Age	867	−.061	.074
Academic			
High School GPA	490	.401	<.001
Standardized Test Scores	720	.286	<.001
Psychological			
QIDS	858	−.072	.034
PSS	845	−.127	<.001
AUDIT	848	−.151	<.001
MPS	852	−.115	.001
Sleep			
Bedtime	867	−.145	<.001
Wake time	867	−.134	<.001
TST	867	.017	.625
SE	867	.068	.047
SOL	867	−.056	.102
WASO	867	.041	.228
TWAK	867	−.064	.058
NAP	867	−.095	.005
Bedtime SD	864	−.151	<.001
Wake time SD	866	−.101	.003
TST SD	866	−.204	<.001
SE SD	866	−.104	.002
SOL SD	866	−.090	.008
WASO SD	866	.041	.232
TWAK SD	866	.047	.170
NAP SD	866	−.091	.007

Note. QIDS = Quick Inventory of Depressive Symptomatology; PSS = Perceived Stress Scale; AUDIT = Alcohol Use Disorders Identification Test; MPS = Marijuana Problem Scale; TST = total sleep time; SE = sleep efficiency; SOL = sleep onset latency; WASO = wake time after sleep onset; TWAK = time awake after arising; NAP = naptime; SD = Standard Deviation.

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Table 4

Final Step of Hierarchical Regression Analysis for Variables Predicting Cumulative GPA Before and After Multiple Imputation.

	Without Multiple Imputation (n = 430)					With Multiple Imputation			
Predictor Variable	**B**	**SE B**	**β**	**t**	**p**	**B**	**SE B**	**t**	**p**
(Constant)	3.408	2.286		1.490	.137	.875	1.704	.513	.608
High School GPA	.523	.080	.297	6.571	<.001	.577	.078	7.434	<.001
Standardized Test Scores	.233	.051	.212	4.536	<.001	.222	.040	5.591	<.001
Ethnicity_1	.003	.090	.002	.032	.974	.047	.075	.629	.530
Ethnicity_2	−.140	.112	−.074	−1.255	.210	−.063	.092	−.686	.493
Ethnicity_3	.230	.145	.078	1.584	.114	.251	.112	2.235	.026
Gender	.178	.065	.118	2.739	.006	−.146	.054	−2.697	.007
Academic Rank	.083	.030	.116	2.750	.006	.081	.021	3.783	.000
QIDS	.015	.010	.090	1.539	.125	.010	.008	1.228	.220
PSS	.022	.016	.232	1.383	.167	.033	.013	2.520	.013
AUDIT	−.008	.007	−.054	−1.157	.248	−.013	.005	−2.516	.012
MPS	−.010	.010	−.048	−1.074	.283	.001	.008	.170	.865
Bedtime	.469	.297	.816	1.581	.115	.047	.231	.202	.840
Wake time	−.494	.299	−.895	−1.656	.099	−.075	.232	−.325	.745
TWAK	−.016	.005	−.267	−2.968	.003	−.009	.004	−2.170	.031
TST	.018	.008	1.658	2.196	.029	.009	.006	1.455	.148
SE	−.049	.027	−.399	−1.805	.072	−.021	.021	−1.009	.314
NAP	.001	.002	.025	.331	.741	−1.921E-5	.001	−.013	.989
Bedtime SD	−.052	.054	−.048	−.975	.330	.027	.042	.640	.523
Wake time SD	.029	.046	.030	.620	.536	.036	.042	.844	.401
SOL SD	.003	.002	.084	1.084	.279	−.001	.002	−.381	.703
TST SD	−.002	.001	−.127	−2.052	.041	−.003	.001	−3.680	<.001
SE SD	−.014	.013	−.104	−1.050	.294	.004	.009	.391	.696
NAP SD	−.002	.002	−.080	−1.076	.283	−.001	.001	−.516	.606
PSS Quadratic	−.001	.000	−.331	−1.951	.052	−.001	.000	−3.246	.001
TST Quadratic	−9.823E-6	.000	−.826	−2.131	.034	−8.660E-6	.000	−2.248	.026

Note. QIDS = Quick Inventory of Depressive Symptomatology; PSS = Perceived Stress Scale; AUDIT = Alcohol Use Disorders Identification Test; MPS = Marijuana Problem Scale; TWAK = time awake after arising; TST = total sleep time; SE = sleep efficiency; NAP = naptime; SD = Standard Deviation TIB = time in bed; SOL = sleep onset latency.