Health-Related Variables and Academic Performance Among First-Year College Students: Implications for Sleep and Other Behaviors

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Abstract. The authors analyzed the effect of several health behaviors and health-related variables on grade point averages of a random sample of 200 students living in on-campus residence halls at a large private university. The set of variables included exercise, eating, and sleep habits; mood states; perceived stress; time management; social support; spiritual or religious habits; number of hours worked per week; gender; and age. Of all the variables considered, sleep habits, particularly wake-up times, accounted for the largest amount of variance in grade point averages. Later wake-up times were associated with lower average grades. Variables associated with the 1st-year students' higher grade point averages were strength training and study of spiritually oriented material. The number of paid or volunteer hours worked per week was associated with lower average grades.

Key Words: academic performance, college students, grade point average, health-related behaviors, sleep

mproved academic performance is an appropriate goal for college health promotion personnel, just as improved job performance is a desired outcome for worksite health promotion professionals. A common measure of academic performance is grade point average (GPA), and determining the factors that most affect it is important to universities. Good grades in college are highly related to career success.[1]

Health behaviors potentially affecting college student GPA include a wide range of actions and habits: exercise, sleep, and nutritional habits; development and use of social support systems; time and stress management techniques.[2] Health-related variables in addition to other physical, emotional, social, and spiritual health indicators potentially affect college students' academic performance. Clearly, it is not possible for one study to consider the entire range of health-related variables that are potential influences on college students' GPAs.

In this study, we analyzed the effects of several health-related variables on 1st-year college students' GPAs. Although several studies have identified the influence of many health-related factors on academic performance, the results have often been inconsistent. Furthermore, college-specific information regarding academic performance and its relationship to health-related behaviors is rare.[3] Such information has implications for developing programs and services, helping colleges and universities retain students, improve students' academic performance, and reduce the resource burden for student support services.[3,4]

Previous Studies

Exercise

A few researchers have evaluated the effect of exercise on university students' academic performance. Turbow,[5] in a study involving 891 upperclassmen and graduate students, found students who exercised 7 or more hours per week obtained significantly lower grades than students who exercised 6 or fewer hours weekly or not at all. However, a study involving 710 students at California State University, Fresno,[6] was unable to show a significant relationship between academic achievement and exercise. The reasons for these disparate results are not apparent.

Sleep Habits

Reports in the literature implicate a negative effect of sleep deprivation on college students' cognitive performance.[7] One observer found poorer academic performance among university students whose weekend sleeping periods were significantly delayed compared with weeknight sleep-

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ing times.[8] Similar results have been observed among high school students.[9]

Nutrition

Although the effects of eating breakfast[10-12] and other nutritional variables on elementary students'[13] academic performance have received much attention in the literature, little information on the effects of nutritional habits on college students' academic performance can be found. One reported study involving university students, however, showed improved immediate recall and spatial memory as a result of eating breakfast.[11]

Mental Health and Stress Management

In several studies, researchers have reported on the effects of depression, anxiety, and stress on academic performance. One report found depressed mood had no impact on medical school grades.[14] In 1996, Haines[15] reported that measures of depression in college students were negatively correlated with academic performance. In addition, the authors found that self-reported mood ratings (eg, level of happiness) better predicted academic performance than measures of intelligence.

Walter[16] found that a stress-management program had no effect on anxiety but did improve GPA among study participants. A more recent study revealed the opposite, finding that a stress-management program was effective in reducing adolescent anxiety, but was not effective in improving academic performance.[17]

Time Management

Moore[18] found a positive association between time management practices and college students' academic performance. This association was independent of aptitude as predicted by scores on the Scholastic Aptitude Test (SAT). Price[19] found a significant positive relationship between time management scores and college GPAs.

Social Support

Results of studies linking social support options to college students' academic performance are divided. Cutrona and associates[20] reported that parents' social support predicted college GPA, after controlling American College Test (ACT) scores. By contrast, another study found that academic performance was negatively related to social support among medical students, particularly women.[21] In still another study, Hackett and associates[22] reported that encouragement from faculty members predicted university students' academic performance but that peer support and academic performance were negatively related.

Outside social support from friends and family members, but not from peers, moderated the negative effects of test anxiety on students' examination performance, according to Orpen.[23] Another report indicated that social support ratings were significant predictors of graduate GPAs among African American, Hispanic, and Asian American doctoral students, but not among students of American Indian origin.[24]

Spiritual Health

Very little literature is available on the effect on academic performance of spirituality or religiosity. Oh[25] found a negative relationship between religiosity of high school students and their academic achievement, and Helm[26] found that African American high achievers did not differ in spirituality from low achievers.

