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The Relationships Between Sleep and Measures of Health and Well-Being in College Students: A Repeated Measures Approach

June J. Pilcher, PhD, and Elizabeth S. Ott, BS

The stability of subjective measures of sleep, health, and well-being, as well as the stability of the relationships between sleep and health and well-being were assessed over 3 months. Healthy college students with no consistent sleep complaints completed a 7-day sleep log and battery of surveys related to health and well-being at 3 separate times during the 3 months. Measures of health and well-being were more strongly related to the quality than to the quantity of sleep. Further analyses using the repeated measures results found that participants reported improved sleep and better health, but the affect balance, life satisfaction, and mood states were unchanged across the 3 testing periods. The relationships between the measures of sleep and measures of health and well-being remained constant across the experimental period. Even when working with a non–sleep-disturbed population, healthcare professionals should consider sleep quality as a consistent correlate of daily health and well-being.

***Index Terms**: health, self-reports, sleep quality/quantity, well-being*

Although the relationship between adequate sleep and long-term good health has been investigated in a number of clinical populations,[1–5] few studies have investigated how sleep and health are related in nonclinical populations. Examining only physical health does not present a total picture of good health. For example, the World Health Organization has defined good health as a combination of mental, social, and physical health. To assess this more global concept of good health, one must examine aspects of daily life, such as general well-being and mental health, in addition to physical health. General well-being is commonly documented by assessing its three major components: life satisfaction, negative affect, and positive affect.[6,7]

College students are one nonclinical population with few sleep-related complaints. A recent study of college students[8] indicated that self-reported measures of health and well-being were more closely related to self-reported sleep quality than to sleep quantity. More specifically, in two independent groups of college students at different times in the semester, health, affect balance, satisfaction with life, and feelings of tension, depression, anger, fatigue, and confusion were more closely related to average sleep quality than to the average amount of sleep. Although that study demonstrated a clear relationship between sleep quality and measures of health and well-being, the results did not supply evidence related to the stability of the subjective measures of sleep, health, and well-being over time or to the stability of the relationships between sleep and measures of health and well-being.

Subjective well-being (SWB) has been shown to be generally stable over time. Although SWB appears to be somewhat susceptible to current mood states, the general concept of well-being is constant across a variety of populations,

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including college students.[9–12] By contrast, the stability of reports of subjective health (SH) is less clear. For example, in one study of college freshmen, researchers found that SH decreased during the winter months, then increased again in the spring.[13] Another study found that SH decreased across the 1st year of medical school, presumably as a result of increasing stress levels.[14]

Few researchers have examined the stability of self-reported measures of sleep, especially in nonclinical populations. Results from studies that have examined this relationship have been contradictory. Parkerson and colleagues[14] found that only a portion of the sample of medical students reported a significant decrease in sleep quantity during the 1st year in medical school, whereas Hawkins and Shaw[15] reported a significant decrease in college students' sleep quantity across a semester but no significant change in daily quality.

To address these issues, we examined the stability of self-reported measures of sleep quantity, sleep quality, health, and well-being in college students during a 15-week semester. We hypothesized, on the basis of reports in the literature, that our measures of affect balance, life satisfaction, and mood would remain stable across the semester. We expected SH to improve because we conducted the experiment during the spring semester and most people feel healthier in May than they do in February. In addition, we expected the measures of health and well-being to be more closely related to sleep quality than to sleep quantity, as we had demonstrated in an earlier study.[8]

We also examined the stability of the relationships between measures of sleep (quality and quantity) and measures of health and well-being across the semester. Because no study to date has investigated the stability of these relationships, we based our hypothesis on our previous data, which indicated that the relationships were similar in two different groups of students at different times in the semester. Therefore, we expected the relationships between sleep and measures of health and well-being to remain stable during the 3 months.

