Early to bed, early to rise! Sleep habits and academic performance in college students

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ORIGINAL ARTICLE

Early to bed, early to rise! Sleep habits and academic performance in college students

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Abstract
Purpose Prior studies have placed emphasis on the need for adequate total sleep time for student performance. We sought to investigate the relative importance of total sleep time compared to the timing of sleep and wakefulness for academic performance.
Methods We performed a questionnaire-based survey of college students in October 2007. The questionnaire gathered detailed information on sleep habits including naps, reasons for missing sleep, academic performance, study habits, time spent working outside of school, and stimulant use.
Results Compared to those with the lowest academic performance, students with the highest performance had significantly earlier bedtimes ($p=0.05$) and wake times ($p=0.008$). Napping tended to be more common among high performers ($p=0.07$). Of importance, there were no significant differences in total sleep time with or without naps, weekend sleep habits, study time, gender, race, reasons for staying up at night, nor in use of caffeinated beverages, over-the-counter stimulant pills, or use of prescription stimulants.
Conclusions Timing of sleep and wakefulness correlated more closely with academic performance than total sleep time and other relevant factors. These findings have important implications for programs intended to improve academic performance by targeting sleep habits of students.

Keywords Academic performance · Total sleep time · Bed time · Wake time · Circadian rhythm

Introduction

Habitual sleep patterns undergo substantial changes from childhood to adolescence [1, 2] and young adulthood [3]. These changes are characterized by progressive delay in the sleep phase without a decrease in need for sleep (internal factors) [4, 5]. At the same time, schedules (external factors) frequently require earlier wake times and lead to shorter total sleep time (TST) [6, 7]. Sleep debt accumulated during the week often leads to prolonged sleep periods or catch-up sleep on weekends causing severe day-to-day irregularities of sleep patterns in adolescents and young adults [8]. Insufficient sleep time, with associated sleepiness, fatigue, and inattentiveness, has been identified as a major cause of poor academic performance among high school and college-aged students [9–11]. In fact, various school districts have delayed their high school start times to mitigate the effects of circadian sleep phase delay [12]. Even the US Congress has taken active interest in the issue and has considered legislation known as "Z's to A's" to encourage later school start times for adolescents [13].

The opinions expressed herein are those of the authors and should not to be construed as official or as reflecting the policies of either the Department of the Army or the Department of Defense.

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While it is clear that insufficient sleep is a major factor governing mood, alertness, concentration, learning, and ultimately performance in the academic environment [14], the precise role of sleep quantity versus the impact of circadian rhythms on performance remains ill-defined. We sought to clarify the roles of TST and circadian rhythm on academic performance among young adults by surveying a population of college students.

Methods

Study sample and setting

In October 2007, we conducted a questionnaire-based survey of students at the main campus of Montgomery College, a community college in a northern suburb of Washington, DC with enrollment of 60,000 full- and part-time students. The college is ethnically and culturally diverse with student body composition of Caucasian (40%), African-American (28%), Asian (16%), and Hispanic (16%). Age distribution data show 41% of students are 20 years old or younger, 35% age 21 to 29, and 24% age 30 or older. The student body is 55% female and 45% male.

Members of the teaching faculty distributed a two-page questionnaire by hand to all students present in their classes over a 2-day period. These faculty members informed their students that participation was anonymous and voluntary. Students were given the questionnaire to complete during class time for expeditious collection. The classes incorporated a cross-section of curriculum offerings, such as: biology, history, English, astronomy, and art. The number of questionnaires distributed and collected was tallied by the principle investigator. Approval of this research was granted by the college's Institutional Review Board.

Survey instrument

The principle investigator, three college professors, and two physicians board-certified in sleep medicine constituted a panel to develop the research questionnaire. Their mandate was to limit the survey to two pages printed with 12-font size. The survey instrument asked students about their sleep habits (bed time, wake time, nap frequency and length, week day versus weekend sleep) and how satisfied they were with their sleep. The survey tool further queried about daytime alertness versus grogginess and early-morning versus late-night tendency. School performance was measured by self-reported grade point average (GPA), and students were asked to report their usual amount of study time (hours per day). Students also answered demographic questions, recorded their employment time outside of school (hours per week), and use of stimulants (caffeinated drinks, energy drinks, caffeine pills, and prescription stimulants).

The survey instrument was then administered to a pilot group of students for feedback on question readability, clarity, and question-and-answer format issues. Adjustments in the survey instrument were implemented based upon feedback from the pilot group leading to a two-page tool with 29 questions that required approximately 5 min for completion.