Several of the variables discussed in this review may be predictors of academic performance. However, the lack of research in certain areas and inconsistent findings in others make it difficult to draw strong conclusions concerning the effects of most of these variables in predicting college GPA. Because further investigation is needed, we examined the relationships between several health-related variables and 1st-year college students' academic performance. A random sample design coupled with a high response rate eliminates self-selection bias in making inferences to the study population regarding relationships between health-related variables and academic performance.

METHOD

Participants

The Office of Institutional Studies at a large private university provided the names, on-campus addresses, and phone numbers of a random sample of 200 1st-year students from the entire dormitory population. After the winter semester ended, the same office gave us winter semester GPAs, gender, and age for each of the students. The names were entered into a lottery for cash prizes (one $50 prize and 10 $5 prizes) for participation in the study. The university Institutional Review Board approved this study before the research began.

Instrument

We developed a questionnaire partially based on information from the literature on health-behavior variables that are potential predictors of academic performance. Each question was assigned response options conducive to generation of ordinal data. To ensure content (face) validity, we distributed the instrument to a panel of professionals, including three professors of health education, one professor of physical education, a psychologist responsible for counseling students who lived in one of the on-campus residence halls, and a director of on-campus housing. All items that one or more of these reviewers judged "unclear" on a standardized form were reworded for clarity. We discarded any item the reviewers judged inappropriate. Following these revisions, we prepared the final questionnaire and used it for the remainder of the study (see Table 1).

We administered a mini pilot test of the survey to 4 undergraduate students before we collected data. Each of the 4 felt the survey instructions and items were easily understood and appropriate for the intended college student population.

Procedures and Data Analysis

We mailed the survey, a cover letter, and an informed-consent document to 200 randomly selected students. The

TABLE 1
Items on a Survey of Health-Related Variables Among College Students

1. How many hours per week do you work, either paid, church service, or other volunteer, in addition to your academic responsibilities?
2. On average, at what time do you go to bed for the night? (Round to the nearest hour)
   Weekdays____   Weekends____
3. On average, at what time do you get up in the morning? (Round to the nearest hour)
   Weekends____   Weekdays____

Response options for items 4–14:
    A. 6 or 7 days per week, B. 4 or 5 days per week, C. 2 or 3 days per week, D. Once per week or less, E. Never.

How many days per week do you
4. engage in study of spiritually oriented material?
5. engage in prayer or meditation?
6. engage in at least a moderate amount of physical activity?
   (*"Moderate amount" = 30 minutes of moderately intense activities, such as brisk walking, or 15–20 minutes of more intense activities, such as jogging or playing basketball.*)
7. engage in weight lifting or some form of strength training?
   7b. For an average of ____ minutes
8. take a daily vitamin and mineral supplement?
9. eat breakfast?
10. eat at least 2 servings of fruit? (*See the food guide pyramid for definitions of serving sizes.*)
11. eat at least 3 servings of vegetables?
12. eat at least 2 servings of meat, poultry, fish, dry beans, eggs, or nuts?
13. eat at least 6 servings of bread, cereal, rice, or pasta?
14. consume at least 2 servings of milk, yogurt, or cheese?

Response options to questions 15–24: A. Always, B. Usually, C. Often, D. Sometimes, E. Rarely, F. Never

15. How often are you happy?
How often do you feel
16. anxious or worried?
17. overwhelmed by time pressure?
18. sad or depressed?
19. angry or irritated?
20. the support you get from friends meets your needs?
21. the support you get from family members meets your needs?
22. the support you get from professors or teaching assistants meets your needs?
23. How often do you use a planner or action list to manage time and meet responsibilities?
24. How often do you feel satisfied with your spiritual health?
25. Do you consistently engage in at least a moderate amount of physical activity on all, or most, days of the week?
   A. No, and I do not intend to in the next 6 months; B. No, but I intend to in the next 6 months; C. No, but I intend to in the next 30 days; D. Yes, I have been for less than 6 months. E. Yes, I have been for more than 6 months.