METHOD

Participants

We offered volunteers from two large introductory psychology classes extra credit for their participation in this study. Participants were informed that no extra credit would be given to persons who failed to complete all portions of the experiment. Of the 87 initial volunteers, 75 (54 women and 21 men) completed the entire experiment. The mean age of the participants was 18.9 years (SD = 0.83). The study design was approved by the Bradley University Committee on the Use of Human Participants in Research, and the participants completed informed consent forms when the procedure was described to them at the beginning of the experiment.

Procedure

The participants maintained sleep logs for 7-day periods during the 4th, 10th, and 15th weeks of a spring semester (middle of February, end of March, and beginning of May, respectively). They completed the sleep log each morning, immediately after awakening. On the day following the last sleep-log night, the participants completed a battery of surveys on average sleep quality, SH, and SWB. The surveys were administered in a classroom setting between 6 PM and 8 PM and took between 30 and 45 minutes to complete. The presentation of surveys was counterbalanced to control for order effects.

Self-Reported Measures

We modeled the sleep log after one used by Hawkins and Shaw.[15] It contained six items asking about (1) total amount of time in bed for longest sleep period of the day with the intention of sleeping, in hours and minutes; (2) total amount of time asleep for major sleep period, in hours and minutes; (3) rating of daily sleep quality (ranging from *awful* = 1 to *great* = 7); (4) time to bed the previous night; (5) time out of bed in the morning; and (6) number of minutes napping or dozing during the day.

The sleep log provided two measures of sleep quantity (Questions 1 and 2) and one measure of daily sleep quality (Question 3). Self-reported data on sleep habits are frequently used in sleep-related research and have been highly correlated with polygraphic measures of sleep.[16,17] In addition, self-reported data on sleep habits have provided information about the effects of psychological distress on sleep that are not provided by polygraphic measures in a sleep laboratory setting.[18]

To measure average sleep quality, we had each participant complete the Pittsburgh Sleep Quality Index (PSQI),[19] which has strong internal validity (coefficient alpha = .83) and temporal stability (.85 across an average of 28.2 days). The PSQI consists of 10 questions related to normal sleep habits. We instructed the participants to respond to the questions in a manner that would reflect most of the days and nights during the previous week. Higher numbers on the PSQI indicated a more severe sleep disturbance.

We used the Cornell Medical Index (CMI), adapted from the revised Cornell Medical Index,[20] as a measure of health. The CMI has been widely used as an aid in taking medical histories; significant correlations (.52 for women and .57

for men) have been obtained between physicians' ratings and self-ratings of psychological and physical health.[21] We simplified the CMI for administration to college students by eliminating any questions that applied specifically to aging or to a single gender (a copy of the questions we used in our modified version of the CMI is available upon request).

The remaining questions were grouped into clusters representing different types of health complaints. Clusters A through K contained questions on physical health (eg, digestion, respiratory system, frequency of illness). Clusters L through R contained questions on psychological health (eg, nervousness, depression, worrying); participants answer yes or no to questions in each cluster.

To measure SWB, we used the Satisfaction With Life Scale (SWLS),[22] the Bradburn Affect Balance Scale (ABS),[23] and the Profile of Mood States (POMS; Educational and Industrial Testing Service, San Diego, CA). The SWLS is a collection of five statements regarding subjective life satisfaction. The participants are asked to rate whether they agree (7) or disagree (1) with each statement; higher numbers indicate greater life satisfaction. The SWLS has consistently shown strong internal reliability (coefficient alpha = .87) and moderate temporal stability (.54 for 4 years).[24]

The ABS consists of 10 yes–no questions, 5 indicating negative affect and 5 indicating positive affect. The ABS has strong internal validity (coefficient alpha = .76) and moderate temporal stability (.50 for four tests at least 2 months apart).[23] We eliminated 1 of the negative-affect questions because of a typographical error that resulted in responses that could represent either positive or negative affect, which resulted in 4 negative affect questions and 5 positive affect questions. The POMS consists of a list of words that relate to six different types of mood states (tension/anxiety, depression/dejection, anger/hostility, vigor, fatigue, and confusion/bewilderment). Participants were told to rank each word according to how they had felt during the previous week. Responses ranged from *not at all* = 0 to *extremely* = 4. The validity of the POMS has been established in several studies and is described in the POMS manual.