Data analysis

Continuous variables were analyzed using the Student's t test. All tests were two-tailed, and p values of <0.05 were assumed to represent statistical significance. Data are presented as mean ± standard deviation or as mean/median with range as appropriate. All analyses were performed using the Statistical Package for the Social Sciences 12.0 (SPSS Inc, Chicago, IL).

Results

Of 170 questionnaires, 157 (92%) were returned by 76 women (48%) and 81 men (52%). The mean age of the surveyed students was 22.4±6.8 years (median 20 years, range 17 to 69 years). Racial composition was 42% Caucasian, 18% Hispanic, 15% African-American, 13% Asian, and 12% self-designated as other. Mean bedtime on nights before class was 12:16 A.M. (range 9:00 P.M. to 4:00 A.M.); mean wake time 7:37 A.M. (range 3:30 A.M. to 12:30 P.M.), with nightly sleep time of 7 h 23 min. Mean total sleep time (including naps) was 7 h 32 min. On nights with no class, bedtime was an hour later (1:12 A.M.) and wake time 2.5 h later (9:58 A.M.) with nightly sleep time 8 h 43 min.

Among the whole group of students, a minority (42%) expressed satisfaction with their sleep, and those who were satisfied slept for an average of 47 min longer each 24-h period. For all students, there was a sizable majority admitting to feeling sleepy during the day and more specifically feeling groggy during class.

Data for the highest quintile of performers by GPA were compared with the data gathered on the lowest quintile of performers (see Table 1). The racial composition of the highest performing quintile of students and the lowest quintile of performers were similar to the composition of the whole group and were not different from each other. While TST did not differ between groups, there was a significant difference in the timing of sleep between high and low academic performers. Specifically, those with the highest GPA had earlier bed times (12:00 A.M. versus 12:38 A.M., $p=0.05$) and earlier wake times (7:13 A.M.

Table 1 Demographic data, grades, sleep times, and study times

	All students	Lowest quintile (GPA<2.7)	Highest quintile (GPA>3.5)	*p* value[a]
Age (years)	22.4±6.8	22.8±7.6	23.2±10.8	0.96
Gender (%male)	52	55	40	0.35
GPA out of 4.0	3.2±0.5	2.6±0.3	3.8±0.2	<0.001
Bedtime before class (range)	12:16 A.M. (9:00 P.M.–4:00 A.M.)	12:38 A.M. (10:30 P.M.–3:00 A.M.)	12:00 A.M. (9:00 P.M.–4:00 A.M.)	0.05
Wake time before class (range)	7:37 A.M. (3:30 A.M.–12:30 P.M.)	8:02 A.M. (6:00 A.M.–12:00 P.M.)	7:13 A.M. (5:00 A.M.–9:30 A.M.)	0.008
Total sleep time before class	7 h 23 min	7 h 35 min	7 h 29 min	0.62
Bedtime with no class (range)	1:12 A.M. (9:00 P.M.–10 A.M.)	1:29 A.M. (10:00 P.M.–5:30 A.M.)	12:51 A.M. (9:00 P.M.–5:30 A.M.)	0.28
Wake time with no class (range)	9:58 A.M. (6 A.M.–4:30 P.M.)	10:25 A.M. (7:00 A.M.–2:00 P.M.)	9:27 A.M. (7:00 A.M.–2:00 P.M.)	0.11
Total sleep time with no class	8 h 43 min	8 h 53 min	8 h 35 min	0.50
Naps (% yes)	42	29	52	0.07
Study time	2 h 48 min	2 h 23 min	2 h 47 min	0.40

[a] *p* value derived from *t* test comparison between values of lowest and highest quintiles of GPA

versus 8:02 A.M., $p=0.008$) than those with the lowest GPA. There were no statistically significant differences in TST with and without naps, weekend sleep habits, or study time between the high performers and the low performers. High performers were more likely to take naps regularly than low performers (52% versus 29%, $p=0.07$). The percentages of students who acknowledged a morning tendency and those who were satisfied with their sleep were not statistically different between high and low performers (see Table 2). However, low-performing students were more likely to factor sleep into their class schedules ($p=0.04$). No other variables were associated with academic performance. Specifically, there were no differences in reasons provided for staying up at night, use of caffeinated beverages, use of over-the-counter stimulant pills, or use of prescription stimulants.

Discussion

Chief among the findings of this study is that timing of sleep and wakefulness appears to be a more important contributor to academic performance than total amount of sleep. TST did not correlate with self-reported grade point average, while earlier bed times and wake times did correlate with higher grades.