Note: Table has been edited to save space.

consent form authorized students' winter semester GPAs to be released to the principal investigator. Three days later, we sent a reminder note to all students who had not yet responded. After 6 days, we sent a duplicate survey to those who still had not responded; 8 days later, we sent a letter informing nonrespondents that a study investigator would call to conduct the survey by telephone. Beginning 9 days after the first mailing, the investigators called every nonrespondent, making repeated attempts at various times of day and on different days. The telephone survey was conducted by the principal investigator, trained graduate students, and senior undergraduate students. To maintain confidentiality, the principal investigator was the only person who had access to GPA information. Furthermore, the links of GPA scores to the survey responses were based on matching control numbers. Interviewers were given standardized clarification responses/definitions to answer questions that arose while they were conducting the telephone surveys.

The telephone interviews used exactly the same survey items as those in the mail survey. If the participant had not read the informed consent form, the interviewer read the directions aloud before the interview continued. Callers recorded responses on confidential surveys identified by control numbers. Although written consent was not obtained from telephone respondents, potential respondents were given an opportunity to consent or decline participation after they read or listened to the statements in the consent form. Semester GPA scores and all additional information needed to complete the data set were obtained from the released university records.

Of the 200 students we sampled, 142 (71%) responded to the mail survey. An additional 43 students completed the questionnaire by telephone, yielding a total response rate of 92.5%. One participant who completed the survey did not consent to release his or her GPA to the principal investigator, leaving a usable response rate of 92%.

We observed some differences in mean semester GPAs between participants who completed the survey by mail and the students who completed the survey by telephone (two-tailed, $p = .027$). The mean semester GPAs for mail respondents and telephone respondents were 3.04 and 2.70, respectively, for the two groups. Clearly, the differences in GPA are not a function of the data-gathering methods we used because they were not a reported survey item but were drawn from university records.

In 1995, Perko and colleagues[27] observed that the lower the GPA, the more likely were college athletes to engage in poor lifestyles and health-threatening habits. As a result, we believe that it is reasonable to assume that certain poor health behaviors would be greater among those with lower GPAs. In addition, those persons with lower GPAs may be less willing to talk about lifestyle issues. However, the difference in GPA between the data-collection groups underscores the usefulness of combining these two survey research methods to obtain a more heterogeneous sample and to maximize response rates when conducting research with college students. Our high response rate allowed us to

account for nearly all randomly selected participants and enabled us to identify the potential nonrespondents as having a lower GPA, compared with respondents who responded by mail.

We used two-tailed Spearman's rank-order correlation analyses to examine how each item was related to academic performance. In addition, we used a stepwise regression analysis to identify which independent variables were the best predictors of main effect on academic performance.

RESULTS

Spearman's correlation analyses revealed significant (α .05) relationships between the following variables and higher 1st-year college GPAs (Table 2): studying spiritually oriented material ($r = .238$; $p = .001$), eating breakfast ($r = .241$; $p = .001$), using a planner to organize time ($r = .224$; $p = .002$), age ($r = .169$; $p = .023$), and female gender ($r = .169$; $p = .046$). The following variables were associated

TABLE 2
Spearman's Rank Order Correlation Analysis of Health-Related Variables and Grade Point Average (GPA)

Variable with GPA	Correlation coefficient
1. Work hours per week	−.158*
2. Weekday bedtime	−.292***
3. Weekend bedtime	−.211**
4. Weekday wake-up time	−.350***
5. Weekend wake-up time	−.321***
6. Hours of sleep, weekdays	−.140
7. Hours of sleep, weekends	−.169*
8. Study of spiritually oriented material	.238***
9. Prayer	.138
10. Aerobic exercise	.031
11. Strength training	.134
12. Time spent strength training	.112
13. Vitamin and mineral supplementation	.067
14. Eating breakfast	.241***
15. Eating fruit group foods	.116
16. Eating vegetable group foods	.097
17. Eating meat group foods	−.100
18. Eating bread group foods	.072
19. Eating milk group foods	.097
20. Happiness	−.065
21. Anxiety	−.036
22. Time pressure	−.065
23. Depression	−.039
24. Anger	−.015
25. Social support, friends	−.022
26. Social support, family	.067
27. Social support, professors	.093
28. Use of a planner	.224**
29. Satisfaction with spiritual health	.049
30. Age	.169*
31. Gender (female = 1, male = 0)	.147*

*p .05; **p .01; ***p .001, all two-tailed.

with lower GPAs: later weekday wake-up ($r = -.350$; $p < .001$) and later weekend wake-up times ($r = -.321$; $p < .001$); later weekday ($r = -.292$; $p < .001$) and later weekend bedtimes ($r = -.211$; $p = .004$); greater number of hours of sleep on weekend nights ($r = -.169$; $p = .022$); and number of hours worked per week ($r = -.158$; $p = .033$). No other variables were significantly associated with academic performance.