Data Analyses

In the analyses, we used the data from the 75 participants who completed all three portions of the study. Of these 75 participants, 8 did not complete every item in the sleep logs or survey batteries. To control for the effect of missing data, we also analyzed only the data for the participants who completed every item in the survey battery and the sleep log for all three repetitions in our analysis. However, we chose to report the results for all 75 participants because the results from both analyses were virtually identical and the missing data were not limited to any particular item.

We scored the sleep logs and surveys separately for each of the three repetitions, averaging across the 7 days for each of the questions. The surveys were scored according to the written directions for each scale, giving us 9 scores: 1 PSQI (average sleep quality), 1 SWLS (life satisfaction), 1 ABS (total affect), and 6 POMS scores—tension, depression, anger, vigor, fatigue, and confusion. Higher numbers on the SWLS indicated more life satisfaction, higher numbers on the ABS indicated more positive affect, and higher numbers on the POMS scales indicated an increase in that particular mood variable (eg, higher scores on the POMS tension scale indicated more tension). Higher numbers on the PSQI scale indicated poorer sleep quality. In addition, we calculated two health variables from the Cornell Medical Index.

To determine a score for psychological health complaints, we calculated the percentage of yes responses to questions in Clusters L through R. We also derived the score for total physical health complaints by calculating the percentage of yes responses to questions in Clusters A through K. Higher percentages on the CMI indicated increased health complaints.

We used the SAS program (SAS Institute, Cary, NC) to complete all statistical analyses. First, to examine the stability of the sleep, SH, and SWB measures over time, we used a repeated measures MANOVA with repetition (time) as the grouping factor. Second, to isolate where significant differences occurred among the three repetitions, we performed Bonferroni-corrected dependent *t* tests on variables showing a significant change over time. Third, to calculate the relationships between measures of sleep and measures of SH and SWB, we conducted a Pearson correlation. Fourth, to control for any effect of sleep quantity on the correlations between sleep quality and the measures of SH and SWB, we calculated Pearson partial correlations.

Last, to test the stability of the relationships between measures of sleep and measures of SH and SWB, we performed the Fisher's *r* to *z* transformation, using standard Pearson correlations. We normalized the correlation coefficients at each of the three repetitions by converting them to *z* scores, using the method described by Cohen and Cohen.[25] Finally, we conducted a chi-square analysis on each of the *z* scores to test for significant differences across the three repetitions.

RESULTS

The range of scores and the means and standard deviations of all measures for each of the three repetitions are presented in Table 1. The repeated measures MANOVA analysis indi-

cated few significant changes in self-reported sleep, SH, and SWB over the semester. Reported time asleep increased significantly, $F(2, 73) = 3.30$, $p < .05$, across the three repetitions. The PSQI score decreased significantly, $F(2, 73) = 10.51$, $p < .0001$, indicating a significant improvement in average sleep quality. None of the measures of SWB changed significantly over the semester. By contrast, participants reported significantly fewer psychological health complaints $F(2, 73) = 13.84$, $p < .0001$, and fewer physical health complaints, $F(2, 73) = 42.40$, $p < .0001$, over time.

Bonferroni-corrected dependent t tests indicated few significant differences among the three repetitions. Although we found no significant differences among the three time points in the estimated amount of time the participants slept, participants reported a significant decrease in average sleep quality, $t(75) = 4.63$, $p < .01$, between the first repetition (February) and the second repetition (March).

The participants reported significantly fewer psychological complaints, $t(75) = 3.56$, $p < .05$, and physical health complaints, $t(75) = 6.77$, $p < .01$, between February and March. In addition, both psychological health complaints, $t(75) = 5.05$, $p < .01$, and physical health complaints, $t(75) = 7.98$, $p < .01$, decreased significantly between February and May.