Table 2 Morning tendency, daytime symptoms, reasons for staying up at night, and stimulant use

	All students	Lowest quintile (GPA<2.7)	Highest quintile (GPA>3.5)	*p* value[a]
Morning tendency (% yes)	25	29	40	0.35
Sleep affect class schedule? (% yes)	61	68	42	0.04
Satisfied with sleep (% yes)	42	35	45	0.50
Sleepy during the day (% yes)	62	65	53	0.90
Groggy during class (% yes)	75	81	78	0.97
Stay up for school (% yes)	53	52	55	0.80
Stay up for job (% yes)	30	32	35	0.79
Stay up to socialize (% yes)	54	52	45	0.62
Stay up for other reasons (% yes)	46	42	39	0.80
Job hours per week	19±15	20±15	16±12	0.25
Caffeinated drinks per day	1.6±1.6	1.5±1.6	1.3±1.2	0.44
Stimulant pill use (% yes)	5	6	6	0.57
Use prescribed stimulant (% yes)	7	3	6	0.57

[a] *p* value derived from *t* test comparison between values of lowest and highest quintiles of GPA

The lack of correlation of TST with grades mirrors findings of a prior report using similar methods [15]. However, the published literature contains many studies that have demonstrated the importance of total sleep time for full enhancement of intellectual functioning as well as student safety behind the wheel [16]. The concept that sleep deprivation erodes performance, academic and otherwise, is not in debate. The importance of the current findings is that circadian factors or the synchrony effect [17] also plays a major role in academic performance.

This synchrony effect should be factored into any interventional program designed for sleep improvement as a means to enhancing school performance. It has been previously demonstrated that moving school start times does have the salutary effect of increasing total sleep time [18] and improving attendance, but improvements as measured with grades may not follow as was shown in the Minneapolis Public Schools Start Time Study [12]. (http://education.umn.edu/carei/Reports). In fact, later wake-up times may be associated with lower average grades [19].

Compared to lower-performing students, higher-performing students in our study had sleep onset almost 40 min earlier on average and awakened almost 50 min earlier with no significant difference in TST. The importance of sleep timing is particularly interesting since there does not appear to be a congruent association of morning tendency with academic performance in this cohort. These results suggest that higher-performing students are able to find a way to shift their sleep phase somewhat earlier than lower-performing students despite the same degree of morning/evening preference. It may be that the findings of the current study would be more pronounced in sleep phase-delayed students attending high school where class schedules are less flexible than they are in college.

It is also interesting that higher-performing students show a trend of napping more commonly than low performers, though TST with naps is not statistically different between groups. None of the other measured variables serve to suggest a different interpretation. Specifically, use of caffeinated beverages, over-the-counter stimulants, and prescription stimulants were the same for both groups. Equally interesting, gender, race, and total study time did not predict GPA for this group of students.

The implications of the findings of the current study with regard to the development of an educational program may include the need for greater flexibility in the timing of course offerings. Flexibility of class schedules, as opposed to rigid schedule requirements, may allow students to find a more natural sleep–wake cycle and improve academic performance. An institution interested in creating a sleep improvement program may benefit from the use of the questionnaire created for this study (available as online supplement). Additionally, it may be useful to include questions on majors, year of study, and individually important information such as body mass index and sleep quality. Such information may greatly enhance the understanding of specific sleep issues facing the college students.

Many of the other findings of the current study parallel those reported in populations of similar ages and circumstances. The sleep habits of our student population lead to a sleep debt during the school week followed by attempts to catch up on weekends. Furthermore, our students sleep less than recommended amounts and on average do not go to sleep before midnight despite schedules that require waking before a full night's sleep is accomplished. The prevalence of stimulant pills and drug use is also similar to that previously reported [20].

Limitations of this study include the use of self-reported data for sleep times and school grades rather than objective data measured by actigraphy and grades reported by the college registrar. However, sleep survey results have been shown to be as reliable as objective measures, at least in studies involving adolescent-aged subjects [21]. Another limitation is the use of a single question rather than a validated questionnaire to determine subject tendency for morningness and eveningness [22]. However, in order to distribute a survey tool that would not require an inordinate amount of class time, it was necessary to limit its length.

The importance of adequate amounts of sleep for peak performance is not being questioned by the findings of this study. Our data underscore the important contribution of timing of sleep and wakefulness relative to the academic schedule. To summarize, while it has been previously shown that rest is an important contributor to performance, circadian rhythm or an earlier habitual sleep period may be more influential than TST with regard to academic performance.

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