Stepwise regression analysis determined that the independent variables accounted for 23.9% of the total variance in GPAs (Table 3). When we used list-wise deletion, 11 of the 184 available cases were removed from analysis. However, because missing data for 8 of these 11 cases was limited to "time spent strength training," we replaced missing data for this variable with the mean response rate. Because time spent strength training was not a variable included in our model, replacing missing data for this variable with the mean response allowed us to include all but three cases lost by subsequent listwise deletion without introducing potential bias resulting from our use of imputed data. Therefore, we used data from 181 cases (90.5% of the random sample) in the final regression analysis.

Weekday and weekend wake-up times had the largest relative effects on semester GPA. For each hour of delay in reported average weekday wake-up time, the predicted GPA decreased by 0.132 on a standard 0.00 to 4.00 grading scale, controlling for all other independent variables in the model. When we controlled for weekday wake-up times and all other independent variables in the model, each hour of delay in average weekend wake-up time corresponded to a decrease in predicted GPA of 0.115.

Each step of the stepwise regression analysis allows for inclusion of the next best predictor of GPA with a p value α .05 in the regression model. At the same time, we discarded variables when the p value increased to > .05 as the model was constructed. Using this procedure, we found that the following variables remained in the regression model as predictors of GPA: weekday wake-up time, weekend wake-up time, work hours, study of spiritual material, and strength training.

As we expected, variables showing a positive effect on GPA in the regression model also revealed a positive relationship with GPA in the correlation analysis. Furthermore, regression model variables that had a negative effect on GPA also had negative relationships with GPA in correlation analyses. The relationships identified are best described as modest but statistically significant.

COMMENT

Our goal in conducting this study was to determine which of several health-related variables might affect college students' academic performance. We hoped that such knowledge could be used in motivating students to improve their health behaviors. Although our findings are a meaningful step in that direction, further research is necessary to determine whether or not the modest associations we observed in this study represent causal relationships.

TABLE 3
Stepwise Regression Analysis of Variables in a Study of Health-Related Behaviors and Grade Point Average (GPA)

| Step | Variable | Unstandardized coefficients | | Standardized coefficients | Cumulative R^2 | Change in R^2 |
		B	SE	β		
1	Weekday wake-up time	−.193	.037	−.367	.135	.135
2	Weekday wake–up time	−.183	.036	−.348		
	Study of spiritually oriented material	.09451	.035	.184	.168	.033
3	Weekday wake–up time	−.194	.036	−.368		
	Study of spiritually oriented material	.100	.035	.195		
	Number of work hours per week	−.01716	.006	−.188	.203	.035
4	Weekday wake–up time	−.127	.043	−.241		
	Study of spiritually oriented material	.08905	.034	.173		
	Number of work hours per week	−.01846	.006	−.203		
	Weekend wake–up time	−.110	.041	−.221	.234	.031
5	(Constant)	4.758	.424			
	Weekday wake–up time	−.132	.043	−.251		
	Study of spiritually oriented material	.08606	.034	.168		
	Number of work hours per week	−.0176	.006	−.193		
	Weekend wake–up time	−.115	.041	−.230		
	Strength training	.05719	.029	.133	.251	.017

Note. Dependent variable: GPA. Listwise deletion was used, leaving 181 cases for analysis; all coefficients are significant at $\alpha = .05$.

The relationship between sleep habits and higher GPA appears to be the most significant finding of this study and provides strong support for the hypothesis that sleep habits account for some of the variance in 1st-year college students' GPAs. The statistically robust predictive value of weekday and weekend wake-up times could be the result of significant co-correlating factors not controlled for in this study.

Negative effects of alcohol use on college students' GPAs have been identified in other studies.[28,29] The apparent negative effect of weekend wake-up times on GPA may inadvertently have been classified as spurious, explainable by weekend alcohol consumption and associated morning hangover. However, we collected the data for this study from a random sample of students who live in residence halls at a large, *dry*, private university where students agree to abstain from alcohol as part of a strictly enforced honor code. Alcohol-consumption behavior sufficient to cause morning hangover would be difficult to hide in the monitored residence halls of this university.