As we expected, measures of SH and SWB across the duration of the experiment were more closely related to sleep quality than to sleep quantity. Both average sleep quality and daily sleep quality had many significant relationships with measures of SH and SWB during the February testing period (see Table 2). As participants' average sleep quality decreased, their complaints about psychological and physical health and feelings of tension, depression, anxiety, fatigue, and confusion increased significantly. In addition, we found a significant decrease in positive affect. Similarly, as daily sleep quality decreased, participants' complaints about psychological and physical health and feelings of tension, depression, anxiety, fatigue, and confusion increased significantly.

In addition, we found a significant decrease in positive affect, satisfaction with life, and vigor as daily sleep quality decreased. At the second testing period (ie, March), aver-

TABLE 1
Range, Means, and Standard Deviations for Each Repetition in Study of Sleep and Measures of Health and Well-Being

Measure	Range	Repetition 1		Repetition 2		Repetition 3	
		M	*SD*	*M*	*SD*	*M*	*SD*
Sleep log							
Time in bed (h)	4.61–9.93	7.75	0.98	7.79	0.83	7.83	1.00
Time asleep (h)	4.00–9.28	7.13	1.02	7.28	0.88	7.38	1.03*
Daily sleep quality†	2.14–7.43	5.04	0.91	5.04	0.74	5.20	0.80
Time into bed‡	2300–0500	0135	1.18	0125	1.18	0140	1.12
Time out of bed‡	0700–1300	0915	1.15	0920	1.00	0930	1.10
Time napping (min)	0–95	17.68	21.48	13.78	14.88	18.40	20.44
Pittsburgh Sleep Quality index§	1.00–13.00	5.83	2.47	4.69	1.96	4.96	2.20****
Cornell Medical Index							
Psychological complaints	0.00–44.64	13.04	9.34	10.12	8.68	9.26	8.66****
Physical complaints	0.00–31.50	12.00	6.73	8.77	6.00	8.00	5.60****
Bradburn Affect Balance Scale	1.00–9.00	6.11	1.41	5.99	1.43	5.95	1.61
Satisfaction with Life Scale	8.00–35.00	25.57	5.95	25.67	5.10	26.16	5.18
Profile of Mood States							
Tension/anxiety	1.00–29.00	10.11	5.33	9.97	4.37	11.09	5.31
Depression/dejection	0.00–37.00	9.23	8.53	9.67	7.62	9.72	8.60
Anger/hostility	0.00–32.00	8.44	7.28	8.55	5.42	9.27	7.13
Vigor	3.00–32.00	16.41	6.32	15.43	6.31	15.13	6.36
Fatigue	0.00–25.00	8.53	5.44	8.56	5.22	8.61	5.24
Confusion/bewilderment	0.00–20.00	7.80	4.21	8.24	3.51	8.40	4.11

Note. †Higher numbers indicate poor sleep quality; ‡standard deviations are given in hours; §higher numbers indicate good sleep quality. Repetition 1 = February; 2 = March; 3 = May.
Significant differences across the three repetitions: *$p < .05$, **$p < .01$, ***$p < .001$, ****$p < .0001$.

TABLE 2
Correlations Between Sleep Quality and Repeated Measures of Health and Well-Being

Measure	Pittsburgh Sleep Quality Index†			Daily rating‡		
	R 1	R 2	R 3	R 1	R 2	R 3
Cornell Medical Index						
Psychological complaints	.41***	.32**	.23*	–.36***	.02	–.18
Physical complaints	.48***	.26*	.19	–.42***	–.12	–.16
Bradburn Affect						
Balance Scale	–.23*	–.39***	–.33**	.42***	.21	.16
Satisfaction with Life Scale	–.17	–.36	–.22	.28**	.11	–.07
Profile of Mood States						
Tension/anxiety	.24*	.29*	.24*	–.27*	–.12	–.05
Depression/dejection	.40***	.33**	.20	–.32	–.12	.01
Anger/hostility	.41***	.41***	.36**	–.38***	–.12	.07
Vigor	–.15	–.30**	.01	.25*	.02	.06
Fatigue	.26*	.43***	.39***	–.32**	–.06	–.03
Confusion/bewilderment	.41***	.34**	.21	–.39***	–.04	–.08

Note. †Higher numbers on the Pittsburgh Sleep Quality Index indicate poor sleep quality; ‡higher numbers on daily ratings indicate good sleep quality. Repetition (R) 1 = February; R 2 = March; R 3 = May.
*$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 3
Correlations Between Sleep Quality and Repeated Measures of Health and Well-Being

Measure	Time in bed			Time asleep		
	R 1	R 2	R 3	R 1	R 2	R 3
Cornell Medical Index						
Psychological complaints	–.09	–.06	–.01	–.21	.01	–.02
Physical complaints	–.02	.24	.17	–.15	.24	.14
Bradburn Affect Balance Scale	–.04	–.16	–.09	–.05	–.05	.05
Satisfaction with Life Scale	.03	–.15	–.15	.14	–.09	–.16
Profile of Mood States						
Tension/anxiety	–.02	.17	–.17	–.07	.15	–.17
Depression/dejection	.06	.25*	–.07	–.04	.24*	–.10
Anger/hostility	–.06	.06	–.07	–.23*	–.07	–.12
Vigor	.06	–.10	–.03	.03	–.21	–.13
Fatigue	–.28**	.03	–.06	–.28	.02	–.07
Confusion/bewilderment	–.30**	–.08	–.20	–.39***	–.08	–.17

Note. Repetition (R) 1 = February; R 2 = March; R 3 = May.
*$p < .05$. **$p < .01$. ***$p < .001$.

age sleep quality continued to be significantly correlated with a variety of SH and SWB measures. As average sleep quality decreased, psychological and physical health complaints and feelings of tension, depression, anger, fatigue, and confusion increased significantly; positive affect, life satisfaction, and vigor showed a significant decrease. Decreases in daily sleep quality were not significantly correlated with any of the measures of SH or SWB. This basic pattern continued in the third repetition, when decreases in average sleep quality were significantly correlated with

TABLE 4
Partial Correlations Between Sleep Quality and Repeated Measures of Health and Well-Being

Measure	Pittsburgh Sleep Quality Index†			Daily rating‡		
	R 1	R 2	R 3	R 1	R 2	R 3
Cornell Medical Index						
Psychological complaints	.38***	.34**	.25*	–.31**	.02	–.18
Physical complaints	.44***	.36**	.23*	–.37***	–.11	–.16
Bradburn Affect						
Balance Scale	–.24*	–.35**	–.23*	.45***	.17	.10
Satisfaction with Life Scale	–.12	–.36**	–.32**	.22*	.08	–.07
Profile of Mood States						
Tension/anxiety	.23*	.23	.25*	–.26*	–.09	–.01
Depression/dejection	.38***	.36**	.18	–.30**	–.09	.03
Anger/hostility	.37***	.40***	.35**	–.32**	–.12	–.02
Vigor	–.18	–.40***	.14	.26*	.01	.11
Fatigue	.29*	.44***	.44***	–.30**	–.06	–.01
Confusion/bewilderment	.43***	.30**	.24*	–.33**	–.06	–.06

Note. †Higher numbers on the Pittsburgh Sleep Quality Index indicate poor sleep quality; ‡higher numbers on daily ratings indicate good sleep quality. Repetition (R) 1 = February; R 2 = March; R 3 = May. *$p < .05$. **$p < .01$. ***$p < .001$.

increases in psychological health, feelings of tension, anger, and fatigue and a decrease in positive affect. Decreases in daily sleep quality were not significantly correlated with any of the SH or SWB measures.