Other explanations for the effect of weekend wake-up times on student GPAs seem more plausible.[9] For example, a recent study found that students who delay weekend bedtime and corresponding weekend wake-up time may be diminishing their ability to recall complex material learned earlier in class.[30]

The mean number of hours students slept per night was approximately 7 on weekdays and 8 on weekends. Only 2 students averaged less than 5 hours of sleep per night, indicating that chronic sleep deprivation serious enough to hamper academic performance was not a problem in this student population. Research by Pilcher and Walters[7] demonstrates the negative effects of a 24-hour period of sleep deprivation on academic performance. Note, however, that data for the present study included measures of average number of sleep hours and did not include measures of periodic sleep deprivation likely to occur among college students before major examinations. Recent studies confirm the significance of irregular sleep patterns on impaired driver safety and on dozing and driving among college students.[31,32] These studies highlight the significance of college students' irregular sleep patterns and emphasize the value of sleep-related research associated with health behaviors.

The relationship between eating breakfast and academic performance identified by correlation analysis is probably partially a result of collinear sleeping-habit factors; students have to get up earlier if they intend to eat breakfast. As we noted earlier, eating breakfast resulted in improved immediate recall and spatial memory among university students.[11] However, our present study demonstrates that eating breakfast did not significantly affect semester GPA after controlling for the effects of weekend and weekday wake-up times. The potential effect of eating breakfast on college students' academic performance should be considered because it is related to sleep habits, even if it is not a sig-

nificant main-effect predictor. In any case, sleep habits (particularly weekday and weekend wake-up times) appear to share the greatest amount of variance associated with positive academic performance.

Except for eating breakfast, none of the nutrition-related variables had any effect on GPA. Double-blind placebo trials have shown better academic performance among children who receive a daily multivitamin and mineral supplement than among children who receive a placebo.[33,34] However, similar studies have failed to replicate this finding.[35,36] Inconsistent results cast doubt on the plausibility of the influence of vitamin and mineral supplementation on academic performance.

Results that Turbow[5] obtained indicate that too much time spent exercising correlates with poorer academic performance. However, this hypothesis is inconsistent with the positive predictive value we observed for strength training and the lack of effect we observed for the amount of time spent strength training. Exercise-induced increases in nutrient intake, as well as fluctuations in exercise-mediated hormones, have been discussed elsewhere in the literature[37] as possible mechanisms for the effect of exercise on academic performance. Both of these are plausible explanations for the observed positive value for strength training in predicting GPA.

We observed no significant correlation between any of the effective process variables and GPA. Using a planner to manage time and meet responsibilities was identified as a factor related to GPA by correlation analysis, but not by regression analysis. As indicated, other studies have identified the relationship between time management strategies and improved academic performance.[13,14] In the present study, however, the effect on GPA of using a planner to manage time and meet responsibilities was not significant after controlling for the effects of hours per week worked, sleep habits, and lifting weights. Further research may clarify the value of time management strategies on college GPA.

We also observed no significant relationship for any of the perceived social support variables. Among the three spiritual domain variables, only regular study of spiritually oriented material was significant. This may reflect the presence of study habits in general, rather than spiritual wellbeing or religiosity.

The relationship between hours of employment and academic performance seems intuitive: More time spent at work could encroach on time otherwise available for studying. The findings from the stepwise regression analysis and the correlation analysis support the hypothesis that increased work time may be weakly associated with poorer college GPA among 1st-year college students. Scheduling work hours (working during the day versus the night), which we did not account for in the present study, may also affect students' academic performance.

This study represents preliminary work. Studies designed to measure correlations between changes in health behaviors over time and changes in academic performance would be an excellent next step in identifying cause-and-effect

relationships. In addition, further research is needed to clarify how sleep habits and work schedules affect GPA.

Factors other than health-related variables such as aptitude, previous academic performance, and study habits also influence academic performance[3] and are also likely predictors of college GPAs. Other limitations of this study should be noted. Data, except for GPA, were self-reported. Finally, as previously mentioned, an enforced, alcohol-free policy exists among all students at this large private university, making consideration of the effects of alcohol consumption on academic performance unfeasible. However, a strength of this study was that the investigators were able to consider the association between academic performance and several other health-related variables without having to control for the effects of the use of alcohol and coffee.

Our findings are relevant for counselors, administrators, health programs, and health promotion personnel who serve college student populations. Of particular interest is the significant relationship between sleep habits and 1st-year college GPA. The work of Davidhizar and colleagues[38] suggests clear recommendations for sleep interventions for college students.

Although further research to establish a cause-and-effect relationship is called for, health promotion and health education professionals may be able to enhance students' academic performance by encouraging them to improve their sleep habits, suggesting they use a planner for time management, eat breakfast, and change other behaviors. Because college students are likely to be concerned about GPAs, those who conduct health promotion programs may be able to use our findings to motivate positive changes in students' health behaviors.

NOTE

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