By contrast, we did not find a clear pattern of correlations for either measure of sleep quantity, for estimated time in bed, or for estimated time asleep (Table 3). During the first repetition, estimated time in bed and estimated time asleep were significantly correlated only with feelings of fatigue and confusion. During the second repetition, estimated time in bed and estimated time asleep were significantly correlated with physical health complaints and depressed mood only. Neither measure of sleep quantity was significantly correlated with any measure of SH or SWB during the third repetition.

Partial correlations for sleep quality, accounting for the covariance related to sleep quantity, are shown in Table 4. The partial correlations for sleep quality are virtually identical to the normal Pearson correlations for sleep quality (Table 2). The similarity between the normal Pearson correlations and the partial correlations indicated that sleep quantity did not contribute significantly to the relationships observed between sleep quality and the measures of SH and SWB.

To test for the stability of the relationships between the measures of sleep quantity and sleep quality and the measures of SH and SWB, we completed a Fisher's r to z conversion and a chi-square analysis of the z scores. Virtually none of the correlations changed significantly over the duration of the experiment. Only the correlations between physical health complaints and estimated time asleep, $\chi^2(2, N = 73) = 6.07$, $p < .05$, changed significantly over the course of the semester because of the higher positive correlations at the second repetition only.

In sum, although sleep habits and subjective health improved over a 3-month period, SWB variables remained unchanged. As we expected, sleep quality, especially as measured by the PSQI, was more strongly related to measures of SH and SWB than to sleep quantity at each of the three data gathering points in the semester. In addition, the pattern of relationships between sleep quality and the measures of SH and SWB remained stable across the three repetitions.

DISCUSSION

Although many of the measures of sleep, subjective health (SH), and subjective well-being (SWB) remained stable over the semester, some of the variables changed sig-

nificantly as the semester progressed. Participants reported a significant increase in average sleep quality, accompanied by a significant increase in time asleep, but no significant increase in time spent in bed. This finding is not surprising. One would expect that an increase in time asleep without a similar increase in time spent in bed would result in an improvement in perceived sleep quality because the time it takes to go to sleep is one component of sleep quality.

The general improvement in sleep habits in the current study, indicated by improved average sleep quality and increased time asleep, may be a reflection of the participants' having adapted to the academic and social demands of the semester and gradually feeling less stress. It is important to note that our last data-gathering point was scheduled immediately before the beginning of final exams in an effort to avoid that particularly stressful time for students. If we had chosen to complete the final portion of the experiment during final exam week, we might have been less likely to find a significant increase in time asleep and average sleep quality.

Daily sleep quality, in contrast to the significant improvement in average sleep quality, did not change significantly over the semester. Our finding that daily sleep quality tended to improve, a finding similar to the reports Hawkins and Shaw,[15] further supports the conclusion that students sleep better as the semester progresses.

The increase in time asleep that we found in the current study contrasts with the conclusions drawn in previous studies, in which researchers found either a significant decrease in sleep quantity in a segment of the participants studied[14] or a significant decrease in sleep quantity across all participants.[15] The most likely explanation for the differences between the current findings and previous reports is in the types of students the researchers studied. Parkerson and colleagues[14] surveyed medical students who were older than the current participants and most likely had greater academic challenges. The college population that Hawkins and Shaw[15] studied was more diverse than the participants we surveyed; they were older, and many were nontraditional college students. By contrast, all of our participants were 18- to 20-year-old traditional college students who lived either on campus or in apartments near the university. Therefore, it is possible that social, family, and academic demands may have had a greater influence on the sleeping habits of the students in the previous studies than on those in our current study.

In conjunction with reporting better sleep, the participants in the current study reported improved health. Participants reported decreased physical and psychological health complaints during the semester, thus supporting the conclusion drawn by Marx and colleagues[13] in their 1975 study. The change in seasons may have been one reason for the decrease in health complaints in our study. A significant change in health complaints occurred from the middle of February to the end of March and from the middle of February to the beginning of May, but not between the end of March and the beginning of May. That finding suggests that health complaints are more likely to occur in the middle of winter, followed by a rapid decrease with the beginning of spring, when health complaints stabilize. Future studies could be conducted at other times of the year or in locations where winter weather is less severe to examine the stability of SH under other conditions.

Although both measures of health decreased over the semester, subjective estimates of affect balance, life satisfaction, and mood remained stable across 3 months. It is noteworthy that both health and sleep improved across the experimental period, whereas the general measures of well-being did not change. These data suggest that self-reported estimates of sleep and health may be more easily influenced by environmental conditions, such as weather and levels of stress, than subjective well-being.

Furthermore, the data indicate that self-reported sleep and health may be subject to and react in similar manners to the same environmental conditions. The Fisher's r to z analysis indicated that only the relationship between physical health complaints and estimated time asleep seemed to have changed during the semester. However, this relationship is uncertain, based on the number of statistics tested. In general, the stability of the relationships between sleep quality and measures of health and well-being can be viewed as one indication of the potential importance of these relationships to daily life.

An additional point of interest is that the measure of average sleep quality (PSQI) was related to measures of SH and SWB more closely than to daily ratings of sleep quality over the three data-gathering points during the semester. Because the PSQI required participants to estimate the average quality of their sleep over the previous week by answering a variety of questions, it is possible that the scale provided a more stable measure of sleep quality than the 1-item daily sleep quality rating scale. This could indicate that participants might assess average sleep quality according to the PSQI somewhat differently and perhaps with more accuracy and less variability than they assess their daily sleep quality.

The findings from the current study are limited because the data were gathered from volunteer participants. However, the participating volunteers for the study were very similar to the group of potential volunteers. For example, the

proportion of men and women and the ages of those who volunteered for the study were similar to the proportions and ages of the men and women in the classes where volunteers were solicited. Because the volunteers were recruited early in the semester, they were not necessarily reacting to a last-minute effort to increase their grades with the extra-credit points.

In addition, virtually all of the participants who did not complete the study dropped out before the second repetition, indicating that those with better (or worse) grades did not decide to quit the experiment at the last second. Of the 87 initial volunteers, only 12 did not complete the entire study. The numbers of men and women and the ages of the students who did not complete the survey were equivalent to the proportions and ages of their classmates who completed the study. Therefore, it is unlikely that a significant difference between the participants and nonparticipants could have affected self-reported sleep, health, and well-being.

Another limitation of our study is that the conclusions are based on self-reported data. Self-reported data on sleep, health, and well-being, however, can be viewed as a positive attribute of the study. Although it is important to gather objective data on these variables, it is equally important to assess them from the individual's perspective. The stability of many of the measures of sleep, health, and well-being that we found provides additional evidence for the accuracy of the self-reported data.

Our findings suggesting that measures of SH and SWB are more closely related to self-reported sleep quality than to sleep quantity are also limited: The findings are correlational and, as such, cannot imply causality. It is unlikely that a simple causality chain among sleep, health, and well-being can be found; it is more likely that the three are intertwined to the extent that each contributes the others. Changes in any of the variables could result in changes in the other variables.

In sum, the current results demonstrate that college students' sleep habits, as indicated by average sleep quality and estimated time asleep, improved during the semester. Self-reported health improved between February and May, whereas affect balance, life satisfaction, and mood remained stable. Our findings indicate not only that sleep quality is more closely related to measures of health and well-being than sleep quantity is but also, perhaps more important, that the relationships remain consistent for 3 months. These data provide additional support for the importance of a better understanding of sleep quality and its relationship to daily life in a young healthy, non–sleep-disturbed population. This consideration could be particularly important because sleep quality and related issues, such as insomnia, may be a lifelong pattern. If sleep quality is consistently related to daily health and well-being across different age groups, sleep quality could prove to be an early indicator of potential concerns with health and well-being.

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NOTE

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